THE STUDY IDENTIFICATION AND PRIORITIZATION TOOL (SIPT)

Process and Technical Guide

Danville MPO

Prepared for the Danville Metropolitan Planning Organization

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ACKNOWLEDGMENTS

Joseph Bonanno, Senior Planner, West Piedmont Planning District Commission
Michael Armbrister, Executive Director, West Piedmont Planning District Commission

ABOUT GAP-TA

Visit vtrans.org/about/GAP-TA for information about the Growth and Accessibility Planning Technical Assistance program.
OIPI will provide a blurb describing the GAP-TA program

CONTACT INFORMATION

Joseph Bonanno, Senior Planner
(276) 638-3987
jbonanno@wppdc.org
MPO Administrator
West Piedmont PDC
P.O. Box 5268
Martinsville, VA 24115

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EXECUTIVE SUMMARY

In 2021, the Danville MPO won a Growth and Accessibility Planning (GAP) Technical Assistance grant, a program under the Virginia Office of Intermodal Planning and Investment (OIPI). In its application, the MPO sought ways to systematically identify parts of the regional transportation network that needed further study. During the 2045 Long Range Transportation Plan (LRTP) update, staff found that certain roadway corridors and intersections required further study to develop project-level recommendations. However, the MPO lacked a system to identify and prioritize those areas that needed further study. The GAP effort focused on addressing that issue and supplied the region with a metric-driven study prioritization tool, called the Study Identification and Prioritization Tool (SIPT).

The SIPT can help make identifying study locations repeatable, performance-based, and transparent. It is a spreadsheet tool that uses various transportation and related data to identify potential study locations to advance the region's mobility and accessibility, safety, economy, community and nature, and operational efficiency goals. This Excel-based tool processes raw data and produces tables that show the highest-scoring segments and the highest-scoring corridors. Simple steps can transform those tables in maps, using Geographic Information Systems (GIS).

The following chapters further describe the SIPT and provide MPO staff with guidance on operating and managing the tool. Chapter 1 functions as a process guide that further explains the purpose of the SIPT and how the MPO should integrate this exercise into its annual work program. Chapter 2 provides MPO staff with instructions on how to collect and process data needed for operating the SIPT and consequently on how to identify study locations. Chapter 3 is a technical guide that explains how to run and troubleshoot the SIPT and interpret the results. In the appendices, there are additional resources and technical instruction. These attachments include an inventory of funding programs to finance transportation studies, evaluation of data sources, orientation to the Interact VTrans portal, and information on evaluated measures.

The MPO should integrate the SIPT into its annual Unified Planning Work Program (UPWP) and make this tool a core part of the region's transportation planning process. Regional officials should also think of the SIPT as an extension of the LRTP, helping to explore further those parts of the transportation network that may need additional study. The subsequent chapters offer the guidance and resources to achieve these objectives.

CHAPTER 1: DANVILLE MPO PERFORMANCE-BASED PLANNING PROCESS (PBPP) GUIDE

Introduction

This Process and Technical Guide details a data-driven approach for identifying transportation study locations in the Danville Metropolitan Planning Organization (DMPO) area. Development of this process occurred as part of the Growth and Accessibility Planning Technical Assistance (GAP-TA) program overseen by the Office of Intermodal Planning and Investment (OIPI). This GAP-TA project's purpose is to develop a methodology for identifying viable transportation studies in the Danville MPO area and ultimately deliver transportation improvements that support statewide and regional goals.

This document explains how to use the MPO's tool for identifying and prioritizing potential study locations in the Metropolitan Planning Area (MPA). A spreadsheet tool, called the Study Identification and Prioritization Tool (SIPT), receives data inputs and ranks segments of the region's transportation network for future study. Chapter 1 is a process guide that directs MPO staff on how to integrate this SIPT into its regular programming and operations. The following text defines roles and formalize steps for identifying future transportation studies. This guide also aims to:

- Describe the documents, tools, and schedule for maintaining a record of study locations,
- Identify further screening methodologies that will help the MPO select the most appropriate locations for further study, and
- Present a user-friendly and transparent process for study selection.

What is a Study

The term "study" is core to this Process Guide, but the definition can be potentially vague. In some cases, MPO studies can be more regional in nature, like a "regional safety study" or even the Long Range Transportation Plan (LRTP). However, this document focuses on specific project-level studies for locations with high priority needs, like congestion and safety. This more nuanced definition of "study" shows the intent to identify viable solutions that improve the region's ability to safely move people, goods, and services.

Benefits of a Data Driven Approach

DMPO works closely with the Virginia Department of Transportation (VDOT) Lynchburg District, an essential partner that helps secure funding for transportation studies and other programs. District, regional, and local staff work together to develop various transportation investments, represented in the DMPO's Long Range Transportation Plan (LRTP) and its project lists. While the region has successfully identified and secured funding for studies through local knowledge and expertise, there are changing conditions that may require a more systematic and replicable process to continue that effectiveness.

Long-Term Process

Primarily, past studies relied more on knowledgeable individuals than on established, replicable processes. While existing staff at the VDOT District, regional level, and localities are skilled at securing resources for studies, individual professionals eventually move on or retire. However, instilling their skill into a lasting system achieves two benefits. First, it allows the region to continue its successes, beyond the tenure of any individual, and it establishes a model that can be transferable to other communities and regions.

Changes at the State and Federal Level

There continue to be transportation policy changes at the state and federal level. The Commonwealth regularly updates VTrans and funding processes. New transportation authorization legislation on the national scale also amends funding programs and standards. With these changing programs and evolving political realities, a systematic and data-driven tool will help the region better adjust, anticipate, and plan for future efforts in a strategic way.

Limited Resources

While there are short-term stimulus dollars coming from federal and state legislation, the long-term trend shows declining public coffers. With a downward trend in transportation funds, regions like Danville-Pittsylvania will need to work harder and smarter to compete for limited resources. A formalized set of procedures and the SIPT will help the region adapt and better compete in future funding cycles. This guide will help to target the best use of limited funds using a metric-based process.

Process by Stakeholder Roles

DMPO works closely with the Virginia Department of Transportation (VDOT) Lynchburg District, an essential partner that helps secure funding for transportation studies and other programs. District, regional, and local staff work together to develop various transportation investments, represented in the DMPO's Long Range Transportation Plan (LRTP) and its project lists. While the region has successfully identified and secured funding for studies through local knowledge and expertise, there are changing conditions that may require a more systematic and replicable process to continue that effectiveness.

The Danville MPO applied for the GAP-TA program to develop this process and the related "tool" for identifying and prioritizing study locations. As such, the MPO will control the final project deliverables and serve as the main administrator for operating and maintaining items listed in this Process Guide. Other stakeholders involved in this process, however, include state and local staff. The following summary describes the overall process and the roles of the stakeholders involved.

MPO Staff: The West Piedmont Planning District Commission (WPPDC) staffs the MPO and should maintain the procedures described in this Guide. Regional staff should facilitate the steps and coordinate with the VDOT District, MPO officials, and local staff. Responsibilities include:

- Maintaining this Process Guide,
- Updating the data and technical elements described in **Chapter 2**,
- Using the Study Identification and Prioritization Tool,
- Coordinating with VDOT, OIPI, and localities through the study prioritization process,
- Working with the MPO Policy Board to develop a rolling plan of high-priority study locations, and
- Developing the MPO's Unified Planning Work Programs (UPWP) on an annual basis that include selected studies from this process.

VDOT Lynchburg District: The VDOT Lynchburg District is an essential partner in this process, helping the MPO with maintaining data and overseeing steps to secure funding for studies under VDOT programs. Responsibilities include:

- Acting as a technical adviser to MPO staff,
- Assisting with future updates to the data and technical elements described in **Chapter 2**,
- Helping to insert local data into the process, and
- Helping to secure financing for studies.

DRPT: The Department of Rail and Public Transportation will serve a similar role as VDOT but will assist the MPO with transit and Travel Demand Management (TDM) needs. DRPT representatives can advise on upcoming programs that will help to assess applicable studies. They can also influence whether Transit Development Plan (TDP) updates include transit needs identified in the process.

OIPI: The Office of Intermodal Planning and Investment will be responsible for providing resources on updates to the statewide transportation plan, VTrans, and SMART SCALE. OIPI will also be the state's warehouse for transportation-related data that will populate the tool.

MPO Policy Board: The MPO's policy body should review the list of study locations on an annual basis. The Policy Board has the authority to formally adopt a list of studies within the UPWP. They should also work with MPO staff to track progress on new studies and adopt a schedule for future years.

MPO Technical Committee: The Technical Committee should review a rolling plan for funding the list of potential study locations on a regular basis, such as every three years. Each year, the Technical Committee should recommend a selection of locations for inclusion in the UPWP. They should also provide feedback on changes to the data, tool, and overall process.

Local Officials: Local officials participate with the MPO through the Technical Committee and Policy Board and should be kept apprised of current and future transportation studies**.**

Documents and Program

Because identifying and prioritizing study locations would be a recurring effort, this process should function as a regular task within the UPWP. While the previous section defines roles, the following lists documents and other components that make up the process.

UPWP: The process of identifying study locations would fall under the UPWP's Section II, Work Program Tasks. Staff could list this work under the "Program Administration and Management" or under the "Data Collection and Analysis" Task. Once the MPO selects locations for study, those specific studies would fall under "Special Studies." The UPWP should include a "Future Fiscal Years" section that lists other studies planned for the subsequent two fiscal years.

SIPT: The Study Identification and Prioritization Tool will accept data inputs and produce a draft list of study locations, based on defined deficiencies, and needs. Chapter 3 functions as a technical guide for MPO staff to operate the SIPT. The output, a list of locations, requires additional analysis, described under Step 2 in the process section below.

Data Inventory: Chapter 2 provides a list of datasets and instructions on how to update those figures that go into the SIPT. MPO staff should maintain an inventory of this data, along with the Chapter 2 guidance, as a resource for continued updating of that data.

Study Tracking Sheet: Each year, MPO staff should update a study tracking sheet. This sheet should include several columns that track future studies and other relevant information. Specifically, it tracks:

- A priority ranking of pending studies and the latest high priority locations that arose from the process,
- Programs and funding sources matched with each study,
- A schedule of when to pursue resources for each study,
- Points of contact for the office (MPO, VDOT, DRPT, Local representatives) that have access to those funds,
- Cost estimates for each study,
- Status for each location, and
- Other helpful information.

Once a study is completed, the MPO should list specific project recommendations under a second tab. When there is an appropriate time to update the LRTP, the MPO staff should list all project recommendations in the plan's vision list. During the next LRTP update, the planning process should consider those locations for project prioritization. The VDOT District staff already enters completed study locations and accompanying recommendations into the Pathways for Planning data tool.

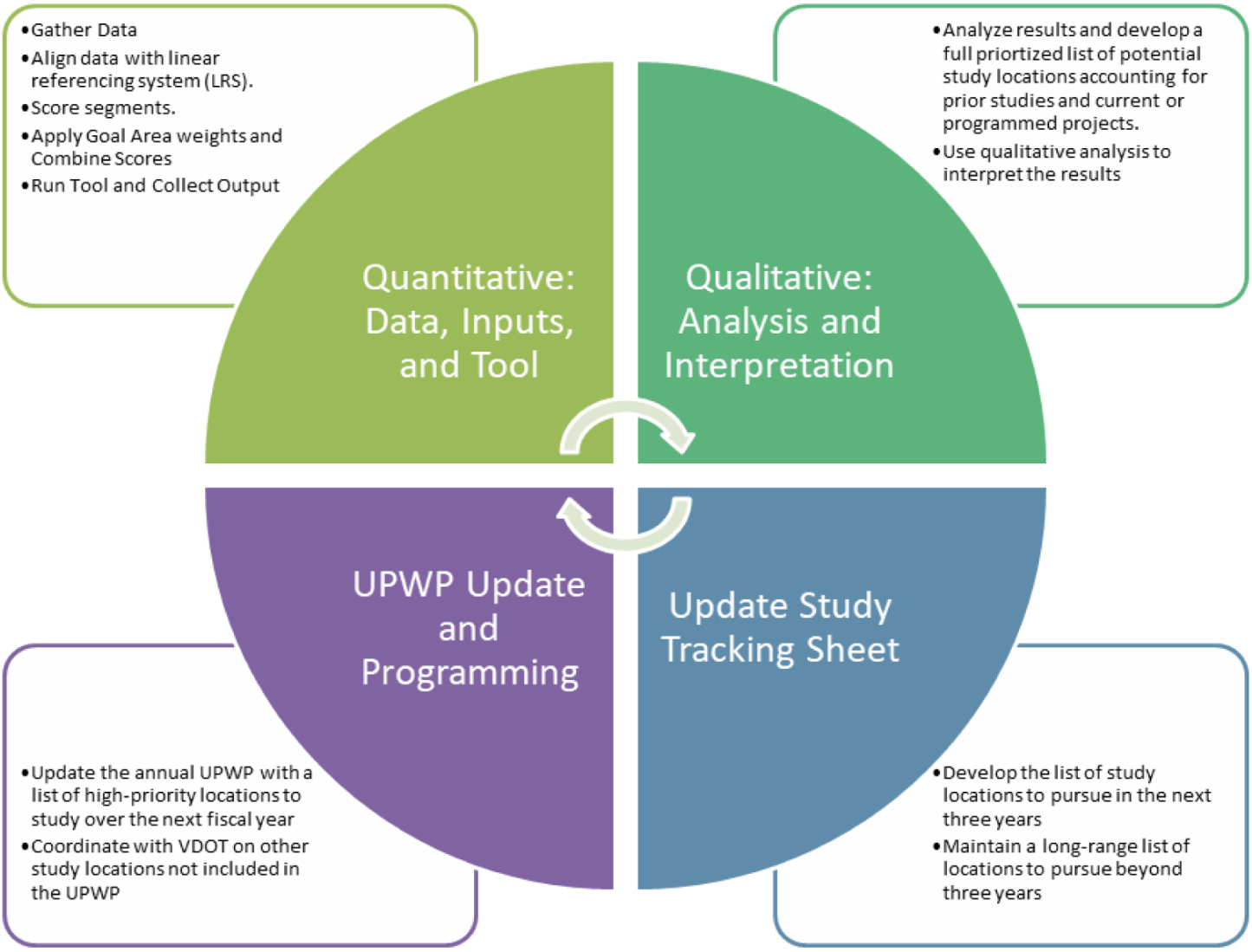
Annual Status Report: As a companion piece with the Study Tracking Sheet, the MPO should develop an annual memo to the MPO Policy Board that provides updates on the list of pending studies. The Technical Committee should also review the memo and use it as a reference to develop the UPWP.

Interact VTrans: Virginia's Statewide Transportation Plan evolved to become an interactive tool and resource that informs transportation-related decisions across the Commonwealth. MPO staff should frequent this online resource at https://www.vtrans.org/interactvtrans/map-explorer. This platform provides essential factors and considerations that inform the process steps described on the subsequent pages.

Process

The SIPT should be a recurring effort maintained during each fiscal year. There are four basic steps that roughly coincide with the MPO's annual program schedule, as described in the UPWP. The following graphic depicts those steps and the schedule.

