



## TECHNICAL MEMORANDUM

# Advanced Tableau Guidance for Transportation Uses

Task 4 – Synthesis Development



Support for Urban  
Mobility Analysis

*A technical memorandum to the*  
**Support for Urban Mobility Analysis (SUMA)**  
**FHWA Pooled Fund Study**

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*Submitted by the*



## Executive Summary

Creating content for all stakeholders is crucial to incorporating the views and needs of everyone. From a transportation perspective, neglecting to incorporate stakeholder needs in the planning, design, and policy processes could limit individuals' physical, economic, and social mobility.

Therefore, interactive transportation content must be relevant, easy to understand, and accessible to all audiences and stakeholders. This means that data visualizations should visualize roadways and networks where possible, use relevant and understandable performance measures, quality control views for accuracy, and ensure all visualizations meet Section 508 of the Rehabilitation Act of 1973 accessibility standards to reach all users of all abilities.

This synthesis provides practical tips and guidelines for using Tableau software to achieve these goals and build useful, Section 508-compliant transportation visualizations. Additionally, helpful resources are provided at the end that go beyond the scope of this synthesis for additional assistance in creating interactive data visualizations.

## Key Points

- ▲ GIS and Tableau should not compete against each other; GIS is helpful to create spatial content while Tableau is helpful to display and quality control that content while joining it with other disparate data sources.
- ▲ Aggregate roadway segments to an appropriate level of detail and assign each a unique segment ID number.
- ▲ Visualize road networks and paths at the highest aggregation needed to convey meaning.
- ▲ Use a calculation test table in Tableau to build complex calculations and ensure their accuracy.
- ▲ Visually inspect all visualizations to ensure quality and performance.
- ▲ Transform performance measures into meaningful values and include definitions and context.
- ▲ Visualizations must comply with WCAG 2.0 “AA” standards to be Section 508 compliant.
- ▲ In Tableau, authors need only be concerned 8 WCAG 2.0 success criteria:
  - 1.1.1 Non-text Content.
  - 1.3.1 Information and Relationships
  - 1.3.3 Sensory Characteristics
  - 1.4.1 Use of Color.
  - 1.4.3 Contrast (Minimums).
  - 2.4.3 Focus Order
  - 2.4.6 Headings and Labels.
  - 3.3.2 Labels for Instructions.
- ▲ Display less than 1,000 marks in a Tableau view to ensure the data render in the browser to make visualization Section 508 compliant.
- ▲ Use titles, captions, and labels with descriptive terms to adequately describe the visualization, legends, filters, and graphical views.
- ▲ Provide alt text for all images and icons.
- ▲ Use colors that are distinct and colorblind-friendly, like orange and blue, and avoid green and red comparison.
- ▲ Use colors that contrast at a ratio of 4.5:1.

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## Introduction

Creating content for all stakeholders is crucial to incorporating the views and needs of everyone. From a transportation perspective, neglecting to incorporate stakeholder needs in the planning, design, and policy processes could limit individuals' physical, economic, and social mobility.

Therefore, interactive transportation content must be relevant, easy to understand, and accessible to all audiences and stakeholders. This means that data visualizations should use best practice concepts for displaying information (discussed in "Transportation Performance Monitoring Visualization Tools," a synthesis report in FY2018 for the MMUT pooled fund study), use relevant performance measures and transform them into something understandable and relevant to the target audience, visualize roadways and networks where possible, and ensure the visualizations meet accessibility standards to reach all users of all abilities (1).

This synthesis will discuss how to meet these goals, specifically by discussing techniques and tips using Tableau to display roadway networks, to verify calculations are accurate, to create meaningful measures, and to ensure visualizations are accessible and meet federal requirements.

## Tableau and Baseline Assumptions

This synthesis will discuss relatively advanced topics in Tableau software use. Tableau offers several free online courses and resources that will help acquaint one with the terminology and features of the software. Please refer to these sources for more depth and explanation of features in the software that are discussed here.

This synthesis will assume the use of Tableau version 2019.3 and later.

## Displaying Transportation Networks

Tableau has always offered a means to display basic geographical information. However, this has historically been limited to predefined geographies, like countries, states, counties, zip codes, and some other basic U.S. Census geography. In newer versions of the software, users are now able to map custom boundaries, such as metropolitan planning organization (MPO) boundaries, department of transportation (DOT) district boundaries, and transportation analysis zones (TAZs).

Additionally, Tableau now offers an option to map networks or custom vector geographies. This feature can be useful in mapping roadway networks, segments, and corridors or trip paths. Note that Tableau is not a replacement for geographic information systems (GIS), but instead works with GIS operations to better-display transportation data.

### GIS vs. Tableau

One question must be answered first: why not just use GIS instead of Tableau? This is a common question among managers and policy makers. Each tool (Tableau and GIS) has its strengths and weaknesses that make each good at solving certain issues.

