BMC Transit Dashboard

USER GUIDE & TECHNICAL DOCUMENTATION

Contents

1. Overview

This document contains documentation and reference materials supporting the BMC Transit dashboard development. The purpose of this dashboard is two-fold: (1) to allow users to explore in detail the existing transit conditions and (2) to compare changes in transit service over the past 30 years.

This document is organized into **User Guide** and **Technical Documentation** sections. The goal of the **User Guide** section is to describe the core functionality of the dashboard from a user's perspective, providing an overview of the dashboard organization and highlighting specific features of interest. The goal of the **Technical Documentation** section is to equip developers with the tools and knowledge needed to make updates to the data showcased in the dashboard.

2. User Guide

The dashboard is structured around four tabs: **Regional Service Characteristics**, **Ridership and Finances**, **Level of Service Maps**, and **Level of Service Timelapse**. The first two tabs display data from the National Transit Database for each transit service provider between 1990 to 2020, while the level of service tabs display data from Fall 2022 GTFS.

2.1 Regional Service Characteristics

The **Regional Service Characteristics** tab allows for the user to explore the network size, level of service, and vehicles used between 1990 to 2020 by each transit agency, selected in parameter (1). Users can segment the data by mode, mode status as of 2020, and type of service using the filters pane on the left hand side of the dashboard (2). High-level summaries of 2020 transit service such as Total Directional Route Miles and Total Revenue Hours can be found in the top right-hand side of the dashboard (3). The four charts show changes in the transit service offered by each agency from the earliest available year up to 2020. These charts are **Network Size**, represented by Directional Route Miles (4), **Vehicle Revenue Hours** (5), **Vehicle Revenue Miles** (6), and **Peak Vehicles**, calculated as Vehicles Operated in Maximum Service (7). Agencies are shown as a single line, combining all modes. For mode-by-mode data, each mode can be selected individually with the filters.
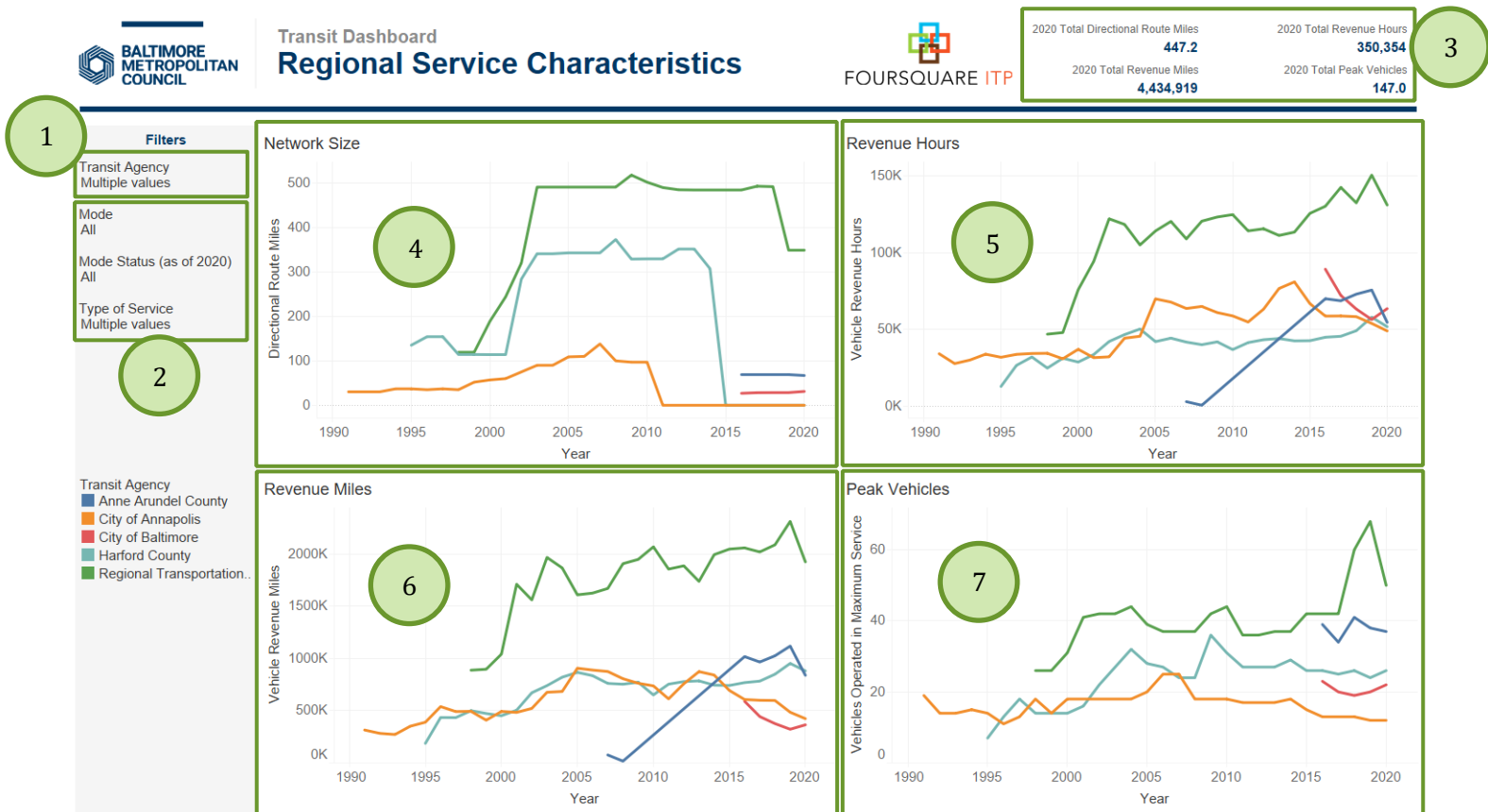