Figure 1: Process



Step 1: Quantitative Data, Inputs, and Tool

The first step of the process is to collect or update the Data Inventory needed to identify and prioritize the transportation network. This data will feed into the SIPT. While this Process Guide recommends an annual process, MPO staff may only need to make minor adjustments until there are more substantive changes to the datasets. The most common revision may be accounting for newly funded studies. **Chapter 3** is a detailed guide that describes the process for scoring the roadway network within the Danville MPO area to identify potential study locations. **Chapter 2** describes the data collection and processing steps required to run the SIPT. A summary of activities listed in **Chapter 2** include:

I. **Gather Data:** Under this proposed process, staff would collect and process data sources to populate measures used for identifying study locations.

II. **Align Segmentation to Linear Referencing System (LRS):** Staff can join data with the State's LRS so that all data and measures use the same segmentation.

III. **Score Segment Across Goal Areas:** In this step, the Study Identification and Prioritization Tool scores each segment based on conflated data and measures to begin to prioritize potential study locations.

IV. **Apply Goal Area Weights and Combine Scores:** The Study Identification and Prioritization Tool then normalizes the data and applies the MPO's Long Range Transportation Plan goals to create a single score for segments.

V. **Output:** The output from this proposed process is a ranked list of segments in the Danville MPO area. This list of segments will be provided through the tool. The high-ranking segments have the most critical transportation needs within the region. Studies at these locations can lead to projects that advance the region towards its goals.

Step 2: Qualitative Analysis and Interpretation

The SIPT is one part of the process and will require further qualitative analysis and interpretation. MPO staff should review the prioritized list and work with the VDOT District staff to detect any variables that the Tool could not take into consideration. Joining the spreadsheet containing final segment scores to the LRS will allow the segment scores to be mapped and may help staff in spatially analyzing and interpreting tool results. The District and MPO office may decide to make minor revisions to the prioritized list, based on their local experience. *Interact VTrans* provides information on each segment and signifies existing spending or studies on the region's roadways (https://www.vtrans.org/interactvtrans/map-explorer). MPO staff may remove segments that already received study resources. It may be useful to examine the goal area scores through the tool to determine if past studies in a given location have examined the goals that caused the SIPT to flag the segment as a potential study location. MPO staff should also explore whether current or programmed projects may affect performance related to high-scoring goal areas. The final study list should go before the MPO's Technical Committee during the summer or early fall, allowing the Committee an opportunity to review the list and any changes.

For more guidance on analyzing the results, refer to the "Interpreting Results" section under Chapter 3. The following is a summary of steps:

I. **Review the Output:** MPO Staff will review the Tool's outputs and work with the VDOT District to analyze results.

II. **Qualitative Variables:** The MPO and District staff will identify any qualitative issues that the Tool could not consider. They will use local knowledge and experience to revise the list, as needed.

III. **Consolidation:** Staff will also review locations and determine whether to combine sites into a single study. For example, multiple locations along a single road segment may lead to a corridor study that captures each point.

Other steps may include:

- **MPO Internal Review**
  - Summarize tool results
  - Evaluate how locations have changed as compared to previous tool assessments (e.g. is location low priority but in previous cycle it was high? Why did it change? What issues does that tell us about the tool and data)
  - Compare locations to priorities in LRTP or other public comments
  - Evaluate other factors not addressed in tool (new economic development, implementation, new local concern, etc.)
  - Refine project study priority list
  - Identify and document tool issues for possible refinement
  - Refer to Interact VTrans to consider other potential factors

- **Other agency review**
  - Share priority list with other agencies including VDOT and local agencies
  - Develop a possible questionnaire/survey. For example:
    - Do you agree with these locations as priority for study?
    - What other locations do you feel are important to be studied and why?
    - For each priority location, are there specific strategies you would like addressed or considered within the study (e.g., complete streets, low-cost operational, bike/ped, etc.)
  - Update priority list based on agency review and comments

- **MPO Committee review**

Step 3: Update Study Tracking Sheet

MPO staff should work with the Technical Committee to develop a list of short-term studies to pursue within the next three fiscal years. The MPO and VDOT District should coordinate on identifying the best funding and program options for supporting a study for each segment. Of these, the highest priority locations that fall under the MPO's umbrella should go into the MPO's draft UPWP. MPO staff should work with the VDOT District to identify other studies that may go to different programs. The final deliverable from this step will be the Study Tracking Sheet.

Step 4: UPWP Update and Programming

Staff should present the Study Tracking Sheet and Annual Report Memo that will inform the annual UPWP, typically approved in the early spring. Regional staff should also work with the VDOT District to pursue other study programs. By the late summer, MPO staff should make any revisions, if applicable, to the data in Step 1, beginning the process for the next fiscal year. In this schedule, the MPO Policy Board should review and affirm the list of study locations once each year.

CHAPTER 2: METHOD AND MEASURE DEVELOPMENT

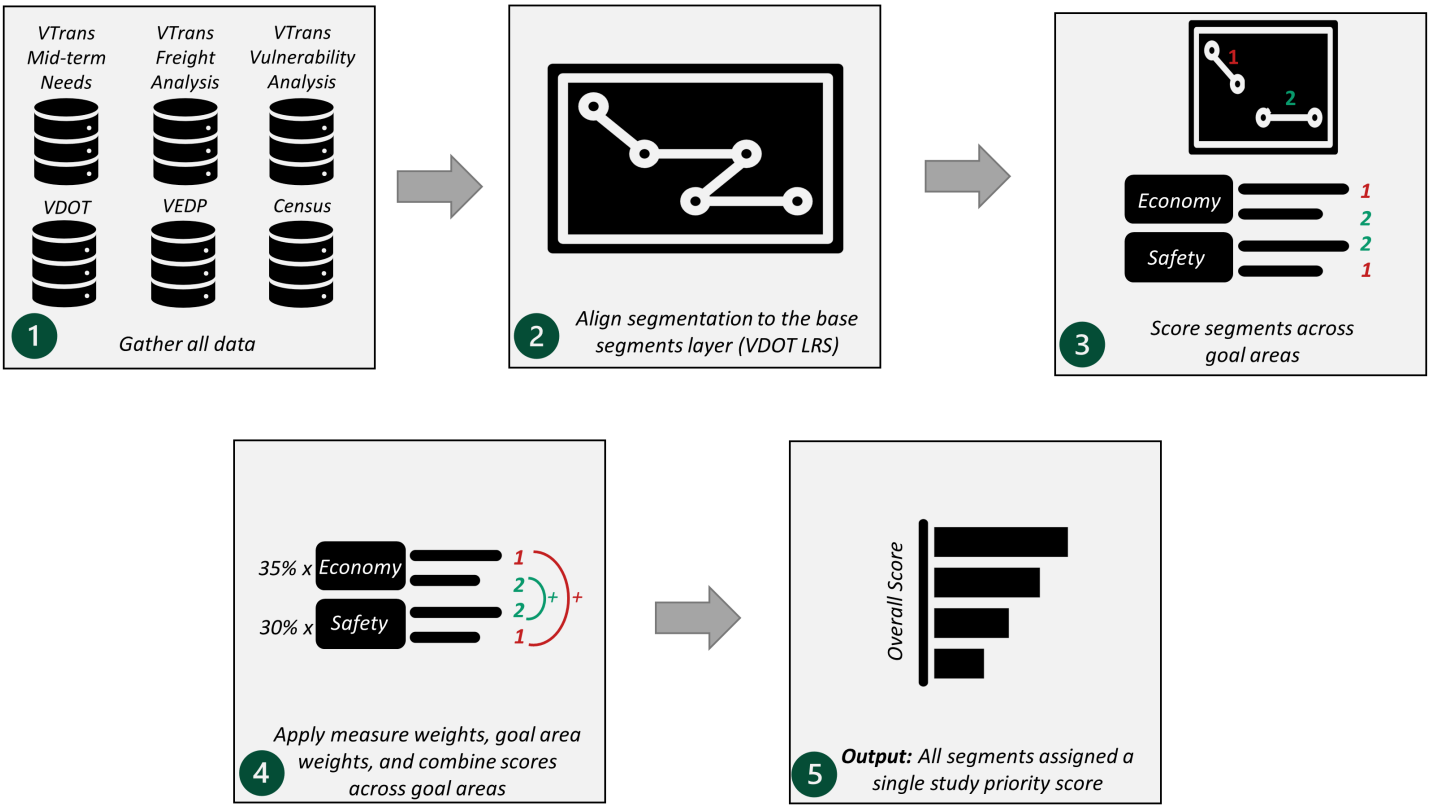
Introduction

This guide details the process proposed within task 2 ("Method and Measure Development") of the GAP-TA project.

This chapter mirrors the SIPT process itself in that—after this introduction—it has a section detailing each of the five steps in the process, as shown in Figure 2 below. A final section relates to potential future refinements. The tool that the consultant team will build as part of task 4 ("Performance Measure Tool and Process") of the GAP-TA project is expected to perform many components of Steps 3 through 5 based on data imported to the tool from Step 2. Steps 1 and 2 will be conducted outside of the tool.

The proposed process uses the measures shown in Figure 2 to support screening the roadway network within the Danville MPO area for potential study locations. Each measure is aligned with a goal of the Danville MPO long-range transportation plan[1] to ensure that these study locations support the future that the region envisions. The subsequent sections in this chapter detail the data collection and processing steps required to use these measures for identifying transportation study locations.

Figure 2: Steps of Study Location Identification Process for Danville MPO



[1]Danville MPO (2020). 2045 Long Range Transportation Plan. Retrieved from https://danvillempo.org/long-range-transportation-plan/.

Figure 3: Alignment between 2045 Danville MPO Long-Range Transportation Plan Goals and Proposed Measures

Step 1: Gather Data

Under this process, data from the following twelve sources will be collected and processed to allow the measures used for identifying study locations to be calculated. The process for obtaining data from each source is provided below along with details of the measures that derive in whole or in part from the data sources.

These data sources were selected considering both the quality of the data and the relative ease of converting raw data into the measures. Prior to proposing these data sources, the consultant team examined many potential data sources and measures. It examined each data source against the following characteristics to retain only the best and most reliable data sources. Appendix B shows the data sources that were evaluated.

- **Granularity / spatial precision:** How precise is the data set's geometry, if applicable? For instance, if there is segmentation in the data, do the segments break at logical locations?
- **Local completeness:** How complete is the data set on the local network?
- **Correspondence with goal:** How closely does the data set correspond with the relevant goal areas in the Danville MPO long-range transportation plan.[2]

I. **Linear Referencing System (LRS):** The VDOT LRS provides the segments for this analysis to which other data sets will be aligned.

- **Accessing the data set:** The LRS can be downloaded using the process described below.

1. Go to the following "VDOT LRS" website: https://vdot.maps.arcgis.com/apps/MapAndAppGallery/index.html?appid=7ad6fb5c1f9148ff986db843e7f7b67c#!
2. Download the most recent version of the LRS, which is LRS version 21.1 as of February 2022. The subheading of the LRS on the site should read 'Map Package.' Selecting this will initiate the download.
3. When the download is complete, open the file in ESRI ArcMap.
4. There will be multiple layers in the Map Package. Export the feature named "VDOT_EDGE_RTE_OL_MPST_LRS" as a geodatabase.
5. Using a GIS tool, buffer the Danville MPO boundary by 1/10th of a mile and clip the LRS to this boundary.
6. Only keep the following attributes from the LRS:
   - **EDGE_RTE_KEY:** Unique segment identifier
   - **RTE_NM:** VDOT route name
   - **RTE_COMMON_NM:** Common route name
   - **STREET_NM:** Street name
   - **TRANSPORT_EDGE_FROM_MSR:** From mile point
   - **TRANSPORT_EDGE_TO_MSR:** To mile point
   - **FROM_JURISDICTION_NM:** From jurisdiction name

[2]Danville MPO (2020). 2045 Long Range Transportation Plan. Retrieved from https://danvillempo.org/long-range-transportation-plan/

- **TO_JURISDICTION_NM:** To jurisdiction name
- **MASTER_RTE_NM:** Master route name
- **MASTER_RTE_COMMON_NM:** Master route common name
- **MASTER_RTE_SOURCE_ID:** Master route source ID
- **RTE_OPPOSITE_DIRECTION_RTE_NM:** Route name of opposite direction

II. VTrans Prioritized Mid-term Needs: The VTrans prioritized mid-term needs are segment-level needs produced by OIPI. Needs are assigned one of four priority levels (i.e., "Very High," "High," "Medium," "Low"). Segmentation is based on the Virginia Department of Transportation's (VDOT) LRS,[3] and the most recent version of the prioritized needs as of February 2022 is based on LRS version 19.1. Future versions of VTrans will be based on future versions of the LRS. The prioritized needs are updated periodically. Details about processing that produced the VTrans prioritized mid-term needs are available in the VTrans mid-term needs technical memo.[4]

- The following measures derive from this data set:
  - Reliability Priority
  - Pedestrian Need Priority
  - Bicycle Need Priority
  - Transit Access Need Priority
  - Highway Safety Priority
  - Pedestrian Safety Priority
  - VTrans Need Coordination
- **Accessing the data set:** Mid-term needs priority data can be downloaded using the process described below.

1. Go to the 2019 VTrans Prioritized Mid-term Needs on the "Interact VTrans" website: https://vtrans.org/interactvtrans/map-explorer?layer=2019%20VTrans%20Prioritized%20Mid-term%20Needs&field=Statewide%20Priority&center=-79.42091791156685%2C38.018031417766714&zoom=8. Appendix C provides an orientation to downloading data from the website.
2. Select the downward-facing arrow to the right of "2019 VTrans Prioritized Mid-term Needs" to download the data.

III. VTrans Freight Analysis: The VTrans Freight Element includes the results of additional segment-level analysis of freight movement using the same segmentation as the VTrans Mid-term Needs. More details on this analysis can be obtained at the OIPI VTrans Freight Element website.[5]

- The following measures derive from this data set:
  - Cumulative Truck Delay
  - Truck Travel Time Reliability
- **Accessing the data:** Prioritized freight needs data can be downloaded using the process described below.

1. Go to the Freight Performance Measures on the "Interact VTrans" website: https://vtrans.org/interactvtrans/map-explorer?layer=Freight%20Performance%20Measures&field=Truck%20Bottlenecks&center=-79.42091791156685%2C38.018031417766714&zoom=8.
2. Select the downward-facing arrow to the right of "Freight Performance Measures" to download the data.

IV. VTrans Vulnerability Analysis: The VTrans Vulnerability Analysis is segment-level analysis of the potential impacts of climate and weather on the transportation system. Details of the VTrans vulnerability analysis are provided on the OIPI website.[6]

- The following measures derive from this data set:
  - Vulnerability to Environmental Hazards (Inland Riverine Flooding)
- **Accessing the data:** Vulnerability data can be downloaded using the process described below.