GIS works well to create .shp files (GIS-based spatial files) with related data attributes through complex calculative procedures. For example, GIS excels at taking two geographic files and performing spatial calculations to create a new geographic layer. GIS easily handles creating buffers around geographic shapes, calculating distances, joining certain types of complex data to spatial data, conflating two geographic datasets together, or performing other types of analysis.

When displaying transportation data, GIS' main strength lies in creating roadway networks, conflating roadway networks together, and creating custom segmentation for later analysis in other statistical programs.

Tableau, on the other hand, primarily serves to join disparate datasets together and then display them in an aesthetically pleasing manner. Tableau was not designed to handle complex calculations, perform custom calculations on the fly, or to create original data sources. Instead, Tableau excels at creating appealing interactive visualizations using existing data that enable data insights that would not be easily determined using other methods.

### Mapping Networks

With a basic understand of the difference between Tableau and GIS, mapping networks becomes a little clearer. While GIS can easily map a network, it cannot easily join multiple data sources or visualize them in a simple or appealing way. To do so, one would need Tableau.

To map roadways or any type of vector (line) network or path in Tableau, use the following steps:

1. **Create a base network .shp file at the lowest level of detail necessary.** This step is performed in GIS or by downloading a .shp file from sources like the federal Highway Performance Monitoring System (HPMS) or some other source.

Note that the shapefile should be segmented at the appropriate level of detail necessary for the visualization, and its corresponding data table only contain information

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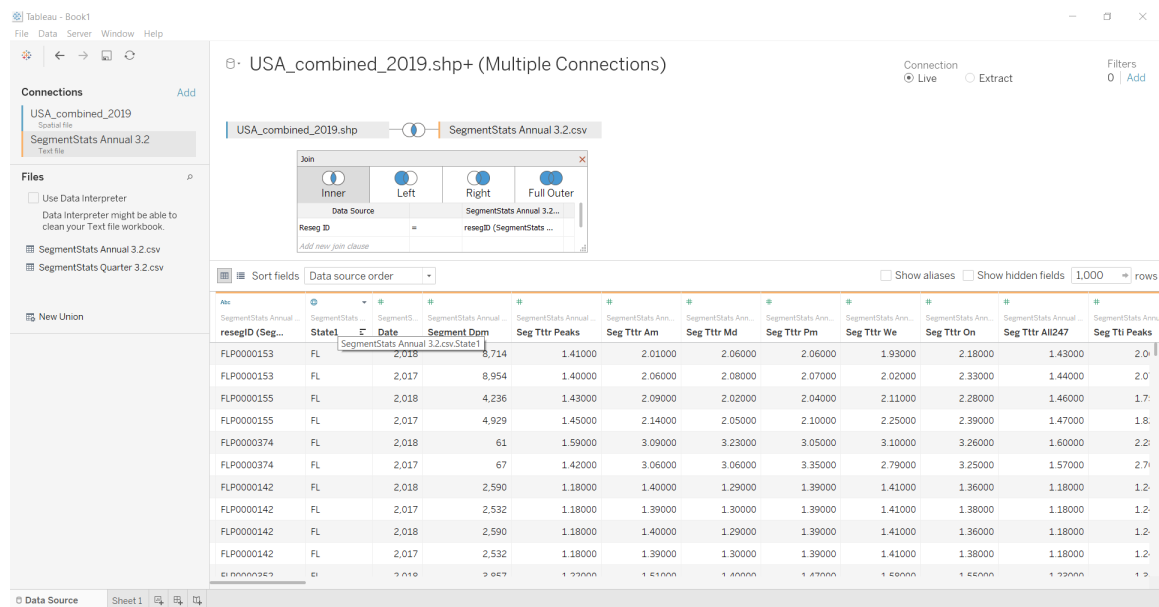
*Tip: Create a segment ID field or unique identifier in your spatial file that corresponds to segment data in other sources, like Excel, SAS, or other databases.*

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that will readily be used in the visualization, including a segment ID or some unique identifier. Too much detail can reduce the performance of the visualization and make it more difficult to aggregate segments into the needed view. Practically, this means that if the visualization only requires 5-mile corridors to be displayed, do not create a TMC-level .shp file. Instead, roll up the TMCs into 5-mile segments, assign each segment with an appropriate segment ID number, and then import to Tableau.

2. **Load the spatial file into Tableau and join to other data sources.** Open Tableau and select “Spatial File” under the possible data types to load. Choose the .shp (or other spatial file format) from the prompt.

When the file appears, join it to any other relevant data sources in the visualization. Note that the first data source added to a visualization will anchor all other data sources. If the spatial file will not change throughout the visualization process, it may be prudent to add it first. Otherwise, load the primary data source first and create joins from that file. Figure 1 illustrates a spatial file joined with another data file.

