General Overview
Piedmont Together, completed in 2013, used CommunityViz software to measure and evaluate the impacts of competing growth scenarios for the twelve-county Piedmont Triad Region. Building on this momentum, the Piedmont Authority for Regional Transportation (PART) identified resources to develop the Piedmont Triad CommunityViz Model Guidebook, which studied the merits, needs, capabilities and next steps for building a new CommunityViz model for the region. Thoughts, ideas and recommendations in the Guidebook are a resource for the region while they decide if/when/how they may want to move forward on this initiative.

The Guidebook summarizes the planning process, study area considerations, recommended data needs and analysis tools, and intended Model outcomes that could support several transportation and land use planning studies or processes being completed now or in the future for the region (or portions thereof). The document is organized into six main sections:

General Overview — a brief overview of the planning process, a case for moving forward, potential project partners, and opportunities to integrate data, tools, indicators, etc. from the Piedmont Triad CommunityViz Model with other initiatives in the region.

Early Decisions — a summary of important decision topics that need to be addressed early in the process to develop a Piedmont Triad CommunityViz Model, including study area considerations, reporting geographies, and a partnering strategy for the region. Decisions on how best to proceed for these topics could significantly impact the scope, budget and schedule for developing a Model.

Software Information — general information about CommunityViz software, including: system requirements, key terms and definitions, and recommendations for the status and location of an official Piedmont Triad CommunityViz Model.

PTCM, Future Year Allocation Tool — a summary of the recommended future year allocation tool for a Piedmont Triad CommunityViz Model that would be created to allocate socio-economic data for the Piedmont Triad Regional Model; including data needs, model architecture, theory and features behind components of the model, data output and calibration activities.

Project Schedule — a hypothetical timeline developed by the consultant to build the Piedmont Triad CommunityViz Model assuming the model architecture and recommendations presented in this Guidebook.

Guidebook Planning Process

The project team for the Piedmont Triad CommunityViz Model Guidebook — including PART staff, PTRC staff, and the consultant — implemented a seven-step planning process using a two-month schedule. Key components of the process are summarized below.

Project Kick-Off Meeting

The project team met with state, region and local government officials on May 4, 2017 to kick-off the planning process. The meeting was used to preview the project, discuss important decisions required for building a land use allocation model and facilitating a scenario planning process, and hearing from the region about project needs or work tasks that should be addressed during the planning process to develop the Guidebook.

Date Inventory & Analysis

The project team identified data and tools available in the region — geographic information system data, technical documents, adopted plans and studies, etc. — to evaluate the potential of building a Piedmont Triad CommunityViz Model that could meet the different desires and needs of the region voiced during the project kick-off meeting.
Stakeholder Group Interviews

The project team met with stakeholders in the region on May 22, 2017. The three stakeholder groups identified for building a future CommunityViz Model included staff for the Piedmont Authority for Regional Transportation, the Piedmont Triad Regional Council, and the Piedmont Triad Regional Model Technical Team (including NCDOT staff).

The interviews were scheduled for the benefit of the project team, letting them listen and learn from future model developers and data managers about available data (quantity and quality), history with CommunityViz software (especially for Piedmont Together), and available time and resources for hosting a future Piedmont Triad CommunityViz Model.

Focus Group Meetings

The project team met with focus groups in the region on May 23, 2017. The three focus groups identified for building a future Piedmont Triad CommunityViz Model included urban area interests, rural area interests, and metropolitan planning organization officials.

The interviews were scheduled for the benefit of the project team, letting them listen and learn from model users about potential uses for a future Piedmont Triad CommunityViz Model (transportation or otherwise), commitments to partner during data collection and model calibration activities, and the merits for streamlining and normalizing the process to develop socio-economic data to use in the Piedmont Triad Regional Model.

Model Framework & Key Concepts

The consultant developed the initial model architecture, potential study area considerations, data needs list, and generalized milestone schedule for building a Piedmont Triad CommunityViz Model. The recommendations were based on: 1) data available in the region, 2) previous work completed in CommunityViz for Piedmont Together, 3) the wants and needs for a future Piedmont Triad CommunityViz Model voiced during the planning process, and 4) the commitments made by potential project partners for building, hosting and maintaining the Model. This is the starting point for the region to continue vetting the merits of a future Piedmont Triad CommunityViz Model, and the time and resources needed to start the model building process.

Policy-Maker Briefings

The project team met with MPO and RPO officials on June 22 and 23, 2017 to preview the consultant team’s recommendations for building, hosting and maintaining a future Piedmont Triad CommunityViz Model. Important items for discussion included a recommended partnering strategy, list of interested organizations in the region with potential responsibilities assigned, the initial Model framework and key concepts, and next steps for moving forward.

Documentation

The consultant developed the Piedmont Triad CommunityViz Model Guidebook as a resource for the region while vetting the value and process for developing a Model. It should evolve and be revised over time as important decisions are made regarding: 1) the study area and potential sub-region reporting, 2) available time and resources for the project team (especially for PART and PTRC staff), and the ultimate list of features (socio-economic data allocation, transportation performance measures, return-on-investment performance measures, etc.) that will be added to the Model now or in the future.

The Case for Moving Forward

Discussions with state, regional and local government officials throughout the planning process identified several reasons to move forward with building a Piedmont Triad CommunityViz Model at this time. Generally speaking, the data and tools created under this initiative could greatly improve the quantity and quality of information available for many federal- or state-mandated planning processes; or for local government initiatives to measure and evaluate the trade-offs of competing growth alternatives. A summary of potential benefits associated with building a Piedmont Triad CommunityViz Model — taking advantage of the model output, partnerships and
collaboration needed to build and maintain the Model — are summarized below.

**Strengthen Other Processes & Tools**

Traditional processes and tools for developing region-wide data sets generally follow a top-down approach, whereby data for the state or country are proportionally assigned to the region using some form of shift-share analysis. In terms of allocating socio-economic data, this approach causes problems when the type or intensity of new growth assigned to parts of the region is not supported by the local governments’ adopted land use policies, zoning requirements or subdivision standards that control the type, location, pattern and intensity of allowable development.

The lack of understanding for allowable, yet-to-be-built development in parts of the region using a top-down approach creates a potential mismatch for future year growth allocation. This mismatch could significantly impact trip generation in the Piedmont Triad Regional Model because industrial employees are assigned where only residential developed is allowed, or continued growth is assumed in an area that is already built out (two hypothetical examples).

A future Piedmont Triad CommunityViz Model would use a bottom-up approach for determining build out potential in the region. Incorporating parcel-level development status and community type (land use) assignments with jurisdiction-specific height, bulk and density requirements for each community type category could greatly improve the precision of assigning future year socio-economic data in the region.

**Meet Federal Plan Rules & Guidelines**

Both the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) advocate for scenario planning, performance-measure testing, and land use-transportation-economic development coordination in various MPO and RPO transportation plans and studies. Recent documents published by the two organizations highlight best practices and opportunities to voluntarily include them in future transportation plans and studies:

- FHWA Scenario Planning Guidebook
- FHWA Congestion Management Process Guidebook
- FTA New Starts Application
- FTA Small Starts Application

The Piedmont Triad CommunityViz Model could provide starting data and performance measures for several factors that would be considered in future transportation plans and studies. In other regions, information from region-wide CommunityViz models is being used to evaluate candidate road projects (evaluating access to employment centers as one criteria), or to track congestion management performance measures (evaluating proximity to transit service, project presence in existing and emerging growth centers, and proximity of industrial development to strategic freight corridors as criteria).

**Make Things More Reliable, Predictable & Transparent**

Traditional processes and tools used in the PTRM portion of the PTCM study area twelve-county PTRC region to develop future year socio-economic data varies by MPO or RPO, while the data, tools and processes to use and maintain the Piedmont Triad Regional Model (or the North Carolina Statewide Travel Demand Model in RPO areas) are standardized.

In other regions, the need to standardize socio-economic data forecasting and allocation processes is being recognized as an opportunity to make things more reliable, predictable and transparent. It also provides consistent data for doing sub-regional planning that may include one or more jurisdictions, essentially eliminating ‘the edge effect’ at jurisdictional boundaries that can hinder a planning study. Officials also believe region-wide land use data sets are more defendable to critics who are concerned the data going into the travel demand model is complete, comprehensive and coordinated.

Participants in several of the outreach activities for the Piedmont Triad CommunityViz Model Guidebook stressed the importance of normalizing and streamlining socio-economic data processes used in the region.
**Bolster Interactions between Land Use (Demand) & Transportation (Supply) Studies**

Demand-side solutions for improving the regional transportation system should focus on land use, development density and urban design principles that promote lower vehicle trip generation (internal capture), shorten travel distance, and increase the use of non-vehicular travel modes. Land use mix; development location, pattern and intensity; and site design elements in one or more growth scenarios considered for a study area — the region or a county, city, small area, corridor, etc. — could help improve overall efficiency of the transportation system by lowering demand for vehicle trips.

In other regions, MPOs and RPOs are running multiple growth scenarios (socioeconomic data sets) and multiple transportation networks in the regional travel demand model to balance demand- and supply-side solutions for an efficient transportation system.

**Piedmont Together**

*Piedmont Together*, completed in 2013, used CommunityViz software to measure and evaluate the impacts of competing growth scenarios for the twelve-county PTRC region. Parts of the model architecture and the data collected for the study area should be used and adapted to expedite work on the *Piedmont Triad CommunityViz Model*. The capacity and familiarity with CommunityViz software developed during the *Piedmont Together* scenario planning initiative would be valuable for building and maintaining a new model for the region.

**Potential Project Partners**

The *Piedmont Triad CommunityViz Model* should be created with help and guidance from federal, state, regional and local government agencies working together. Key stakeholders and their general roles are summarized below:

**Program Manager & Model Custodians**

The organizations listed below should be directly responsible for the project program, data collection protocols, coding, model build and maintenance, coordination activities, and data sharing protocols to support the *Piedmont Triad CommunityViz Model*:

- Piedmont Authority for Regional Transportation
- Piedmont Triad Regional Council

Considerations specific to geographic areas in the twelve-county study area for the *Piedmont Triad CommunityViz Model* are provided on pages 11 and 12.