1. Go to the VTrans Flooding Risk Assessment on the "Interact VTrans" website: https://vtrans.org/interactvtrans/map-explorer?layer=VTrans%20Flooding%20Risk%20Assessment&field=Vulnerability%20-%20SLR%20(Extreme)&center=-79.42091791156685%2C38.018031417766714&zoom=8.
2. Select the downward-facing arrow to the right of "VTrans Flooding Risk Assessment" to download the data.

V. VDOT Pathways for Planning: Pathways for Planning is a VDOT tool with segment-level transportation data.

- The following measure derives from this data set:
  - Pavement Condition
- **Accessing the data:** Follow the process described below to download the data, some of which are illustrated in Figure 4.

1. Go to the Pathways for Planning page at the following location: https://vdotp4p.com/.
2. Log in. If you do not have login credentials, select "Contact Us" to request access.
3. Close the welcome box.
4. Select "Add Layers" in the lower right-hand side of the site.
5. Select "Route Physical Characteristics" followed by "Pavement Condition." Click "Add Layers."
6. Click on the upward-facing arrow next to the "Pavement Condition" layer name to download.
7. Select "File Geodatabase" and then "Download."

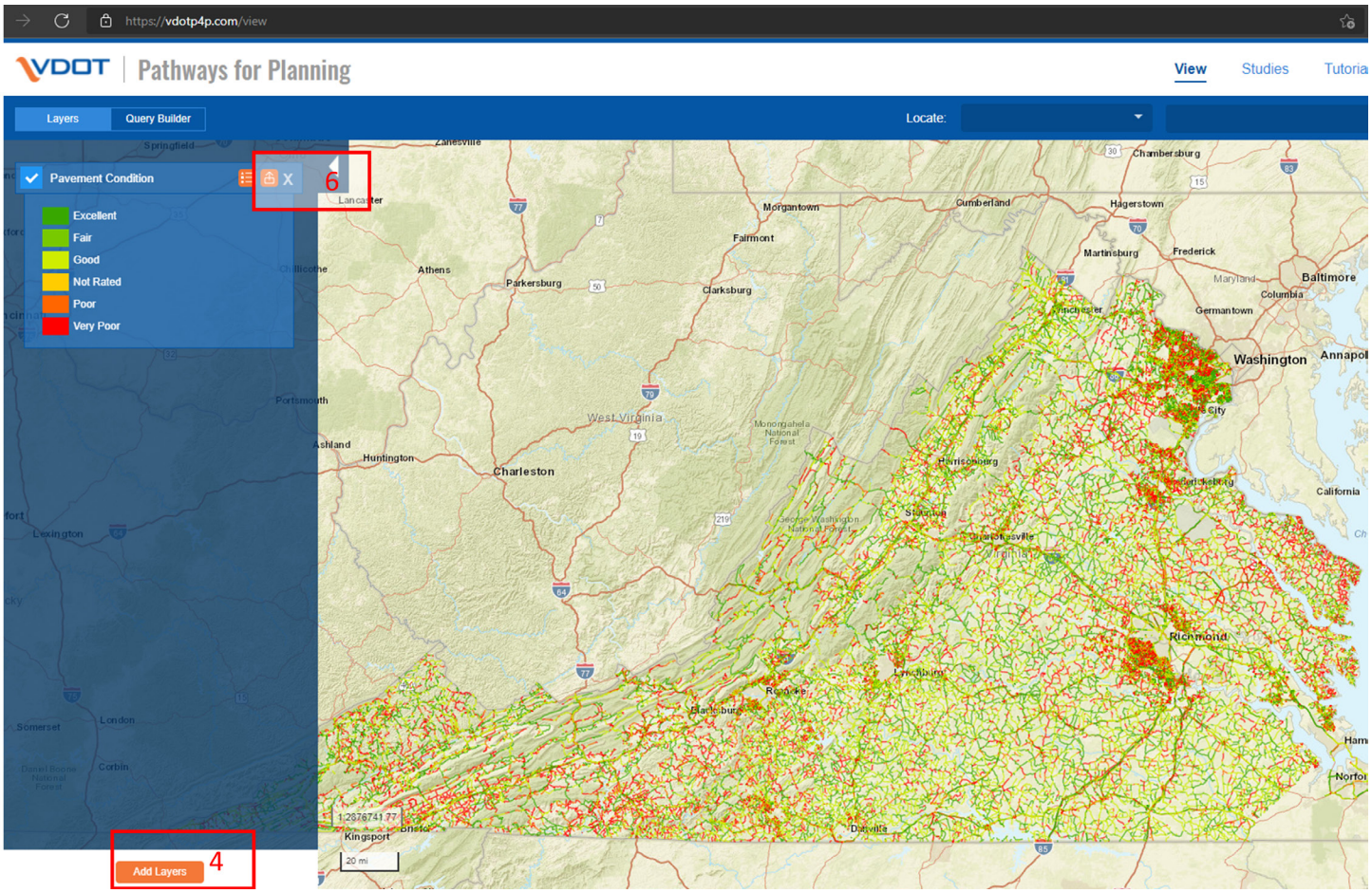
[3]Virginia Department of Transportation (n.d.). LRS Release Documents. Accessed November 18, 2021. Retrieved from https://vdot.maps.arcgis.com/apps/MapAndAppGallery/index.html?appid=7ad6fb5c1f9148ff986db843e7f7b67c#!.

[4]Office of Intermodal Planning and Investment (2021). Technical Guide for the Identification and Prioritization of the VTrans Mid-term Needs. Retrieved from https://vtrans.org/resources/2021_Technical_Guide_Mid-Term_Needs.pdf.

[5]Office of Intermodal Planning and Investment (n.d.). Freight Element. Retrieved from https://vtrans.org/mid-term-planning/freight-plan.

[6]Office of Intermodal Planning and Investment (n.d.). VTrans Megatrend 1: Climate. Retrieved from https://vtrans.org/long-term-planning/megatrend-climate.

Figure 4: Orientation to VDOT's Pathways for Planning Website



VI. VDOT Virginia Roads: The Virginia Roads application provides segment-level data. While not explicitly aligned with the VDOT LRS, the consultant team has tested the alignment to ensure that it is close enough to use in this process.

- The following measures derive from this data set:
  - o Bridge Condition
  - o Truck AADT
- **Accessing the data:** Follow the process described below to download the data.

1. Go to the following locations:
   a. Bridges: https://www.virginiaroads.org/datasets/vdot-bridges-and-culverts
   b. Truck ADT: https://www.virginiaroads.org/datasets/vdot-traffic-volume-2020
2. Select the downward-facing arrow to download the data. Select a geodatabase format.

VII. INRIX XD: INRIX provides segment-level data related to travel time, congestion, and reliability. The data is available without cost to metropolitan planning organizations (MPO) in Virginia.

- The following measure derives from this data set:
  - o Travel Time Index (TTI)
- **Accessing the data:** Follow the process described below to download INRIX XD data for TTI.

1. It is expected that INRIX XD data may become available on Interact VTrans: https://vtrans.org/interactvtrans/map-explorer. Please check for the data there first before taking the subsequent steps. If INRIX XD data is available on Interact VTrans, use that data instead.
2. Gain access to the Regional Integrated Transportation Information System (RITIS) platform.
   a. Agencies must sign a data user agreement with RITIS/INRIX if they have not already completed that action. There is no cost for an MPO to obtain access. If the Danville MPO does not already have access, complete the actions described below to obtain access.

i. Complete the data use agreement (DUA): https://tetcoalition.org/wp-content/uploads/2015/02/VPPII_DUAv9_signed fillable-primary.pdf.
ii. If there are questions, contact Mai Quynh Le (mqle@tetcoalition.org) or Denise Markow (dmarkow@tetcoalition.org).
iii. To become an affiliate member of the Coalition, send an email to Patty Reich requesting membership in The Eastern Transportation Coalition at preich1@tetcoalition.org. Danville MPO is not currently an affiliate member.[7]

3. Download the data.
   a. Log in at www.ritis.org.
   b. Select "Data Archive" tab at top of screen.
   c. Select "Probe Data Analytics" option at top of screen.
   d. Select the "Trend Map" tool.
   e. Enter the following options for Trend Map tool:
      i. "XD" for Segments selection.
      ii. Using the Map function, select the area you wish to analyze.
      iii. Select the dates to include. Typically include the most recent calendar year.
      iv. Select option to "Create a single time period for this range" then select to only include weekdays (M-F).
      v. Select the "Add Time Period" green box.
      vi. Select data sources as "INRIX" only.
      vii. Select "1 hour" for granularity.
      viii. Click "submit."
   f. Let the report run, which may take about 10-15 minutes.
   g. From map screen produced from the report run, select "Travel Time Index" in the dropdown box in upper left corner.
   h. Select the disk icon in upper right corner of screen and select "Save as" and "XML file (for use in EXCEL)."
   i. Save the file to disk. This file contains a row for every XD segment in selected area with a travel time index for every hour of day.
4. Obtain the corresponding XD shapefile.
   a. Obtain the latest INRIX XD "ShapeFile" from VDOT. The XD Shapefile version should correspond to the year of data extracted.
5. Follow the process described below in ESRI ArcMap or another GIS platform to join the shapefile and the Excel file.
   a. Open the XD shapefile obtained from VDOT.
   b. Import the Excel file of travel time index values by XD segment.
   c. Link the two files based on XD segment value.
   d. Find maximum hourly travel time index across all hours for each segment.

VIII. Corridors of Statewide Significance (CoSS): The corridors of statewide significance are "an integrated, multimodal network of transportation facilities that connect major centers of activity within and through the Commonwealth and promote the movement of people and goods essential to the economic prosperity of the state."[8] It is one of the data sets to be used for identifying ingress and egress routes to industrial and economic development areas (IEDA).

- The following measure derives in part from this data set:
  o Access to Industrial and Economic Development Areas (IEDA)
- **Accessing the data:** CoSS locations can be downloaded using the process described below .

1. Go to the CoSS Roadway Components on the "Interact VTrans" website: https://vtrans.org/interactvtrans/map-explorer?layer=CoSS%20Roadway%20Components&field=Name&center=-79.42091791156685%2C38.0180314177667 14&zoom=8..
2. Select the downward-facing arrow to the right of "CoSS Roadway Components" to download the data.

IX. Virginia Economic Development Partnership (VEDP): VEDP provides locations of industrial development sites. Each site has x-y coordinates.

- The following measure derives in part from this data set:
  o Access to Industrial and Economic Development Areas (IEDA)
- **Accessing the data:** Follow the process described below to download sites in the Danville MPO area.

1. Go to the VEDP site search website at the following location: https://sites.vedp.org/virginia/site.
2. Click "filter" in the upper left and make the following selections.
   - Property Type: Sites/Land
   - Locality: Pittsylvania and Danville
   - Minimum Acres: 15
3. Select the star next to each of the resulting sites on the left-hand side of the tool.
4. Click "compare" in the upper left to download an Excel version.

[7]The Eastern Transportation Coalition (n.d.). Member Agencies. Accessed November 29, 2021. Retrieved from https://tetcoalition.org/member-agencies-2/.

[8]Office of Intermodal Planning and Investment (2021). VTrans Travel Markets. Accessed November 30, 2021. Retrieved from https://www.vtrans.org/mid-term-planning/

5. Combine the locations in the city of Danville and in Pittsylvania County into a single spreadsheet.
6. Import the coordinates into a GIS tool, such as ESRI ArcMap or QGIS. To do this in ArcMap, select the "File" dropdown menu, followed by "Add Data" and "Add XY Data."
7. Use the menu to select the spreadsheet.
8. Input the longitude to the X field and the latitude to the Y field.
9. Export the resulting file as a shapefile. This shapefile allows for VEDP industrial locations to be mapped to facilitate identification of ingress and egress routes to site.

X. Equity Emphasis Area (EEA) Index: The equity emphasis area (EEA) index describes "a Census Block Group that has a higher concentration of residents who are considered low-income, minority, [limited English proficiency], disabled, or over age 75, or Hispanic/Latino than the regional average concentration."[9]

- The following measure derives from this data set:
  o Equity Emphasis Area
- **Accessing the data:** EEA data can be downloaded using the process described below.

1. Go to the Equity Emphasis Area (EEA) Index on the "Interact VTrans" website: https://vtrans.org/interactvtrans/map-explorer?layer=Equity%20Emphasis%20Area%20(EEA)%20Index&field=Equity%20Emphasis%20Area%20Index&center=-79.42091791156685%2C38.018031417766714&zoom=8.
5. Select the downward-facing arrow to the right of "Equity Emphasis Area" to download the data.

XI. Population Totals:

- The following measure derives in part from this data set:
  o Population and Employment Density
- **Accessing the data:** Population totals can be downloaded using the process described below.

1. Download block group-level population data for Virginia from the 5-year American Community Survey for the most recent year available.
   o Table: B01003 TOTAL POPULATION
   o URL: https://data.census.gov/cedsci/table?q=population&t=Population%20total&g=0400000US51,51%241500000&d=ACS%205-Year%20Estimates%20Detailed%20Tables&tid=ACSDT5Y2019.B01003.
2. Join with block groups shapefile from U.S. Census Bureau's TIGER/Line Shapefiles for the same year based on the common field GEOID.
   o URL: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2019.html.

XII. Employment Totals:

- The following measure derives in part from this data set:
  o Population and Employment Density
- **Accessing the data:** Employment totals can be downloaded using the process described below.

1. Download block level employment data for Virginia from the LEHD Origin-Destination Employment Statistics (LODES) dataset for the most recent year available.
   o URL: https://lehd.ces.census.gov/data/#lodes
   o Version: LODES7
   o State/Territory: Virginia
   o Type: Residence Area Characteristics (RAC)
2. Employment totals are the column called "C000."
3. Create a new field "GEOID" that is the first 12 characters of the field "w_geocode." These first 12 digits represent the block group.
4. Create a new field called "Employment" by grouping the data by "GEOID" and summing the field "C000", the employment total. This represents the block group's total employment.
5. Join with block groups shapefile from U.S. Census Bureau's TIGER/Line Shapefiles for the same year based on the common field GEOID.
   o URL: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html

- **Combine Population and Employment Totals**

1. Convert the block group shapefile's area into square miles by multiplying the field "ALAND" by 0.0000003861.[10]
2. Create a new field that is the sum of the employment total and population total for each block group.
3. Create the population and employment density field by dividing the employment and population sum by the area in square miles.

[9]Office of Intermodal Planning and Investment (2021). Technical Guide of the Identification and Prioritization of the VTrans Mid-term Needs. Retrieved from https://vtrans.org/resources/2021_Technical_Guide_Mid-Term_Needs.pdf.

[10]Retrieved calculation from https://stackoverflow.com/questions/31246602/shape-area-and-aland-awater-in-tiger-census-data

Step 2: Align Segmentation to Linear Referencing System (LRS)

All data sets except for the CoSS and VEDP-provided industrial and economic development locations should be joined with the completed LRS. Joining the data sets allows the measures that derive from them to be directly compared and combined since the join gives them the same segmentation. In most cases, the join will occur using an ESRI ArcMap processing tool, called "Overlay Route Events." For the INRIX XD data, a crosswalk should be created using geographic information system (GIS) tools to subsequently permit a tabular join via the crosswalk. The population and employment density data and the EEA data use a spatial overlay process separate from the "Overlay Route Events" tool.