Figure 1 Regional Service Characteristics Tab

2.2 Ridership and Finances

The **Ridership and Finances** tab allows for the user to explore the expenses, revenue, and transit usage between 1990 to 2020 by each transit agency, selected in parameter (1). Users can segment the data by mode, mode status

as of 2020, and type of service using the filters pane on the left hand side of the dashboard (2). High-level summaries of 2020 transit service such as Total Operating Expenses and Total Unlinked Passenger Trips can be found in the top right hand side of the dashboard (3). The four charts show changes in the finances and ridership for each agency from the earliest available year up to 2020. These charts are **Total Operating Expenses** (4), **Ridership**, represented by Unlinked Passenger Trips (5), **Fare Revenue** (6), and **Passenger Miles** (7). Agencies are shown as a single line, combining all modes. For mode-by-mode data, each mode can be selected individually with the filters.
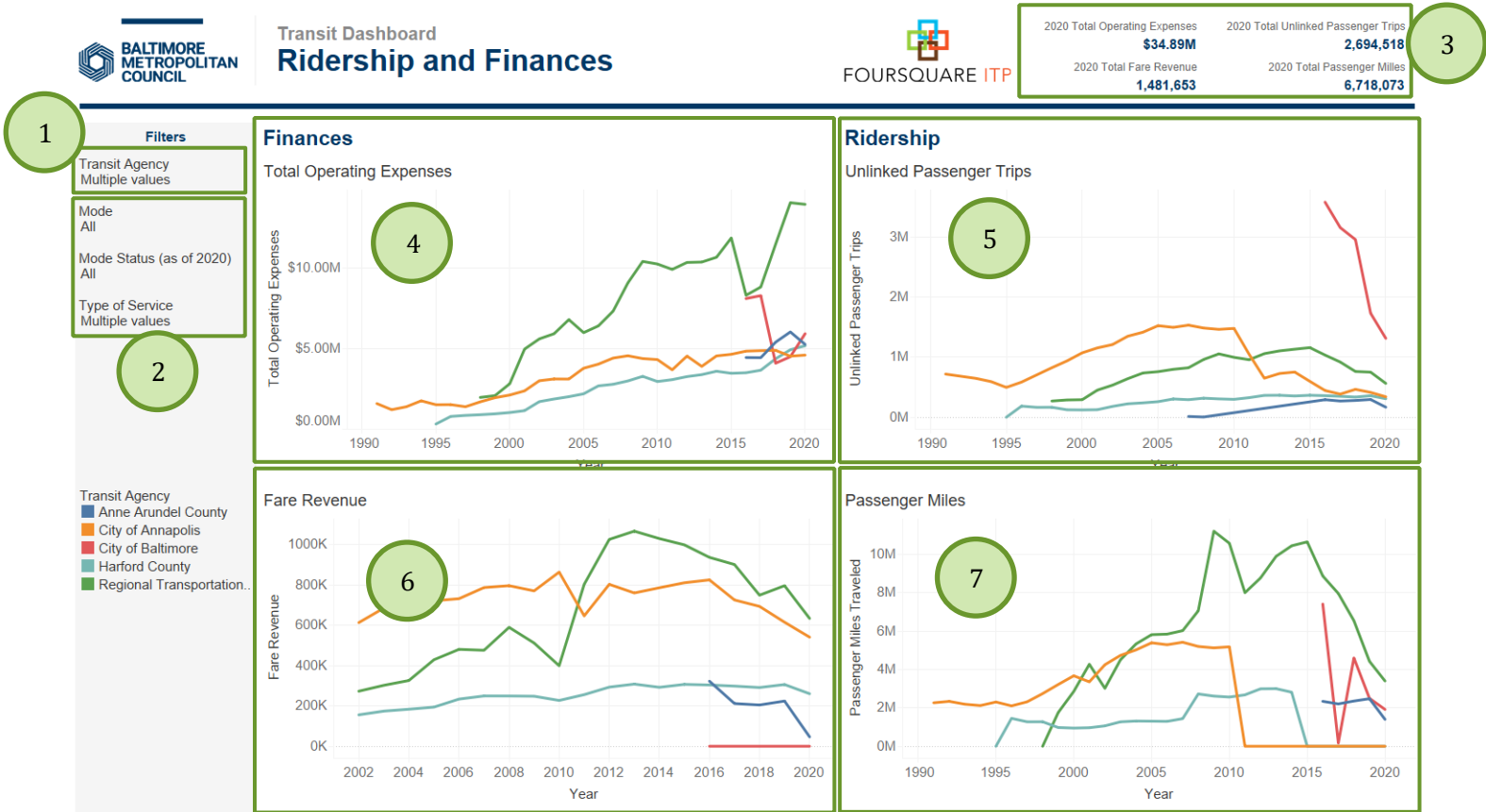

