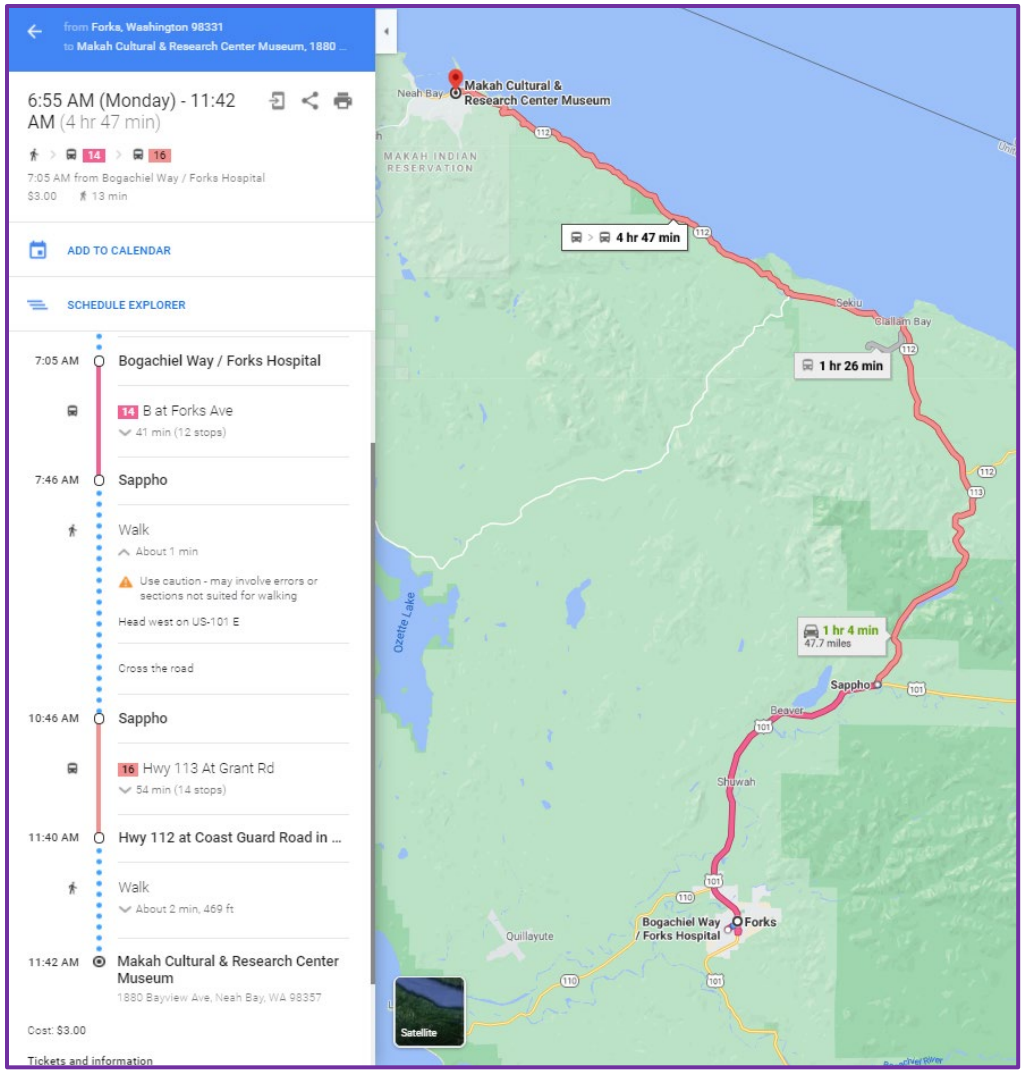

GTFS BUILDER GUIDEBOOK

May 2021

National RTAP Rural Transit Assistance Program

A Program of the Federal Transit Administration, Administered by the Neponset Valley TMA

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Appendix

Introduction

General Transit Feed Specification (GTFS) is the international standard used to digitize and publish trip plan data and can also be used to generate timetables used on an agency's website. GTFS Builder consists of two Excel files including the **ImportExport** file and the **Schedule Generator** file. An agency must have Microsoft Excel downloaded to use the GTFS Builder Web App. In the **ImportExport** file, there are 12 tabs in which data is entered. Data in each tab is exported into separate text files using an automated process enabled in the Excel file through a macro. A valid GTFS is the result of compressing or "zipping" these text files together. The GTFS data is saved in a URL and that URL is made available to trip planners, such as Google Maps. National RTAP offers free and secure hosting of the URL which contains the GTFS data.

The instructions provided in *Sections 1 through 14* are for developing GTFS data for fixed routes. An add-on to GTFS, known as GTFS-Flex is currently in development, and when complete, will accommodate on-demand, dial-a-ride and flex route services. Until GTFS-Flex is fully available, GTFS Builder offers a "work-around" consistent with current GTFS data guidelines to publish trip information related to on-demand and flex routes. Instructions for the workaround are found in *Section 15*. *Section 16* offers a partial list of trip planners or feed registries that publish GTFS data.

Using the **ImportExport** file, data that defines the attributes of agencies, service days, fare types, routes, stops and others are entered using one of the 12 data tabs. At a minimum, data must be entered in the **agency, routes, calendars, calendar_dates, stops** and **feed_info** tabs. Data must also be entered in the **trips** and **stop_times** tabs. However, data is not manually entered into those tabs, but rather is generated in the **Schedule Generator** file and then copied and pasted back into the **ImportExport** file **trips** and **stop_times** tabs. Data entry in remaining four tabs is optional depending on services provided. Instructions for filling in the data for the required tabs is provided in *Sections 1 through 12*. Instructions for completing data in optional tabs follows in *Sections 13 and 14.*

The **Schedule Generator** file is used only to input trip schedules and generate trips and stop_times information. The user enters schedule information in the file and then runs a macro to generate data into the **trips** and **stop_times** tabs. The data in the **trips** and **stop_times** tabs is then copied and pasted into similarly named tabs in the **ImportExport** file. The **Schedule Generator** file can also be used independently to generate an agency's schedule or table to be uploaded to an agency website.

To view the entire specification for each data element to be entered in each tab visit **http://gtfs.org/.** This is an excellent resource, and it is strongly suggested the link remain open while data is entered in both the **ImportExport** and **Schedule Generator** files. The information at this website will provide additional detail, beyond the basic information provided herein, for each data element from the GTFS.

Other training resources are available at **GTFS Builder Support** including a series of eleven videos. Links and descriptions of each video follow.

1. **What is GTFS and Should My Agency Proceed.** This first **video** provides an introduction to GTFS and what GTFS looks like on a published trip plan. It also discusses resources needed to develop GTFS including software and time, and presents options for developing GTFS files.

2. Trip Planner Licensing Agreements. Understanding trip plan data licensing agreements and what, if any, are the risks. An attorney translates a sample agreement from legalese into English in this **video**.

3. An Introduction to GTFS Builder (Download and Setup). This **video** offers an introduction to National RTAP's GTFS Builder tool and describes how is it used to develop GTFS data. The video reviews how the application is downloaded from National RTAP's website and how to set up a folder/workspace on a desktop appropriate for GTFS. Other topics include enabling GTFS Builder macros, common GTFS terminology and where to find comprehensive GTFS resources. The **video** supports and expands on information provided in *Section 1* of this Guidebook.

4. Agency, Calendar, Calendar_dates, Routes, Fare and Transfer Tabs in the ImportExport File. This **video** demonstrates how data is entered into each of these tabs. The **video** supports *Sections 2, 3, 4, 5 and 13* of this Guidebook.

5. Identify Bus Stop Coordinates and Complete the Stops Tab in the ImportExport File. This **video** demonstrates how bus stop coordinates are established using a combination of Google's MyMaps and Google Earth Pro. Once the stops are identified, the video shows how bus stop data is entered into the **stops** tab. This **video** supports *Sections 6 and 7* of this Guidebook.

6. Using the Schedules_V3 Tab in the Schedule Generator File to complete the Trips and Stop Times Tabs in the ImportExport File. This **video** demonstrates how to develop schedule data using GTFS Builder's **Schedule Generator** file and then enter that data into the **stop_times** and **trips** tabs in the **ImportExport** file. The **video** also provides an in-depth explanation of the important distinction between routes and trip groups. The **video** supports *Sections 8 and 9* of this Guidebook.

7. Feed _info Tab, Exporting, Validating and Hosting GTFS Data. This **video** demonstrates completing the **feed_info** tab in the **ImportExport** file, exporting the data into text files, compressing the data, validating/checking the data, resolving common errors and how to host the data so it can be consumed by a trip planner (for example Google). The **video** supports *Section 12* of this Guidebook.

8. Creating Trip Group Shapes and Complete the Shapes Tab in the ImportExport File. This **video** details creating the shape for each trip group using Google's MyMaps and Google Earth Pro along with entering that data into the **ImportExport** file. A method to check that bus stops are reasonably close to the trip group shape file is also presented. While shapes are optional, riders appreciate seeing the route on the road. The **video** supports *Section 14* of this Guidebook.

9. Demand Response Services. Until all trip planners allow flexible on-demand services to be published, GTFS Builder offers an easy workaround to ensure these services are seen on trip planners. This **video** shows how to build a "flex workaround" dataset within the current constraints of "fixed and timed" schedules required by Google and other trip planners. The **video** supports *Section 15* of this Guidebook.