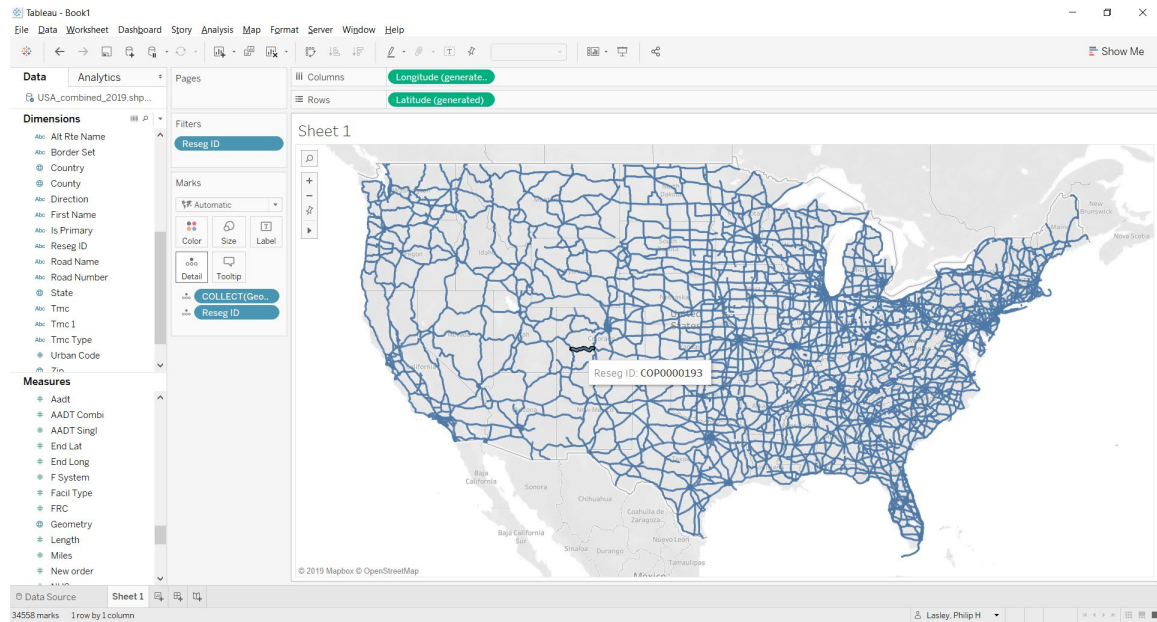


**Figure 1: Spatial File Join with Other Data Source**

Note that in Figure 1, an inner join connects the .shp file with the data file using the join clause “Reseg ID = ressegID (SegmentStats).” This join connects the two files based on a customized segment ID number that was created in GIS as the network was being conflated. Also note the inner join: only segment ID numbers located in both files will be included in the Tableau visualization. This can be changed by using a different join type; however, using other joins may create null value errors later in your visualization. As a rule of thumb, it is best to use either an inner join or (in this case) a right join to ensure all the data from the primary set is included.

3. **Visualize the network at the correct level of detail.** The final step involves building the visualization of the roadway network. Once the data are connected, in a new sheet, locate the measure “Geometry” from the Measures bin on the left side of the screen. Double-clicking “Geometry” will automatically create a visualization of the entire spatial file. The road network should now appear as blue lines on the screen.

However, hovering over the roadways will reveal that Tableau is treating all roadways as one data point. This is because the correct level of detail has not been included; Tableau does not know that it should or how to split up the roadway segments. To fix this, drop the segment ID value (either a measure or a dimension [if it is a measure, change it to a dimension]) onto the detail marks card. Hovering over the map now will reveal each roadway segment as a unique data point. Figure 2 illustrates this outcome. Adding additional dimensions to the detail marks card will further increase the level of detail, such as directionality.



**Figure 2: Example Mapped Network Broken Down by Roadway Segment.**

4. **Build the rest of the visualization.** Once the map is built, performance measures and other visual analyses can be added or performed to create the desired visualization. The roadway segments function like data points and can be grouped, filtered, colored, re-sized, and calculated using other variables.

## Verifying Calculations Are Accurate

Using calculations in Tableau can allow one to combine and visualize many complex and disparate data sources quickly and relatively easily. However, transportation data can be tricky, being based at varying levels of detail, time periods, and scales. It is crucial that dashboards and calculations be quality controlled for accuracy.

While there are numerous ways to go about quality control in Tableau, this guide will provide some helpful tips to check and verify calculations are working as they are supposed to from a general perspective.