Figure 2 Ridership and Finances Tab

2.3 Level of Service Maps

The **Level of Service Maps** tab allows for the user to explore the frequency and span of all fixed-route transit services in the BMC region. Users can segment the data by agency, mode, service day, and time period using the filters pane on the left hand side of the dashboard (1). The total transit vehicle trips for the selected agencies and time period can be found in the top right hand side of the dashboard (2). The two maps visualize level of service characteristics in two different formats. The **Service Grid** map (3) displays a hexagon grid across the region, with a ¼-mile buffer around bus stops and a half-mile buffer around rail stations. For each hexagon cell, the number of transit trips on any fixed-route service in the cell are summed to show the combined frequency of transit at that location. If a cell has no service during the selected service day and time period, the cell is not shown. The **Stops and Routes** map (4) displays the headway for each route and the total number of trips at each stop during the selected time period. If a stop is served by multiple routes, the trips from those routes are summed. To view only the stops or the routes, each layer can be turned on or off using the **Layer Control** button on the map. If a route or stop has no service during the selected service day and time period, it is not shown.
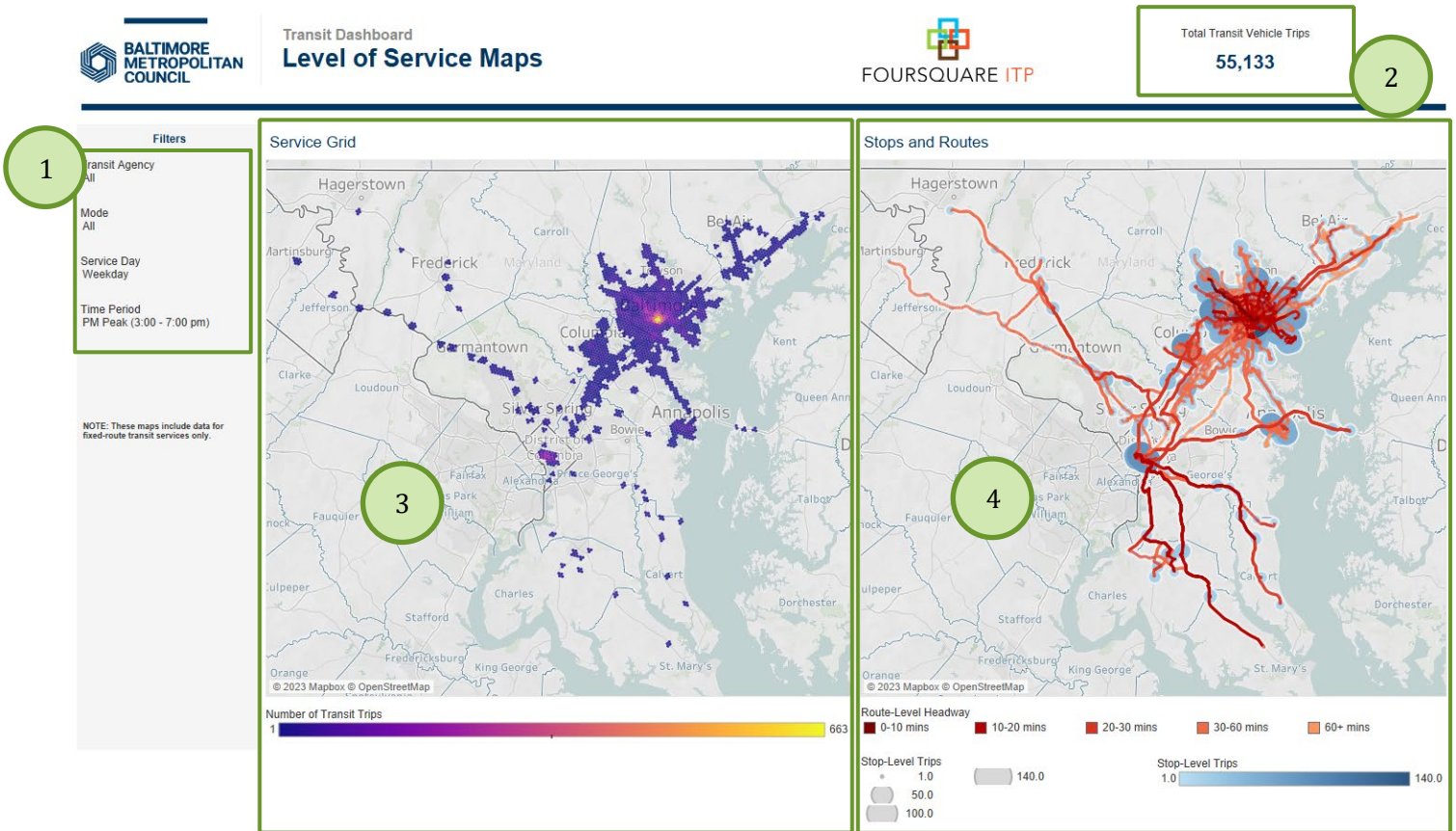