10. Uploading Data to a Trip Planner (such as Google). Focused primarily on Google's trip planner, testing, feed configuration, data visualization, how to request to launch and other relevant topics are covered in this **video**. This **video** supports and expands on information offered in *Section 16* of this Guidebook.

11. Keeping GTFS Up to Date. This **video** reviews how to maintain and update existing GTFS.

For further technical assistance, please contact National RTAP either by email (support@nationalrtap.org) or by phone (888-589-6821). These contacts can also be used to provide input on this document. Constructive feedback is appreciated and used to improve the process for future users of GTFS Builder.

1. First Steps

Additional support and a demonstration of the explanations provided in this section are available in this **video**.

1.1.Download and Configure Google Earth

Section 6 of this guidebook provides instructions on how to geocode or locate bus stop coordinates. Google Earth will be needed for this process. Google Earth will also be needed if trip shapes files are to be developed. Although bus stop coordinates are required, trip shape files are optional. For more information on shape files, refer to *Section 14*. If the desktop version of Google Earth is not currently available on the PC used to manage this project, download the desktop version of Google Earth Pro. There is no cost for this version of Google Earth. This link is to the landing page to secure **Google Earth Pro on Desktop** version: **Google Earth.** Configure Google Earth following these three steps.

1. Go to Tools>Options>3D View>Show lat/long
2. Select Decimal Degrees
3. Select Apply and OK

1.2. Checklist

A checklist of all the items to be completed through the development of GTFS data can be found in the Appendix. This is a useful tool for those who may work intermittently on this process.

1.3.Macros

Macros in both files need to be enabled for GTFS Builder to function properly. The macros in the two GTFS Builder files are scripts that automate several processes required to fully generate the data needed for a GTFS file. It is recommended that an agency's IT department be contacted before enabling macros.

Depending on the operating system being used, macros may be enabled simply by responding "yes" to the question "Make this a Trusted File?". However, if this question does not pop-up, enable macros in the GTFS files, or folder containing the files, using these general steps.

1. Open Excel
2. Select Options at the bottom of the left menu.
3. Select Trust Center at the bottom of the left menu.
4. Click on the Trust Center Settings button. At this point two options are available:
    a. Enable macros in a folder in which both the **ImportExport** and **Schedule Generator** files are stored.
        i. Select "Trusted Locations" near the top of the left menu.
        ii. Select "Add New Location" and use the Browse button to find the folder in which the two GTFS Builder files are stored.

b. Select individual files.
    i. Select “Trusted Documents” in the left menu.
    ii. Check the box next to “Allow documents on a network to be trusted.”
    iii. Click on OK.

1.4.GTFS Builder Guidebook Terms

The following terms are used in the tables contained in this guidebook:

Public Facing: If a “yes” is shown what is entered in this document’s tables will display on a trip planner. A “no” indicates the data is used internally.

Required/Optional: Required indicates data must be entered for GTFS data to be complete and pass validation test (described later in *Section 12*). Data may or may not be entered in the columns labeled optional.

Trip Group: A trip group includes all trips provided by a route in which the same consecutive bus stops are serviced. For example, if Route A morning and late afternoon trips service stops 1, 2, 3, 4 and 5 and midday trips services stops 1, 3 and 5, the route would consist of two trip groups each with a unique name.

1.5.Final Notes

It is recommended that data be entered into GTFS Builder in the order presented in this Guidebook. However, if it is preferred to obtain and enter bus stop coordinates first, skip ahead to and complete *Section 6.0 Identify and Geocode Bus Stop Location* and *Section 7 Complete the stops Tab in the ImportExport File.* But be sure to return to the beginning of the guidebook and complete all required sections.

If the route name, or any data, is copied directly from the agency website, be sure to paste it as plain text.

No data, including Stop names, entered into either the **ImportExport** or **Schedule Generator** files can include a comma (“,”). The final exported text files are comma separated and extraneous commas will invalidate the data.

Do not change cell formats in either the **ImportExport** or **Schedule Generator** files. Reformatting may result in invalid data.

It is suggested an agency enter and validate one route to ensure data is being entered correctly before proceeding with additional routes.

Good Luck!

2. Complete the agency Tab in the ImportExport File

Using the example data and explanatory information in Table 2.1 enter data in the **agency** tab. Figure 2.1 depicts how the public facing data is depicted on a trip plan. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

Table 2.1 agency Tab

Field	**agency_id**	**agency_name**	**agency_url**	**agency_timezone**
Sample Data	CTS	Clallam Transit System	https://www.clallamtransit.com	America/Los_Angeles
				America/Phoenix
Public Facing	No	Yes	Yes	Yes
Required/Optional	**Required**	**Required**	**Required**	**Required**
Format	Text	Text	URL	Time zone
Notes	Any name, abbreviation or number is acceptable.	Agency name is identical to what is published at the agency_url.	This is the URL of the agency's public website. It allows riders to link back to the agency website for additional information. If an agency does not have a website, visit **Website Builder 3.0** for information on a no-cost Website Builder tool.	For a list of time zones, refer to: **https://en.wikipedia.org/wiki/List_of_tz_database_time_zones** In this website, and in the table called List, use the TZ database name shown in the third column. Timezones (TZ), in this specification are not "Pacific" or "Mountain" or "Central".

This table continues on the next page.

Table 2.1 agency Tab (continued)

Field	agency_lang	agency_phone	agency_fare_url	agency_email
Sample Data	en	(360) 452-4511	https://www.clallamtransit.com/Fares-Passes	info@clallamtransit.com
		978-844-RIDE		
Public Facing	No	Yes	Yes	Yes
Required/Optional	**Required**	Optional	Optional	Optional
Format	Language Code	Text	URL	email
Notes	"en" for English. Establishes the primary language the transit agency publishes its website. Enables translating from primary language to other languages.	Can include numbers, dashes and dialable letters.	URL of a web page that provides information related to fares, purchasing tickets or other fare instruments.	

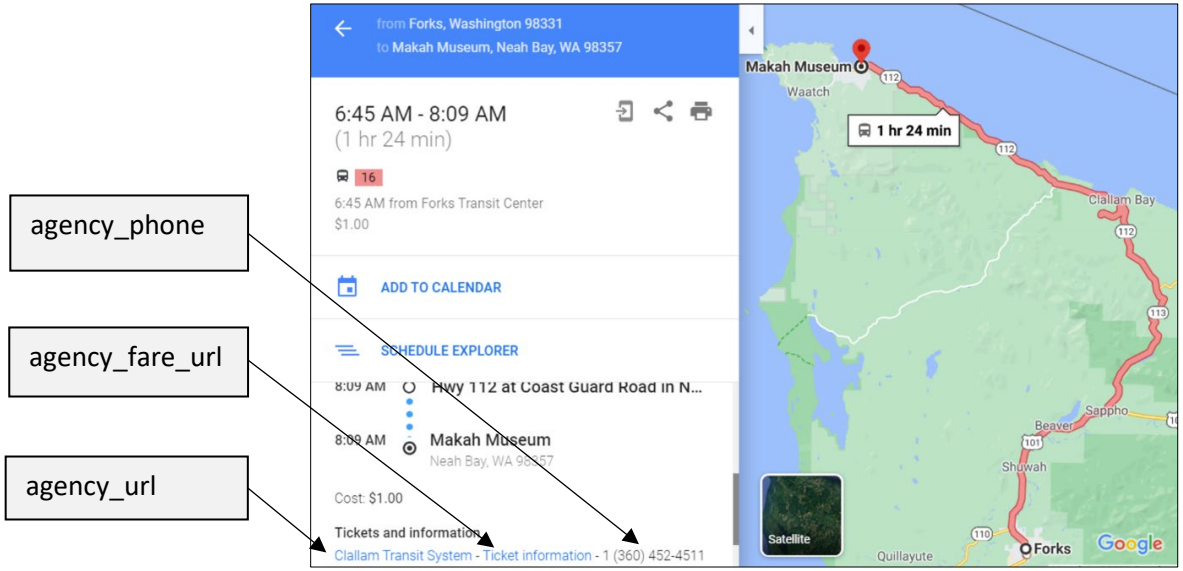

Figure 2-1 Agency Tab Data Displayed on a Trip Plan

3. Complete the calendar Tab in the ImportExport File

Service-related calendar information is established and entered in the **calendar** tab. It establishes a service_id which defines the days of the week various routes or trips can operate during a specific time period. Various combinations of days of service within a time period can be entered. Service_ids may be assigned to multiple routes or trip groups. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

Using the example data and explanatory information in Table 3.1 enter data in the **calendar** tab.

Table 3.1 calendar Tab

Field	service_id	monday	tuesday	wednesday	thursday	friday
Sample Data	mtwtf	1	1	1	1	1
	sat	0	0	0	0	0
	67	0	0	0	0	0
Public Facing	No	No	No	No	No	No
Required/Optional	**Required**	**Required**	**Required**	**Required**	**Required**	**Required**
Format	Text or Number	Number	Number	Number	Number	Number
Notes	Uniquely identifies a set of dates when service is available for one or more trips or routes.	**1** - Service is available for all Mondays in the date range. **0** - Service is not available for Mondays in the date range.	**1** - Service is available for all Tuesdays the date range. **0** - Service is not available for Tuesdays in the date range.	**1** - Service is available for all Wednesdays in the date range. **0** - Service is not available for Wednesdays in the date range.	**1** - Service is available for all Thursdays in the date range. **0** - Service is not available for Thursdays in the date range.	**1** - Service is available for all Fridays in the date range. **0** - Service is not available for Fridays in the date range.