**Oversight & Coordination**

The organizations listed below should review and provided comments (as necessary) on the process, tools and data created for the *Piedmont Triad CommunityViz Model*:

- Federal Highway Administration
- North Carolina Department of Transportation

**Data Collection, Model Calibration & Model Users**

The organizations listed below should help PART and PTRC staffs: 1) identify and secure the data needed to build and maintain a *Piedmont Triad CommunityViz Model*, 2) review new data created for the Model to ensure its accuracy, and 3) comment on output data from the Model related to its abilities to allocate future growth in the region. One or more of these organizations may decide to do their own work with the *Piedmont Triad CommunityViz Model*, or adapt the Model for their own needs (e.g., changing the unit of analysis from grid cell to parcel or building footprint):

- Burlington-Graham MPO
- Greensboro Urban Area MPO
- High Point Urban Area MPO
- Winston-Salem Urban Area MPO
- Northwest Piedmont RPO
- Piedmont Triad RPO
- Cities, Towns & Counties in the Region
- Special Interest Groups in the Region
Potential Model Plug-Ins & Interactions

The Piedmont Triad CommunityViz Model Guidebook originally started as a document focused on the potential for developing a region-wide scenario planning model that could be used to quickly and efficiently create socioeconomic data for the regional travel demand model. Attention changed after the project kick-off meeting to evaluate several other opportunities to integrate data, performance measures, and partnering processes for the Piedmont Triad CommunityViz Model with other plans and processes for the region (both transportation and non-transportation related).

The paragraphs that follow describe opportunities to integrate data, tools, indicators, etc. from the Piedmont Triad CommunityViz Model with other initiatives in the region. It will be important that the project team — considered to be staff from PART and PTRC at this time — understand the full spectrum of potential applications for the Model before starting the build process because it could impact the project’s model architecture, data collection protocols, schedule, etc.

Piedmont Triad Regional Model

One of the tools available for studying long-term impacts to the regional transportation system is the Piedmont Triad Regional Model (PTRM), which is a computer program that forecasts future year demand on existing and planned transportation facilities using anticipated land use, demographic information and travel patterns unique to the region. Planning horizon years in the travel demand model consider conditions 10, 20 and 30 years beyond base year conditions. Approximating future year conditions on the transportation system helps transportation officials assess the implications of growth, compare alternative transportation solutions, and provide a framework for measuring the impact of policy decisions.

The foundation for the PTRM is socioeconomic data — including population, housing, students and employment estimates — organized into distinct geographic subareas referred to as traffic analysis zones (TAZs). Collectively, this information represents the assumed growth and development potential for the PTRM study area. Demand on the transportation system (trip generation) is calculated directly from the model’s socioeconomic data.

Historically, updating socioeconomic data for the PTRM study area was time intensive, and the top down–bottom up, manual process created significant challenges for allocating future year growth in the region. Specifically, it: 1) created a mismatch between demand and supply statistics for growth allocation in some growth categories and in some parts of the region, 2) marginalized some of the unique conditions for cities and towns in the region, 3) used a non-standardized methodology for translating local plans and ordinances into buildout potential for the region, and 4) used a non-standardized methodology for determining growth hot spots (areas most likely to develop by horizon period) throughout the region. The manual process also limited the ability to evaluate the effects of alternative development patterns on the efficiency of the regional transportation system.

Socioeconomic data allocated in a Piedmont Triad CommunityViz Model (traffic analysis zone level reporting) could streamline the workflow for running the Piedmont Triad Regional Model. Output data would be normalized for the PTRM portion of the PTCM study area and formatted for direct input into the travel demand model software; saving time and potential errors translating data from several sources.

Metropolitan Transportation Plans

The starting growth scenario for the Piedmont Triad CommunityViz Model — community plans — would meet federal rules and requirements for developing the Metropolitan Transportation Plan (MTP) required for all metropolitan planning organizations in the region. Specifically, it would consider land use and development controls reflected in adopted local government plans and ordinances for preparing the documents. Data and tools for the community plans growth scenario would inform the MTP planning processes, and would be useful for identifying, prioritizing and scheduling specific transportation projects included in the MTP documents.

The Piedmont Triad CommunityViz Model also affords the opportunity to study alternative growth
scenarios in a MTP planning process, highlighting the relationships between land use (demand), urban form (design), and transportation (supply) for influencing travel behavior and promoting a more sustainable regional transportation system.

Alternative growth scenarios could help validate the planning process and build support (both empirical and political) for a preferred growth scenario that influences socioeconomic data in the Piedmont Triad Regional Model and specific project recommendations in the individual Metropolitan Transportation Plans.

**Comprehensive Transportation Plans**

The starting growth scenario for the Piedmont Triad CommunityViz Model—community plans — also meets the rules and requirements in North Carolina for developing the Comprehensive Transportation Plans (CTP) required for all metropolitan planning organizations and rural planning organizations in the region. Specifically, it considers land use and development controls reflected in adopted local government plans and ordinances for preparing the document. Data and tools for the community plans growth scenario would inform the CTP planning processes, and would be useful for identifying, prioritizing and scheduling specific transportation projects included in the CTP documents.

**Congestion Management Process**

The congestion management process (CMP) for metropolitan areas identified as transportation management areas (TMAs) routinely includes goals, objectives, and performance measures for reducing vehicle congestion, increasing multi-modal travel, and creating more livable, walkable communities. By design, the process also brings together an expanded group of stakeholders to the transportation planning process, including organizations responsible for land use and zoning. Several MPOs designated as TMAs throughout the country include measures in their CMP for accessibility (the ability to reach employment centers, retail centers, activity centers that produce or attract travel demand) and land use (the mix of uses and patterns/intensities of development).

The Piedmont Triad CommunityViz Model affords the opportunity to include several factors and performance measures that could be used to strengthen the relationships between land use (demand), urban form (design), and transportation (supply) in a more comprehensive, more effective congestion management process.

**NEPA Process**

The National Environmental Protection Act (NEPA) requires one or more prepared documents to evaluate the environmental impacts for an array of project types. The Environmental Assessment (EA) is prepared when a determination is needed for whether a project could have negative impacts on human quality of life. The Environmental Impact Statement (EIS) is a more detailed assessment of environmental impacts (following an EA) that considers several project design alternatives simultaneously. Both an EA and EIS require consideration of ‘project build’ and ‘project no build’ conditions to measure and evaluate impacts.

Other regions are using the scenario planning capabilities of CommunityViz software to evaluate ‘project build’ and ‘project no build’ conditions in the NEPA process. Specifically, the land suitability analysis wizard in the software is being used to study the ‘attractiveness’ of a proposed project for influencing future growth and development around it, while varying community type or development status assignments for one or more scenarios in the software is being used to study different development types, patterns and intensities influenced by a proposed project and all its alternatives.

**TBEST Software**

The Florida Department of Transportation, in partnership with the Center for Urban Transportation Research, developed a transit modeling software — Transit Boardings Estimation and Simulation Tool, TBEST — that is being used throughout the country to evaluate different transit service areas, network configurations, service frequency, spans of service and fare sensitivity. The Piedmont Authority for Regional Transportation is working now to incorporate TBEST into its current and long range transit planning processes.
Parcel-level land use data required to run the TBEST model is very detailed, including: land use category, total land area, buildable area, number of residential dwelling units, non-residential square feet in buildings, and average population by parcel. Future year conditions for all of these categories could be approximated using the Piedmont Triad CommunityViz Model (assigning grid cell level data to parcel level data with a series of overlap equations in the software).

**Local Government Plans, Studies & Policies**

The model architecture and data collection protocols for a Piedmont Triad CommunityViz Model could be established to support a variety of topics important to local government plans, policies and studies in the region. Areas of interest may include:

- fiscal impact analysis;
- value capture analysis;
- future land use map alternative studies;
- zoning district regulation testing;
- demand or impact studies for community facilities and services;
- green infrastructure studies; or
- a livability index.

For each category above, the project team would need to establish data needs list, unit of analysis, study area size, and reporting geography to integrate with one or more local government planning processes.

**Others’ Experience in the Mid-Atlantic Region**

Several other regions in the US Mid-Atlantic are already using CommunityViz software to create data for, or complete one or more of, the potential project applications described above — including the Piedmont Triad Region for the scenario planning initiative that supported Piedmont Together. Figure 1 on page 8 illustrates where CommunityViz software is being used now for region-wide scenario planning using the protocols and recommendations presented in the Piedmont Triad CommunityViz Model Guidebook.
Figure 1: Application of CommunityViz Software for Other Regions in the US Mid-Atlantic Triad

1. Memphis Urban Area MPO
   - Travel Demand Model
   - Metropolitan Transportation Plan
   - Congestion Management Process
   - Regional Studies
   - Local Government Plans

2. Nashville Area MPO
   - Travel Demand Model
   - Metropolitan Transportation Plan
   - Regional Studies
   - Local Government Plans

3. Fredericksburg Area MPO
   - Travel Demand Model
   - Metropolitan Transportation Plan
   - Regional Studies
   - Local Government Plans

4. Shaping Our Future
   - Travel Demand Model
   - Metropolitan Transportation Plan
   - Regional Studies

5. CONNECT Our Future
   - Travel Demand Model
   - Metropolitan Transportation Plans
   - Congestion Management Process
   - Regional Studies
   - Local Government Plans

6. Piedmont Together
   - Regional Studies

7. Imagine 2040
   - Travel Demand Model
   - Metropolitan Transportation Plans
   - Regional Studies
   - NEPA Process
   - Local Government Plans

8. Plan It East
   - Regional Studies

9. BCD Council of Governments
   - Travel Demand Model
   - Metropolitan Transportation Plan
   - Regional Studies
   - Local Government Plans
Early Decisions
This section of the document summarizes important topics that should be discussed early in the process to develop a *Piedmont Triad CommunityViz Model*. Decisions on how best to proceed for these topics could significantly impact the scope, budget and schedule for developing a Model.

**Study Area Considerations**

The size and shape of the study area for the *Piedmont Triad CommunityViz Model* could have tremendous impacts on the time, resources, partnerships and schedule needed to build the Model and calibrate its outputs. The largest suggested study area — the twelve counties represented in the *Piedmont Together* study — is expansive, slightly larger than the state of Connecticut. It covers 5,875 square miles and over 800,000 parcels (see Figure 2 on page 10). The geography includes 61 cities or towns ranging in size from large, metropolitan centers to suburban bedroom communities to rural crossroads. Environmental features — lakes, rivers, water basins, prime agriculture soils, and air quality — could bind the region together and potentially blur political boundaries.