Figure 3 Level of Service Maps Tab

2.5 Level of Service Timelapse

The **Level of Service Timelapse** tab allows for the user to explore the frequency and span of all fixed-route transit services in the BMC region using the Kepler.gl visualization tool, which is embedded into the Tableau dashboard. Users can segment the data by agency, mode, and service day using the filter pane on the left hand side of the dashboard (1). The map (2) visualizes the same data as the Service Grid map in the **Level of Service Maps** tab, showing the combined number of trips in each hexagon cell, but in a three-dimensional view with an animated timelapse feature. Users can pan the map by clicking and dragging, change the angle by holding the CTRL key while clicking and dragging, and zoom in and out by scrolling. The panel at the bottom of the map (3) allows users to control the timelapse. First, a window of time must be selected, such as a one-hour window, by dragging the two points on the timeline. Then, the animation can be started using the **Play** button on the left. The speed of the animation can be adjusted using the **Rocket** button in the top right. The legend for the color and height of each hexagon can be seen by clicking on the **Show Legend** button (4).
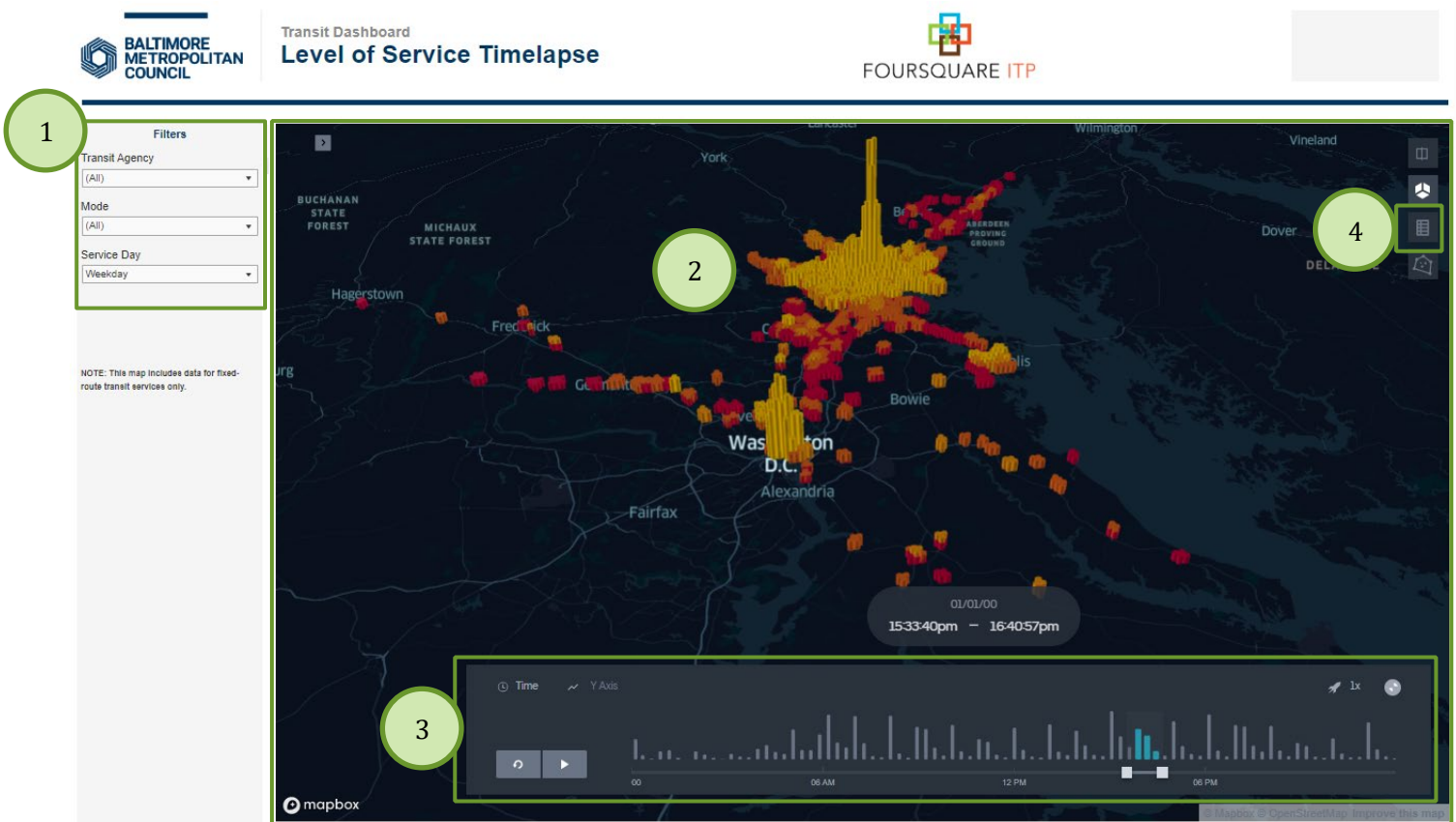

Figure 4 Level of Service Timelapse Tab

2.5 Dashboard Features

Each dashboard is equipped with auxiliary features that help enhance the user experience and provide a rich set of "details on demand," or further details that are hidden in a visualization's default state but are available upon user need via user interaction (e.g., tooltips).