Prepare Data

Follow this process to prepare the VTrans prioritized mid-term needs dataset.

- Delete all attributes except the following:
  - **VDOT_RM** (alias: "Route Name"): Route name[11]
  - **VDOT_COMMON_NM** (alias: "Route Common Name"): Route Common Name
  - **From_measure** (alias: "From Measure"): Segment's start point
  - **To_measure** (alias: "To Measure"): Segment's end point
  - **Segment_Length** (alias: "Segment Length"): Length of a segment in miles
  - **AADT Final** (alias: "Average Annual Daily Traffic Final"): Annual average daily traffic
  - **CoSS_reliability_priority** (alias: "Need Priority - Reliability (CoSS)"): reliability priority on corridors of statewide significance (CoSS)
  - **RN_reliability_priority** (alias: "Need Priority - Reliability (RN)"): Reliability priority at regional network level
  - **RN_AC_pedestrian_access_priorit** (alias: "Need Priority - Pedestrian Access (RN)"): Need priority for pedestrian access to activity centers (AC) within regional networks (RN)
  - **RN_AC_Bicycle_Access_Priority** (alias: "Need Priority - Bicycle Access (RN)"): Need priority for bicycle access to activity centers (AC) within regional networks (RN)
  - **RN_AC_Transit_Access_priority** (alias: "Need Priority - Transit Access (RN)"): Need priority for transit access to activity centers (AC) within regional networks (RN)
  - **Safety_segments_statewide_prior** (alias: "Need Priority - Statewide Safety Improvement"): Safety priority at statewide level
  - **Safety_segments_district_priori** (alias: "Need Priority - Construction District Safety Improvement"): Safety priority at construction district level
  - **Safety_Pedestrian_priority** (alias: "Need Priority – Pedestrian Safety Improvement"): Need priority for pedestrian safety
  - **Statewide_priority** (alias: "Statewide Priority"): Overall statewide need priority
  - **District_priority** (alias: "Construction District Priority"): Overall VDOT construction district need priority

Follow this process to prepare the VTrans freight analysis data set.

- Delete all attributes except the following:
  - **VDOT_RM:** Route name
  - **From_Measu:** Segment's start point
  - **To_Measure:** Segment's end point
  - **Cumulative_Truck_Delay:** Cumulative truck delay priority
  - **Truck_Travel_Time_Reliability:** Truck travel time reliability priority

Follow this process to prepare the VTrans vulnerability analysis data set.

- Delete all attributes except the following:
  - **VDOT_RM:** Route name
  - **From_Measu:** Segment's start point
  - **To_Measure:** Segment's end point
  - **Vulnerability_IRF_500_Yr_Buff** (may be abbreviated to "Vulner_5"): "This field indicates vulnerability, based on the Inland Riverine Flooding (500 Yr + Buffer) scenario, on a three-point scale (High, Medium, and Low) assigned to roadway segments."[12]

Create Crosswalks for VDOT, Vulnerability, Freight, and Mid-term Needs Data

Use the Overlay Route Events tool in ESRI ArcMap to overlay the attribute table for the clipped LRS (clipping described on page 3) with the attribute tables for the pavement, bridge, truck ADT, vulnerability, freight, and prioritized mid-term needs data. The following fields serve as inputs for the Overlay Route Events tool.

LRS

Use the following LRS inputs for all overlays.

- **Input Event Table:** Select the name of the LRS
- **Route Identifier Field:** RTE_NM
- **Event Type:** Line
- **From-Measure Field:** TRANSPORT_EDGE_FROM_MSR
- **To-Measure Field:** TRANSPORT_EDGE_TO_MSR
- **Type of Overlay:** Intersect

[11] Office of Intermodal Planning and Investment (2021). 2019 VTrans Mid-term Needs Prioritization (March 2021). Updated August 12, 2021. Retrieved from https://oipi.maps.arcgis.com/home/item.html?id=e22c120ca024408ab01740bfebdaabbf.

[12] Office of Intermodal Planning and Investment (2021). VTrans Vulnerability 2021/08/23. Updated September 1, 2021. Retrieved from

- Check the following boxes
  - "Include all fields from input (optional)"
  - "Build index (optional)"

Pavement
Use the following inputs for the pavement overlay only.
- **Overlay Event Table:** Select the name of the previously exported attribute table for the pavement data set.
- **Route Identifier Field:** ROUTE_NAME
- **Event Type:** Line
- **From-Measure Field:** FROM_MEASURE
- **To-Measure Field:** TO_MEASURE

Bridge
Use the following inputs for the bridge overlay only.
- **Overlay Event Table:** Select the name of the previously exported attribute table for the bridge data set.
- **Route Identifier Field:** ROUTE_NAME
- **Event Type:** Point
- **From-Measure Field:** ROUTE_FROM_MEASURE

Truck ADT
Use the following inputs for the truck ADT overlay only.
- **Overlay Event Table:** Select the name of the previously exported attribute table for the VDOT truck ADT data set.
- **Route Identifier Field:** ROUTE_NAME
- **Event Type:** Line
- **From-Measure Field:** ROUTE_FROM_MEASURE
- **To-Measure Field:** TO ROUTE_TO_MEASURE

Vulnerability
Use the following inputs for the vulnerability overlay only.
- **Overlay Event Table:** Select the name of the previously exported attribute table for the vulnerability data set.
- **Route Identifier Field:** VDOT_RM
- **Event Type:** Line
- **From-Measure Field:** From_Measu
- **To-Measure Field:** To_measure

Freight
Use the following inputs for the freight overlay only.
- **Overlay Event Table:** Select the name of the previously exported attribute table for the freight data set.
- **Route Identifier Field:** VDOT_RM
- **Event Type:** Line
- **From-Measure Field:** From_Measu
- **To-Measure Field:** To_measure

Prioritized Mid-term Needs
Use the following inputs for the mid-term needs overlay only.
- **Overlay Event Table:** Select the name of the previously exported attribute table for the mid-term needs data set.
- **Route Identifier Field:** VDOT_RM
- **Event Type:** Line
- **From-Measure Field:** From_Measure
- **To-Measure Field:** To_measure

Summarize to EDGE_RTE_KEY
Export each table resulting from the Overlay to MS Excel and use a pivot table to summarize to the level of "EDGE_RTE_KEY" as described in the following pavement, bridge, truck ADT, freight, vulnerability, and mid-term needs subsections.

Pavement
Summarize to the level of "EDGE_RTE_KEY," retaining the worst condition in the "CONDITION" field, which describes pavement condition. For instance, where two segments are along a given segment of the VDOT LRS, one in "poor" condition and the other in "excellent" condition, assign "poor" to the segment.

Bridge
Summarize to the level of "EDGE_RTE_KEY," retaining the worst condition in the "GCR_NAME" field, which describes bridge condition along a general condition rating (GCR). For instance, where there are two bridges along a given segment of the VDOT LRS, one in "fair" condition and one in "good" condition, assign "fair" condition to the segment.

Truck ADT
Sum the following fields into a new field called "PERCENT_TRUCK":

- **"PERCENT_TR"** (may also be called "PERCENT_TRUCK_2_AXLE"): Percentage of vehicles that are two-axle trucks.
- **"PERCENT__1"** (may also be called "PERCENT_TRUCK_3_AXLE"): Percentage of vehicles that are three-axle trucks.
- **"PERCENT__2"** (may also be called "PERCENT_TRUCK_1_TRAIL"): Percentage of vehicles that are trucks with one trailer.
- **"PERCENT__3"** (may also be called "PERCENT_TRUCK_2_TRAIL"): Percentage of vehicles that are trucks with two trailers.

Create a new field "TRUCK_ADT" by multiplying "PERCENT_TRUCK" by the field "AAWDT" from the truck ADT data.

Summarize to the level of "EDGE_RTE_KEY," retaining the highest value for "TRUCK_ADT" where there are multiple truck ADT segments that match with a given segment from the VDOT LRS.

Freight
For cumulative truck delay, summarize to the level of "EDGE_RTE_KEY," retaining the highest priority in the "Cumulative" field, which describes the cumulative truck delay priority level of a segment. For truck travel time reliability, also summarize to the level of "EDGE_RTE_KEY", retaining the highest priority in the "Truck_Trav" field, which describes the truck travel time reliability priority level of a segment. For instance, where two segments are along a given segment of the VDOT LRS, one with "Low" priority and one with "High" priority, assign "High" priority to the segment.

Vulnerability
For vulnerability, summarize to the level of "EDGE_RTE_KEY," retaining the highest priority in the "Vulnerab_5" field, which describes the inland riverine flooding vulnerability priority level of a segment. For instance, where two segments are along a given segment of the VDOT LRS, one with "Medium" priority and one with "High" priority, assign "High" priority to the segment.

Mid-Term Needs
For mid-term needs, summarize to the level of "EDGE_RTE_KEY," retaining the highest priority in the following fields:

- Statewide_priority, District_priority, RN_reliability_priority, CoSS_reliability_priority, RN_AC_pedestrian_access_priorit, RN_AC_Bicycle_Access_Priority, RN_AC_Transit_Access_priority, Safety_segments_district_priori, Safety_segments_statewide_prior, Safety_Pedestrian_priority.[13]

For "Statewide_priority" and "District_priority", the highest priority value is "Priority 1" and for the other fields the highest priority is Very High. For instance, where two segments are along a given segment of the VDOT LRS, one with "Priority 1" Statewide_priority and one with "Priority 4" Statewide priority, assign "Priority 1" to the segment. Similarly, where two segments are along a given segment of the VDOT LRS, one with "High" RN_reliability_priority and one with "Medium" RN_reliability_priority, assign "High" to the segment.

Create a Crosswalk for INRIX XD Data

VDOT does not currently have a crosswalk between INRIX XD data and the LRS.[14] Therefore, a crosswalk will need to be developed based on the segment geometries. The consultant team created an initial crosswalk, which can be retained for future use provided that neither the LRS nor the INRIX XD segments change significantly. This crosswalk creation is described below and can be completed using a GIS tool.

1. Buffer the INRIX XD Virginia network by 50 feet.
2. Find the length of each LRS segment.
3. Conduct a spatial intersection between the LRS and the buffered INRIX data.
4. Find the length of each segment post-spatial intersection and calculate a ratio by dividing the post-intersection length by the pre-intersection length.
5. Only keep segments in which the length ratio is greater than 0.25 and the post-intersection length is greater than 75 feet. The minimum length eliminates cross streets from the crosswalk table, and the minimum ratio filters out segments that barely intersect.
6. Create a separate dataset summarized to the level of "EDGE_RTE_KEY" by summing the post-intersection length field created in action #4 and joining the sum to the filtered data from action #5.
7. Create a new ratio field that is the post-intersection length (action #4) divided by the summed post-intersection length found in action #6. This ratio serves as a weight for TTI before summing across XD segments associated with a single LRS segment. This action concludes the process for developing the crosswalk table.

Follow these actions to use the crosswalk table to align INRIX XD data for the TTI measure to the LRS segmentation.

8. Left join the data from action #7 with the raw TTI XD data based on the "Field1" in the TTX XD data and "SegID" in the data from action #7.
9. Calculate the maximum TTI value from Field9, Field10,..., and Field 28 in the INRIX XD data set.
10. Multiply the maximum TTI value by the new ratio field, found in action #7.
11. Summarize at the "EDGE_RTE_KEY" level by summing the weighted TTI value from action #10. The resulting value is the maximum TTI for the LRS segment.

Overlay Population and Employment Density Data

Using a GIS tool, perform a spatial intersection between the block group dataset and the LRS. Then summarize to the level of "EDGE_RTE_KEY," taking the average employment and population density value. For instance, where two block groups are along a given segment of the LRS, one with a population and employment density of 1,000 and one with a population and employment density of 2,000, assign the LRS segment a value of 1,500 (which results from (1,000+2,000)/2).

[13]Aliases for these fields are on page 21 and 22.

[14]Email from Jungwook 'JJ' Jun, VDOT Planning Data Solutions Manager on November 22, 2021.

Conduct Data Joins
Using a GIS tool (e.g., ESRI ArcMap, QGIS), left join the clipped LRS with the data sets using "EDGE_RTE_KEY" as the join field. The left join retains all rows from the LRS and only matching rows from the other data sets from Step 2.

Overlay Equity Emphasis Area Data
Assign the "Equity Emphasis Area Index" field to segments based on the segment's overlap with the equity emphasis area. When a segment overlaps with multiple areas, retain the greatest EEA index value.

Step 3: Score Segments Across Goal Areas

In Step 3, the segments receive a score for each measure along a four-point score. Scoring places all measures on a common scale that allows for them to be combined in Step 4, which serves to identify the locations with multiple transportation needs that may merit transportation studies.

Prior to proposing these measures, the consultant team evaluated a much larger list of possible measures on the following characteristics. The recommended measures described in this section are drawn from the high-scoring measures in this list to make a well-rounded set of measures that respond to multiple aspects of the Danville long-range transportation plan goal areas. Appendix D shows how the measures were evaluated.

- **Data extent:** How widely available on the Danville MPO network is the required data?
- **Ease of data gathering and processing:** How much data processing is required to convert raw data into the measure, and how complex is it to reproduce?
- **Understandability:** How easy is it to explain and communicate the measures to a lay audience?
- **Alignment with goal:** How closely does the measures align with at least one aspect of the relevant goal area in the Danville MPO long-range transportation plan?
- **Outcome vs. output focus:** While not relevant for all measures, this characteristic seeks to privilege measures that focus on observed data closely related to the transportation system rather than agency outputs. For example, an outcome-focused measure could be the observed congestion in a network through a measure such as TTI, while an output-focused measure could be the dollars spent by the agency on congestion-related projects.

The measure scoring, documented in the following pages, utilizes the final output from Steps 2 and 3. The data should be clipped to the MPO boundary, aligned to the mid-term needs segmentation, and have past study locations removed.