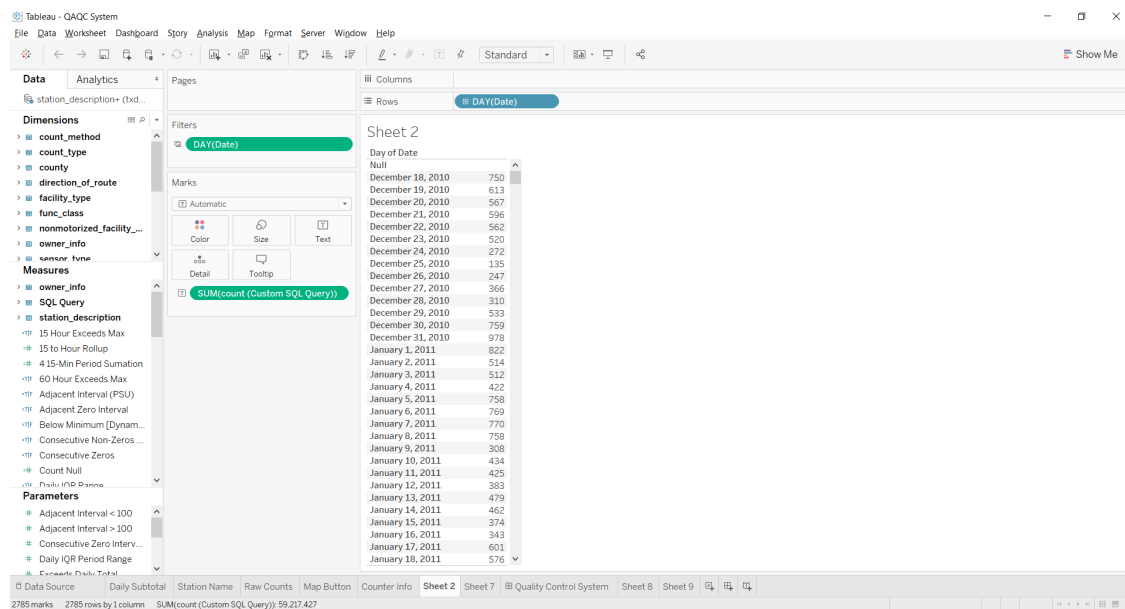
### Create a Calculation Test Table

Calculations involving dates (years, quarters, months, days), times (hourly or minute intervals, both discrete or continuous), and other attributes that add a pseudo-longitudinal dimension can be extremely complex in Tableau. It may seem that steps taken to correctly calculate a measure do not actually work, giving erroneous outputs. There are often background issues complicating the calculation steps.

To avoid making these errors and verify from the beginning that the calculation is returning the correct results, create the calculation in a test table on a separate worksheet first. This will allow you to see a tabular behind-the-scenes look at how Tableau is running the calculation and adjust on it the fly.

To do this, use the following steps:

1. **Create a new worksheet tab in Tableau.**
2. **Build out the calculation in tabular form.** For example, if a calculation is requiring a complex summation, a level of detail expression, or some other roll-up or ranking, it helps to see how the calculation works without having to navigate through a map, chart, or other type of visualization. Figure 3 provides an example of what this looks like.



**Figure 3: Worksheet Verifying a Daily Summation Calculation.**



The worksheet in Figure 3 displays bicycle and pedestrian count data collected at a 15-minute interval. These data must be summed to display a daily count. While this may sound simple, there are multiple ways that Tableau may calculate this number, several of which will give the wrong value. By creating a table, the user can easily see how the calculation is working.

3. **Verify the calculation is working as expected.** This step requires that the user understands the data and how any calculation should work. Once a test table has been built, manually verify a select number of results are correct. It is best to open the original data sources (if possible) and manually run a calculation and match with Tableau to see if the answers are the same.

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*Tip: Expand the value out to 2 or 3 decimal places beyond what is needed to better ensure the accuracy of the formula.*

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If Tableau is calculating the wrong answer, manipulate the visualization (pills in the row/column shelf or marks card, filters and filter order, table calculations, level of detail calculations, or custom calculation) until you reach the correct answer.

4. **Translate the test table into the main visualization.** Once the calculations have been verified and the correct formulas have been established, replicate the conditions of the test visualization in the primary visualization.

## Visually Inspect the Data

While many issues can be avoided from the beginning by creating calculations in a test table, there may be times where this technique may not be feasible. Regardless if this is used, one should always visually inspect and manually verify a random sample to ensure correct results.

### *Check the Magnitude and Scale*

A simple method to quickly inspect if values listed from calculations are correct is to judge the magnitude and scale of the number being reported with reality. For example, should the cost of congestion value for a roadway segment be in the millions-of-dollars or thousands-of-dollars range? This all depends upon what longitudinal scale the value is being reported.

Similarly, check to ensure percentages of a whole all add up to 100% (or 1) or parts of a whole add up to the summed value. In many cases, it may be shown that they come up less than an expected value. This is usually indicative of a filtering issue either on the filter shelf or at the data source level (consider changing from an inner join to a left or right join).

### *Inspect Maps for Network Errors*

One task Tableau excels at is quality controlling spatial files. It is extremely difficult to verify the results of a GIS process in the GIS program itself; however, Tableau allows a user to easily see if roadway segments are labeled appropriately or are identified with the correct attributes.