A partnership between the Piedmont Authority for Regional Transportation (PART) and the Piedmont Triad Regional Council (PTRC) would be essential to support a twelve-county study area. Three sub-regions in the study area are recommended to match project needs with available resources, and focus individual work programs with agency goals and regional responsibilities. Potential sub-regions for the *Piedmont Triad CommunityViz Model* include:

- **Priority Areas** — cities and towns served by transit and included in the study area for PART’s new Transit Boardings Estimation and Simulation Tool (TBEST). Land use and market data used in the *Piedmont Triad CommunityViz Model* (parcel-level data) should be reviewed and updated annually by PART staff (as needed) to keep the TBEST model up-to-date for a variety of planning tools, studies and applications.

- **Core Area** — portions of the twelve-county region inside the study area for the *Piedmont Triad Regional Model*. Socio-economic data allocated to traffic analysis zones in the *Piedmont Triad

*CommunityViz Model* should be updated every four years to coincide with updates to the *Piedmont Triad Regional Model*.

- **Expanded Area** — portions of the twelve-county region outside the study area for the *Piedmont Triad Regional Model*. Data should be updated periodically to coincide with updates to the Northwest Piedmont RPO and Piedmont Triad RPO Comprehensive Transportation Plans.

Figure 3 on page 11 illustrates the extents recommended for the priority, core and expanded areas represented in the *Piedmont Triad CommunityViz Model*. Figure 4 on page 12 illustrates the recommended areas of responsibility for PART (priority and core areas) and PTRC (expanded area) to support a *Piedmont Triad CommunityViz Model*.

**Reporting Geographies**

Summarizing data output from the *Piedmont Triad CommunityViz Model* by sub-geography or interest area could support plans and studies prepared regularly by agencies in the region: metropolitan transportation plans, comprehensive transportation plans, congestion management processes, NEPA studies, transit master plans, comprehensive plans, etc.

The number and extent of sub-geographies or interests represented in the Model is limitless. Grid cells used in the software could be assigned any number of specific traits — representing the different metropolitan planning organizations,
Figure 2: Recommended Study Area for the Piedmont Triad CommunityViz
Figure 3: Recommended Sub-Regions for the Piedmont Triad CommunityViz
Figure 4: Recommended Areas of Responsibility for the Piedmont Triad
rural planning organizations, jurisdictions, traffic analysis zones, etc. in the region — and summed by trait to report results for the geography or area of interest. Raw data from the Model could also be clipped and exported in ArcGIS shapefile format for use by agencies in the region.

**Partnering Strategy**

**PTCM Model Development Team**

A model development team for the Piedmont Triad CommunityViz Model — including staff from the Piedmont Authority for Regional Transportation and the Piedmont Triad Regional Council — should work ‘in the trenches’ to build the Model in a way that supports a variety of applications and scales for analysis and reporting. Individuals on the model development team should be trained in using CommunityViz software from the onset of the project, and assigned tasks throughout the model build process.

An official model custodian should coordinate the work of the model development team, review work of other team members, complete quality control checks, and align the team’s work within the overall scenario planning initiative identified for the Piedmont Triad Region.

**Project Steering Committee**

A project steering committee for the Piedmont Triad CommunityViz Model should be formed to provide direct oversight and counsel for building the model and collecting data identified to run it. Those on the steering committee should represent a broad base of interests, viewpoints and concerns in the PTCM study area.

**Focus Group Meetings**

The project team should meet with three focus groups to build the Piedmont Triad CommunityViz Model. Each will be very important for collecting data, validating assumptions, and calibrating results for the Model. A brief description of each focus group and their input to the project follows.

**Business & Development Interests**

A focus group with business and development interests should be used to capture the effect of market conditions or business site selection criteria for making one area more attractive to developers over others in the region. Participants would rank ‘growth drivers’ in order of importance and answer general questions about ‘hot spots’ in the region for future growth. General interests represented by the group should include: business development, finance, developers, real estate, and business leaders.

**Local Utility Service Providers**

A focus group with local utility service providers should be used to capture the influence of infrastructure for making some areas more attractive to develop over others in the region. General interests represented by the group should include water and sewer service providers.

**Chief Planning Officials**

A focus group with chief planning officials should be used to understand the effect of local land use policies and ordinances for estimating development potential in the region. Cities, towns, and counties in the region should be included in the focus group.

**Sub-Region Coordination Meetings**

A series of sub-region meetings should be scheduled at set milestones in the planning process to share results and findings with local governments for their feedback. The meetings should help calibrate community type and development status assignments used in a Piedmont Triad CommunityViz Model and validate default values assumed for the general development lookup tables. Key assumptions and initial results from CommunityViz — carrying capacity, land suitability, build-out potential, and growth allocation — should also be presented to local governments for calibrating the Model. Meetings should be scheduled with a host city in each county to maximize attendance.
Policy-Maker Briefings

The project team should provide regular briefings to MPO and RPO technical committees and policy-makers to keep them involved during the model build process and its applications. These meetings should summarize key issues for a Piedmont Triad CommunityViz Model so committee members could provide their input prior to finalizing the data and tools. Through these efforts, committee members should have a greater understanding of how the process evolves, which will be essential for endorsing Model results in the future.

PTRM Communication Strategy Group

The project team should meet regularly with staff and officials responsible for the Piedmont Triad Regional Model to ensure the communication strategy selected for converting CommunityViz output data to TransCAD socioeconomic input data is complete, comprehensive and efficient.

Model Users Group

A Piedmont Triad CommunityViz Model users group should work with the project team to offer advice or recommend improvements to safeguard the technical process and data used to create the scenario planning tools. Highlights for the group should include a three-day CommunityViz software training event (held twice in the region) and a test drive of the models and data sets available to local governments for their continued use beyond the initial Model build.

The two training events would demonstrate basic commands and functions in the software; including work on a case study each afternoon that uses the Piedmont Triad CommunityViz Model to teach students how to create their own models from initial concept idea through calibration. Copies of the Piedmont Triad CommunityViz Model should be made available to local governments via file share site following the training events.
Software Information
This section of the document summarizes general information about CommunityViz software. System requirements, key terms and definitions, and the official model location and status discussions apply to both components of the *Piedmont Triad CommunityViz Model*: the base year data management tool (described in Section D) and the future year allocation tool (described in Section E).

**CommunityViz Software Overview**

CommunityViz is an extension of ESRI’s ArcGIS desktop software that facilitates the visualization and comparison of alternative development scenarios. It was originally developed by the Orton Family Foundation, a non-profit group that focuses on technology and tools for more informed community decision-making.

There are two software components in CommunityViz. The first is Scenario 360, which is a two-dimensional map and data analysis component of the software. It adds the functionality of a spatial spreadsheet to ArcGIS for Desktop software, similar to how a spreadsheet program like Microsoft Excel handles numerical data. Dynamic calculations embedded in the spatial spreadsheet are controlled by user-written formulas that change value as referenced input values change. The impact of physical development or policy decisions under consideration may be measured side-by-side in two or more growth scenarios contemplated in the software.

The second component of CommunityViz software, Scenario 3D, is a visualization tool that constructs three-dimensional models of buildings, roads, landscapes or entire communities using two-dimensional information generated in the Scenario 360 analysis.

More information on CommunityViz and its capabilities for regional planning is available on their website (www.communityviz.com) or *The Planner’s Guide to CommunityViz* published by the American Planning Association in 2011.

**System Requirements**

CommunityViz is an extension for all levels of ESRI’s ArcGIS for Desktop software (Basic, Standard or Advanced). The current version, CommunityViz v. 5.1, requires ArcGIS for Desktop v. 10.4 or greater. Other software requirements include Windows 7 or 10, Microsoft .Net Framework 3.5 or a above, and Windows DirectX 9.0c or higher (required for running Scenario 3D only).

Minimum, preferred and ideal hardware configurations published by the software developer for running CommunityViz are summarized in Table 1.

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<th>System Requirement</th>
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<th>Preferred</th>
<th>Ideal</th>
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<td>64 MB</td>
<td>128+ MB</td>
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</table>

**Key Terms & Definitions**

CommunityViz uses several terms inside the software to organize data, build equations and present results. Knowing these terms and how they relate to each other is critical for building a *Piedmont Triad CommunityViz Model*. A brief summary of key terms used in the software is provided below. See the Help Menu in CommunityViz for more information.
Analysis

An analysis is the term used in CommunityViz to describe a project file; similar to a Microsoft Word document or Microsoft Excel spreadsheet. It includes the map data, scenarios, calculations and data for the work you are doing.

Data

Data includes all of the shapefiles, raster (grid) files or tables referenced in an analysis. CommunityViz uses a file geodatabase structure to store data that is dynamic (all layers that contain at least one Scenario 360 formula). Non-dynamic data is stored in the analysis outside of the geodatabase. Data layers that are dynamic may refer to one or more other data layers outside the analysis geodatabase for computing attribute or indicator values.

Map Feature

A feature represents the individual point, line or polygon illustrated on a work map. Many features in the same data set depict geographic information. Features and the data associated with them are represented by rows in an attribute table.

Attribute

Attributes are fields (columns) in a spatial or numeric table that describe the characteristics associated with features in a data set. Each feature is assigned a value for each field in the table, which may be stored directly in the table cell or referenced from an external lookup table. Static attributes do not change values in the analysis. Dynamic attributes update automatically using formulas written in CommunityViz that respond to changes made in other areas of the analysis.

Attribute data may be exported from CommunityViz to other software platforms (e.g., Microsoft Excel) for reporting or other analyses.

Assumption

Assumptions are used as one input to capture the values, conditions or opinions important to an analysis. They are often referenced in the formula for dynamic attributes, which update automatically every time the assumption values change. Assumption values may be numeric, text or a yes/no format.

Assumptions may also be fixed or variable. A fixed assumption may not be changed in the analysis, and will affect all growth scenarios the same way. A variable assumption may be changed in the analysis using a slider bar, choice button or drop-down list. It can also vary across different development scenarios.

Indicator

Indicators are impact or performance measures that apply to an entire scenario. They summarize conditions using a single statistic similar to the “field summarize” function in ArcGIS. Results are displayed in charts or tables for monitoring conditions inside CommunityViz, and often become the criteria for ranking growth alternatives in a scenario planning process. Indicators update automatically using formulas written in the software that respond to changes made in other areas of the analysis.

Indicator values may be exported from CommunityViz to other software platforms (e.g., Microsoft Excel) for reporting or other analyses.