This table continues on the next page.

Table 3.1 calendar Tab (continued)

Field	saturday	sunday	start_date	end_date
Sample Data	0	0	20210101	20221231
	1	0	20210101	20221231
	1	1	20210101	20221231
Public Facing	No	No	No	No
Required/Optional	**Required**	**Required**	**Required**	**Required**
Format	Number	Number	YYYYMMDD	YYYYMMDD
Notes	**1** - Service is available for all Saturdays in the date range. **0** - Service is not available for Saturdays in the date range.	**1** - Service is available for all Sundays in the date range. **0** - Service is not available for Sundays in the date range.	The start_date is set to the first date the trip will operate. The range cannot be completely in the future. At least one of the start_dates for one service_id must be current or in the past.	The future date the service_id terminates.

4. Complete the calendar_dates Tab in the ImportExport File

In the **calendar_dates** tab, enter exceptions to service_ids listed in the **calendar** tab. Exceptions could include holidays with no service on a date encompassed in the range of dates entered in the **calendar_dates** tab, a Saturday service schedule operating on the day after Thanksgiving and others. For example, entries in this tab can also omit or remove a weekday service and add in a Sunday service for that date. Multiple exceptions can be added for each service_id, however only one exception can be entered per row. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

For convenience, a list of Federal holidays, in the required GTFS data format, can be found **here.**

Using the example data and explanatory information in Table 4.1 enter data in the **calendar_dates** tab.

Table 4.1 calendar_dates Tab

Field	**Service_id**	**date**	**exception_type**
Sample Data	mtwtf	20210215	2
	Sat	20211126	1
Public Facing	No	No	No
Required/Optional	**Required**	**Required**	**Required**
Format	Text	YYYYMMDD	Number
Notes	Must exactly match one of the service_ids listed in the **calendar** tab.	Date when service exception occurs. Typically, holidays are listed.	**1** - Service has been added for the specified date. **2** - Service has been removed for the specified date.

Figure 4.1 shows how data entered in the **calendar** and **calendar_dates** tabs is depicted on a trip plan. In this trip plan, no service is provided on Monday, February 15, 2021 as it is a federal holiday. Therefore, the next scheduled trip is on Tuesday.

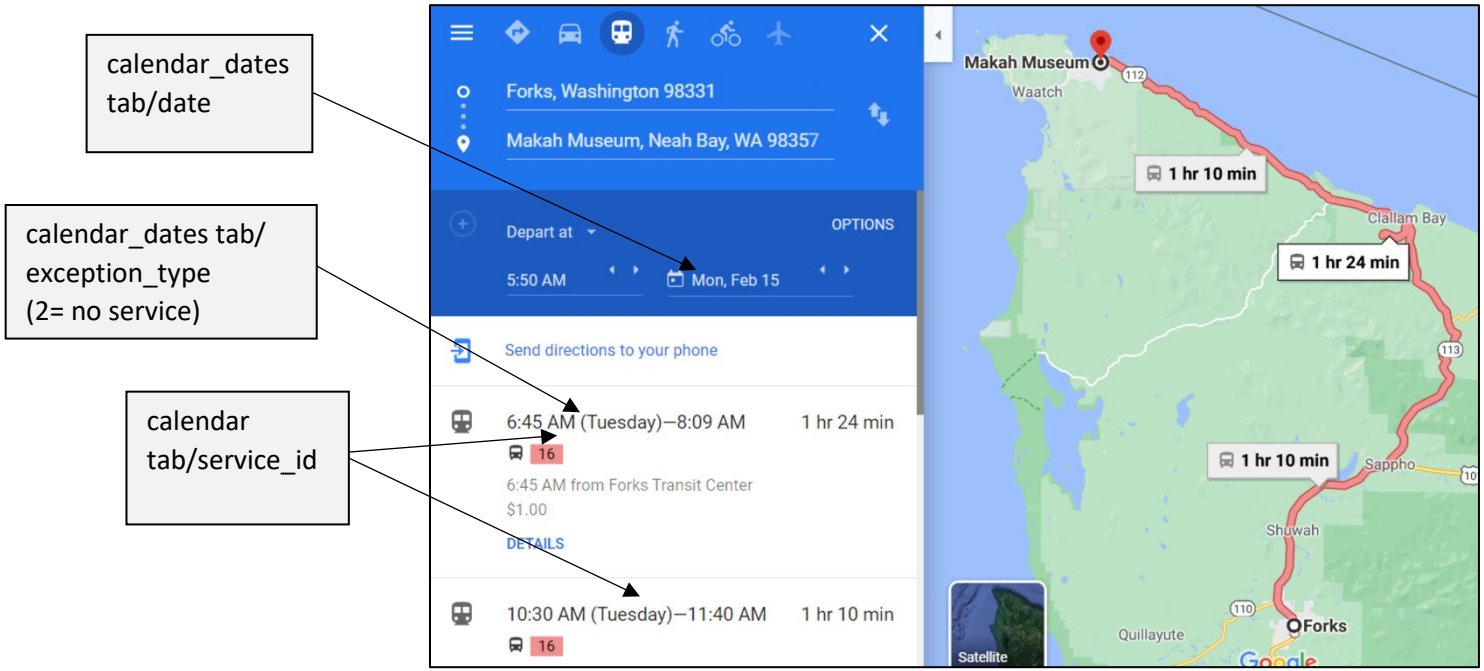

Figure 4-1 Calendar and Calendar_Dates Tabs Data Displayed on a Trip Plan

5. Complete the routes Tab in the ImportExport File

Routes are published as displayed on an agency's website. A route may consist of one or more trip groups. Trips within the same route may have the same or different schedules on different days of the week and may service the same or different bus stops. For example, a route may run eight trips a day. Two trips that occur during peak commuting periods may service a greater number of stops than six midday trips that may service only a few stops. In this case, the route consists of two trip groups. Each route's trip groups will be defined later in the process. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

Using the example data and explanatory information in Table 5.1 enter data in the **routes** tab.

Table 5.1 routes Tab

Field	route_id	agency_id	route_short_name	route_long_name	route_desc	route_type	route_url
Sample Data	16	CTS	16			3	https://www.clallamtransit.com/route16
	TransitP	TransitTown		Downtown Plaza		3	http://www.transitTown.gov/ purple
Public Facing	No	No	Yes	Yes	No	No	Yes
Required/Optional	**Required**	**Required**	Optional	Optional	Optional	**Required**	Optional
Format	Text	Text	Text	Text	Text	Number	URL
Notes	Identifies name of route. Each route_id value can appear only once in the **routes** tab.	Must match one name listed in the **agency** tab.	Generally, one word or number under six characters. A short or long name must be entered, but not both.	A short or long name must be entered, but not both.	It is recommended this column be left blank. A detailed description of a route is not shown on trip planners.	Typically, **3** for short or long-distance bus routes. For other modes refer to: **https://developers.google.com/transit/gtfs/reference#routestxt for others.**	URL or web page for a route. If the route's schedule details are found at the agency_url, this column must be left blank.

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Table 5.1 routes Tab (continued)

Field	route_color	route_text_color	route_sort_order	continuous_pickup	continuous_drop_off
Sample Data	FF9999	000000	1	1	1
	ff7c4f	FFFFFF	2	2	0
Public Facing	Yes	Yes	No	No	No
Required/Optional	Optional	Optional	Optional	Optional	Optional
Format	Six Character Color Code	Six Character Color Code	Number	Number	Number
Notes	Establishes the background of the route_ text_color. Must match public facing colors used at the agency website. Defaults to blue when omitted or left empty. Select Color Codes here: **https://htmlcolorcodes.com**	Establishes the route text color which is displayed over the background color (route_color). Defaults to black (000000) when omitted or left empty. White is commonly used (FFFFFF). Select Color Codes here: **https://htmlcolorcodes.com** Feed validation performed later is the process will confirm the color contrast meets accessibility requirements.	Establishes the order routes display when published as a list. Routes with smaller values display first.	Indicates if a rider can board the vehicle any-where along the route at an intersection of two roads. Valid options are: **0** - Continuous stopping pickup. **1** or empty - No continuous pickup. **2** - Must phone an agency to arrange continuous pickup. If 0 or 2 are selected, a trip shape must be created. See *Section 14* for instructions on creating a shape file. When only a segment or portion of a trip is flexible use the **Schedules_V3** tab. See *Section 8*.	Indicates if a rider can alight the vehicle any-where along the route at an intersection of two roads. Valid options are: **0**- Continuous stopping drop-off. **1** or empty - No continuous drop-off. **2** - Must phone an agency to arrange continuous drop-off. If 0 or 2 are selected, a trip shape must be created. See *Section 14* for instructions on creating a shape file. When only a segment or portion of a trip is flexible use the **Schedules_V3** tab. See *Section 8*.

Figure 5.1 depicts how the public facing data in the **routes** tab is depicted on a trip plan.