Look for spatial features (like a roadway segment) in the wrong location when a filter is selected. For example, if “California” is selected as a filter and a segment appears in Ohio, there is an issue **in the base data** with that roadway segment. In most cases, issues of this nature are issues in the base data and cannot be fixed in Tableau. One must go to the original data source to make any edits.

### *Review All Possible Iterations of a View*

Finally, be sure to review all possible iterations of a visualization’s view. This does not mean to select or hover over every single data point. This simply means that one should inspect the view under each filter

or parameter condition to ensure links, calculations, and views work as expected under different conditions. In many cases, it may be that some filter actions do not work when some other variable is selected or filtered.

Performing this sort of check can be used in the development process or as a last line of defense in the quality control process to ensure users receive the best service.

## Displaying Meaningful Performance Measures

One key element of creating any type of successful graphic or visualization is to use metrics and measures that the intended audience or user will readily understand. If a user cannot grasp the meaning of a measure nearly instantly, then the point will be lost and the effort of putting that measure on the visualization is lost—even if it is a good measure.

Creating meaningful measures is a constant battle for transportation professionals in all areas. Transportation performance relies heavily on the use of index values, but indexes inherently have no meaning or scale.

For example, measures such as the international roughness index (IRI, a pavement quality measure), the planning time index (PTI), or the travel time index (TTI), though generally well known in their fields, mean almost nothing to someone outside of the field. A value of 1.20 or 3.67 means nothing to one not in the industry.

In data visualizations, performance measures should have some sort of inherent meaning or immediate explanation and context. In the previous example of indexes, putting these in terms meaningful to a wider audience will ensure the measure is scrutinized and understood. There are two primary ways to accomplish this:

1. **Transform the measure into a meaningful value.** For example, placing PTI or TTI in terms of added travel time or planning time in minutes (e.g., “A TTI of 1.20 means that for a 20 minute commute, drivers spent an extra 4 minutes in traffic.”). While the index value is shown, one who does not understand the index immediately can understand its context and implication to their own life.
2. **Define the measure or add context.** For example, providing the lay definition of a pavement score and including a base or max value. Placing the definition or contextual clues as close to the measure will reduce the amount of time and effort a user will need to understand the visualization.

Finally, be sure to add context or scale to performance measures when possible. For example, instead of simply displaying the cost of congestion, also display the percentage of that cost with a greater whole. This may be accomplished using visual tools within the view.

## Ensuring Accessibility for All Users

According to the U.S. Census Bureau's most recent report on disability, in 2014 approximately 27.2% of the U.S. population (85.3 million people) lived with a disability; 17.6% (55.2 million people) lived with a severe disability. This is an increase of roughly 9% and 5% respectively among the population since 2010 using the same definitions (2, 3).

While websites and web graphic or interactive content have removed many barriers for disabled Americans to participate in transportation planning, design, and policy processes, barriers to these sources still exist. Of the U.S. population in 2014:

- ▲ 12.4% (29.7 million people) had difficulty lifting or grasping, greatly impacting the use of a mouse or keyboard.
- ▲ 5.1% (12.3 million people) had a visual disability and may rely on a screen reader or accessible color scheme.<sup>1</sup>
- ▲ 7.1% (17.1 million people) had a hearing disability and may rely on captioning or transcripts of audio and visual media on the web (3).

## The Case for Making Websites and Visualizations Accessible

Transportation agencies have many reasons to ensure visualizations and websites are accessible to as many users as possible. One study in the United Kingdom found that 71% of web users with a disability will leave a website as soon they realize it is not accessible (4). Using this high rate with Americans with disabilities reveals the loss of a significant proportion of the largest minority (5). Ensuring this large number of people are included in the transportation planning process will provide better representation of all types of people, increasing a DOT's customer base.

The U.S. General Services Administration (GSA) noted that deploying accessible websites reduces company costs and could bolster profits from lost revenue and customers (by minimizing the number of people who abandon or become disengaged with a website) (5). For DOTs and MPOs, cost savings could come in other ways. Creating a more inclusive and accessible web presence and planning process could reduce the amount spent litigating lawsuits or correcting transportation designs and policies that are found to neglect the needs of the disabled.

Incorporating accessibility into websites and the planning process has also been shown to improve innovation (4, 5). The transportation industry and design process thrive from innovative and creative solutions to better equip transportation users with mobility options. Increasing transportation innovation will be crucial to dealing with future needs and issues.

Finally, it is the law. Section 508 of the Rehabilitation Act of 1973 requires federal agencies to make their electronic and information technology accessible to people with disabilities. While Section 508 only directly applies to federal agencies, most states have passed their own rules similar to Section 508 or requiring the state to follow the federal rules (6).

## What is Section 508?

Section 508 of the Rehabilitation Act of 1973 requires federal agencies to make their electronic and information technology accessible to people with disabilities comparable to the access available to others.

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<sup>1</sup> The author of this report lives with both protanopia and deuteranopia color blindness. Many reds, greens, yellows, and blues are difficult to see, especially in darker hues. Creating visualizations that use colorblindness palettes ensures that valuable information is not lost in translation.