Charts

Values for indicators or assumptions in CommunityViz are displayed using charts. They update automatically within the analysis and display their previous values for comparison. Data may be presented by item, active scenario or across all scenarios. Charts may be displayed in bar, line, pie, point, doughnut or stacked formats. Threshold lines may be used in combination with charts to determine if a goal, target or constraint condition has been reached because of changes tested for the scenario.

Categories

Categories are used to organize groups of attributes, assumptions, indicators or charts in the analysis. They may be filtered or sorted for a larger analysis to keep track of information.
**Scenarios**

CommunityViz is capable of analyzing one or more growth scenarios simultaneously. All scenarios contain the same map layers, static attributes, formulas for dynamic attributes, assumptions, indicators and charts. Map features or values for dynamic attributes, assumptions, indicators and charts may vary between scenarios.

Each growth scenario is displayed in the table of contents window for ArcGIS Desktop. The active scenario is displayed in the work map. Switching between scenarios in an analysis is done through the Scenario 360 window.

**External Lookup Table**

CommunityViz includes a feature that links tables in Scenario 360 to external tables so when changes are made to the external table they are automatically recognized and updated in the analysis. This feature can be used for linking external tables in text (*.txt), comma separated values (*.csv) or Microsoft Excel (*.xls or *.xlsx) formats.

**Official Model Location & Status**

The official version of the *Piedmont Triad CommunityViz Model* should be maintained by the Piedmont Authority for Regional Transportation and the Piedmont Triad Regional Council. Copies of the Model should be made available to all metropolitan planning organizations, rural planning organizations, and local governments (or their partners) in the PTCM study area that want to use the tool.
Piedmont Triad CommunityViz Model

Base Year Data Management Tool
The Piedmont Triad CommunityViz Model (PTCM) Guidebook originally started as a document focused on the potential for developing a region-wide scenario planning model that could quickly and efficiently create socioeconomic data for the Piedmont Triad Regional Model (PTRM). The next two sections of the document summarize recommendations for creating a CommunityViz model for this purpose. Efforts should focus on the PTRM portion of the PTCM study area first based on the schedule for the next round of MPO Metropolitan Transportation Plan updates; however, the Model could easily be expanded to include the planning areas for RPOs in the future if the NCDOT and others are interested in using it to develop socioeconomic data to include in the statewide travel demand model.

The proposed Piedmont Triad CommunityViz Model would include two major components: a base year data management tool discussed here and a future year allocation tool discussed in the next section of the document. The base year data management tool would organize point, polygon and numeric data created by MPOs for the PTRM portion of the PTCM study area into a single, comprehensive data set. Information summarized in the PTRM data set would include dwelling units (households), dwelling unit population, group quarters population, students and employees (the control total subcategories included in the PTRM).

The base year for the Piedmont Triad CommunityViz Model should match the base year for the Piedmont Triad Regional Model. General topics addressed for the base year data management tool include: unit of analysis, starting data, model architecture, data output and calibration activities.

**Unit of Analysis: Traffic Analysis Zone**

The unit of analysis for the base year data management component of the Piedmont Triad CommunityViz Model should be the traffic analysis zone. Dwelling units (households), dwelling unit population, group quarters population, student and employee data would be aggregated to this unit of analysis for data reporting.

**Starting Data Sets**

Base year data for dwelling units (households), dwelling unit population, group quarters population, students and employees in the PTRM portion of the PTCM study area would rely on several published data sources. Data should be summarized by county, traffic analysis zone or point location for all sixteen control total categories used in the PTRM. MPOs in the PTRM portion of the PTCM study area may vary some of the assumptions, work flows, calculations, partner activities, etc. used to create their base year data within the shared framework.

The project team should collect dwelling units (households), dwelling unit population, group quarters population, student and employee data in the PTRM portion of the PTCM study area from the individual metropolitan planning organizations, verify it was complete, and create the base year data management component of the Piedmont Triad CommunityViz Model (data sets for each MPO should be submitted individually using either ArcGIS shapefile or Microsoft Excel formats).

**Model Architecture**

The base year data management component of the Piedmont Triad CommunityViz Model would use a region-wide modeling platform to summarize data by traffic analysis zone. Data would be reported for dwelling units (households), dwelling unit population, group quarters population, students and employees using data provided by the individual MPOs in the PTRM portion of the PTCM study area (organized by the sixteen control total subcategories included in the PTRM).

Information for specific processes in the model architecture is provided below. The difference in processes used for importing data in CommunityViz should be a function of the data format used by MPOs for submitting their data (Microsoft Excel worksheet, ArcGIS polygon shapefile, or ArcGIS point shapefile).

**Table Join Process in ArcGIS**

In ArcGIS, the table join data tool would be used to append the fields and values of one table to another using a common attribute (in this case the Piedmont...
**Triad Regional Model** traffic analysis zone identification number. The table join process would be used for data transferred to the project team for the **Piedmont Triad CommunityViz Model** in either Microsoft Excel worksheet or ArcGIS polygon shapefile formats.

Data in the joined table would be sorted using descending order by traffic analysis zone identification number to isolate features for the specific MPO data set. The “field calculator” tool in ArcGIS would be used to transfer data from the MPO to region-wide traffic analysis zone files in CommunityViz using paired column headings. The table join would be removed for each MPO once all sixteen PTRM control total categories have been copied into the region-wide traffic analysis zone files.

The process would be repeated for each MPO that provides data in Microsoft Excel worksheet or ArcGIS polygon shapefile formats.

**Overlap Sum Function in CommunityViz**

In CommunityViz, the overlap sum function adds together the values of an attribute for all features in one data set that fall within the boundary of features in another data set. Data is reported as the sum of all underlying features within the boundary of the larger feature. For example, thousands of points in the PTRM portion of the PTCM study area representing employees could quickly be summarized by traffic analysis zone using the boundary of each traffic analysis zone as the criteria for adding together underlying point feature values (in this case by PTRM employee control total category).

The overlap sum function would be run in a single ‘temporary dynamic attribute variable’ created for the CommunityViz model, which could be modified several times to represent the different control total categories and MPO areas of interest for importing data using this method. Data in the column would be sorted using descending order to isolate features for the specific MPO data set. The “field calculator” tool in ArcGIS would be used to transfer data from the temporary dynamic attribute column to the corresponding category in the region-wide traffic analysis zone file.

The process would be repeated for each MPO that provides data in ArcGIS point shapefile format.

**Model Calibration**

A significant amount of time should be reserved in building the base year data management tool to validate the model architecture and methodology, evaluate different base year data sources, and calibrate results against observed existing conditions. These activities would instill confidence in the analysis tools and help with reaching greater consensus among metropolitan planning organizations and their partners for the results.

The project team should use regular coordination calls, emails, web meetings and on-site coordination meetings to build and calibrate the base year data management tool for the **Piedmont Triad CommunityViz Model**. Key quality control issues addressed by the team should include: data quality and availability, model architecture, model input data and values, and beta model results.
The **Piedmont Triad CommunityViz Model (PTCM) Guidebook** originally started as a document focused on the potential for developing a region-wide scenario planning model that could quickly and efficiently create socioeconomic data for the **Piedmont Triad Regional Model** (PTRM). This section and the one before it summarize recommendations for creating a CommunityViz model for this purpose. Efforts should focus on the PTRM portion of the PTCM study area first based on the schedule for the next round of MPO Metropolitan Transportation Plan updates; however, the Model could easily be expanded to include the planning areas for RPOs in the future if the NCDOT and others are interested in using it to develop socioeconomic data to include in the statewide travel demand model.

The proposed **Piedmont Triad CommunityViz Model** would include two major components: a base year data management tool and a future year allocation tool. The future year allocation tool would approximate build out potential, development attractiveness, and future year growth allocation by horizon year (using control total categories from the **Piedmont Triad Regional Model**) for grid cells and traffic analysis zones in the PTRM portion of the PTCM study area. Future year allocation periods in the CommunityViz model should match those used in the **Piedmont Triad Regional Model**.

General topics addressed for the future year allocation tool include: unit of analysis, data needs, model architecture, theory and features behind the tool, data output and calibration activities.

**Unit of Analysis: Grid Cell**

Grid cells should be used as a common geography in the future year allocation tool to address size and complexity issues for modeling in a large study area. They would be used to aggregate parcel-level data, and support a number of calculations focused on the study-area-as-a-whole.

The size of grid cells used in the PTRM portion of the PTCM study area would vary to reflect different development types, patterns and intensities anticipated for the study area. Smaller size grid cells, generally ten acres each, would be used to represent the planning areas for cities and towns throughout the study area (defined by the boundaries used for the Future Land Use Map in locally-adopted comprehensive plans). Larger size grid cells, generally ranging between 40 acres and 2,560 acres, would be used for more rural areas (primarily unincorporated areas) and land held in permanent conservation. Increasing the size of grid cells in areas where development types, patterns and intensities are slower to change would reduce the total number of features in the data set.

Recommended rules for assigning grid cell sizes in the region are summarized in Table 2 on page 21. (Note: a relatively small number of grid cells in the PTRM portion of the PTCM study area would not conform to the simple area rules highlighted in Table 2 on page 21. These grid cells would be located at the boundary of the study area, and are smaller in size because they would be clipped to eliminate representation outside the study area.)

The opportunity to use graduated grid cells for the PTRM portion of the PTCM study area would improve overall model performance and allow stakeholders greater flexibility for assigning values and reporting results. Overall, the use of grid cells over parcels in the CommunityViz model would reduce the number of records in the database to something manageable for region-wide planning and analysis.

**Unit of Analysis: Traffic Analysis Zone**

The unit of analysis for the future year allocation component of the **Piedmont Triad CommunityViz Model** should be the grid cell except for two instances: student growth allocation (six categories) and group quarters population allocation (one category). Both of these processes should rely on traffic analysis zones to approximate available supply, store land suitability scores (averaged from underlying grid cells), and allocate future year growth.
Data Inventory & Analysis

Data collection for the future year allocation component of the *Piedmont Triad CommunityViz Model* would start with data collected for *Piedmont Together* and would continue through completion of the model build. Overall, the quantity and quality of data available in the study area would be an asset for developing the model in CommunityViz, and the partnerships formed with the local governments for exchanging data would benefit both the *Piedmont Triad CommunityViz Model* and other plans, studies and initiatives underway (e.g., comprehensive plan updates, comprehensive transportation plans, development ordinance updates, water and sewer master plans, etc.).