2.6.1 Quick Tips

- **Reset Individual Filters**   Users can reset a specific filter to its default selection (in most cases ALL) by clicking the *Clear Filter* button that shows up when hovering over the downward arrow in the filter box.

- **Tooltips**   Users can hover over chart components to obtain further details via tooltips.
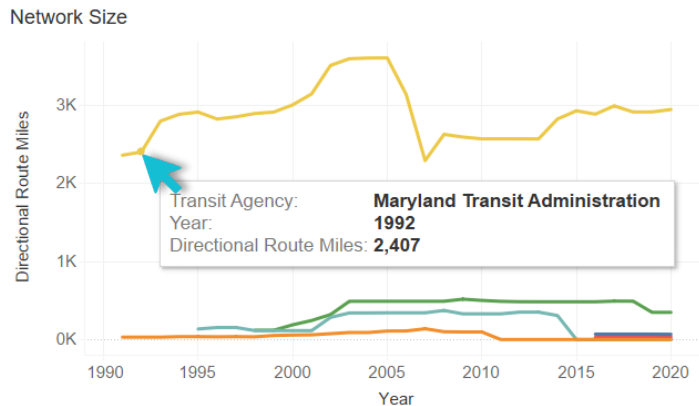
2.6 Saving Data and Images

Users can save data, tables, charts, and map images from the dashboard corresponding to the filter selections that are made. Users can also save the whole dashboard as an image or save any specific table, map, or chart as an image or data file. The procedures for saving are described in the subsequent sections.

2.6.1 Saving as Images

Through Tableau Online, to save the dashboard as an image, users can navigate to ***Choose a format to download > Image*** on the main menu bar of Tableau Online.

Through Tableau Reader, to save the dashboard as an image, users should exit the full-screen view and navigate to ***Dashboard > Export Image*** on the main menu bar of Tableau Reader. Users will be asked to provide a file name and folder location to save the dashboard as an image.

2.6.2 Exporting as PowerPoint

Through Tableau Online, to save the dashboard as a PowerPoint, users can navigate to ***Choose a format to download > PowerPoint*** on the main menu bar of Tableau Online as shown in Figure 4.1.

Through Tableau Reader, to save the dashboard and/or the elements of the dashboard as a PowerPoint, users may navigate to ***File > Export as PowerPoint*** on the main menu bar. Users will be asked to select the content to include in the PowerPoint slide from the following three options:

- *This View* – Tableau generates a PowerPoint slide with the current view.
- *Specific sheets from this dashboard* – Users can select and generate PowerPoint slides for each element selected (i.e., the selected charts, maps, summaries generated in separate sheets).
- *Specific Sheets from this workbook* – Users can select and get PowerPoint slides on each element selected (i.e., the selected charts, maps, summaries generated in separate sheets). In this case, users will find the elements/sheets in the Tableau file. Please note that, the last two options will provide the same outcome for the dashboard in question.

Finally, users will be asked to provide file name and folder location to save the dashboard as a PowerPoint file.

2.6.3 Exporting as PDF

Similar to exporting as PowerPoint, users can also export the dashboard and its element to a PDF file. To do so, users may navigate to *File > Print to PDF* on the main menu bar in Tableau Reader or select **PDF** as download option in Tableau Online. Likewise, in PowerPoint export, users will have options to export only the dashboard using *Active sheet* option. Users can export all the different sheets with different elements of the dashboards (i.e., the entire workbook) in a single PDF file by selecting *Entire workbook*. Finally, users will be asked to provide a file name and folder location to save the dashboard as a PDF file.