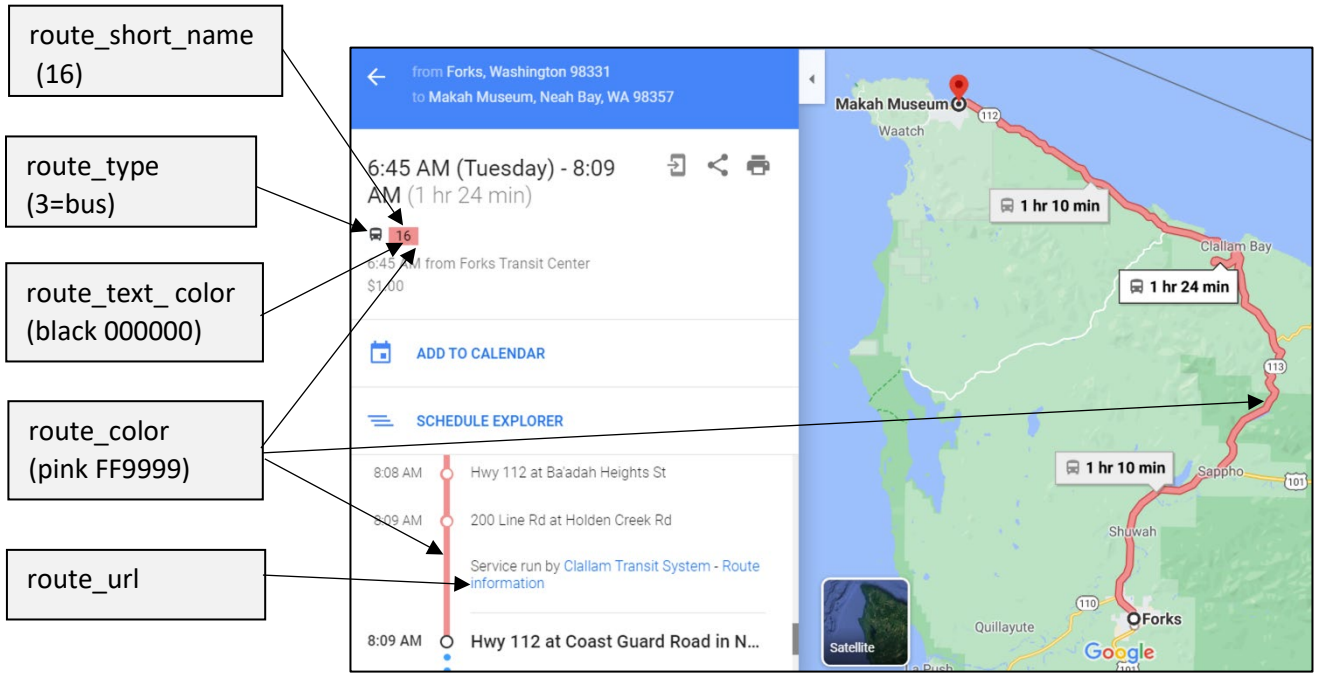

Figure 5-1 Routes Tab Data Displayed on a Trip Plan

6. Identify and Geocode Bus Stop Locations

Bus stop locations are entered in the **ImportExport** file in the **stops** tab. But first, the stops need to be precisely identified and located through Global Position System (GPS) coordinates known as longitude and latitude. This is process is known as geocoding. The required datum is WGS84.

For routes with only flag stops, it is recommended several stops where riders frequently flag buses, and are considered safe locations, be selected along the route. These on-demand bus stop locations also need to be geocoded. For routes and segments of trips with a combination of fixed and flag stops, options for continuous_pickup and drop_off can be set in the **Schedules_V3** tab. A single stop can be used by multiple routes, trips and agencies.

In this step, the **ImportExport** file can be minimized as other applications will be used.

Coordinates can be established using many different approaches. In some cases, state DOTs, regional planning agencies/organizations, county or city GIS planning departments or dispatch software may already have stop coordinates available for an agency or may be able to assist with this process. Bus stop coordinates can also be established using proprietary GIS software such as ArcGIS, smart phone applications or others. If one of these methods are used, it is important to test the coordinates by entering them into Google Earth and confirm they are accurately located off the road and positioned where riders can safely wait for a bus. Once a list of bus stops is obtained and confirmed to be accurate, skip ahead to *Section 7 stops Tab.* However, without outside support or GIS software, agencies can, for free, download and use Google Earth Pro for Desktop or a combination of Google MyMaps and Google Earth to establish their bus stop coordinates. An agency may enter the list from their partner agency into the **ImportExport** file and then view all the stops.

This section of the guidebook offers detailed instructions for two methods to geocode or identify bus stop locations. Although there are several steps to geocoding bus stops, they are presented as simply as possible and can be easily completed by someone new to the process. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

6.1. Method 1 – MyMaps and Google Earth

Method 1 is appropriate when more than five stops need to be geocoded. Using Google's MyMaps to geocode bus stops allows an agency to easily share bus stop locations with others in the agency and to review or modify stop locations as needed.

1. Create (or access) and log-in to a Google account
2. Go to mymaps.google.com
3. Create a new map and layer
    a. Click on the red button "+Create a New Map."
    b. Click on "Untitled Map" and re-name the map "GTFS Bus Stops" (or other title).
    c. Click on "Untitled Layer" and re-Name the layer "Stops" (or other title).
    d. Click on "Base Map" and select the Satellite view (top middle block).

4. Identify bus stops (remember a bus stop shared by different routes or trips is entered only once in the **stops** tab)
    a. Click on the  in the menu bar.
    b. Bring the + to the exact location of the first bus stop and click. Make sure the stop is located on the side of the road and not in the center of the road or on a sidewalk. Once the location is selected, a dialog box will appear.
    c. In the first block, input the stop_id**,** in the second block provide the stop_name (do not enter any commas in the name) and then select Save.
    d. Repeat **a** through **c** until all stops are identified.
5. Export the bus stop locations from MyMaps to Google Earth.
    a. Click on three dots next to map name and select "Export to KML/KMZ". Select the correct layer where the stops are contained.
    b. Check "Export as KML instead of KMZ…" then Download and Save
    c. Depending on a computer's settings:
        1. Google Earth may automatically launch, or
        2. It may be necessary to open Google Earth and then open the KML file in the computer's download folder (that may be in the lower left side of screen).
    d. In each of these cases, the KML file should automatically appear under My Places or Temporary Places (in the left side of the screen) and the stops should appear on the map identified by pins. Zoom in to view a few stops to confirm they are in the correct location.
6. Prepare to copy stops into the **ImportExport** file
    a. The KML file will display on the left side in Google Earth under either My Places or Temporary Places.
    b. Right click on small blue globe next to the file name.
    c. Select Copy, or from the top navigation menu select Edit>Copy.
7. Proceed to *Section 7 Complete the **stops** tab in the **ImportExport** File.*

6.2.Method 2 – Google Earth

In Method 2, bus stop locations are geocoded directly in Google Earth. It is appropriate for five or fewer stops or location updates.

1. In Google Earth - desktop version (if not already downloaded, see *Section 1 First Steps* for download instructions).
    a. On left menu, right click on My Places>Add>Folder.
    b. Name the folder.
2. Identify bus stops
    a. On the map, go to the approximate bus stop location.
    b. Click on the yellow placemark pin in top menu. A  pin will appear on the map and a dialog box will open.

c. Move the placemark pin to the exact bus stop location. Make sure the stop is located on the side of the road, not in the center of the road, not too close to the curb or on a sidewalk. The stop does not need to be located exactly at the bus stop sign or shelter, just nearby.

d. In the placemark dialog box, add name (a simple code or abbreviation). This will be shown as the **stop_id** in GTFS Builder.

e. In the placemark dialog box, add a description. This will be input as the **stop_name** in GTFS Builder.

f. Select OK and the stop should appear in the folder.

g. Repeat steps **a** through **f** as necessary to identify all bus stops, including paired stops located on both sides of the street. Even though a website may use one name for a paired stop, both stops need to be geocoded and both must have different stop_ids.

3. Prepare to copy stops into the **ImportExport** file

   a. In the left menu, right click on small blue globe next to the folder name.

   b. Select Copy or, from the top navigation menu, select Edit>Copy.

4. Proceed to *Section 7 Complete the **stops** tab in the **ImportExport** File.*

7. Complete the stops Tab in the ImportExport File

1. Open the **ImportExport** file and **stops** tab, go to a blank row in Column A.
2. Double left click, and when the pop up displays, type 4 (Paste Point(s)).
3. The file's macro will populate the stop_id, stop_name, and latitude and longitude columns. Remove or replace any commas (",") in the stop_id or stop_name.
4. To establish if the bus stop is wheelchair accessible, manually enter a "1" in the last column: wheelchair_boarding. Leave this column blank if unknown.
5. As needed, fill in data designed as "Optional" for each stop_id.