Mobility and Accessibility

Travel Time Index

1. Use the crosswalk developed in Step 2 to join the TTI data to the LRS that has been previously been clipped to the Danville MPO area.
2. Filter out segments where the maximum TTI is less than 1.25 or 1.20. This threshold is selected to be slightly lower than the threshold than 1.3 that OIPI used for statewide analysis in the VTrans mid-term needs analysis to reflect the lower levels of congestion in the Danville region compared with some parts of Virginia.[15] The final threshold will be recommended after examining the data in task 4 of the GAP-TA project at a level that identifies a reasonable number of congested segments.
3. Assign points by maximum TTI:
   a. 4 points – Top 25% of segments
   b. 3 points – Next highest 25% of segments
   c. 2 points – Next highest 25% of segments
   d. 1 point – Bottom 25% of segments plus all segments with a blank TTI value

Reliability Priority

1. Use the mid-term needs data that was previously joined with the LRS data.
   a. Fields: CoSS_reliability_priority (alias: "Need Priority – Reliability (CoSS)") and RN_reliability_priority (alias: "Need Priority – Reliability (RN)")
2. Combine the two need priority fields into a single field, retaining the highest priority.
3. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Population and Employment Density

1. Use the field for population and employment density whose overlay with LRS segments is described on page 13.
2. Assign points.
   a. 4 points – Top 25% of segments

[15]Office of Intermodal Planning and Investment (2021). Technical Guide of the Identification and Prioritization of the VTrans Mid-term Needs. Retrieved from https://vtrans.org/resources/2021_Technical_Guide_Mid-Term_Needs.pdf.

b. 3 points – Next highest 25% of segments
c. 2 points – Next highest 25% of segments
d. 1 point – Bottom 25% of segments

Pedestrian Need Priority

1. Use the mid-term needs data that was previously joined with the LRS data.
   a. Field: RN_AC_pedestrian_access_priorit (alias: "Need Priority – Pedestrian Access (RN)")
2. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Bicycle Need Priority

1. Use the mid-term needs data that was previously joined with the LRS data.
   a. Field: RN_AC_Bicycle_Access_Priority (alias: "Need Priority – Bicycle Access (RN)")
2. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Transit Access Need Priority

1. Use the mid-term needs data that was previously joined with the LRS data.
   a. Field: RN_AC_Transit_Access_priority (alias: "Need Priority – Transit Access (RN)")
2. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Safety

Highway Safety Priority

1. Use the mid-term needs data that was previously joined with the LRS data.
   a. Fields: Safety_segments_statewide_prior (alias: "Need Priority - Statewide Safety Improvement") and Safety_segments_district_priori (alias: "Need Priority - Construction District Safety Improvement")
2. Combine the two need priority fields, retaining the highest priority.
3. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Pedestrian Safety Priority

1. Use the mid-term needs data that was previously joined with the LRS data.
   a. Field: Safety_Pedestrian_priority (alias: "Pedestrian Safety Need Priority")
2. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Economy

Access to Industrial and Economic Development Areas

1. Identify important ingress and egress routes between previously mapped VEDP locations and corridors of statewide significance (CoSS). If needed, confirm the ingress and egress routes with Pittsylvania County, City of Danville, and/or Southern Virginia Regional Alliance.
2. Assign points based on the roadway providing IEDA access or not:
   a. 4 points – Segment provides IEDA access

Truck ADT

1. Use the truck ADT data that was previously joined with the LRS data.
2. Filter out any segments where truck ADT is 0 or null.
3. Assign points based on truck ADT:
   a. 4 points – Top 25% of segments
   b. 3 points – Next highest 25% of segments
   c. 2 points – Next highest 25% of segments
   d. 1 point – Bottom 25% of segments

Cumulative Truck Delay

1. Use the VTrans freight data that was previously joined with the LRS data set.

a. Field: "Cumulative_Truck_Delay "

2. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Truck Travel Time Reliability

1. Utilize the VTrans freight data that was previously joined with the LRS data set.

   a. Field: "Truck_Travel_Time_Reliability "

2. Assign points:
   a. 4 points – Very High
   b. 3 points – High
   c. 2 points – Medium
   d. 1 point – Low

Community and Nature

Vulnerability to Environmental Hazards (Inland Riverine Flooding)

1. Use the VTrans vulnerability data that was previously joined with the LRS data.

   a. Field: Vulnerability to inland riverine flooding under a 500-year flood with buffer ("Vulnerability_IRF_500_Yr_Buff," which may be abbreviated to "Vulner_5").

2. Assign points:
   a. 4 points – "High"
   b. 2.5 points – "Medium"
   c. 1 point – "Low"

Equity Emphasis Areas (Index)

1. Use the Equity Emphasis Area data that was previously joined with the LRS data.

   a. Field: Equity Emphasis Areas (EEA) Index ("Equity Emphasis Area Index"). The EEA Index identifies where there is a greater proportion of the population considered to be low-income, minority, Hispanic or Latino, over age 75, of limited English proficiency, or with a disability, as compared to the regional average.[16]

2. Assign points:
   a. 4 points – Top 25% of segments
   b. 3 points – Next highest 25% of segments
   c. 2 points – Next highest 25% of segments
   d. 1 point – Bottom 25% of segments

Operational Efficiency

Pavement Condition

1. Use the pavement condition data that was previously joined to the LRS within the Danville MPO area.

   a. Field: Pavement condition ("Condition")

2. Assign points.
   a. 4 points – Very Poor
   b. 3 points – Poor
   c. 2 points – Fair
   d. 1 point – Excellent or Good or blank (meaning the segment does not have pavement condition data)

Bridge Condition

1. Use the bridge condition data that was previously joined to the LRS within the Danville MPO area.

   a. Field: Bridge condition according to the general condition rating ("GCR_NAME")

2. Assign points to segments with associated bridges.
   a. 4 points - Poor
   b. 2.5 points – Fair
   c. 1 point – Good or unclassified

VTrans Need Coordination

1. Use the mid-term needs data that was previously joined with the LRS data.

   a. Field: Statewide_priority (alias: "Statewide Need Priority"), District_priority (alias: "Districtwide Need Priority")

2. For each segment, use the greater priority of Statewide and Districtwide. Priority 1 is a higher priority than Priority 4.

3. Assign points based on need priority designation:
   a. 4 points – Priority 1
   b. 3 points – Priority 2
   c. 2 points – Priority 3
   d. 1 point – Priority 4

[16]Office of Intermodal Planning and Investment (2021). Technical Guide of the Identification and Prioritization of the VTrans Mid-term Needs. Retrieved from https://vtrans.org/resources/2021_Technical_Guide_Mid-Term_Needs.pdf.

Step 4: Apply Measure and Goal Area Weights and Combine Scores

Step 4 applies measure-level weights within each goal area, normalizes scores within each goal area, and applies goal area-level weights to create a final segment score. Sets of measure-level and goal area-level weights are described in this section but it is proposed that the tool developed for Task 4 will allow for adjustments to these weights.

As a default, the measure-level weights will evenly distribute amongst all measures within a goal area. For example, the Economy goal area has four measures and thus each will be given equal weight, 25%, towards the Economy score. In the case of the Operational Efficiency goal area, which has three total measures, weights will be evenly distributed based on whether a segment has a bridge - either 33.3% each if a segment does have a bridge, or 50% each if a segment does not have a bridge. This ensures that roadways without a bridge will not be penalized.

The next step of normalizing the scores within each goal area accounts for the number of relevant measures with data along a given segment within each goal area. For instance, some measures are not relevant to a particular segment, such as the bridge condition measure for a road segment with no bridges, and this step avoids penalizing a roadway because a measure is not relevant or does not have data available. Normalizing the scores within each goal area converts the points received to a value from 0 to 1 for each goal area, where a value closer to 1 indicates that the segment received higher scores for all relevant measures with available data, and a value closer to 0 indicates that the segment received lower scores for relevant measures with available data. Higher scores indicate a greater transportation need associated with a given goal area.

The normalized scores for each goal area are then weighted based on the goal area points used for project scoring in the Danville MPO 2045 Long Range Transportation Plan.[17] Default weights are recommended for this process that are consistent with the long-range transportation plan and that closely approximate the SMART SCALE goal area weights for category D MPOs, which include the Danville MPO.[18] Weighting means that goal areas with higher weight contribute more to each segments' final score than goal areas with lower weight, regardless of the number of measures associated with each goal area.

The following equation describes the normalization and weighting process. For each goal area, weight the points assigned to each measure, sum the total number of weighted points assigned to a segment and divide by the total number of possible points a segment can receive under that goal area. Multiply this value by the respective goal area weight.

$$Score = \sum_{g \in G} \left(\frac{\sum_{m \in M} (weight_m * points_m)}{possible\ points_g} \times weight_g \right)$$

Where,

- $weight_{measure}$ is the weight for a given measure m. The weights are evenly distributed among the measures within a goal area.
- $points_{measure}$ is the number of points assigned for a given measures m out of all measures M.
- possible $points_{goal}$ is the number of possible points available for a given goal area g out of all goal areas G. Possible points is the sum of the maximum number of points for any measures for which data is available for a given segment. The possible points for segments with data available for all measures are listed below.
  - Economy: 16
  - Safety: 8
  - Mobility and Accessibility: 24
  - Community and Nature: 8
  - Operational Efficiency (Segments w/Bridges): 12
  - Operational Efficiency (Segments without Bridges): 8
- $weight_g$ is the weight for a given goal area g. The weights for all goal areas, G, are listed below and match the weights used for project scoring in the Danville MPO 2045 Long Range Transportation Plan.[19]
  - Economy: 35%
  - Safety: 30%
  - Mobility and Accessibility: 20%
  - Community and Nature: 10%
  - Operational Efficiency: 5%
  - Score is the score for a given road segment.

As previously described, data not being available on all segments or a measure not being applicable (e.g., no bridge condition score for a segment without bridges) will sometimes limit the ability to score segments on all measures. An exact number of measures that should have scores for a segment to be evaluated may be recommended in tasks 3 and 4 of this GAP-TA project. Segments for which data is not available for more measures than the threshold would be filtered out to avoid basing study location recommendations on very incomplete data.

[17]Danville MPO (2020). Danville MPO 2045 Long Range Transportation Plan. Retrieved from Long-Range Transportation Plan | Danville MPO.

[18]Office of Intermodal Planning and Investment (2021). SMART SCALE Technical Guide. Table 4.2: Factor Weights by Category. Revised February 2021. Retrieved from https://smartscale.org/documents/2020documents/technical-guide-2022.pdf.

[19]Danville MPO (2020). Danville MPO 2045 Long Range Transportation Plan. Retrieved from https://danvillempo.org/long-range-transportation-plan/.

Step 5: Output

The output from this proposed process is a ranked list of segments in the Danville MPO area. This list of segments will be provided through the tool to be developed for Task 4. The high-ranking segments have the most severe transportation needs within the region. Studies at these locations can lead to projects that advance the region towards its goals.

The scores for each of the five goal areas help identify the transportation needs that exist in that location that the study should focus on. Goal areas with scores closer to 1 are needs in the location that should be addressed by future studies, while goal areas with scores closer to 0 are not currently needs in that location.

Because some of the locations may already have been recently studied, the highest ranked segments should be compared with recent study locations occurring within the past 5-10 years to see if a study that is relevant to the needs observed at this location has already been conducted. A relevant study would have addressed transportation needs that currently exist in that location as evidenced by goal area scores closer to 1. High ranking segments without a recent relevant transportation study should strongly be considered for future transportation studies.

Considerations for Future Refinements

There may be new data sources in the future that can improve this analysis by filling gaps for which data is not currently available at an acceptable level of data processing. For example, ideally a measure for bicyclist safety would be included in this methodology. However, at present, only raw bicycle crash data requiring extensive processing is available. This absence should be filled in future iterations of this tool if possible. One potential data source that VDOT is currently exploring[20] is the Safer Streets Priority Finder, which users local road and crash data to estimate risks that bicyclists and pedestrians encounter on roads.[21]

[20] Conversation with David Cook (VDOT) on November 3, 2021.

[21] Safer Streets Priority Finder. Retrieved from https://www.saferstreetspriorityfinder.com/.

CHAPTER 3: TECHNICAL GUIDE FOR THE DANVILLE MPO STUDY IDENTIFICATION AND PRIORITIZATION TOOL (SIPT)

Tool Tutorial

The SIPT can help make identifying study locations repeatable, performance-based, and transparent. As an Excel spreadsheet, it uses various datasets and equations to process a significant amount of data. The output is a prioritized list of study locations where transportation recommendations are most likely to advance the region's mobility and accessibility, safety, economy, community and nature, and operational efficiency goals. This Excel-based tool produces tables that show the highest-scoring segments and the highest-scoring corridors. Simple steps can transform those tables into maps, using Geographic Information Systems (GIS), which more effectively depict those priority areas.

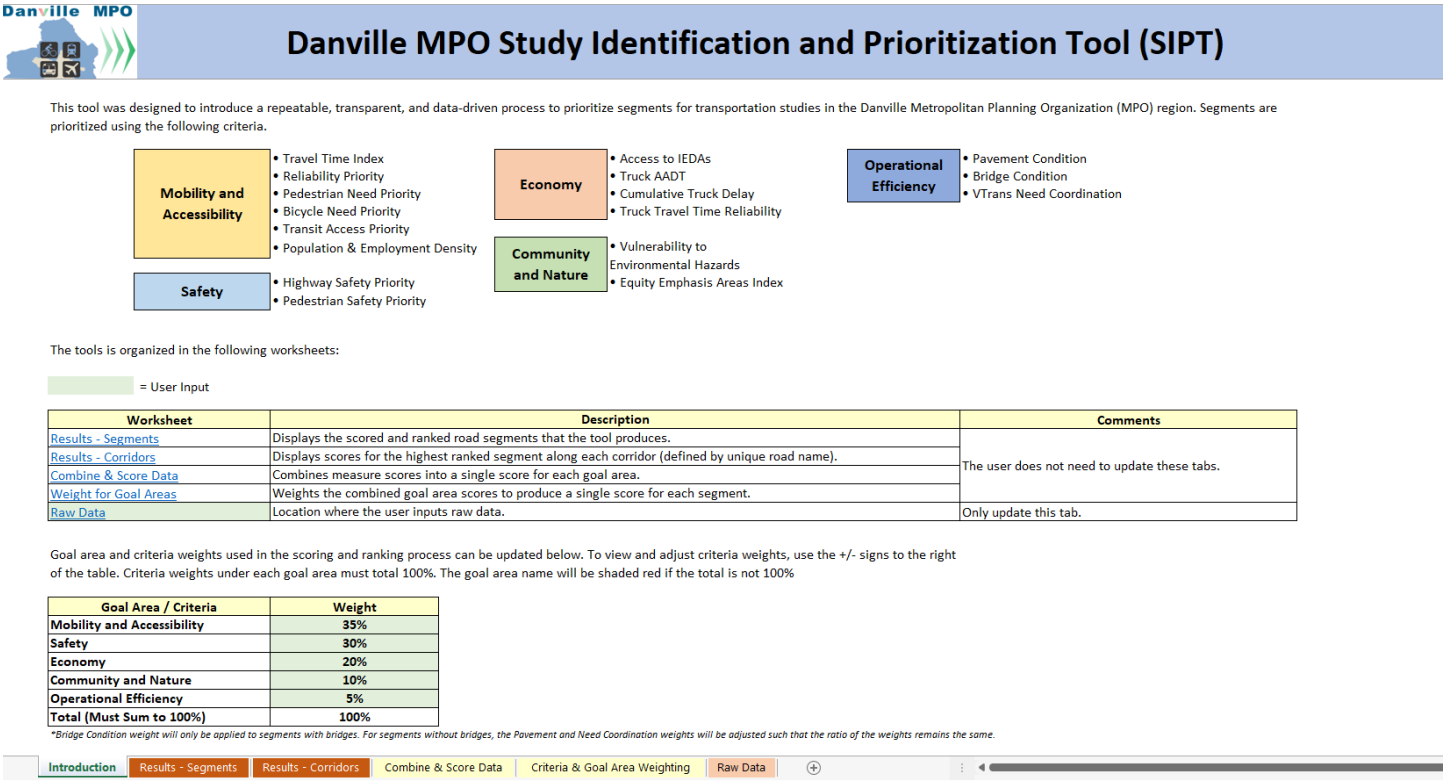
When working with the SIPT, the first step is to open the spreadsheet and refer to the first tab, labeled Introduction. This opening page, depicted below, explains the tool, and provides descriptions for the various tabs. Worksheets include:

- **Results – Segments:** Displays the scored and ranked road segments that the tool produces
- **Results – Corridors:** Displays scores for the highest-ranked segments along each corridor (defined by unique road name)
- **Combine & Score Data:** Combines measure scores into a single score for each goal area
- **Weight for Goals Areas:** Weights the combined goal area scores to produce a single score for each segment
- **Raw Data:** Location where the user inputs raw data

On the first tab, the user can adjust the weights for each goal area. These percentages affect the outputs and influence which areas the tool prioritizes, based on how important each goal area is to the region. The goal areas arose from the MPO's Long Range Transportation Plan and include:

- **Mobility and Accessibility:** Provide a transportation system that facilitates the efficient movement of people and goods.
- **Safety:** Provide a safe and secure transportation system.
- **Economy:** Retain and increase business and employment opportunities.
- **Community and Nature:** Improve the quality of life and protect the environment.
- **Operational Efficiency:** Preserve the existing transportation system and promote efficient system management.