The law establishes the U.S. Access Board as the body responsible for setting the standards for making electronic and information technology (including data visualizations) accessible.

On January 18, 2018, the Board enacted a final rule that updated Section 508 to follow standards that match the World Wide Web Consortium (W3C) Web Content Accessibility Guidelines (WCAG 2.0) (7).

## Principles for Access

The WCAG 2.0 standard is built on four principle pillars under which 12 guidelines fall. These guidelines are the basic goals to work toward. While they are not testable, they provide a framework and objectives to help designers understand specific success criteria (testable) and implement better techniques (8).

**Web content must score “AA” on the all the different success criteria to be Section 508 compliant. Conformance to WCAG 2.0 is all or nothing—it must be completely accessible or else it is not.**

The following lists the 4 principles and the guidelines for meeting Section 508 compliance (8):

1. **Perceivable:** Information and user interface components must be presentable to users in ways they can perceive.
  - ▲ Guideline 1.1: Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language.
  - ▲ Guideline 1.2: Time-based media: Provide alternatives for time-based media.
  - ▲ Guideline 1.3: Create content that can be presented in different ways (for example simpler layout) without losing information or structure.
  - ▲ Guideline 1.4: Make it easier for users to see and hear content including separating foreground from background.
2. **Operable:** User interface components and navigation must be operable.
  - ▲ Guideline 2.1: Make all functionality available from a keyboard.
  - ▲ Guideline 2.2: Provide users enough time to read and use content.
  - ▲ Guideline 2.3: Do not design content in a way that is known to cause seizures.
  - ▲ Guideline 2.4: Provide ways to help users navigate, find content, and determine where they are.
3. **Understandable:** Information and the operation of user interface must be understandable.
  - ▲ Guideline 3.1: Make text content readable and understandable.
  - ▲ Guideline 3.2: Make web pages appear and operate in predictable ways.
  - ▲ Guideline 3.3: Help users avoid and correct mistakes.
4. **Robust:** Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.
  - ▲ Guideline 4.1: Maximize compatibility with current and future user agents, including assistive technologies.

Note that web content that scores “AAA” (the highest score) may still be inaccessible to many people with all types, combinations of, or degree of disabilities.

The W3C provides an extensive online manual explaining WCAG 2.0, which also provides success criteria, detail about meeting these criteria, and examples to show what does and does not comply. This manual can be found at <https://www.w3.org/TR/WCAG20/#guidelines> (8).

## Tips for Making Tableau Accessible and Section 508 Compliant

Tableau visualizations created in version 10.2 and later will contain WCAG 2.0-compliant elements, with each version gaining more and more accessibility. Tableau Desktop version 2019.3 can produce fully compliant visualizations **so long as they are embedded in a WCAG 2.0-compliant web page**. If the page is not compliant, the visualization will also not be compliant. Tableau version 2019.4 now allows visualizations created in Tableau Online and Tableau Server to be natively compliant. Both are caveated that the visualizations themselves are built observing WCAG 2.0 principles listed earlier. A Tableau visualization can be non-compliant if it is poorly built.

Of the many success criteria given under each WCAG 2.0 guideline, Tableau users only need to be concerned with eight of them (9):

1. 1.1.1 Non-text Content.
2. 1.3.1 Information and Relationships
3. 1.3.3 Sensory Characteristics
4. 1.4.1 Use of Color.
5. 1.4.3 Contrast (Minimums).
6. 2.4.3 Focus Order
7. 2.4.6 Headings and Labels.
8. 3.3.2 Labels for Instructions.

All the other success criteria either do not apply or have already been satisfied by Tableau engineers. In Tableau, there are some elements that are fully conformant and a few that still are not. Table 1 lists those features that conform and do not conform as of Tableau 2019.3 (9).