Using the example data and explanatory information in Table 7.1, complete data entry for the **stops** tab. Note that stop latitude/longitude must be in the WGS84 datum. Also, once the stop data is entered into the **stops** tab, stops can be seen on Google Maps. To view a single stop on Google Maps, click inside a row containing stop data and in the pop-up menu, click on the number 3. To view all stops, select 1 or 2. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

Table 7.1 stops Tab

Field	**stop_id**	**stop_code**	**stop_name**	**stop_desc**	**stop_lat**	**stop_lon**
Sample Data	14_14	3789	Hwy 112 at Ba'adah Heights St.		48.070021	-124.279060
	16_14	4678	Hwy 112 at Coast Guard Road in Neah Bay		48.369034	-124.598663
Public Facing	No	Yes	Yes	Yes	No	No
Required/Optional	**Required**	Optional	**Required**	Optional	**Required**	**Required**
Format	Text	Text	Text	Test	Latitude in decimal degrees accurate to six decimal places on the	Longitude in decimal degrees accurate to six decimal places on the
Notes	Multiple routes may use the same stop. It can refer to stops, stations or station entrances.	Unless an agency uses a mobile app, it is recommended this column be left blank.	Name of location that precisely matches the name published at the agency's website.	Suggest leaving this column empty. It is not published on trip planners.	Stop latitude and longitude combine to form the geocoding or stop coordinate (a point) used to show the stop's exact location on a map. These are established using Google MyMaps and/or Google Earth as described in *Section 6.*	

This table is continued on the next page.

Table 7.1 stops Tab (continued)

Field	zone_id	stop_url	location_type	parent_station	stop_timezone	wheelchair_boarding
Sample Data					America/Los_Angeles	1
	A				America/New_York	0
Public Facing	No	Yes	No	No	Yes	Yes
Required/Optional	Optional	Optional	Optional	Optional	Optional	Optional
Format	Text	URL	Number	Text	Time zone	Number
Notes	This field is required only when fares will be published using a distance or zone fare. The zone_id is used in the **fare_rules** tab as described in *Section 13*. If the stop is in a station or at a station entrance, the zone_id is ignored.		Valid Options: **0 or empty**: Stop or Platform (empty is recommended). **1**: Station **2**: Station Entrance/Exit **3**: Generic Node. A location within a station, not matching any other location_type **4**: Boarding Area	Use only for stops inside a station, for a transfer location or for a Transit Center.	If the stop is in the same time zone as the agency, then this can be left blank. For list of time zones, refer to this site: **https://en.wikipedia.org/wiki/List_of_tz_database_time_zones** In website and in the table called List, use the TZ database name shown in the third column.	Indicates whether wheelchair boardings are possible. Valid options are: **0 or empty** - No accessibility information for the stop is available **1** - Some vehicles at this stop can be boarded by a rider in a wheelchair **2** - Wheelchair boarding is not possible at this stop

Figure 7.1 depicts how the public facing data from the **stops** tab is depicted on a trip plan.

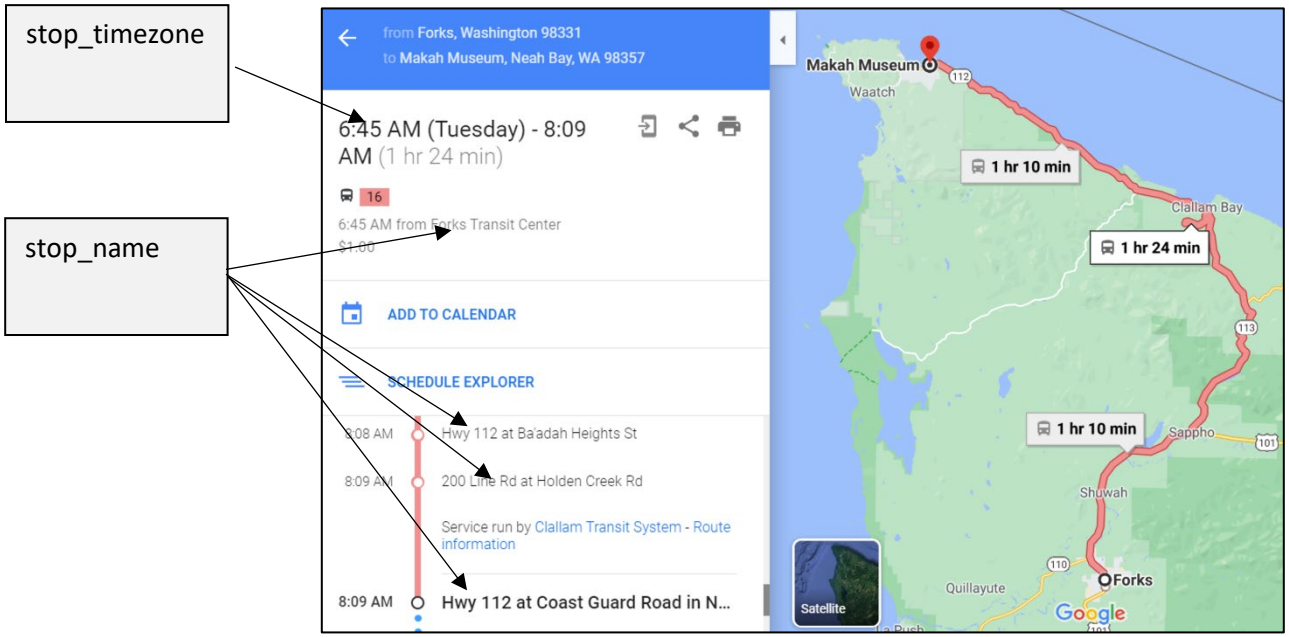

Figure 7-1 Stops Tab Data Displayed on a Trip Plan

8. Generate Trip and Stop_times Data in the Schedule Generator File

The **Schedule Generator** file is used to develop data for the **ImportExport** file **trips** and **stop_times** tabs. It is not used to directly export data to GTFS text files. Data is manually entered in the **Schedules_V3** tab. Data is then automatically generated in the **trips** and **stop_times** tabs using the file's macros.

In this file, a trip group includes all trips provided by a route in which the same consecutive bus stops are serviced. For example, if Route Z morning and late afternoon trips service stops 1, 2, 3, 4 and 5 and midday trips services stops 1, 3 and 5, the route would have two trip groups. In this case, the trip groups for Route A could be called RouteZAMPM and RouteZMID. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

8.1. Enter Schedule Data

1. Open the **Schedule Generator** file and, if not completed yet, enable macros per the instructions in *Section* 2 *Enable Macros.*
2. Go to **Schedules_V3** tab.
3. In Row 2
    a. Enter the name of the first trip group in column A.
    b. For trips that will have defined shapes, enter the shape_id associated with trips starting in column R and all columns to the right in that row that have a trip shape associated with it. Shapes are optional. Instructions to create trip shapes are described in *Section 14 Optional – shapes Tab.*
    c. If the trip group is serviced by a vehicle with a wheelchair lift, a "1" can be entered in Column P. Enter once for each trip group.
    d. If the trip group is serviced by a vehicle that can accommodate a bicycle, a "1" can be entered in Column Q. Enter once for each trip group.
    e. If a block_id for a route is to be included, it is entered in the same cell as the shape_id. Block_ids are generally used when a rider can remain on a vehicle for inbound and outbound trips or between the last stop on a trip and first stop of the next trip, which may be a different route. Data must be entered with the shape_id in this format: **shape_id:block_id**. The block_id name is either generated by scheduling software or manually. For agencies offering GTFS real-time information, a block_id may be required.
    f. No other information is entered in this row.
4. Fill in the remaining data per Table 8.1 and the sample data provided in Table 8.2. Do not leave any cells blank in the trip columns. A blank or empty cell in the trip rows will stop the trip. When times are unknown, enter an "*" asterisk. The start and end of a trip group cannot use an "*". Trips may have blanks for a partial trip that begins below the first stop. Any stops listed below the blank cell will not be shown for that trip.
5. For the next trip group leave a row blank and then, similar to row 2, enter in column A the trip group name (needs to be different for every route variation) and then the wheelchair, bicycle and corresponding trip shape and block_id information. Then on the following rows repeat step 4.

Table 8.1 Schedules_V3 Tab

Field	Trip Group	route_id	service_id	direction_id	trip_headsign
Public Facing	No	No	No	No	Yes
Required/Optional	**Required**	**Required**	**Required**	**Required**	Optional
Format	Text	Text	Text	Number	Text
Notes	Use the trip group title to help define the service (weekday, inbound/ outbound). All stops must be consecutive in a trip group. Create a new trip group when a bus stop is omitted or added on a trip or a different service_id is used.	Must match one of the route_ids listed in the **routes** tab in the **ImportExport** file. Enter the route_id in all rows where a stop is listed.	Must match one of the service_ids listed in the **calendar** tab in the **ImportExport** file. Enter the service _id in all rows where a stop is listed.	Indicates the direction of travel for a trip. Valid options are: **0** - Travel in one direction (outbound). **1** - Travel in the opposite direction (inbound). **1** - For loop routes Enter the direction_id in all rows where a stop is listed.	Set to the last stop on the trip. It is only entered in the row with the first stop's time information. Although optional, providing the trip_headsign data will expedite review by some trip planners.

This table continues on the next page.