Figure 5: Introduction Tab of SIPT Tool



Danville MPO

Danville MPO Study Identification and Prioritization Tool (SIPT)

This tool was designed to introduce a repeatable, transparent, and data-driven process to prioritize segments for transportation studies in the Danville Metropolitan Planning Organization (MPO) region. Segments are prioritized using the following criteria.

Mobility and Accessibility	• Travel Time Index • Reliability Priority • Pedestrian Need Priority • Bicycle Need Priority • Transit Access Priority • Population & Employment Density
Safety	• Highway Safety Priority • Pedestrian Safety Priority
Economy	• Access to IEDAs • Truck AADT • Cumulative Truck Delay • Truck Travel Time Reliability
Community and Nature	• Vulnerability to Environmental Hazards • Equity Emphasis Areas Index
Operational Efficiency	• Pavement Condition • Bridge Condition • VTrans Need Coordination

The tools is organized in the following worksheets:

= User Input

Worksheet	Description	Comments
Results - Segments	Displays the scored and ranked road segments that the tool produces.	The user does not need to update these tabs.
Results - Corridors	Displays scores for the highest ranked segment along each corridor (defined by unique road name).	
Combine & Score Data	Combines measure scores into a single score for each goal area.	
Weight for Goal Areas	Weights the combined goal area scores to produce a single score for each segment.	
Raw Data	Location where the user inputs raw data.	Only update this tab.

Goal area and criteria weights used in the scoring and ranking process can be updated below. To view and adjust criteria weights, use the +/- signs to the right of the table. Criteria weights under each goal area must total 100%. The goal area name will be shaded red if the total is not 100%

Goal Area / Criteria	Weight
Mobility and Accessibility	35%
Safety	30%
Economy	20%
Community and Nature	10%
Operational Efficiency	5%
Total (Must Sum to 100%)	100%

*Bridge Condition weight will only be applied to segments with bridges. For segments without bridges, the Pavement and Need Coordination weights will be adjusted such that the ratio of the weights remains the same.

Introduction | Results - Segments | Results - Corridors | Combine & Score Data | Criteria & Goal Area Weighting | Raw Data

Method for Updating SIPT Data

This tool builds on the data sources and measure calculations described in Chapter 2, on method and measure development. Please reference that chapter for its description of how to collect and process data. The result of that method is a series of data sets that are aligned to the VDOT linear referencing system (LRS) and that contain the unique segment identifying field called "EDGE_RTE_KEY."

Occasionally the LRS will be updated and new segments will be added. When adding new segments or updating the segmentation for a new version of the LRS, first delete data in the rows associated with the VDOT LRS as the field source in Table 1. Then, paste in the new values for these fields based on the processing of the LRS described in Chapter 2 on method and measure development. These are new for the analysis. When segments are updated, all other fields in the "Raw Data" tab will need to be updated as well, as described in the following paragraphs.

The fields not containing identifying information for segments in the LRS can be updated when the LRS segments are updated in the tool or when new data is available for one or several of them. To update a field—

1. Delete all the data in that field.
2. Use a vlookup() function in MS Excel to join data from that table with the appropriate row in the "Raw Data" tab, which is uniquely identified using the EDGE_RTE_KEY field in column A. Chapter 2, on method and measure development, will have already resulted in a table with the EDGE_RTE_KEY, which is the unique segment identifier, and the metrics that are being updated.
3. Drag down the vlookup() equation to cover all LRS segments.
4. Copy the row and paste as a value to eliminate the equations. This prevents values from subsequently changing or being lost if the table that the equation references change or is moved.
5. Finally, replace all instances of #N/A with a blank using the find and replace function in MS Excel.

Table 1 below shows the fields included in the "Raw Data" tab, their source, and example entries. Information on obtaining and/or calculating each is available in Chapter 2, on method and measure development.

Table 1: Fields in "Raw Data" Tab

Field Name	Field Description	Field Source	Example Data 1	Example Data 2
EDGE_RTE_KEY	Unique segment identifier	VDOT LRS	143093-R-VA071SC01505SB	5387224-R-VA US00058WBBUS014
RTE_NM	VDOT route name		R-VA071SC01505SB	R-VA US00058WBBUS014
RTE_COMMON_ NM	Common route name		Rt. 1505S (Pittsylvania County)	BUS US-58W (14 City of Danville)
STREET_NM	Street name		Greenwood Dr	Riverside Dr
TRANSPORT_EDGE_			0	5.452
FROM_MSR	From mile point		0.25	5.535
TRANSPORT_EDGE_			Pittsylvania County	City of Danville
TO_MSR	To mile point		Pittsylvania County	City of Danville
FROM_ JURISDICTION_NM	From jurisdiction name		R-VA071SC01505NB	R-VA US00058WBBUS014
TO_JURISDICTION_ NM	To jurisdiction name		SC-1505N (Pittsylvania County)	BUS US-58W (14 City of Danville)
MASTER_RTE_NM	Master route name		7101505	CFUS00058W
MASTER_RTE_ COMMON_NM	Master route common name		SC-1505N (Pittsylvania County)	BUS US-58W (14 City of Danville)
MASTER_RTE_ SOURCE_ID	Master route source ID		7101505	CFUS00058W
RTE_OPPOSITE_ DIRECTION_RTE_ NM	Route name of opposite direction		R-VA071SC01505NB	R-VA US00058EBBUS014

Field Name	Field Description	Field Source	Example Data 1	Example Data 2
Segment_Length	Segment length in miles	Calculated within tool based on "TRANSPORT_EDGE_FROM_MSR" and "TRANSPORT_EDGE_TO_MSR"	0.25	0.083
Travel Time Index	Travel Time Index			1.02
CoSS Reliability Priority	VTrans Need Priority - Reliability (CoSS)	VTrans Prioritized Mid-term Needs		No Need
RN Reliability Priority	VTrans Need Priority - Reliability (RN)	VTrans Prioritized Mid-term Needs		No Need
Population and Emp. Density	Population and employment density	U.S. Census Bureau	795.85	1,329.29
Pedestrian Needs Priority	VTrans Need Priority - Pedestrian Access (RN)	VTrans Prioritized Mid-term Needs		No Need
Bicycle Needs Priority	VTrans Need Priority - Bicycle Access (RN)	VTrans Prioritized Mid-term Needs		High
Transit Access Needs Priority	VTrans Need Priority - Transit Access (RN)	VTrans Prioritized Mid-term Needs		High
Highway Safety Statewide Priority	VTrans Need Priority - Statewide Safety Improvement	VTrans Prioritized Mid-term Needs		Low
Highway Safety District Priority	VTrans Need Priority - Construction District Safety Improvement	VTrans Prioritized Mid-term Needs		High
Pedestrian Safety Priority	VTrans Need Priority - Pedestrian Safety Improvement	VTrans Prioritized Mid-term Needs		No Need
Access to IEDAs	Access routes to industrial and economic development areas (IEDAs)	Virginia Economic Development Partnership (VEDP)	Not IEDA Access	Not IEDA Access

Field Name	Field Description	Field Source	Example Data 1	Example Data 2
Truck AADT	Truck annual average daily traffic	VDOT Virginia Roads		87431.89
Cumulative Truck Delay	VTrans Freight Element Cumulative Truck Delay	VTrans Freight Analysis		Low
Truck Travel Time Reliability	VTrans Freight Element Truck Travel Time Reliability Issues	VTrans Freight Analysis		No
Vulnerability	Vulnerability based on the Inland Riverine Flooding (500 Yr + Buffer) scenario, on a three-point scale (High, Medium, and Low) assigned to roadway segments	VTrans Vulnerability Analysis	No IRF Exposure	No IRF Exposure
EEA Index	VTrans Equity Emphasis Area Index	Interact VTrans	3	5.58
Pavement Condition	Pavement condition	VDOT Pathways for Planning		
Bridge Condition	Bridge condition	VDOT Virginia Roads		
VTrans Need Coordination - Statewide	VTrans Statewide Priority	VTrans Prioritized Mid-term Needs		Priority 4
VTrans Need Coordination - District	VTrans Construction District Priority	VTrans Prioritized Mid-term Needs		Priority 2

Troubleshooting Instructions

How to add more rows/segments

If future versions of the linear referencing system (LRS) include more segments than are built into the tool, you may need to lengthen the tables inside the tool by dragging down equations to process them. This would apply to the "Criteria & Goal Area Weighting" tab, the "Combine & Score Data" tab, and the "Results – Segments" tab. After pasting in the new LRS segments and associated metrics into the "Raw Data" tab, simply take the following steps on each tab.

- **Criteria & Goal Area Weighting:** Select the last row with equations, and drag it down to the number of rows with segments in the "Raw Data" tab.
- **Combine & Score Data:** Select the last row with equations, and draw it down to the number of rows with segments in the "Raw Data" tab.
- **Results – Segments:** Select cell C9, which is the first segment in the unique segment identifier column. Change references that are currently to the final row (which is row 14130 in the original version of the tool) to the final row with data in the "Raw Data" tab. Draft this updated equation down to the bottom of the table. Then, select the final row in the table, and draft it down to the number of rows with segments in the "Raw Data" tab.

Is it a problem that some segments are missing data?

Not every segment will have data for every measure. That is expected and reflects the coverage limitations of the underlying data sources. The tool can still function with segments missing data for some measures.

The tool is not processing the raw data correctly

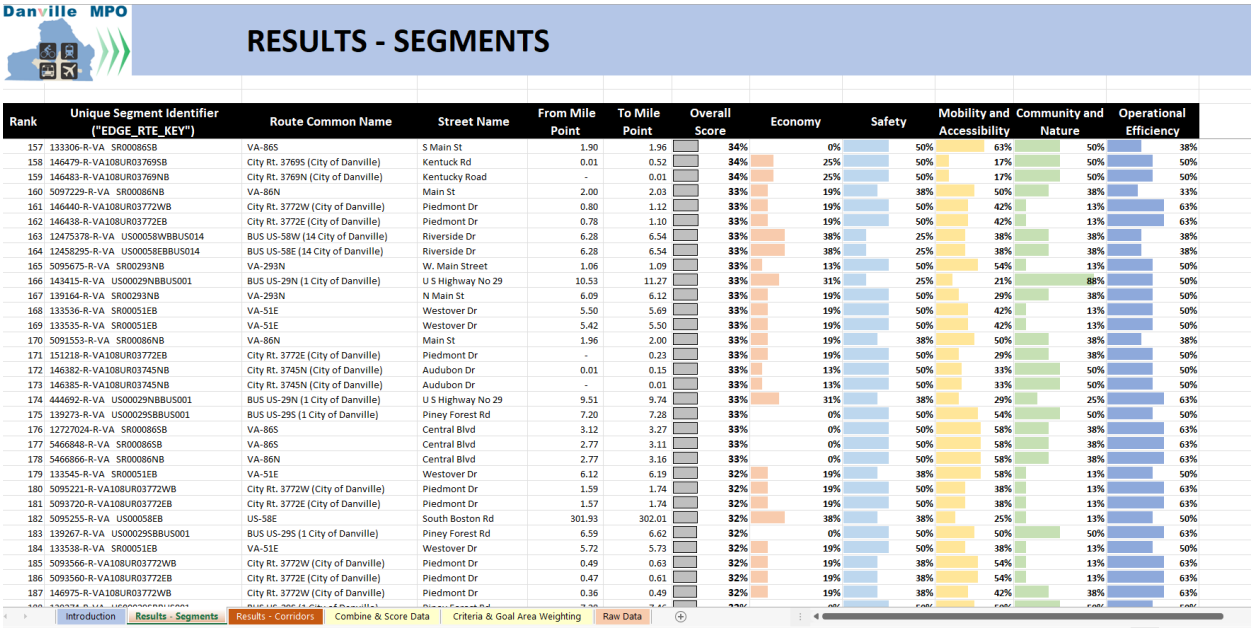
If the results page includes segment information or scores showing errors such as "#N/A" or "#DIV/0," there may be several possible causes.

- First, check to make sure that the data was entered into the proper columns in the "Raw Data" tab. For instance, if the tool is expecting a number and a character string is input, it may cause errors in the intermediate equations and conditional statements.
- Next, check that no columns have been left unpopulated in the "Raw Data" tab, particularly columns with information identifying the segment such as the road name or mileposts.
- Finally, ensure that none of the intermediate tabs (e.g., "Combine & Score Data" and "Criteria & Goal Area Weighting") have been changed or had equations deleted.

Method for Analyzing Readouts and Interpreting Results

After processing the data and following the instructions in this manual, select the two orange results tabs. The first tab depicts the prioritized ranking of road segments, used to find precise locations and to use the results to map the scores. The second shows results by corridors, used to summarize the highest-ranking corridors and when the MPO is not yet interested in specific locations. Refer to the following screenshots, which show the results pages. Note that the spreadsheet will automatically update with any changes to the goal weights or data.