A file transfer protocol (FTP) site should be set up for exchanging data in the PTRM portion of the PTCM study area. Data would be kept up-to-date by staff for the Piedmont Authority for Regional Transportation and the Piedmont Triad Regional Council. Any government agency, research group or project team working in the study area should be allowed access to the data using a log-in and password.

Data collected for the *Piedmont Triad CommunityViz Model* is described here under three general headings: GIS data, policy and plan documents and resource documents.

### GIS Data

Geographic information system (GIS) data would be essential for building the *Piedmont Triad CommunityViz Model*. The project team should start with data created during the *Piedmont Together* scenario planning process (2013 to 2015), and partner with local governments in the PTRM portion of the PTCM study area to update data for the *Piedmont Triad CommunityViz Model* (2016 and 2017). Data should be collected for three general categories: base map layers, analysis layers and reference layers. Other data should be added to the database as the model build processes evolves.

GIS data needed to build the *Piedmont Triad CommunityViz Model* are summarized in Table 3 on page 22.

### Policies & Plan Documents

Policies and plan documents should be collected from local governments in the PTRM portion of the PTCM study area; including comprehensive plans, small area plans, corridor studies or zoning ordinances.

---

**Table 2: General Rules for Assigning Grid Cells in CommunityViz**

<table>
<thead>
<tr>
<th>Grid Cell</th>
<th>Dimensions</th>
<th>Area</th>
<th>General Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>¼-mile</td>
<td>660’ x 660’</td>
<td>10 acres</td>
<td>Land inside city or town planning boundaries (consistent with the Future Land Use Map boundary presented in locally-adopted comprehensive plans)</td>
</tr>
<tr>
<td>½-mile</td>
<td>1,320’ x 1,320’</td>
<td>40 acres</td>
<td>Land outside city or town planning boundaries but generally within ½-mile of a US Highway or NC Highway</td>
</tr>
<tr>
<td>1 mile</td>
<td>2,640’ x 2,640’</td>
<td>160 acres</td>
<td>Land outside city or town planning boundaries and generally greater than ½-mile away from a US Highway or NC Highway</td>
</tr>
<tr>
<td>1 mile</td>
<td>5,280’ x 5,280’</td>
<td>640 acres</td>
<td>Land not likely to develop in the future (e.g., large water bodies, state parks, etc.)</td>
</tr>
<tr>
<td>2 mile</td>
<td>10,560’ x 10,560’</td>
<td>2,560 acres</td>
<td>Land not likely to develop in the future (e.g., large water bodies, state parks, etc.)</td>
</tr>
</tbody>
</table>
Table 3: Summary of GIS Data Needed for Building the Future Year Allocation Component of the Piedmont Triad CommunityViz Model

<table>
<thead>
<tr>
<th>File Name</th>
<th>Shapefile Format</th>
<th>Responsible Party</th>
<th>CommunityViz Module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Map Data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City-County Labels</td>
<td>Point</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td>Interstate Shields</td>
<td>Point</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td>US &amp; NC Highway Shields</td>
<td>Point</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td>PTRCM Study Area Boundary</td>
<td>Polygon</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td>PTRM Study Area Boundary</td>
<td>Polygon</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td>Interstates</td>
<td>Polyline</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td>County Boundaries</td>
<td>Polygon</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td><strong>Analysis Data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduated Grid Cells</td>
<td>Polygon</td>
<td>PART</td>
<td>All Modules</td>
</tr>
<tr>
<td>Traffic Analysis Zones</td>
<td>Polygon</td>
<td>PART</td>
<td>All Modules</td>
</tr>
<tr>
<td>Permanent Conservation Areas</td>
<td>Polygon</td>
<td>Non-Profits</td>
<td>Carrying Capacity</td>
</tr>
<tr>
<td>National Wetlands Inventory</td>
<td>Polygon</td>
<td>USGS</td>
<td>Carrying Capacity</td>
</tr>
<tr>
<td>Stream Buffer Protection Areas</td>
<td>Polygon</td>
<td>PTRC</td>
<td>Carrying Capacity</td>
</tr>
<tr>
<td>Major Water Bodies</td>
<td>Polygon</td>
<td>PART</td>
<td>Carrying Capacity</td>
</tr>
<tr>
<td>Existing Rights-of-Way</td>
<td>Polygon</td>
<td>PART</td>
<td>Carrying Capacity</td>
</tr>
<tr>
<td>Composite Development Constraints Layer</td>
<td>Polygon</td>
<td>PART</td>
<td>Carrying Capacity</td>
</tr>
<tr>
<td>Interchanges</td>
<td>Point</td>
<td>MPO/RPO</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Major Intersections</td>
<td>Point</td>
<td>MPO/RPO</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Major Roads</td>
<td>Polyline</td>
<td>MPO/RPO</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Metropolitan Centers</td>
<td>Polygon</td>
<td>PTRC</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Town Centers</td>
<td>Point</td>
<td>PTRC</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Major Activity Centers</td>
<td>Point</td>
<td>PTRC</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Watershed Protection Areas</td>
<td>Polygon</td>
<td>NCDEQ</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Flood Hazard Areas</td>
<td>Polygon</td>
<td>NCDEQ</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Water Service Areas</td>
<td>Polygon</td>
<td>PART</td>
<td>Land Suitability</td>
</tr>
<tr>
<td>Sewer Service Areas</td>
<td>Polygon</td>
<td>PART</td>
<td>Land Suitability</td>
</tr>
<tr>
<td><strong>Reference Data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoning Maps / Future Land Use Maps</td>
<td>Polygon</td>
<td>PTRC</td>
<td>Build-Out Potential</td>
</tr>
<tr>
<td>Points of Interest</td>
<td>Point</td>
<td>PTRC</td>
<td>Build-Out Potential</td>
</tr>
<tr>
<td>Parcels</td>
<td>Polygon</td>
<td>PTRC</td>
<td>Build-Out Potential</td>
</tr>
<tr>
<td>Building Footprints</td>
<td>Polygon</td>
<td>PTRC</td>
<td>Build-Out Potential</td>
</tr>
<tr>
<td>Height/Bulk/Density Thresholds by Community Type</td>
<td>N/A</td>
<td>PTRC</td>
<td>Build-Out Potential</td>
</tr>
<tr>
<td>Aerial Photography</td>
<td>Raster</td>
<td>USDA</td>
<td>Build-Out Potential</td>
</tr>
<tr>
<td>Growth Control Totals</td>
<td>N/A</td>
<td>MPO/RPO</td>
<td>Growth Allocation</td>
</tr>
<tr>
<td>Traffic Analysis Zones (PTRM)</td>
<td>Polygon</td>
<td>PART</td>
<td>Reporting</td>
</tr>
<tr>
<td>Traffic Analysis Zones (NCDOT)</td>
<td>Polygon</td>
<td>NCDOT</td>
<td>Reporting</td>
</tr>
</tbody>
</table>
Resource Documents

Several resource documents should be consulted for building the future year allocation component of the *Piedmont Triad CommunityViz Model*. Collectively, they should be used to refine the model architecture, validate assumptions, and write equations for CommunityViz. Resource documents consulted for the PTCM build should include:

- *Piedmont Triad Regional Model Users Guide*
- *Piedmont Together Regional Scenario Planning Report*

Committed Development

Local governments in the region are continually approving development projects that are expected to start construction before the first horizon year in the travel demand model. Stakeholders in other regions have asked that committed development of a certain size known between the base year and first horizon year in the travel demand model be hardcoded in the CommunityViz model to alleviate any concerns about development patterns and intensities assumed for the first planning period. This step in the process increases confidence in the model’s output, and should be used for developing the *Piedmont Triad CommunityViz Model*.

New residential neighborhoods; multifamily developments; commercial, office, or industrial centers; and mixed-use projects should be considered for the database and hardwired into the Model. Project thresholds for each development type should include:

<table>
<thead>
<tr>
<th>Category</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>&gt; 250 d.u.’s</td>
</tr>
<tr>
<td>Neighborhoods</td>
<td></td>
</tr>
<tr>
<td>Multifamily</td>
<td>&gt; 150 d.u.’s</td>
</tr>
<tr>
<td>Development</td>
<td></td>
</tr>
<tr>
<td>Commercial Centers</td>
<td>&gt; 250,000 s.f.</td>
</tr>
<tr>
<td>Office Centers</td>
<td>&gt; 250,000 s.f.</td>
</tr>
<tr>
<td>Industrial Centers</td>
<td>&gt; 250,000 s.f.</td>
</tr>
<tr>
<td>Mixed-Use Projects</td>
<td>&gt; 250,000 s.f. &amp;</td>
</tr>
<tr>
<td></td>
<td>150 d.u.’s</td>
</tr>
</tbody>
</table>

Committed development below the thresholds noted above should be assigned using the Allocator 5 wizard in CommunityViz software.

Data Manipulation

Two new GIS data sets — development status and community types — were created for *Piedmont Together* in 2013, which would need to be updated (where appropriate) for the *Piedmont Triad CommunityViz Model*. A description of both data sets and information that should be used for creating the databases is provided on the following pages.

Development Status

Development status in the PTRM portion of the PTCM study area tells CommunityViz which set of equations to use for estimating the development yield (build-out potential) of a grid cell. And when combined with the land suitability scores and community type assignments, it would establish the order and supply available for a grid cell to receive future growth in the model.

Development Status Assignments

Development status would be assigned to parcels in the PTRM portion of the PTCM study area using then current aerial photography, property appraiser data, and topic-specific GIS data sets (e.g., existing land use, farmland, or vacant land inventories, etc.). Emphasis on one or more of the data sets would vary by the development status category being coded, which is highlighted in the category descriptions below. Values for development status would be recorded in a new column created for the parcel files. Internal scripts in the CommunityViz model would transfer values from parcels to grid cells using an overlap most function.

Category Descriptions

Development status categories used for the PTRM portion of the PTCM study area should include: open space, developed, undeveloped, redevelopment area and committed development. A brief description of each category follows:
**Open Space** — active or passive land dedicated to permanent or semi-permanent open space, including: water bodies, state parks, conservation areas, parks and recreation fields, and land set aside for open space in residential neighborhoods, commercial centers, business parks, etc. GIS data (water bodies, conservation easements, points of interest, etc.) and/or land ownership information in a property appraiser database could be used to assign permanent open space status.

Future year growth would not be allocated to grid cells identified as open space in the PTRM portion of the PTCM study area.