2.6.4 Saving a Chart or Table

To save a specific table or data for any chart shown on the dashboard, Tableau Reader users must select the specific table or chart first. Then, users may navigate to *Menu > Worksheet > Export > Image*.

Cross-tabulation can also be generated by selecting *Crosstab to Excel* option. This procedure will generate the crosstab in an Excel sheet, but the file is *NOT* automatically saved. Users must save the file in Excel software to store the data on their local system.

Tableau Reader users can copy and paste a chart or underlying data to a presentation slide or document using the quick export feature of the dashboard. Users need to right-click on a chart and navigate to *Copy* option to copy the chart as an image, data table, or cross-tabulation and paste it in a document.

3. Technical Documentation

This technical documentation section serves to describe in detail the steps to follow in order to properly set up the backend data sources and update the data used in the Tableau dashboard. Updates to the data sources could be made upon availability of updated GTFS and National Transit Database datasets.

3.1 Gather Data

The Federal Transit Administration (FTA) releases new National Transit Database (NTD) data for each fiscal year, as well as monthly updates for some datasets. This data can be added to the **Regional Service Characteristics** and **Ridership and Finances** tabs of the Tableau dashboard to include recent data in the charts. Similarly, updated General Transit Feed Specification (GTFS) data can be used in the **Level of Service Maps** and **Level of Service Timelapse** tabs to represent recent transit service conditions. Only one set of GTFS data can be visualized for each transit agency, so new data will replace any GTFS feeds used for the existing dashboard.

3.1.1 National Transit Database

The most recent NTD data can be downloaded from the FTA website. One Excel data file is needed to update the dashboard, containing **Annual Time Series Service and Operating Expenses Data by Mode**. This file is typically named "TS2.1 Service Data and Operating Expenses Time-Series by Mode.xlsx" and can be accessed at https://www.transit.dot.gov/ntd/data-product/ts21-service-data-and-operating-expenses-time-series-mode-2. This file should be saved in the same folder to be used for the Python processing scripts.

3.1.2 GTFS

The most recent GTFS feeds can be downloaded from various online sources, including agency websites and GTFS data archive sites like transit.land. One GTFS feed should be used for each transit agency (Anne Arundel County OOT, Annapolis Transit, Charm City Circulator, Harford Transit LINK, MDOT MTA, and RTA) and the GTFS feeds should all represent the same time period (e.g., Fall 2022 service). All fixed-route transit modes with available GTFS feeds are included in the Tableau dashboard. In the case that bus and rail services for the same agency have separate GTFS feeds, all feeds should be downloaded for analysis.

All GTFS feeds should be saved in the same folder. Each feed should consist of one unzipped folder containing the feed's text files. The following text files must be present for every feed:

- agency.txt
- calendar.txt
- routes.txt
- shapes.txt
- stop_times.txt
- stops.txt
- trips.txt

Some feeds may also contain the files "frequencies.txt" or "calendar_dates.txt" which, if present, will be used during processing.

3.2 Python Processing Scripts

There are five Python scripts for importing, analyzing, and exporting the NTD and GTFS data for the Tableau dashboard. This section describes how to

3.2.1 Environment and Configuration Files

The **environment.yml** file lists the required Python libraries to run the processing scripts. A virtual environment can be created using a package manager such as conda or pip, or these packages can be installed manually.

The **config.py** file includes all parameters needed to run the remaining four processing scripts. The configuration script is designed such that when re-running the data processing, only aspects of this file require edits. In the configuration file, the user specifies the locations of the relevant data files, the coordinate reference system (CRS) to be used for spatial analysis, and other parameters.

3.2.2 NTD Processing Scripts

The script **01_ntd_yearly.py** uses functions from the **ntd_helpers.py** script to import, analyze, and export the NTD data in CSV format. Parameters must be adjusted in configuration file for the path to the agencies.xlsx file, the name of the NTD data file, and the columns in the NTD data file (if they have changed since the previous year). Once these parameters have been adjusted, the NTD yearly script can be run. This script reads in the NTD file, filters to the relevant agencies, cleans up column names, combines tables, and structures the output data for use in Tableau. The details of the **agencies.xlsx** and the **bmc_yearly_ntd.csv** output files can be found in the **Transit Data Dictionary**.