Figure 6: Segment-level Results Tab

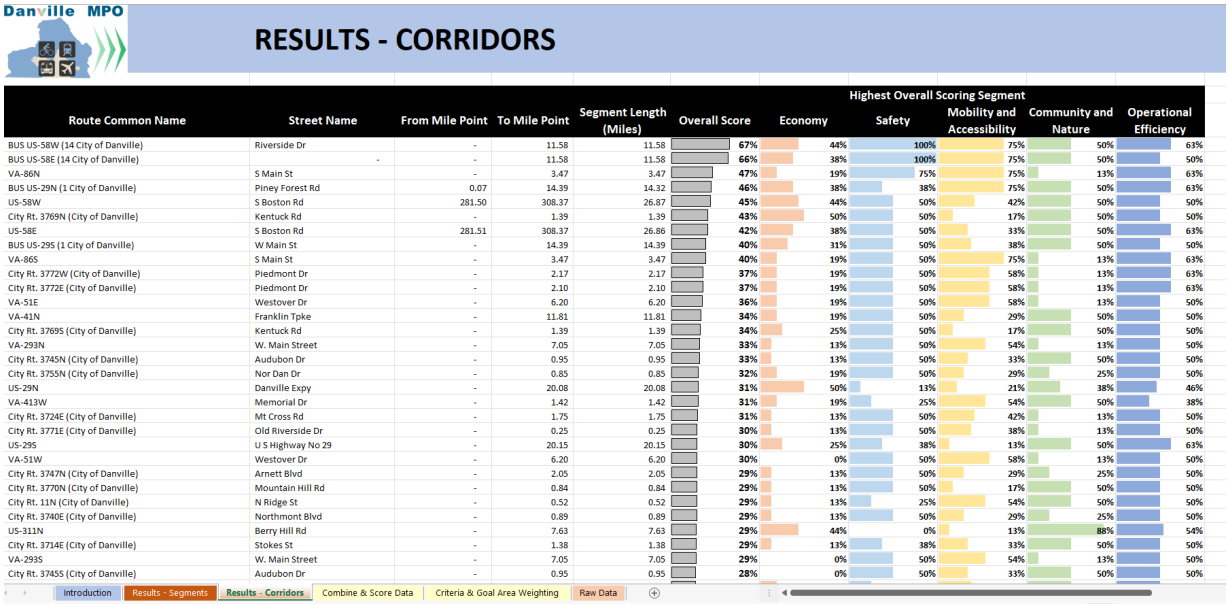


RESULTS - SEGMENTS

Rank	Unique Segment Identifier ("EDGE_RTE_KEY")	Route Common Name	Street Name	From Mile Point	To Mile Point	Overall Score	Economy	Safety	Mobility and Accessibility	Community and Nature	Operational Efficiency
157	133306-R-VA SR00086SB	VA-86S	S Main St	1.90	1.96	34%	0%	50%	63%	50%	38%
158	146479-R-VA108UR03769SB	City Rt. 3769S (City of Danville)	Kentuck Rd	0.01	0.52	34%	25%	50%	17%	50%	50%
159	146483-R-VA108UR03769NB	City Rt. 3769N (City of Danville)	Kentucky Road	-	0.01	34%	25%	50%	17%	50%	50%
160	5097229-R-VA SR00086NB	VA-86N	Main St	2.00	2.03	33%	19%	38%	50%	38%	33%
161	146440-R-VA108UR03772WB	City Rt. 3772W (City of Danville)	Piedmont Dr	0.80	1.12	33%	19%	50%	42%	13%	63%
162	146438-R-VA108UR03772EB	City Rt. 3772E (City of Danville)	Piedmont Dr	0.78	1.10	33%	19%	50%	42%	13%	63%
163	12475378-R-VA US00058WBBUS014	BUS US-58W (14 City of Danville)	Riverside Dr	6.28	6.54	33%	38%	25%	38%	38%	38%
164	12458295-R-VA US00058EBBUS014	BUS US-58E (14 City of Danville)	Riverside Dr	6.28	6.54	33%	38%	25%	38%	38%	38%
165	5095675-R-VA SR00293NB	VA-293N	W. Main Street	1.06	1.09	33%	13%	50%	54%	13%	50%
166	143415-R-VA US00029NBBUS001	BUS US-29N (1 City of Danville)	U S Highway No 29	10.53	11.27	33%	31%	25%	21%	88%	50%
167	139164-R-VA SR00293NB	VA-293N	N Main St	6.09	6.12	33%	19%	50%	29%	38%	50%
168	133536-R-VA SR00051EB	VA-51E	Westover Dr	5.50	5.69	33%	19%	50%	42%	13%	50%
169	133535-R-VA SR00051EB	VA-51E	Westover Dr	5.42	5.50	33%	19%	50%	42%	13%	50%
170	5091553-R-VA SR00086NB	VA-86N	Main St	1.96	2.00	33%	19%	38%	50%	38%	38%
171	151218-R-VA108UR03772EB	City Rt. 3772E (City of Danville)	Piedmont Dr	-	0.23	33%	19%	50%	29%	38%	50%
172	146382-R-VA108UR03745NB	City Rt. 3745N (City of Danville)	Audubon Dr	0.01	0.15	33%	13%	50%	33%	50%	50%
173	146385-R-VA108UR03745NB	City Rt. 3745N (City of Danville)	Audubon Dr	-	0.01	33%	13%	50%	33%	50%	50%
174	444692-R-VA US00029NBBUS001	BUS US-29N (1 City of Danville)	U S Highway No 29	9.51	9.74	33%	31%	38%	29%	25%	63%
175	139273-R-VA US00029SBBUS001	BUS US-29S (1 City of Danville)	Piney Forest Rd	7.20	7.28	33%	0%	50%	54%	50%	50%
176	12727024-R-VA SR00086SB	VA-86S	Central Blvd	3.12	3.27	33%	0%	50%	58%	38%	63%
177	5466848-R-VA SR00086SB	VA-86S	Central Blvd	2.77	3.11	33%	0%	50%	58%	38%	63%
178	5466866-R-VA SR00086NB	VA-86N	Central Blvd	2.77	3.16	33%	0%	50%	58%	38%	63%
179	133545-R-VA SR00051EB	VA-51E	Westover Dr	6.12	6.19	32%	19%	38%	58%	13%	50%
180	5095221-R-VA108UR03772WB	City Rt. 3772W (City of Danville)	Piedmont Dr	1.59	1.74	32%	19%	50%	38%	13%	63%
181	5093720-R-VA108UR03772EB	City Rt. 3772E (City of Danville)	Piedmont Dr	1.57	1.74	32%	19%	50%	38%	13%	63%
182	5095255-R-VA US00058EB	US-58E	South Boston Rd	301.93	302.01	32%	38%	38%	25%	13%	50%
183	139267-R-VA US00029SBBUS001	BUS US-29S (1 City of Danville)	Piney Forest Rd	6.59	6.62	32%	0%	50%	50%	50%	63%
184	133538-R-VA SR00051EB	VA-51E	Westover Dr	5.72	5.73	32%	19%	50%	38%	13%	50%
185	5093566-R-VA108UR03772WB	City Rt. 3772W (City of Danville)	Piedmont Dr	0.49	0.63	32%	19%	38%	54%	13%	63%
186	5093560-R-VA108UR03772EB	City Rt. 3772E (City of Danville)	Piedmont Dr	0.47	0.61	32%	19%	38%	54%	13%	63%
187	146975-R-VA108UR03772WB	City Rt. 3772W (City of Danville)	Piedmont Dr	0.36	0.49	32%	19%	38%	42%	38%	63%

Introduction | Results - Segments | Results - Corridors | Combine & Score Data | Criteria & Goal Area Weighting | Raw Data

Figure 7: Corridor-level Results Tab



RESULTS - CORRIDORS

Route Common Name	Street Name	From Mile Point	To Mile Point	Segment Length (Miles)	Highest Overall Scoring Segment: Overall Score	Economy	Safety	Mobility and Accessibility	Community and Nature	Operational Efficiency
BUS US-58W (14 City of Danville)	Riverside Dr	-	11.58	11.58	67%	44%	100%	75%	50%	63%
BUS US-58E (14 City of Danville)	-	-	11.58	11.58	66%	38%	100%	75%	50%	50%
VA-86N	S Main St	-	3.47	3.47	47%	19%	75%	75%	13%	63%
BUS US-29N (1 City of Danville)	Piney Forest Rd	0.07	14.39	14.32	46%	38%	38%	75%	50%	63%
US-58W	S Boston Rd	281.50	308.37	26.87	45%	44%	50%	42%	50%	50%
City Rt. 3769N (City of Danville)	Kentuck Rd	-	1.39	1.39	43%	50%	50%	17%	50%	50%
US-58E	S Boston Rd	281.51	308.37	26.86	42%	38%	50%	33%	50%	63%
BUS US-29S (1 City of Danville)	W Main St	-	14.39	14.39	40%	31%	50%	38%	50%	50%
VA-86S	S Main St	-	3.47	3.47	40%	19%	50%	75%	13%	63%
City Rt. 3772W (City of Danville)	Piedmont Dr	-	2.17	2.17	37%	19%	50%	58%	13%	63%
City Rt. 3772E (City of Danville)	Piedmont Dr	-	2.10	2.10	37%	19%	50%	58%	13%	63%
VA-51E	Westover Dr	-	6.20	6.20	36%	19%	50%	58%	13%	50%
VA-41N	Franklin Tpke	-	11.81	11.81	34%	19%	50%	29%	50%	50%
City Rt. 3769S (City of Danville)	Kentuck Rd	-	1.39	1.39	34%	25%	50%	17%	50%	50%
VA-293N	W. Main Street	-	7.05	7.05	33%	13%	50%	54%	13%	50%
City Rt. 3745N (City of Danville)	Audubon Dr	-	0.95	0.95	33%	13%	50%	33%	50%	50%
City Rt. 3755N (City of Danville)	Nor Dan Dr	-	0.85	0.85	32%	19%	50%	29%	25%	50%
US-29N	Danville Expy	-	20.08	20.08	31%	50%	13%	21%	38%	46%
VA-413W	Memorial Dr	-	1.42	1.42	31%	19%	25%	54%	50%	38%
City Rt. 3724E (City of Danville)	Mt Cross Rd	-	1.75	1.75	31%	13%	50%	42%	13%	50%
City Rt. 3771E (City of Danville)	Old Riverside Dr	-	0.25	0.25	30%	13%	50%	38%	13%	50%
US-29S	U S Highway No 29	-	20.15	20.15	30%	25%	38%	13%	50%	63%
VA-51W	Westover Dr	-	6.20	6.20	30%	0%	50%	58%	13%	50%
City Rt. 3747N (City of Danville)	Arnett Blvd	-	2.05	2.05	29%	13%	50%	29%	25%	50%
City Rt. 3770N (City of Danville)	Mountain Hill Rd	-	0.84	0.84	29%	13%	50%	17%	50%	50%
City Rt. 11N (City of Danville)	N Ridge St	-	0.52	0.52	29%	13%	25%	54%	50%	50%
City Rt. 3740E (City of Danville)	Northmont Blvd	-	0.89	0.89	29%	13%	50%	29%	25%	50%
US-311N	Berry Hill Rd	-	7.63	7.63	29%	44%	0%	13%	88%	54%
City Rt. 3714E (City of Danville)	Stokes St	-	1.38	1.38	29%	13%	38%	33%	50%	50%
VA-293S	W. Main Street	-	7.05	7.05	29%	0%	50%	54%	13%	50%
City Rt. 3745S (City of Danville)	Audubon Dr	-	0.95	0.95	28%	0%	50%	33%	50%	50%

Introduction | Results - Segments | Results - Corridors | Combine & Score Data | Criteria & Goal Area Weighting | Raw Data

These readouts provide a comprehensive overview of the various segments and corridors, helping the MPO further evaluate what areas should receive attention. Columns K through O illustrate how each score under the five goals: economic, safety, mobility and accessibility, community and nature, and operational efficiency. The bars indicate the score, where 100% equates to the highest score under those criteria. Column J aggregates those results into an overall score.

The MPO should examine the overall score and results to determine if the outputs are consistent with the region's goals. If regional staff feel that certain goals skew the overall score, then return to the first tab and adjust goal weights. Refer to Chapter 1 on how to use these results in the MPO's annual work program and schedule.

For best results, join the results in the segments page by the common field called "EDGE_RTE_KEY" to the LRS version 21.1, which is downloadable here: https://vdot.maps.arcgis.com/apps/MapAndAppGallery/index.html?appid=7ad6fb5c1f9148ff986db843e7f7b67c#!. If in the future the tool is updated with a new version of the LRS, results should be joined with the geometry of that version of the LRS. Using GIS, show the roads layer and an appropriate color ramping to highlight the highest-priority segments.

APPENDIX A: STUDY FUNDING PROGRAMS

Table 2: Study Funding Programs

	Program	Description
State Programming	VDOT - STARS	The STARS (Strategically Targeted Affordable Roadway Solutions) Program offers comprehensive, innovative transportation solutions to relieve congestion bottlenecks and solve critical traffic and safety challenges throughout the commonwealth. VDOT Transportation and Mobility Planning Division leads the program by coordinating local planners, traffic engineers, safety engineers, roadway design engineers and maintenance specialists, along with local stakeholders, to jointly identify cost-effective measures aimed at improving safety and reducing congestion. The program presents a multi-disciplinary approach, that helps to: • Develop innovative, cost-effective solutions, • Evaluate potential solutions more thoroughly, • Identify potential project risks and costs, • Build stakeholder consensus, and • Improve readiness for project implementation. VDOT District offices can leverage Statewide Planning and Research (SPR) funding to help identify, plan, conceptually design, and ultimately program projects that reduce congestion and improve safety. STARS projects typically result in multiple recommended improvements that may be eligible for funding and implementation under maintenance budgets, applications in the SMART SCALE process, applications for the Highway Safety Improvement Program (HSIP), State of Good Repair budgets, and/or applications for revenue sharing. STARS helps to provide a continuous pipeline of projects prepared for implementation. Many elements of the process are on an annual cycle, but a new program will be replacing the program.
	VDOT - PROJECT PIPELINE	Project Pipeline is a new process that seeks to improve project readiness for SMART SCALE. Locations selected for a Project Pipeline have been identified as having one or multiple VTrans Needs, thus meeting the screening requirements to pursue SMART SCALE funding for study recommendations.
	VDOT One-Off Studies	VDOT's Transportation and Mobility Planning Division's (TMPD) Arterial Preservation Plans and one-off safety and operations studies use Statewide Planning and Research (SPR) funding. Those funds renew annually to support transportation planning assistance for non-urbanized areas within the Commonwealth. Refer to 23 U.S.C. 307(c) (SPR funds) and planning as required by Section 135, Title 23, U.S. Code.
Regional Programming	Unified Planning Work Program (UPWP)	Prior to every fiscal year, the MPO adopts a required annual UPWP to receive funding for MPO operations. The work program identifies activities, initiatives, and programs planned for the upcoming year. The document also specifies contracted consultant work. The UPWP would be a potential funding source for transportation studies. The MPO's funding comes from resources authorized by Section 104(f) of Title 23 of the United States Code, referred to as PL Funds, and by Section 1607 (d) of Title 49 of the United States Code, referred to as Section 8 Funds.
Local	The General Fund	Localities may secure resources from the general fund to support transportation studies. The City of Danville and Pittsylvania have used local dollars to fund planning and engineering studies in the past. The requirement for this funding depends on local support and any parameters put on them by the locality.