Table 8.1 Schedules_V3 Tab (continued)

Field	stop_id	stop_name	stop_headsign	pickup_type	drop_off_type
Public Facing	No	No	Yes	No	No
Required/Optional	**Required**	Optional	Optional	Optional	Optional
Format	Text	Text	Text	Number	Number
Notes	Must match one of the stop_ids listed in the **stops** tab in the **ImportExport** file.	Match the stop_name listed for the stop_id in the previous column.	It is recommended the next stop in the trip be entered in this column. This is easily accomplished by linking the cell to the cell located one row down and one column to the left. This field overrides the default trip_headsign. For the last stop, leave the stop_headsign blank. The stop_headsign is used by the trip planner to show the next stop.	Indicates pickup method. Valid options are: **0 or empty** - Regularly scheduled pickup. **1** - No pickup available **2** - Must phone agency to arrange pickup	Indicates drop off method. Valid options are: **0 or empty** - Regularly scheduled drop off. **1** - No drop off available **2** - Must phone agency to arrange drop off

This table continues on the next page.

Table 8.1 Schedules_V3 (continued)

Field	continuous_pickup	continuous_drop_off	timed_stop	wait_time	timepoint
Public Facing	No	No	No	No	No
Required/Optional	Optional	Optional	Optional	Optional	Optional
Format	Number	Number	Number	HH:MM:SS AM	Number
Notes	Indicates whether a rider can board the transit vehicle for that segment of that trip group at any intersection of two roads, not just at identified bus stops. The path is described by the trip shape, from this stop_time to the next stop_time in the trip's stop_sequence. Valid options are: **0** - Continuous stopping pickup. **1 or empty** - No continuous stopping pickup. **2** - Must phone an agency to arrange pickup.	Indicates whether a rider can alight from the transit vehicle for that segment of that trip group at any intersection of two roads, not just at bus stops. The path is described by the trip shape, from this stop_time to the next stop_time in the trip's stop_sequence. Valid options are: **0** - Continuous stopping drop off. **1 or empty** - No continuous stopping drop-off. **2 -** Must phone an agency to arrange drop-off.	Enter a "**1**" in every row with a timed stop. This will allow the file's macro to generate a schedule which can be published on a website. Data in this column is not used in the GTFS.	This is the wait time between when a rider arrives and departs a stop. For a five-minute dwell or wait time enter 12:05:00 AM.	Indicates if arrival and departure times for a stop are exact or approximate. If exact, the bus will not leave prior to the time shown. This field also allows a trip planner to provide interpolated stop-times, while indicating that the times are approximate. Valid options are: **0 or empty** - Times are considered approximate. **1** - Times are considered exact.

This table continues on the next page.

Table 8.1 Schedules_V3 Tab (continued)

Field	wheelchair_accessible	bikes_allowed	T01	T02	T03
Public Facing	No	No	Yes	Yes	Yes
Required/Optional	Optional	Optional	**Required**	Optional	Optional
Format	Number	Number	HH:MM[1]	HH:MM	HH:MM
Notes	Entered one time for the entire trip on the row with trip group name. Indicates wheelchair accessibility. Valid options are: **0 or empty** - No accessibility information for the trip. **1** - Vehicle being used on this particular trip can accommodate at least one rider in a wheelchair. **2** - No riders in wheelchairs can be accommodated on this trip. There is no guarantee to the rider that the wheelchair accommodations will always have a space and riders know this.	Entered one time for the entire trip on the row with trip group name. Indicates whether bikes are allowed. Valid options are: **0 or empty** - No bike information for the trip. **1** - Vehicle being used on this particular trip can accommodate at least one bicycle. **2** - No bicycles are allowed on this trip. There is no guarantee to the rider that the bike rack will always have a space and riders know this.	For each trip and stop along a route, enter arrival time. Hours range from 0 to 24. However, for times occurring after midnight on the next service day, the hour value is entered as a value greater than 24. For example, 1:30 a.m. would be entered as 25:30. For each trip, the stops are entered in stop order and stops cannot be skipped. For stops where the time is unknown, an "*" must be entered. Actual times must be entered for the first and last stops. An "*" cannot be used for the first and last stops. A blank or empty cell in these columns will stop the trip. Stops listed below any blank cell will not be shown on a trip planner.		

[1] The columns are formatted to display 24-hour time; however, the trip planner will likely show the time in a 12-hour format.

In the sample data shown in Table 8.2, note that there is a blank row (Row 33) between the two trip groups. All trip groups must be separated by a blank row.

In the first row of each trip group (Row 2, and then in the example below, row 34) data is entered only in columns A (trip group), P (wheelchair status) and Q (bicycle status). The shape_id (and if used, block-id) associated with each trip is also entered in these rows. No other data should be entered in the first row of each trip group. For further information about Shapes, refer to *Section 14 Optional - shapes Tab.*

Table 8.2 Schedules_V3 Sample Data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	Trip_group	route_id	service_id	direction_id	trip_headsign	stop_id	stop_name	stop_headsign	pickup_type	drop_off_type	continuous_pickup	continuous_drop_off	timed_stop	wait_time	time point	wheelchair_accessible	bikes_allowed	T01	T02	T03	T04
2	16W_NeahBay_viaClallamBay															1	1	16Corrections+NeahBay:16_1			
3		Rt16	mtwtf	0	Neah Bay via Callam Bay	14_24	Forks Transit Ctr.	Tillicum Park and Forks Ave					1		1			6:45:00			
4		Rt16	mtwtf	0		14_29	Tillicum Park and Forks Ave	Hwy 101 at Smokehouse Restaurant										"			
5		Rt16	mtwtf	0		14_20	Hwy 101 at Smokehouse Re	Whitcomb Dimmel Rd and Hwy 101										"			
6		Rt16	mtwtf	0		14_31	Whitcomb Dimmel Rd and H	Gaydeski Rd and Hwy 101										"			
7		Rt16	mtwtf	0		14_32	Gaydeski Rd and Hwy 101	Iverson and Hwy 101										"			
8		Rt16	mtwtf	0		14_33	Iverson and Hwy 101	Mansfield and Hwy 101										"			
9		Rt16	mtwtf	0		14_34	Mansfield and Hwy 101	Salmon Dr and Hwy 101										"			
10		Rt16	mtwtf	0		14_35	Salmon Dr and Hwy 101	Beaver at Hwy 101										"			
11		Rt16	mtwtf	0		14_36	Beaver at Hwy 101	Lake Pleasant at Hwy 101										"			
12		Rt16	mtwtf	0		14_37	Lake Pleasant at Hwy 101	Sappho										"			
13		Rt16	mtwtf	0		14_60	Sappho	Hwy 113 at Grant Rd					1		1			7:01:00			
14		Rt16	mtwtf	0		16_1	Hwy 113 at Grant Rd	Hwy 113 and Hwy 112										"			
15		Rt16	mtwtf	0		16_2	Hwy 113 and Hwy 112	Hwy 112 and Weel Rd										"			
16		Rt16	mtwtf	0		16_3	Hwy 112 and Weel Rd	Eagle Crest Way										"			
17		Rt16	mtwtf	0		16_31	Eagle Crest Way	Clallam Bay					1		1			7:30:00			
18		Rt16	mtwtf	0		16_4	Clallam Bay	Sekiu					1		1			7:37:00			
19		Rt16	mtwtf	0		16_6	Sekiu	Hwy 112 and Airport Rd										"			
20		Rt16	mtwtf	0		16_7	Hwy 112 and Airport Rd	Hwy 112 and Tveit Dr										"			
21		Rt16	mtwtf	0		16_8	Hwy 112 and Tveit Dr	Hwy 112 and Eagle Pt Rd										"			
22		Rt16	mtwtf	0		16_9	Hwy 112 and Eagle Pt Rd	Hwy 112 and Vista Dr										"			
23		Rt16	mtwtf	0		16_10	Hwy 112 and Vista Dr	Hwy 112 Across From Sekiu River Rd										"			
24		Rt16	mtwtf	0		16_33	Hwy 112 Across From Sekiu	Ray's Place										"			
25		Rt16	mtwtf	0		16_11	Ray's Place	Hwy 112 at Ba'adah Heights St										"			
26		Rt16	mtwtf	0		16_12	Hwy 112 at Ba'adah Heights	Hwy 112 and Ba'adah Village Loop Rd										"			
27		Rt16	mtwtf	0		16_13	Hwy 112 and Ba'adah Villag	Hwy 112 at Coast Guard Road in Neah Bay										"			
28		Rt16	mtwtf	0		16_14	Hwy 112 at Coast Guard Roa	Hwy 112 at Warm House										"			
29		Rt16	mtwtf	0		16_15	Hwy 112 at Warm House	Hwy 112 at Marina										"			
30		Rt16	mtwtf	0		16_16	Hwy 112 at Marina	Hwy 112 at Mini Mart										"			
31		Rt16	mtwtf	0		16_17	Hwy 112 at Mini Mart	Arrive Neah Bay										"			
32		Rt16	mtwtf	0		16_18	Arrive Neah Bay						1		1			8:12:00			
33	**Note: a row must be skipped between trip_groups. No data can entered in this row.**																				
34	16_NeahBay_weekday															1	1	16toNeahE	16toNeahE	16toNeahBay:16_3	
35		Rt16	mtwtf	0	Neah Bay	14_24	Forks Transit Ctr.	Tillicum Park and Forks Ave					1		1			10:30:00	14:40:00	17:55:00	
36		Rt16	mtwtf	0		14_29	Tillicum Park and Forks Ave	Hwy 101 at Smokehouse Restaurant										"	"	"	
37		Rt16	mtwtf	0		14_20	Hwy 101 at Smokehouse Re	Whitcomb Dimmel Rd and Hwy 101										"	"	"	
38		Rt16	mtwtf	0		14_31	Whitcomb Dimmel Rd and H	Gaydeski Rd and Hwy 101										"	"	"	
39		Rt16	mtwtf	0		14_32	Gaydeski Rd and Hwy 101	Iverson and Hwy 101										"	"	"	
40		Rt16	mtwtf	0		14_33	Iverson and Hwy 101	Mansfield and Hwy 101										"	"	"	
41		Rt16	mtwtf	0		14_34	Mansfield and Hwy 101	Salmon Dr and Hwy 101										"	"	"	
42		Rt16	mtwtf	0		14_35	Salmon Dr and Hwy 101	Beaver at Hwy 101										"	"	"	
43		Rt16	mtwtf	0		14_36	Beaver at Hwy 101	Lake Pleasant at Hwy 101										"	"	"	
44		Rt16	mtwtf	0		14_37	Lake Pleasant at Hwy 101	Sappho										"	"	"	
45		Rt16	mtwtf	0		14_60	Sappho	Hwy 113 at Grant Rd					1		1			10:46:00	14:56:00	18:11:00	
46		Rt16	mtwtf	0		16_1	Hwy 113 at Grant Rd	Hwy 113 & Hwy 112										"	"	"	
47		Rt16	mtwtf	0		16_2	Hwy 113 & Hwy 112	Hwy 112 & Weel Rd										"	"	"	
48		Rt16	mtwtf	0		16_3	Hwy 112 & Weel Rd	Clallam Bay										"	"	"	