**Developed** — lots or parcels largely built-out with permanent buildings or structures. Developed status would also assigned to surface parking lots that serve adjoining buildings, or to sliver lots adjacent to developed parcels (appearing to be part of the same development or home site) where size, shape or access limitations would generally keep them from developing in the future.

Then current aerial photography, GIS data (existing land use inventory, building footprints, points of interest, etc.) and/or land ownership information in a property appraiser database could be used to assign developed status.

Future year growth would not be allocated to grid cells identified as developed in the PTRM portion of the PTCM study area.

**Undeveloped** — lots or parcels without permanent buildings or structures. Undeveloped status would also assigned to more rural parcels with temporary structures (e.g., pole barn, large storage shed, etc.) that could easily be removed to accommodate new development. Then current aerial photography, GIS data (vacant lands inventory, building footprints, etc.) and/or land ownership information in a property appraiser database would be used to assign undeveloped status.

Future year growth could be allocated to grid cells identified as undeveloped in the PTRM portion of the PTCM study area.

**Redevelopment Area** — lots or parcels with permanent buildings or structures that occupy only a small portion of the property; leaving significant area available for future development. The initial test would be limited to space efficiency, or a mismatch between existing land use and future land use (e.g., residential home in a commercial district). The condition of buildings or structures on the property would not be a consideration for redevelopment status except for obvious cases of neglect.

Then current aerial photography, GIS data (underutilized lands inventory, redevelopment priority areas, etc.) and/or land value and building value information in a property appraiser database could be used to assign redevelopment status. Additional parcels could be (re)assigned redevelopment status in consultation with local government officials during a series of sub-region coordination meetings held in the PTRM portion of the PTCM study area.

Future year growth could be allocated to grid cells identified for redevelopment in the PTRM portion of the PTCM study area.

**Committed Development** — lots or parcels where a project of significant size (see thresholds stated on Table 4 below) would be expected to start construction sometime between the base year and first horizon year in the Piedmont Regional Model. Only the portion of the development program expected before the first horizon year should be included as committed development in the CommunityViz model.

Future growth for committed development should be hardwired at the grid cell level using information in an external database. Committed development below the thresholds noted on page 23 should be assigned using the Allocator 5 wizard in CommunityViz software.

**Community Types**

Piedmont Together introduced the concept of development types to the PTCM study area, which generalized various development categories used by local governments to describe, measure and evaluate the built environment. Development types for
Community types in the PTRM portion of the PTCM study area would tell CommunityViz which set of equations to use for estimating the development yield (build-out potential) of a grid cell. And when combined with the land suitability analysis scores and development status assignments, it would establish the order and supply available for a grid cell to receive future growth in the model.

Community Type Assignments

Community types would be assigned to parcels in the PTRM portion of the PTCM study area using previous work from Piedmont Together (referencing the Current Trend Growth Scenario) and/or more current development status and community type data made available during the Piedmont Together CommunityViz Model build process. Values for community type would be recorded in a new column created for the parcel files. Internal scripts in the model would transfer values from parcels to grid cells using an overlap most function.

Community Type Category Descriptions

Twenty-six community type categories (compared to twelve development types used for Piedmont Together) would capture different development types, patterns and intensities observed in the PTRM portion of the PTCM study area. A brief summary of each community type category is provided below.

Preserved Open Space — land dedicated to permanent conservation by legal means. These areas may be preserved because of their outstanding natural beauty, or because they serve environmental stewardship or wildlife management purposes. The areas are undisturbed or undeveloped and have been protected from development by federal, state or local agencies; or by public, private or non-profit organizations. In the PTRM portion of the PTCM study area, these areas would include state parks, permanent conservation areas, cemeteries and (at a smaller scale) dedicated open space within residential neighborhoods.

Recreational Open Space — land dedicated for active and passive recreational uses. These areas are intended to be publically-accessible. In the PTRM portion of the PTCM study area, these areas would include municipal and community parks, open air sports complexes and athletic fields.

Rural Living — land characterized by large lots, abundant open space and a high degree of separation between buildings. Large acreage, rural family homes and “hobby farms” are scattered throughout the countryside and often integrated into the landscape. The lot size and distance between dwelling units decrease with greater development densities. Small nodes of commercial activity — gas stations, convenience stores or restaurants — are concentrated at rural crossroads, serving some daily needs of the surrounding rural population.

Working Farm — land actively being used for agriculture or forestry activities, including cultivated farmland, timber harvest, livestock and woodlands. These areas may also support the primary residence.
of the property owner and any out-buildings associated with activities on the working farm.

Large-Lot Residential — land generally formed as subdivisions, which consist almost entirely of single-family detached homes. Buildings are oriented interior to the site and are typically buffered from surrounding development by transitional uses, topography or vegetative areas. Many neighborhoods ‘borrow’ open space from adjacent rural or natural settings. Blocks are typically large, and streets rural or suburban in character. In some cases, the neighborhood is served by only one long cul-de-sac.

Single-Family Neighborhood — land generally formed as subdivisions or communities, with a relatively uniform housing type and density throughout. They may support a variety of single-family detached residential types, from mobile homes to large-lot, low-density single-family homes to denser formats of smaller single-family detached homes. Homes are oriented interior to the neighborhood and typically buffered from surrounding development by transitional uses or landscaped areas. Single-family neighborhoods are often found in close proximity to suburban commercial, suburban office and suburban mixed-use centers, which help provide the consumers or employees needed to support these businesses.

Town Home Community — land generally developed to provide pockets of greater residential density, often in locations that create a transition between commercial or mixed-use areas and small-lot or large-lot single family neighborhoods. The more dense development intensities help provide “rooftops” to support nearby suburban commercial, suburban office or suburban mixed-use centers.

Multifamily Neighborhood — land generally formed as complexes or communities, with a relatively uniform housing type and density throughout. They support the highest residential density in the suburban landscape, and may support condominiums or apartments.

Multifamily neighborhoods are found in close proximity to suburban commercial, suburban office and suburban mixed-use centers, which helps provide the consumers and employees needed to support these centers. Buildings are oriented interior to the site and typically buffered from surrounding development by transitional uses or landscaped areas. Large parking lots and low street connectivity are common in suburban multifamily neighborhoods.

Urban Neighborhood — land supporting a mix of moderate- to high-density housing options. These neighborhoods are relatively compact, and may contain one or more of the following housing types: single family detached (small lots), townhomes, condominiums or apartments.
Buildings are generally oriented toward the street. The design and scale of development in an urban neighborhood encourages active living with a complete and comprehensive network of walkable streets. Cul-de-sacs are restricted to areas where topography, environmental constraints or existing development makes other street connections prohibitive.

**Light Industrial Center** — land supporting opportunities to concentrate employment on normal workdays. Each center generally supports manufacturing and production uses; including warehousing, light manufacturing, medical research and assembly operations. These areas are found in close proximity to major transportation corridors (i.e., highway or rail) and are generally buffered from surrounding development by transitional uses or landscaped areas that shield the view of structures, loading docks or outdoor storage from adjacent properties.

Clusters of uses that support or serve one another are often encouraged to locate in the same light industrial center.

**Heavy Industrial Center** — land supporting large-scale manufacturing and production uses; including assembly and processing, regional warehousing and distribution, bulk storage and utilities. These areas are found in close proximity to major transportation corridors (i.e., highway or rail) and are generally buffered from surrounding development by transitional uses or landscape areas that increase in size as development intensity increases.

Heavy industrial centers may require larger sites because activities are not confined entirely to buildings. Conveyer belts, holding tanks, smoke stacks or outdoor storage all may be present. Clusters of uses that support or serve heavy industrial centers generally locate in close proximity.

**Suburban Commercial Center** — land supporting the daily needs of surrounding suburban residential neighborhoods. They typically locate near high-volume roads and key intersections, and are designed to be accessible primarily by automobile. Buildings are set back from the road behind large surface parking lots with little connectivity between adjacent businesses. Common types of suburban centers in the PTRM portion of the PTCM study area include: multi-tenant strip centers, big box stores, small outparcels with a drive-through and large shopping malls.

**Suburban Office Center** — land supporting opportunities to concentrate employment on normal workdays. They include both large-scale isolated buildings with numerous employees as well as areas containing multiple office uses that support and serve one another. They are typically buffered from surrounding development by transitional uses or landscaped areas and are often located in close proximity to major highways or thoroughfares.

**Regional Employment Center** — places that draw people from throughout the study area (and beyond) for employment activities. Development is typically large-scale, including a hierarchy of streets, large sites for a building or group of buildings, supporting amenities and dedicated open space. Centers tend to
locate near major transportation corridors and often at the intersection of two major highways or an interstate exit. Uses in a regional employment center vary greatly; however, most complement each other in some manner for increased learning, production or other economies of scale.

**Walkable Neighborhood** — land developed to offer residents the opportunity to live, shop, work and play in one community. These neighborhoods include a mixture of housing types and residential densities, integrated with goods and services in a walkable community that residents visit on a daily basis. The design and scale of the development encourages active living through a comprehensive and interconnected network of walkable streets. Walkable neighborhoods support multiple modes of transportation.

**Walkable Activity Center** — land developed to serve broader economic, entertainment and community activities (compared to walkable neighborhoods). Uses and buildings are located on small blocks with streets designed to encourage pedestrian activities. Buildings in the core of a walkable activity center may stand three or more stories. Residential units or office space may be found above storefronts.

Parking is satisfied by using on-street parking, structured parking and shared rear-lot parking strategies. A large-scale walkable activity center may be surrounded by one or more walkable neighborhoods that encourage active living, with a comprehensive and interconnected network of walkable streets.

**Town Center** — land that satisfies daily economic, entertainment and community needs for surrounding neighborhoods. Uses and buildings are located on small blocks with streets designed to encourage pedestrian activity. Buildings in a town center typically stand two or more stories in height with non-residential uses on the ground floor and residential units above storefronts.

Neighborhoods surrounding the commercial core are relatively compact and support moderate- to high-density housing options, including: single-family homes (small lots), townhomes, condominiums and apartments.

**Transit Activity Center** — land representing the concentration of mixed-use, dense development around a transit center, whether serving bus rapid transit, light rail or commuter rail. Uses and buildings are located on small blocks with streets designed to encourage bicycle and pedestrian activity. High-density development is located primarily within ¼-mile of the transit station, with progressively lower densities spreading out into neighborhoods surrounding the center.

Different transit technologies would spur slightly different development patterns and intensities around transit centers, but their similarities are more important than their differences for the community type.