APPENDIX B: EVALUATED DATA SOURCES

Table 3: Evaluated Data Sources

Goals	Supporting Data	Data Source	Granularity/ Spatial Precision	Local Completeness	Correspondence with Goal
Economy: Retain and increase business and employment opportunities text goes here	Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) data	U.S. Census Bureau	High (Census Block)	High	Medium
	VEDP Business-Ready Program Sites	State (VEDP via Interact VTrans)	High (polygon)	Medium	High
	Truck Operating Restrictions	State (OIPI, Freight Performance Measures)	High	Medium	Medium
	Truck Operating Restrictions	State (VDOT)	High	Medium	Medium
	Truck Bottlenecks	State (OIPI, Freight Performance Measures)	High	Low	High
	Truck commodity flows	State (OIPI, Freight Performance Measures)	Medium	Medium	High
	Truck travel times (for reliability analysis)	INRIX / NPMRDS	High	Medium	High

Goals	Supporting Data	Data Source	Granularity / Spatial Precision	Local Completeness	Correspondence with Goal
	Truck AADT percentage	INRIX / NPMRDS	High	Medium	Medium
	Truck AADT percentage	VDOT	High	High	Medium
	Cumulative truck delay	State (OIPI, Freight Performance Measures)	High	Medium	High
	Truck travel time index	State (OIPI, Freight Performance Measures)	High	Medium	High
Safety: Provide a safe and secure transportation system	VTrans Crashes (Points)	State (OIPI)	High	High	High
	VTrans AADT (Lines)	State (OIPI, Mid-term Needs)	High	Medium	High
	Potential for Safety Improvement (PSI) Rank	State (OIPI, Mid-term Needs)	High	High	High
	Pedestrian Safety Index	State (OIPI, Mid-term Needs)	Medium	Medium	High
	Non-Motorized Crashes	State (OIPI, Interact VTrans)	High	High	High
	Collision Points	RITIS	High	High	High
	Top Crash Segments	State (STARS)	High	High	High
	Top Crash Intersections	State (STARS)	High	High	High

Goals	Supporting Data	Data Source	Granularity/ Spatial Precision	Local Completeness	Correspondence with Goal
Mobility and Accessibility: Provide a transportation system that facilitates the efficient movement of people and goods	Hours of Congestion (TTI)	State (OIPI, Mid-term Needs)	Medium	Medium	High
	TTI (hourly)	State (STARS)	High	Medium	High
	PTI (hourly)	State (STARS)	High	Medium	High
	Volume to Capacity Ratio	State (STARS)	High	Medium	High
	Hours of Unreliability (LOTTR)	State (OIPI, Mid-term Needs)	Medium	Medium	High
	VTrans Bus Stops (Points)	State (DRPT via OIPI, Mid-term Needs)	High	High	Medium
	Bus Stops (Points)	Local (City of Danville)	High	Low (Danville only)	Medium
	Bus Routes (Lines)	State (OIPI, Interact VTrans)	High	High	High
	Bus Routes (Lines)	Local (City of Danville)	High	Low (Danville only)	Medium
	VTrans Sidewalks (Lines)	State (OIPI, Mid-term Needs)	Medium	Low	Medium
	Sidewalks (Lines)	Local (City of Danville)	High	Low (Danville only)	Medium
	VTrans Bicycle Facilities (Lines)	State (OIPI, Mid-term Needs)	Medium	Medium	Medium

Goals	Supporting Data	Data Source	Granularity/ Spatial Precision	Local Completeness	Correspondence with Goal
	Bike Lanes (Lines)	Local (City of Danville)	High	Low (Danville only)	Medium
	Bicycle Facilities	State (VDOT)	High	Medium	Medium
	Multimodal Facilities	State (OIPI, Interact VTrans)	High	High	Medium
	Business Locations	Local (City of Danville)	High	Low (Danville only)	Medium
	Activity Centers	State (OIPI, Interact VTrans)	High	Medium	High
	Population Density	U.S. Census Bureau (ACS)	High	High	Medium
Community and Nature: Improve quality of life and protect the environment	Danville Trails (Lines)	Local (City of Danville)	High	Low (Danville only)	Medium
	Historic Districts	Local (City of Danville)	High	Low (Danville only)	Low
	Parks (Polygons)	Local (City of Danville)	High	Low (Danville only)	Medium
	Recreation Facilities (Points)	Local (City of Danville)	High	Low (Danville only)	Medium
	Vulnerability to Environmental Hazards (Storm Surge, Inland Riverine Flooding): VTrans Vulnerability Assessment (Lines)	State (OIPI, Vulnerability)	High (depends on measure)	High (depends on measure)	Medium

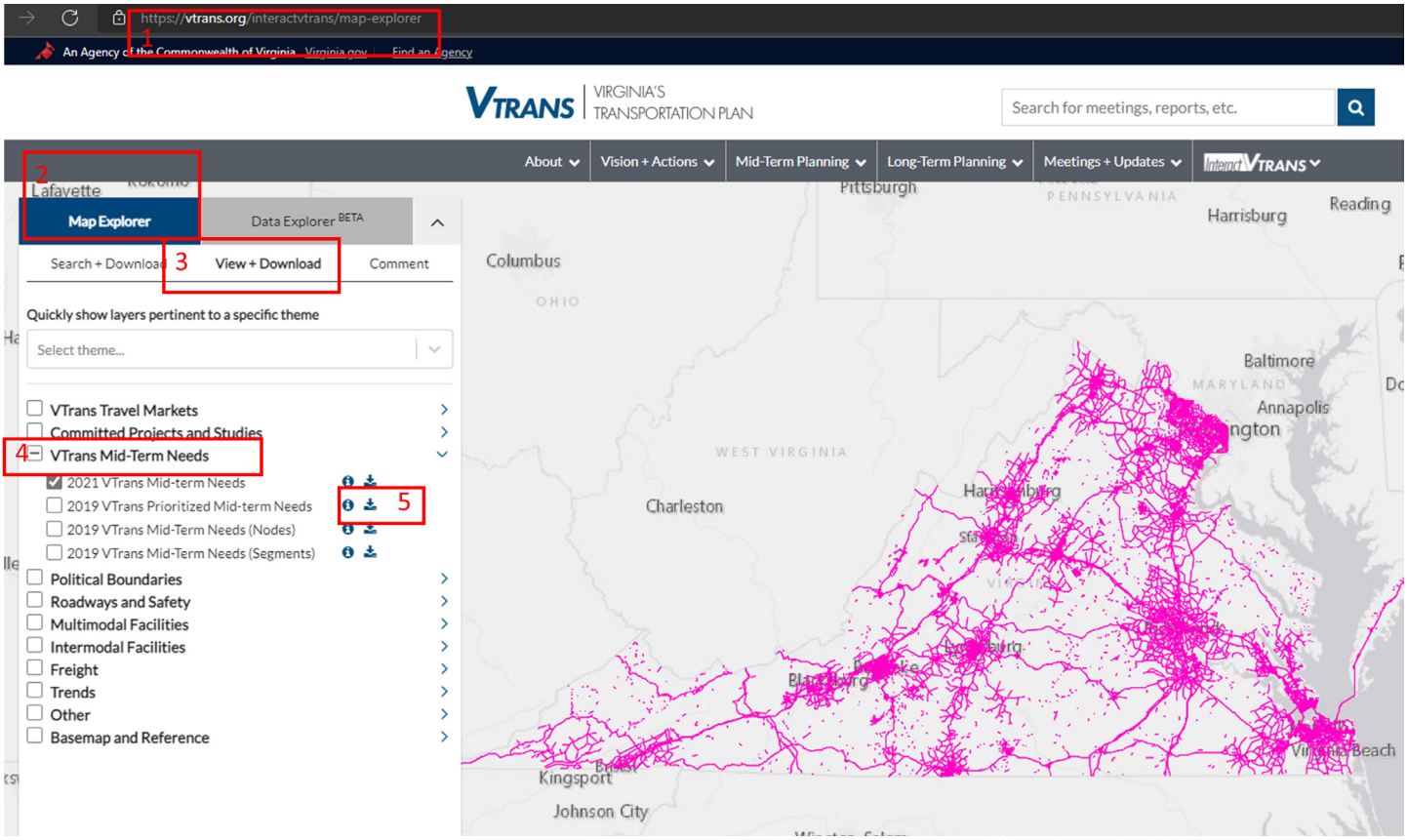
Goals	Supporting Data	Data Source	Granularity/ Spatial Precision	Local Completeness	Correspondence with Goal
	Danville Flood Zones	Local (City of Danville)	High	Low (Danville only)	Medium
	National Flood Hazard Layer	National (FEMA)	High	High	Medium
	VTrans Equity Emphasis Areas	State (OIPI, Interact VTrans)	High (Block group level)	High	Medium
	Trails (Polyline)	Local (City of Danville)	High	Low (Danville only)	High
Operational Efficiency: Preserve the existing transportation system and promote efficient system management	Pavement Condition	State (Vulnerability)	Medium	Low	High
	Pavement Condition	State (VDOT)	High	High	High
	Bridge Condition	State (Vulnerability)	Medium	Low	High
		FHWA (National Bridge Inventory)	Medium (all bridges over 20')	High	High
	Bridge Condition	State (VDOT)	High	High	High
		VDOT's Arterial Preservation Network (via OIPI Mid-term Needs)	High	High	Medium

APPENDIX C: ORIENTATION TO INTERACT VTRANS

Take the following steps to download a data set from Interact VTrans. The example dataset provided here is for the VTrans prioritized mid-term needs. Other data sets can be downloaded following similar steps. The locations of the buttons to click are shown in Figure 4.

1. Go to the following "Interact VTrans" website: https://vtrans.org/interactvtrans/map-explorer.
2. Click on "Map Explorer."
3. Click on "View and Download."
4. Click "VTrans Mid-Term Needs" to reveal the underlying data sets.
5. Select the downward-facing arrow to the right of "2019 VTrans Prioritized Mid-term Needs" to download the data.

Figure 8: Orientation to VDOT's Pathways for Planning Website



APPENDIX D: EVALUATED MEASURES

Table 4: Evaluated Measures – Mobility Goal Area

Measures	Issue the Measure Captures	Data Source(s)	Data extent	Ease of data gathering and processing	Understand-ability	Alignment with goal	Outcome vs output focus
Travel Time Index	Congestion	State (STARS)	Medium	High	Medium	High	High
Travel Time Index XD	Congestion	INRIX XD	High	Medium	Medium	High	High
Level of Travel Time Reliability	Reliability	VTrans mid-term needs	Medium	Medium	Medium	High	High
Volume-to-capacity ratio	Congestion	State (STARS)	High	High	High	High	High
Level of service	Congestion	Multiple such as STARS or NPMRDS depending on calculation approach.	High	High	High	High	Medium
Travel delay	Congestion	NPMRDS	Low	Medium	High	High	High
Percent of congested travel	Congestion	NPMRDS	Low	Medium	High	High	Medium
Buffer index	Reliability	NPMRDS	Low	Low	Medium	High	High
Planning time index	Reliability	NPMRDS	Low	Low	Medium	High	High
Service of Alternative Transportation Facility	Serves as a connection to alternative transport-ation modes	Bus stops, sidewalks, trails, etc. points	Medium	High	High	Medium	High

Measures	Issue the Measure Captures	Data Source(s)	Data extent	Ease of data gathering and processing	Understand-ability	Alignment with goal	Outcome vs output focus
% of households without access to a vehicle	Demand for alternative transport-ation modes	ACS 1-year estimates or ACS 5-year estimates	Medium	Medium	High	Medium	High
Activity Center Connector (Access to Destinations)	Segments near places of business, economic activity	Vtrans Activity Centers	Medium	High	Medium	Medium	Medium
Pedestrian Need Priority	Pedestrian needs	VTrans mid-term needs	Medium	High	Medium	High	Medium
Population density	Density of potential attractions	U.S. Census Bureau (American Community Survey)	High	High	High	Medium	Low
Population + Employment Density	Density of potential attractions	VTrans mid-term needs	High	High	High	Medium	Medium
Bicycle Needs Score	Bike access and infra-structure	VTrans mid-term needs	High	High	Medium	High	Medium
Bicycle Need Priority	Bicycle needs	VTrans mid-term needs	Medium	High	Medium	High	Medium
Bicycle infrastructure gaps	Bike access	Bicycle infrastructure (VDOT)	Medium	Medium	High	High	High
Transit Access Need Priority	Transit access needs for workers	VTrans mid-term needs	Medium	High	Medium	High	Medium
Transportation Efficient Land Use	Potential of land development patterns to affect transport-ation demand.	Population density (U.S. Census) Destinations (e.g., banks, grocery stores, pharmacies) Accessibility tool	High	Low	Medium	High	High

Table 5: Evaluated Measures – Safety Goal Area

Measures	Issue the Measure Captures	Data Source(s)	Data extent	Ease of data gathering and processing	Understand-ability	Alignment with goal	Outcome vs output focus
Employment Density	Service of areas that spur the most economic activity	U.S. Census Bureau (LODES)	High	Medium	High	High	Low
Access to Industrial and Economic Development Areas		OIPI - Interact VTrans	Low	High	Medium	Medium	Medium
Percentage of traffic that is heavy trucks	Truck volume share	NPMRDS or VDOT	Medium	Medium	High	Medium	Medium
Truck AADT		NPMRDS or VDOT	Medium	Medium	High	Medium	Medium
Truck travel time index	Truck congestion	NPMRDS	Low	Low	High	High	High
Cumulative truck delay	Truck congestion	OIPI - Data requires request	Medium	High	Medium	High	High
Truck travel time reliability	Truck reliability	OIPI - Data requires request	Medium	High	High	High	High
Extent of additional capacity needed due to industrial site development		Pittsylvania County Economic Development	Low	Low	High	High	High
Current truck commodity flows (tonnage)	Commodity flow	OIPI - Data requires request	Medium	Medium	High	Medium	High

Measures	Issue the Measure Captures	Data Source(s)	Data extent	Ease of data gathering and processing	Understand-ability	Alignment with goal	Outcome vs output focus
Forecasted (2045) truck commodity flows (tonnage)	Commodity flow	OIPI - Data requires request	Medium	Medium	High	Medium	High
Forecasted (2045) truck commodity flows (volume)	Commodity flow	OIPI - Data requires request	Medium	Medium	High	Medium	High
Forecasted (2045) truck commodity flows (volume)	Commodity flow	OIPI - Data requires request	Medium	Medium	High	Medium	High
Intermodal Access and Efficiency		Interact VTrans (airports, marine and inland ports, STAA routes) U.S. Census Bureau, LODES (Analyze freight and manufacturing-related employment based on employment share and/or density thresholds.) No source for distribution centers.		Low	Medium	Medium	Medium

Measures	Issue the Measure Captures	Data Source(s)	Data extent	Ease of data gathering and processing	Understand-ability	Alignment with goal	Outcome vs output focus
Pavement Condition	Poor condition assets should be prioritized	VDOT (source for OIPI material)	Medium	High	High	High	High
Bridge Condition	Poor condition assets should be prioritized	VTrans vulnerability analysis	Medium	High	High	High	High
VTrans Need Coordination	Coord-ination with statewide analysis	VTrans Mid-term needs	High	High	High	High	Medium
AADT	Number of users affected	VTrans Mid-term needs	High	High	High	Low	Medium
On VDOT's Arterial Preservation Network	Preserve the existing capacity	VTrans Mid-term needs	High	High	Medium	Medium	Low


Danville MPO