8.2.Generate stop_times and trips

In the **Schedule Generator** file, and **Intro.Control** tab, under the list of Macros:

1. Click on Clear Calculated Data
2. Click on Generate stop_times & trips.

Data should now be populated in the **Schedule Generator** file **stop_times** and **trips** tabs. Note that in the **stop_times** tab, data is generated in an odd format; for example, 10_20_00. *Do not revise this format*. It is required for the data to publish accurately.

8.3.Generate a Schedule for Agency Website

The **Schedule Generator** file can be used independently to generate a simple schedule timetable, easily formatted and copied onto an agency's website.

1. In the **Schedules_V3** tab, enter data as described above in *Sections 8.1 and 8.2*. Be sure to enter a "**1**" in the timed_stop column for each stop to be shown in a schedule timetable.
2. In the **Intro.Controls** tab click on "Generate Timed Stops." A new table is created in the **timed_stop** tab with stops listed in the top row. The table can be transposed using the Excel function Paste Special to have the stops listed in one column with the times to the right.
3. Format the timetable to match agency branding.
4. Copy the schedule directly onto the agency website, or
5. Copy schedule to a Google Sheet (in a Google Account) and then "embed" with a link from the Google Sheet to the agency website*. The Using the Schedules_V3 Tab in the Schedule Generator File to complete the Trips and Stop Times Tabs in the ImportExport File* video found **here** provides additional support and instructions.

9. Copy and Paste the trips and stop_times Tabs into the ImportExport File from the Schedules_V3 File

Make sure both the **ImportExport** and **Schedule Generator** files are open.

1. From the **Schedule Generator** file **trips** tab, copy all data (including row 1) and paste it into the **ImportExport** file **trips** tab. To easily copy an entire worksheet, choose the block left of A and above 1, right click and select copy (or use control+C). To paste an entire worksheet, right click paste in cell A1 (or use control+V). An attempt to paste elsewhere results in a warning to select cell A1 to match the data format of what was copied.
2. From the **Schedule Generator** file **stop_times** tab, copy all data (including row 1) and paste it into the **ImportExport** file **stop_times** tab.
3. Save and close the **Schedule Generator** file. It will not be needed again unless data is identified in the validation process that needs to be corrected or in the future when services are updated.

Figure 9.1 depicts how the public facing data from the stop_times tab is depicted on a trip plan.

Additional support and a demonstration of the explanations provided in this section are available in this **video**.

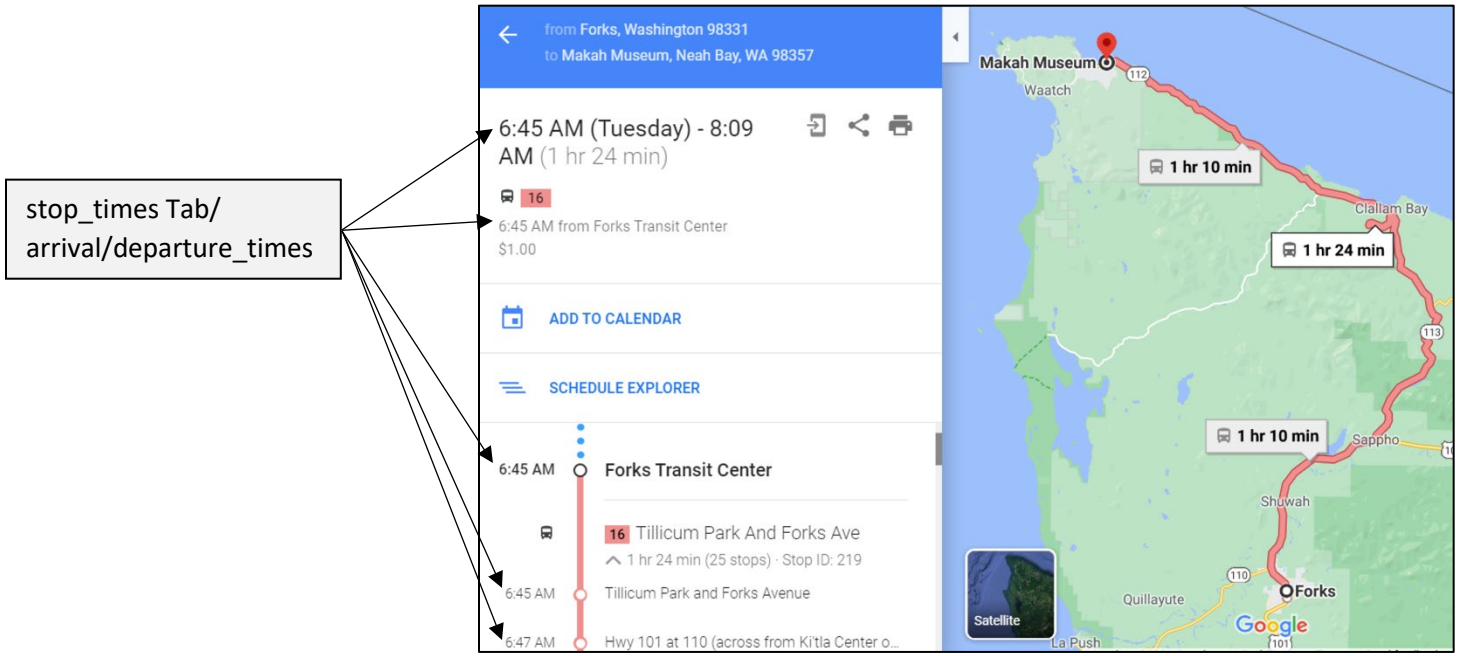

Figure 9-1 \Trips and Stop_Times Tabs Data Displayed on a Trip Plan

10. Complete the feed_Info Tab in the ImportExport File

Using the example data and explanatory information in Table 10.1, enter data in the **feed_info** tab. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

Table 10.1 feed_info Tab

Field	feed_publisher_name	feed_publisher_url	feed_lang	feed_start_date
Sample Data	Clallam Transit System	https://clallamtransit.com	en	20210201
Public Facing	Yes	Yes	No	No
Required/Optional	**Required**	**Required**	Optional	Optional
Format	Text	URL	Language Code	YYYYMMDD
Notes	This is typically the same as the agency_name entered in the **agency** tab	This is typically the same as the agency_url entered in the **agency** tab.	This is typically the same as the agency_lang entered in the **agency** tab.	It is recommended that a start date be entered that matches the earliest start in the **calendar** tab. The dataset provides complete and reliable schedule information for service in the period from the beginning of the feed_start_date day to the end of the feed_end_date day.

Table is continued on next page.

Table 10.1 feed_info Tab (continued)

Field	feed_end_date	feed_version	feed_contact_email	feed_contact_url
Sample Data	20220331	202101201	ops@transittown.org	
Public Facing	No	No	No	No
Required/Optional	Optional	Optional	Optional	Optional
Format	YYYYMMDD	YYYYMMDD	Email	URL
Notes	It is recommended that an end date be entered that matches the latest end date in the **calendar** tab. The dataset provides complete and reliable schedule information for service in the period from the beginning of the feed_start_date day to the end of the feed_end_date day.	This is the date the feed was completed and considered accurate. It is typically the date the data in all tabs is exported to a text file.	Contact information for person responsible for dataset.	URL to a form for recommending edits to this dataset.

11. Next Steps

At this point, all required data has been entered into the **ImportExport** file. However, if data related to fares or transfers is to be entered, skip to *Section 13*. If trip shapes are to be created, skip to *Section 14*. Otherwise, proceed to *Section 12* to create the GTFS data text file and validate the data.