3.2.3 GTFS Processing Scripts

The script **03_gtfs_to_los.py** uses functions from the **gtfs_helpers.py** script to import the GTFS feeds, analyze a typical week of service, calculate levels of service (LOS), and export the data in CSV and GeoJSON formats. Parameters must first be adjusted in the configuration script:

- A dictionary called "**analysis_week_start**" must be edited to contain the names of each GTFS feed and a date in YYYYMMDD format to use as the start of the analysis week. For each feed, a week must be selected that represents a typical week of service during the desired time period, without any holidays or other service anomalies. Best practice is to use the same week for all feeds, but differences between feeds often requires that some feeds use a different analysis week. In any case, the chosen weeks should represent approximately the same period of time (e.g., Fall 2022 service). The script uses the seven days on and after the provided date as the analysis week for each feed.
- The parameter "**weekday_dow**" must be set to the desired weekday that should represent typical weekday service in the dashboard. If any of the transit services have differences in service on a specific weekday (e.g., late night service on Fridays), that day should be avoided, and a day with typical weekday service should be selected.

The GTFS to LOS script calculates the frequency and span at the route and stop levels, generates route and stop geometries, creates a hexagon grid using the H3 library, calculates the number of trips within each hexagon cell, and exports the final datasets as CSV and SHP files. The data in the CSV tables are joined to the shapefiles in Tableau. The details of the six output files (**route_los_all.csv**, **stop_los_all.csv**, **grid_los_all.csv**, **stops_all.shp**, **routes_all.shp**, and **h3_grid.shp**) can be found in the **Transit Data Dictionary**.

3.3 Update Data in Tableau Dashboard

Next, we want to update the data used in the Tableau Dashboard. The first step is navigating to the **Data Source** tab at the bottom of the dashboard in Tableau Desktop. The following diagram shows how the eight data files relate to each other in the Tableau data source. To update one or more of the files, the locations of the files can be updated and the data source can be refreshed.

The developer may need to rebuild the data source completely to match the above diagram. The relationships between each table are shown below, with the fields on the left joined to the fields on the right:

bmc_yearly_ntd.csv	agencies.xlsx
Ntd Id	Ntd Id

agencies.xlsx	stop_los_all.csv
Transit Agency	Agency Name

stop_los_all.csv	grid_los_all.csv
Agency Name Mode Service Period Time Period	Agency Name Mode Service Day Time Period

| stop_los_all.csv	route_los_all.csv
Agency Name Mode Service Period Time Period	Agency Name Mode Service Period Time Period

stop_los_all.csv	stops_all.shp
Agency Name Stop Id	Agency Nam Stop Id

grid_los_all.csv	h3_grid.shp
H3 Id	H3 Id

route_los_all.csv	routes_all.shp
Agency Name Route Id	Agency Nam Route Id

For the data source to work correctly, the developer should ensure that the following six fields are parsed as string data types instead of numeric:

- stop_los_all.csv: Stop Id
- stops_all.shp: Stop Id
- routes_los_all.csv: Route Id, Route Short Name
- routes_all.shp: Route Id, Route Shor
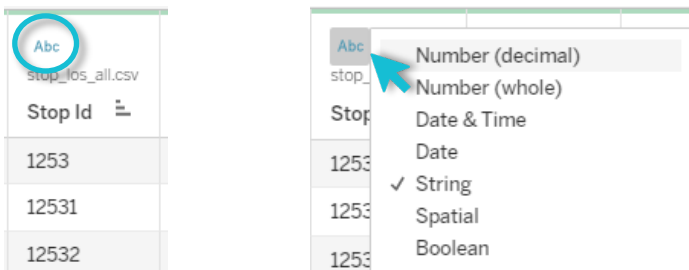
The field data type can be changed in Tableau Desktop by clicking on the data type button at the top of the column.