**Table 1: Accessible and Non-Accessible Elements in Tableau.**

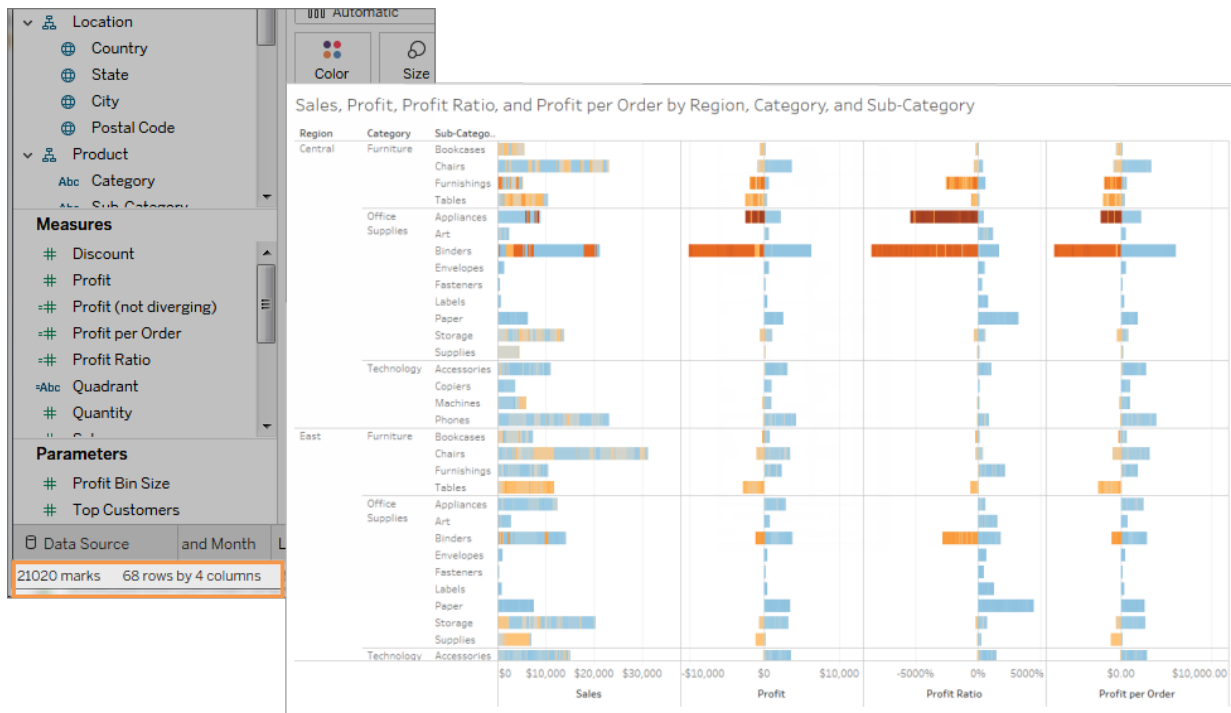
Tableau Accessible Elements	Non-Accessible Elements
Workbook Tabs	Some Filter Types (Scrolling, etc.)
Dashboard Titles and Title Views	Authenticated Data Sources
Chart Views and View Data Windows	
Captions	
List and Dropdown Filters	
Categorical Legends	
Tooltips	
Text Objects	
Web Page Objects	
Image Objects	
Button Objects	
Toolbars	

The following are concepts provided by Tableau to follow to ensure a Tableau visualization meets WCAG 2.0 and Section 508 standards (10, 11, 12, 13, 14).

### *Keep the View Simple*

Reducing the number of marks on a screen will help to keep a visualization simple, clean, and easy for screen readers or keyboards to navigate. Wherever possible, aggregate data or simplify the view to only what is needed or emphasized. This includes simplifying roadway segmentation or limiting the number of segments shown both by default and in each filtered view. Simplifying views also means limiting the number of colors, marks, and shapes at any given time.

**Reduce the number of marks on a screen to less than 1,000.** When there are less than 1,000 marks on a screen, the view is *rendered by the browser* and is WCAG compliant. Views with more than 1,000 marks are *rendered by the server*, which is not yet compliant. **The number of marks can be seen in the bottom left corner of the window in Tableau Desktop.** Use filters (especially by removing the “All” button), parameters, sets, or simply reduce the number of dimensions on a visualization to reduce the number of marks displayed. Views can be forced to render on the client side by setting the render to “true” in the URL (though this may impact performance). Figure 4 illustrates a view with too many marks and where to locate the number of marks on the Tableau Desktop screen. In this view, there are 21,020 marks being displayed, meaning the server must render the visualization making it non-compliant.



**Figure 4: Visualization with Too Many Marks and the Number of Marks Location on the Screen.**

Tableau, by default, enables the “View Data” function, so that any marks on a screen can be read by a screen reader, even if it’s more than 1,000 marks. However, key data points should still be reduced and labeled to increase readability.

Use basic types of charts, such as bar charts or line graphs, wherever possible. Orient categorical bar charts horizontally, so that text can be displayed horizontally as well. Avoid using vertical text anywhere on the visualization. Expand the size of the charts to fit entire views with ample white space.

### **Show More and Helpful Text**

Visualizations by nature are visual, but they also help the user understand a story. Good visualizations should **always use a descriptive title and caption for descriptive text** explaining what is being shown within the visualization.

- ▲ Avoid using one-word titles; instead, use captions or descriptive terms to explain a charts’ axes.
- ▲ Avoid using abbreviations, jargon, or technical terms, especially if there is little context for them.
- ▲ Avoid using symbols, such as “%” or “&.” Many screen readers get these wrong.



- ▲ Use descriptive words in legends, filters, parameter, and other labels.
- ▲ Consider adding adaptive explanatory text (in a tooltip or at the bottom of the view) to provide further context.
- ▲ Avoid using all capital letters, as these can be difficult to read.
- ▲ Do not use words like “image of” or “picture of” as screen readers may already include this text.