**Metropolitan Center** — a major hub for employment, entertainment, civic and cultural activities with a mix of housing types and common open space for active living. As a magnet to
surrounding towns and neighborhoods, the metropolitan center becomes an iconic symbol in the region, starting with very tall buildings and a compact street network.

The walkable environment and mix of residential and non-residential uses in a metropolitan center support multiple modes of transportation.

**Health Care Campus** — a concentration of various medical and medical-related uses, such as primary care, outpatient surgery, birthing centers and other specialty services. They are relatively large in scale, and may include a hospital, teaching facilities, research and rehabilitation centers and private medical office buildings.

Buildings are typically oriented in a campus setting, with large buildings connected via walkways, structured parking or internal network of streets for circulation.

**Educational Campus, K-12** — a public, private or charter school that serves students in kindergarten through twelfth grade (including elementary, middle and high schools). Day care centers and nurseries are not considered part of an educational campus for the *Piedmont Triad CommunityViz Model*.

**University/College Campus, Dormitories** — the area of a university or college campus that includes residence halls (group quarters) occupied by students of the institution. Buildings are often oriented around a highly-walkable network of internal streets and pedestrian pathways, which support several modes of transportation.

**University/College Campus, Academic Buildings** — the area of a university or college campus that includes all of the academic buildings and other ancillary employment uses needed to support an institution for higher education. Buildings are often oriented around a highly-walkable network of internal streets and pedestrian pathways, which support several modes of transportation. Structured parking or large surface lots, dedicated areas for public gathering and distinctive architecture also represent a typical university campus.

Building uses and intensities on campus vary widely based on the school’s mission and available space, topography, etc.

**Airport, Piedmont Triad International** — land that supports commercial and general aviation air traffic into and out of Piedmont Triad International Airport; including multiple runways, terminals, taxiways, jet fuel and storage facilities, and paved aircraft parking areas. Complimentary uses (e.g., rental car facilities, hotels, restaurants, long-term parking lots, etc.) also surround the airport. Restrictions on use, building or structure placement, and maximum height are enforced in designated runway airspace protection areas.

**Airport, All Others in PTCM Study Area** — land that supports commercial or general aviation air traffic into and out of the PTRM portion of the PTCM study area (excluding the Piedmont Triad International Airport). Each airport may include one or more runways, terminals, taxiways, jet fuel and storage facilities, or paved aircraft parking areas. Complimentary uses (e.g., rental car facilities, hotels, restaurants, long-term parking lots) may surround an airport. Restrictions on use, building or structure placement, and maximum height are enforced in designated runway airspace protection areas.

**Special District** — uses that do not meet general definitions or the intent of other community type categories used for the PTRM portion of the PTCM study area. Examples include a regional race track, amusement park, etc. that are unique in the region and often defined by their own planning and design standards.

**Growth Control Totals**

County-level control totals for a thirty-year planning horizon would be provided by metropolitan planning organizations in the region using traditional processes. Each organization would certify the data sets for updating their independent metropolitan transportation plans and comprehensive transportation plans.

Data would be summarized for sixteen growth control categories consistent with the horizon year.
needs of the *Piedmont Triad CommunityViz Model* (future allocation tool component) and the *Piedmont Triad Regional Model*:

- single-family residential dwelling units
- multifamily residential dwelling units
- retail employees (highway)
- retail employees (other)
- industrial employees
- service employees
- office employees
- education employees (K-12)
- university/college employees
- students (K-12)
- university/college students (FTE)
- university/college students (full-time)
- university/college students (part-time)
- total enrolled students (full-time)
- total enrolled students (part-time)
- group quarters population

**Household Category Ratios**

The *Piedmont Triad CommunityViz Model* would calculate residential build out potential (supply) for single family and multifamily dwelling unit categories. Future year growth forecasts from the metropolitan planning organizations would provide only total households for the thirty-year planning horizon (reported in ten year increments).

Household category assumptions used in CommunityViz would approximate the ratio of single-family dwelling units (single family detached or town home) to multifamily dwelling units (condominium or apartment) for the growth allocation process. Ratios developed for the conversion should use county-level data published in the US Census Bureau, American Community Survey, Five Year Estimates (Table B25033 and S2504).

**Employee Space Ratios**

Employee space ratios are used in CommunityViz to convert build out potential for non-residential development (square feet) to available supply (employees) for the growth allocation process. Ratios used for the conversion should rely on information published in the Institute of Transportation Engineers *Trip Generation Manual*.

**Model Architecture**

The future year allocation component of the *Piedmont Triad CommunityViz Model* would use a region-wide modeling platform to run growth scenarios. Certain variables and values used in the calculations would be linked to CommunityViz via lookup tables, which account for the different rules or policies local governments use to regulate development potential.

Growth by control total category would be allocated to grid cells (for dwelling units and employees) and traffic analysis zones (for students and group quarters population) in the Model for one or more growth scenarios. Grid level data would be summarized in CommunityViz by traffic analysis zone and exported to a database format (*.dbf) for creating socioeconomic data in the *Piedmont Triad Regional Model*.

A map of the recommended model architecture for the future year allocation tool is provided on page 32. More information for specific components of the model architecture is provided on the following pages.

**Model Components**

The future year allocation component of the *Piedmont Triad CommunityViz Model* would include
six major components: carrying capacity analysis, external lookup tables, build-out potential analysis, land suitability analysis, growth allocation and TAZ-level reporting.

**Carrying Capacity Analysis**

Some land in the PTRM portion of the PTCM study area would never develop because of physical conditions on the site, land ownership, or the existence of state and local policies that prohibit development. These areas — referred to as ‘highly-constrained for development’ in the *Piedmont Triad CommunityViz Model* — would be removed from the model area to more accurately approximate buildable area in the study area.

Internal scripts in the model would remove ‘highly-constrained areas for development’ from the build-out calculations using an overlap function. A site efficiency factor (specific to each community type category) would be applied to vacant grid cells in the PTRM portion of the PTCM study area to account for land typically set aside for on-site improvements (e.g., internal streets, utility easements, storm water management, open space, etc.) to support new development. Site efficiency factors would be lowered for grid cells located in critical or protected watersheds to limit the maximum buildable area (or maximum lot coverage) consistent with state and local rules or policies.

The portion(s) of a grid cell remaining after the removal of ‘highly-constrained areas for development’ and the application of factors for on-site infrastructure (if vacant) and watershed protection areas (if applicable) would be used to approximate buildable area for the study area.

Recommended features in the PTRM portion of the PTCM study area used to represent highly-constrained areas for development should include:

- Water Bodies;
- Wetlands;
- Stream Buffers;
- Permanent Conservation Areas; and
- Existing Rights-of-Way.
External Lookup Tables

Some variables and values used in the calculations for CommunityViz would be linked to the analysis via external lookup tables, which update automatically every time a change is made outside the software. The tables would be used to capture general development characteristics associated with the different community types, and enumerate household, employee, student and group quarters population control totals for the growth allocation process.

Site Efficiency & Watershed Protection Maximum Lot Coverage Factors Lookup Table

Site efficiency factors in the lookup table would be used to account for the amount of land typically set aside for on-site improvements (e.g., internal streets, utility easements, storm water management, open space, etc.) to support new development. They would be reported in the lookup table as the percentage of land remaining for development after deducting for on-site infrastructure (e.g., a site efficiency factor of 80% means 20% of the land is assumed for on-site infrastructure). Site efficiency factors would vary by community type category. They would be constant for all jurisdictions in the PTRM portion of the PTCM study area.

Maximum lot coverage factors for critical and protected watershed categories in the lookup table would be used to store maximum lot coverage requirements (representing maximum impervious surface) by community type category. They would be consistent for all jurisdictions in the PTRM portion of the PTCM study area. Statistics assumed in the lookup table would be consistent with rules and ordinances enforced by state agencies or local governments in North Carolina.

Site efficiency factors and maximum lot coverage factors for watershed protection areas would both be used in the buildable area calculation, which is part of the carrying capacity module in CommunityViz (see page 33).

General Development Lookup Table

The general development lookup table would be linked to the Piedmont Triad CommunityViz Model using community type categories and jurisdiction code values. Statistics in the table would vary by local government represented in the PTRM portion of the PTCM study area; reflecting small differences in characteristics or expectations for each community type category specific to the jurisdiction’s local comprehensive plan and/or land development controls.

All communities in the PTRM portion of the PTCM study area would be represented in the lookup table organized by county. Each jurisdiction would use the same data columns, naming convention and formatting features to streamline the modeling process. The only variations in the table would be associated with the density and floor area ratio (FAR) values assumed for the variables. Build-out potential factors calculated in the lookup table would streamline calculations inside CommunityViz by multiplying factors outside the model environment.

Recommended information to include in the lookup includes:

General Characteristics
- County Name
- Growth Tier
- Community Type Category
- Jurisdiction Code
- Jurisdiction Name
- % Residential Development
- % Non-Residential Development

Residential Development Characteristics
- Average Density Outside Watershed Areas
- Average Density Inside Watershed Areas (six categorical conditions)
- % Single Family Development
- % Multifamily Development

Non-Residential Development Characteristics
- Average Floor Area Ratio
- % Retail (High) Development
- % Retail (Other) Development
- % Industrial Development
- % Service Development
- % Office Development
- % Education (K-12) Development
Build-Out Potential Factors

- Single Family Development
- Multifamily Development
- Retail (High) Development
- Retail (Other) Development
- Industrial Development
- Service Development
- Office Development
- Education Development

Growth Control Totals Lookup Table: Dwelling Units & Employees

The growth control totals lookup table for dwelling units and employees would be used to store county-level control totals for three interim horizon periods. Dwelling unit data would be reported for single family and multifamily residential categories. Data for employees would be reported for retail (high), retail (other), industrial, service, office and education categories.

Growth Control Totals Lookup Table: Students & Group Quarters Population

The growth control totals lookup table for students and group quarters population would be used to store county-level control totals for three interim horizon periods. Student data would be reported for students (K-12), university/college students (FTE), university/college students (full-time), university/college students (part-time), total enrolled students (full-time), and total enrolled students (part-time). Group quarters population data would be kept in a single category.

Allocation Categories Lookup Table

The allocation categories lookup table is a data set referenced in the “land uses” window of the Allocator 5 wizard in CommunityViz. It would assign a numerical identifier to each growth allocation category (residential, employee, student and group quarters) that streamlines internal scripts and calculations in the software.