Any additional text provided should be precise and consistent throughout the view. Think about how and what order a reader will read through the text. The reader will begin with the view title, then read the chart title, and the legend or other descriptive texts. Tab through the visualization to test the order in which a reader will read the visualization. What information is lost or confusing as the text is read? Figure 5 illustrates how text can be used to properly annotate a data visualization.



**Figure 5: The Proper Amount of Text for Titles, Captions, Legends, and Views.**

Default text sizes in Tableau are WCAG 2.0 conformant. However, it is recommended to make text as large as reasonably possible to improve readability. Avoid using fonts that are elaborate or that may not be universal on all computers.

### Alt Text

To be compliant, all non-text elements need to have a text alternative that serves an equivalent purpose. As stated earlier, this will include descriptive titles, captions, and labels. Since Tableau primarily creates non-text views, the **“View Data” permission must be enabled** to ensure that graphs and charts are WCAG conformant. This will allow a reader to open a data table of what is being viewed that can be fully interactive with the viewer.



Tooltips do serve as alt text so long as they are properly worded. Tooltip text should read like natural text and follow the tips listed earlier.

Pictures, icons, or symbols are the most common element that require some form of alt text. When writing alt text for images, consider the following ( 15):

- ▲ What content does the image provide?
- ▲ What function does the image have in the larger view?

Alt text should not be redundant with existing text on the view but should complement the existing text and be descriptive in useful terms of the image it could replace.

### ***Color and Contrast***

Color can be a powerful tool for providing clarity to a visualization; however, for others, it may make the visualization more confusing. Tableau provides a color palette designed for color blindness that can be used to avoid making color errors. If other colors must be used, ensure that the colors differ enough from each other on a light-to-dark spectrum (think of how colors are printed on a black and white printer). For discrete dimensions, use the color-blind palette or stepped color gradients. For measures that are continuous, consider using the blue or blue-orange diverging color palette with a stepped color of five to seven steps. Avoid red and green comparison (like the popular red, yellow, green maps in transportation) as these are not viewable to the largest number of colorblind persons.

Be sure colors of charts and text contrast significantly from one another. The general rule-of-thumb is to **only use colors with a contrast ratio of 4.5:1** (or 3:1 for large text or graphics). Use the color contrasting tool provided by The Paciello Group to analyze color contrasts for WCAG compliance: <https://developer.paciellogroup.com/resources/contrastanalyser/> ( 16). When in doubt, the default black and white will comply.

When using color, it can be helpful to use other visual cues, such as position, size, shape, and labels. For line charts, consider adding shapes, using differing thicknesses, or using dashed line varieties in addition to color to ensure a reader can follow a chart. Figure 6 illustrates how colors, contrast, and shapes can be used to add clarity to a visualization.



**Figure 6: An Appropriate Use of Color, Contrast, and Shapes for a Visualization.**

### **Publishing the Visualization Online**

Tableau views generally must be created in Tableau Desktop, published to a Tableau Server, and then embedded in a WCAG 2.0 compliant webpage. There are a couple extra steps to ensure the visualizations are Section 508 compliant in the publishing phase.

**Web editing** is not supported in WCAG-conformant views, so this feature **must be turned off** in the published workbook. To do so, in Tableau desktop, select Server > Publish Workbook. Under Permissions, select Edit > All Users > Edit. Skip about halfway down the list to “Web Edit” and check “Deny.” Click OK. Ensure the view data option is enabled and make one final check to ensure displayed marks are less than 1,000.

## Conclusion

Following the principles and guidelines listed above will ensure that interactive visualizations conform to Section 508 and are accessible to a maximum number of people. These tips and tricks will reduce the number of errors and ensure the readability and usability of the information provided in each visualization.

## Helpful Resources

Tableau has provided several helpful resources for ensuring visualization created using their software comply with WCAG 2.0 and Section 508. The following links provide additional tips and examples than described in this synthesis. Please refer to these and the Tableau Community Forum for additional assistance.

- ▲ **Best Practices for Designing Accessible Views:** [https://help.tableau.com/current/pro/desktop/en-us/accessibility\\_best\\_practice.htm](https://help.tableau.com/current/pro/desktop/en-us/accessibility_best_practice.htm).
- ▲ **Author Views for Accessibility:** [https://help.tableau.com/current/pro/desktop/en-us/accessibility\\_create\\_view.htm](https://help.tableau.com/current/pro/desktop/en-us/accessibility_create_view.htm).
- ▲ **Building Accessible Dashboards in Tableau (Webinar):** <https://www.tableau.com/learn/webinars/building-accessible-dashboards-in-tableau#video>.
- ▲ **Colour Contrast Analyser:** <https://developer.paciellogroup.com/resources/contrastanalyser/>.
- ▲ **Color Contrast Tips and Tools:** <https://www.smashingmagazine.com/2014/10/color-contrast-tips-and-tools-for-accessibility/>.

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