Build-Out Potential Analysis

Build-out potential in CommunityViz quantifies the type, location and intensity of development for a theoretical condition where all land available in the PTRM portion of the PTCM study area is developed. Specific information for calculating build-out potential for grid cells (used for dwelling unit and employee allocation categories) or traffic analysis zones (used for student or group quarters population allocation categories) is summarized below.

Dwelling Units & Employees

Build-out potential calculations for dwelling units and employees would simulate a theoretical condition where all grid cells in the PTRM portion of the PTCM study area assigned ‘undeveloped’ or ‘redevelopment’ status are (re)developed consistent with assigned community types and development lookup table values. Internal scripts in the software would start with buildable area and apply rules for land use mix, density or intensity from the General Development Lookup Table to approximate a maximum number of new dwelling units or maximum number of new employees for the grid cells. A factor would be applied in the employee calculations to convert maximum allowable non-residential square feet to total employees for the growth allocation process (see employee space ratio discussion on pg. 31).

Build-out potential statistics would be summarized using eight development categories (single-family residential, multifamily residential, retail high, retail other, industrial, service, office and education) and three horizon periods. Available supply for successive horizon periods would be calculated by subtracting current period allocation statistics from the same horizon period supply statistics (e.g., 2020 available supply – 2020 allocation = 2030 available supply).

Build-out statistics would be summarized by control total category, county location and horizon period for the growth allocation process consistent with control total categories and periods in the Growth Control Totals Lookup Table for Dwelling Units & Employees. This information would be used to represent ‘available supply’ for the growth allocation scripts in CommunityViz.
**Student Categories**

New school locations in the PTRM portion of the PTCM study area would be limited to those identified by public school districts or private education providers, which represent very limited data for a thirty-year planning horizon. Capacity assumptions for existing school facilities in future years would also be limited because conditions are extremely variable for a thirty-year planning horizon: changing school attendance boundaries, changing federal or state minimum classroom size requirements, school board funding decisions, etc.

The *Piedmont Triad CommunityViz Model* would use simple rules for simulating theoretical build-out conditions for schools in the study area. All traffic analysis zones in the PTRM portion of the PTCM study area with students identified for the base year condition would be assumed to grow in the future to meet new demand either through school classroom expansion (portable classrooms or building additions) or new school construction in the same traffic analysis zone. A factor of 30% would be applied to base year student data in the TAZs to calculate ‘available supply’ for future year students.

Build-out potential statistics would be summarized using six student categories (students K-12, full-time equivalent university/college students, full-time university/college students, part-time university/college students, total full-time enrolled students, and total part-time enrolled students) and three horizon periods. Available supply for successive horizon periods would be calculated by subtracting current period allocation statistics from the same horizon period supply statistics (e.g., 2020 available supply – 2020 allocation = 2030 available supply).

Build-out statistics would be summarized by control total category, county location and horizon period for the growth allocation process consistent with control total categories and periods in the *Growth Control Totals Lookup Table for Students & Group Quarters Population*. This information would be used to represent ‘available supply’ for the growth allocation scripts in CommunityViz.

**Group Quarters Population Category**

New group quarters locations in the PTRM portion of the PTCM study area would be limited to those identified by service providers, which represent very limited data for a thirty-year planning horizon. Capacity assumptions for existing group quarters facilities in future years would also be limited because conditions are extremely variable for a thirty-year planning horizon: market-driven decisions to expand existing facilities, changing federal or state size and space utilization requirements, government budget decision, etc.

The *Piedmont Triad CommunityViz Model* would use simple rules for simulating theoretical build-out conditions for group quarters in the study area. All traffic analysis zones in the PTRM portion of the PTCM study area with group quarters population identified for the base year condition would be assumed to grow in the future to meet new demand either through facility expansion or new facility construction in the same traffic analysis zone. A factor of 30% would be applied to base year group quarters population data in the TAZs to calculate ‘available supply’ for future year group quarters population.

Build-out potential statistics for group quarters population would be summarized for three horizon periods. Available supply for successive horizon periods would be calculated by subtracting current period allocation statistics from the same horizon period supply statistics (e.g., 2020 available supply – 2020 allocation = 2030 available supply).

Build-out statistics would be summarized by control total category, county location and horizon period for the growth allocation process consistent with control total categories and periods in the *Growth Control Totals Lookup Table for Students & Group Quarters Population*. This information would be used to represent ‘available supply’ for the growth allocation scripts in CommunityViz.

**Land Suitability Analysis**

Land suitability analysis (LSA) in a GIS environment measures the appropriateness of an area for a specific condition or use. For the PTRM portion of the PTCM study area, it would be used to...
identify locations attractive for growth based on known physical features or policies unique to the area. Physical features in and immediately surrounding the PTRM portion of the PTCM study area would be layered over grid cells in CommunityViz, and calculations performed to determine either percent overlap or proximity of features to individual grid cells. A normalized scale (between 0 and 100) would be used to rank the grid cells from least to most suitable for future development. Factors in the LSA could have a positive or negative correlation to desirability scores.

The land suitability analysis calculations for the *Piedmont Triad CommunityViz Model* would be repeated four times to anticipate changing conditions during the thirty-year planning horizon. Specifically, the model would acknowledge new or emerging growth activity centers would attract future growth over time and/or expanding service areas and infrastructure would increase the desirability to grow in certain patterns and intensities over time. Horizon years assumed for the land suitability analysis would include base year plus three future years. Factors recommended for running the land suitability analysis (data assumed varies over the four horizon years for similar categories) are summarized in Table 5 below.

Factors would also be weighted (using a scale of 0 – not important to 10 – most important) to put more or less significance on one factor compared to others in the calculations. Focus group meetings would help set the weighted values.

**Growth Allocation**

Growth forecasted for the PTRM portion of the PTCM study area would be allocated to grid cells (for dwelling unit and employee allocation categories) and traffic analysis zones (for student and group quarters population allocation categories) using the Allocator 5 wizard in CommunityViz. The tool would help determine where growth is likely to occur using a supply-and-demand approach and a series of probability-based algorithms internal to the software. The allocation wizard would also use a “randomness” factor (available settings range from 0 = strict order, follow LSA scores only to 10 = totally random, ignore LSA scores completely).

Information from previous steps in the modeling process — build-out potential analysis, land suitability analysis for multiple horizon years, and growth control totals — would be fed directly into the wizard for completing the allocation processes.

<table>
<thead>
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<th>LSA Factor</th>
<th>Measurement</th>
<th>Correlation</th>
<th>Base Year</th>
<th>Horizon Year 1</th>
<th>Horizon Year 2</th>
<th>Horizon Year 3</th>
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<tr>
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</table>
Control totals for the thirty-year planning horizon (reported in ten year increments) would rely on socioeconomic data prepared by others (see discussion on pages 29 and 30). Control totals would be constrained by county boundary (growth could not be assigned to other counties) for the growth allocation processes.

Specific information for assigning future year growth to grid cells and traffic analysis zones in the PTRM portion of the PTCM study area is summarized below.

**Dwelling Units & Employees**

Data would be summarized for eight development categories (single-family residential, multifamily residential, retail high, retail other, industrial, service, office and education) and three horizon periods.

**Students**

Data would be summarized for six student categories (students K-12, full-time equivalent university/college students, full-time university/college students, part-time university/college students, total full-time enrolled students, and total part-time enrolled students) and three horizon periods.

**Group Quarters Population**

Data for group quarters population will be summarized for three horizon periods.

**Model Calibration**

A significant amount of time should be reserved in the model build process to calibrate the CommunityViz model and validate the data used to create them. These activities would be critical to developing the new model architecture, data protocols, and key assumptions for building the *Piedmont Triad CommunityViz Model*; instilling confidence in the analysis tools and reaching greater consensus among metropolitan planning organizations and local governments in the PTRM portion of the PTCM study area for the results.

A summary of key calibration/validation activities for building the *Piedmont Triad CommunityViz Model* is provided below.

**Project Steering Committee**

A project steering committee would provide direct oversight and counsel for building the model and collecting data identified to run it. Those on the steering committee should represent a broad base of interests, viewpoints and concerns in the PTRM portion of the PTCM study area.

**Technical Advisory Committee**

A subset of the project steering committee and invited guests should make up a technical advisory committee for the *Piedmont Triad CommunityViz Model*. Their charge would be to discuss very specific data needs, key assumptions and model logic important for building parts of the future year allocation tool in CommunityViz.

Topics discussed in technical advisory committee meetings could include: employee space ratios, regional control total categories, land suitability analysis data and horizon periods, a crosswalk (classification matrix) for matching PTRM control total categories with PTCM community type categories, household size assumptions, and household type percentage split assumptions (single family vs. multifamily by county).

**Sub-Region Coordination Meetings**

Sub-region coordination meetings should be held throughout the PTRM portion of the PTCM study area to present initial data and collect comments for moving forward. Participants should include planning directors, other planning staff, MPO representatives, utility service providers and MPO technical committee members.

Initial data maps should be presented at each meeting and comments recorded for revising data sets. A comment period should remain open for two weeks following each event. Maps and data should be transferred via a file transfer protocol (FTP) site.
Site Validation Studies

Site validation studies should be completed to confirm the values used in the general development lookup table for community types and jurisdictions represented in the PTRM portion of the PTCM study area. Using existing development data, the project team should complete site analyses for the community type categories (three sample sites each) present in the individual jurisdictions. Data should be collected for buildable area, density and floor area ratio.

Information from the validation studies should be shared with local governments during sub-region coordination meetings, and used to adjust lookup table values for conditions unique to each community type and jurisdiction.

Internal Quality Control

The project team should use regular coordination calls, emails, web meetings and on-site coordination meetings to build and calibrate the Piedmont Triad CommunityViz Model and validate the data used to create it. Key quality control issues addressed by the team could include: data quality and availability, model architecture, model input data and values, rates and calculations (especially for the land suitability analysis, build-out potential and growth allocation processes), beta model results, and reporting geographies.
A hypothetical project timeline was developed by the consultant to build a region-wide scenario planning model that could quickly and efficiently create socioeconomic data for the Piedmont Triad Regional Model (PTRM). It assumes one dedicated staff person from the Piedmont Authority for Regional Transportation and some dedicated staff time for the Piedmont Triad Regional Council are used in the model build process. Completion dates are subject to change based on the region’s final decisions about how best to move forward.
### Piedmont Triad CommunityViz Model Initiative

#### Hypothetical Milestone Schedule

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**Note:**

- ● denotes the need for a meeting event