12. Create GTFS Text Files and Validate Data

Additional support and a demonstration of the explanations provided in this section are available in this **video**.

1. Create and Export Text Files
    a. In **ImportExport** file and **Notes** tab, click on the Export button.
    b. The macro will create a subfolder called "feed" in the folder where the **ImportExport** file is located. The text files created by the macro will be stored here.
2. Create a Compressed Zip Folder of the GTFS text files.
    a. Open the Feed folder and highlight all text files by pressing Ctrl+A.
    b. Right click and select "Send to".
    c. Select "Compressed .Zip Folder".
    d. A Compressed .Zip Folder will appear in the Feed folder. The feed folder contains the GTFS data created through GTFS Builder.
3. Confirm the data is correct by using a GTFS validator. There are many validators to choose from. Here is one option: **https://reflect.foursquareitp.com/validator/**
4. Follow the instructions to upload the .zip file and then run the validator.
5. Note any errors and return to the **ImportExport** file and, if needed the **Schedule Generator** file, to make any necessary edits and corrections. Repeat the feed generation and validation process.

A feed will not be accepted by a trip planner if there are "errors". However, "warnings" may indicate only that data needs adjustment or there are new and/or unfamiliar columns. Warnings can be ignored. A common warning is that a stop is not being used in any trip. This warning can be ignored. Another common warning is that travel time between stops exceeds a safe speed. This suggests the time to travel between stops is too fast for the distance covered. The agency, understanding local conditions, may choose to keep the schedule as is or make an adjustment.

A common error is duplicate stops with the same, or too close geocoding. In this case, simply delete the extra stop in all tabs it is referenced. Another common error are colors, determined in the **routes** tab, that are not sufficiently contrasting to meet ADA requirements. This may be resolved by changing from white to black or the reverse.

13. Optional – Complete transfers, fare_attributes, and fare_rules Tabs

To display information related to one-way adult fares and refine how transfers between routes display, data must be entered into these similarly named tabs. Data entry in these three tabs is not required. However, if data is to be entered, data in the columns listed shown in the tables below as "**Required**" must be entered. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

13.1. transfers Tab

Table 13.1 provides sample data, as well as explanatory information for the **transfers** tab.

Table 13.1 transfers Tab

Field	from_stop_id	to_stop_id	transfer_type	min_transfer_time
Sample Data	16_18	16_19	1	120
	16_19	16_18	1	180
Public Facing				
Required/Optional	**Required**	**Required**	**Required**	Optional
Format	Text	Text	Number	Number (seconds)
Notes	Must match one of the stop_ids listed in the **stops** tab. Identifies a stop or station where routes connect. Enter each stop_id by travel direction. Do not assume a transfer applies to the reverse direction. The same stop_id entered for both "from" and "to" indicates a location where drivers will wait to guarantee a successful transfer, even if one trip is running late and the transfer_type is "1".	Must match one of the stop_ids listed in the **stops** tab. Identifies a stop or station where routes connect. Enter each stop_id by travel direction. Do not assume it works in reverse. The same stop_id entered for both "from" and "to" indicates a location where drivers will wait to guarantee a successful transfer, even if one trip is running late.	Indicates the type of connection for the specified (from_stop_id, to_stop_id) pair. Valid options are: **0 or empty** - Recommended transfer point between routes. **1** - Timed transfer point between two routes. The departing vehicle is expected to wait for the arriving one and leave sufficient time for a rider to transfer between routes. **2** - Transfer requires a minimum amount of time between arrival and departure to ensure a connection. The time required to transfer is specified by min_transfer_time. **3** - Transfers are not possible between routes at the location.	Amount of time, in seconds, available to permit a transfer between routes at a specified stop. For example, two minutes would be shown as 120 (2 minutes X 60 seconds). The min_transfer_time should be sufficient to permit a typical rider to move between the two stops, including buffer time to allow for schedule variance on each route.

13.2. fare_attributes Tab

Riders appreciate knowing what it costs to jump on the bus. If a one-way adult fare system cannot be accurately modeled, avoid confusion and leave the fare related tabs blank. As an option, provide a link to more fare information through the agency_fare_url (in the **agency** tab).

Fares will display only for one-way adult trips. Currently, the GTFS do not provide an option to show monthly passes, discounts for seniors/youth or others. Fares require data to be entered in the **fare_attributes** and **fare_rules** tabs.

Table 13.2 provides sample data, as well as explanatory information for the **fare_attributes** tab.

Table 13.2 fare_attributes Tab

Field	**fare_id**	**price**	**currency_type**	**payment_method**
Sample Data	100	1.00	USD	0
	2	3.50	USD	0
Public Facing	No	Yes	Yes	Yes
Required/Optional	**Required**	**Required**	**Required**	**Required**
Format	Text	Number	Currency code	
Notes	Identifies a fare class. Each fare_id value can appear only once in the **fare_attributes** tab. A fare_id may apply to multiple routes.	Entered in the unit defined by currency type. A $ sign should not be used.	"USD" for dollars For other currency codes refer to: **https://en.wikipedia.org/wiki/ISO_4217#Active_codes**	Indicates when the fare must be paid. Valid options are: **0** - Fare is paid on board. **1** - Fare must be paid before boarding.

This table continues on the next page.

Table 13.2 fare_attributes Tab (continued)

Field	transfers	agency_id	transfer_duration
Sample Data	0	CTS	
	2	TTA	5400
Public Facing			
Required/Optional	**Required**	**Required**	Optional
Format		Text	Number (seconds)
Notes	Indicates the number of transfers permitted on this fare. Valid options are: **0** - No transfers permitted on this fare. **1** - Riders may transfer once. **2** - Riders may transfer twice. empty - Unlimited transfers are permitted.	Must match one agency ID listed in the agency tab.	Length of time in seconds before a transfer expires. For example, 30 minutes would be shown as 1800 (30 minutes X 60 seconds).

13.3. fare_rules Tab

Data entered in this tab, specifies how fares_ids, established in the **fare_attributes** tab, are applied to itineraries using route_ids and, if needed, zones. Zones include the origin zone, the destination/final zone and any zones the route passes through (contains_id). Zone-id listed under origin, destination and contains are defined in the **stops** tab. Table 13.3 provides sample data, as well as explanatory information for the **fare_rules** tab.

Additional samples of fares rules can available **here**.

Table 13.3 fare_rules Tab

Field	fare_id	route_id	origin_id	destination_id	contains_id
Sample Data	100	Rt16			
	2	TransitP	A	B	
Public Facing					
Required/Optional	Optional	Optional	Optional	Optional	Optional
Format	Text	Text	Text	Text	Text
Notes	Must match one of the fare_ids listed in the **fare_attributes** tab.	Must match one of the route_ids listed in the **routes** tab.	Must match one of the zones listed in the **stops** tab.	Must match one of the zones listed in the **stops** tab.	Must match one of the zones listed in the **stops** tab.

14. Optional – Complete shapes Tab

On a map, a shape helps snap the trip to roads. Without shapes the route often displays the trip "stop to stop" with straight lines over buildings, rivers and parks. Shapes are associated with trip groups, and consist of a sequence of points on a map through which a vehicle passes in a unique stop order. Establishing and entering shape data into the **shapes** tab is optional and may be time consuming. However, shapes are required elements and must be established if continuous pick-up and drop-off are allowed on a trip group or route. Similar to establishing bus stop locations, Google MyMaps and Google Earth are used to detail the trip's shape. The shape data also assures that all the stops on that trip are in the correct stop order. Agencies can use other mapping software if available. Some prior experience with Google Maps "MyMaps" products may be helpful.

A shapes "line" is generated in .kml. The kml data is entered in the **ImportExport** file in the **shapes** tab as a list of points (latitude and longitude) which define the path of a trip.

Shapes points along a trip do not need to intersect the location of stops exactly, but all stops on a trip should lie within a short distance of the shape for that trip. GTFS Builder checks the distance between the stops and the trip shape, and provides an alert if the stop is located over 30 meters (approximately 100 feet) from the trip shape. It is recommended a shape_point be located ahead of the stop within 30 meters. Instructions on how to test the proximity of stops to trip shapes, and make corrections, are described below.

To observe and follow the steps of creating a new shape, refer to the *Creating Trip Group Shapes and Complete the Shapes Tab in the ImportExport File* **video**.

14.1. Instructions

1. Open the **ImportExport** file and **shapes** tab.
2. Go to mymaps.google.com
    a. Select the map used to establish the bus stop coordinates in *Section 6 Identify Bus Stop Locations.*
    b. Check the box at the bus stop layer so the bus stops are showing on the map.
    c. Click on "Base Map" and select the Satellite view (top middle block).
    d. Click on the curved arrow the in the menu bar. 
    e. Click on "Untitled layer" and re-name it "trip one" or other. The shape_id could also be used as the name.
    f. Under the Driving icon (left menu), enter a bus stop location for location "A". Then enter the final bus stop for the shape in "B." A few middle stops can be entered along the way, by clicking on "Add Destination" and then reordering (by dragging) the list. Up to ten stops (A to J) along a trip group path can be entered. All stops do not need to be defined or listed. This is an approximate path on the roads the trip will travel.
    g. The initial trip shape path is shown on the map in blue. Confirm that it respects one-way streets.
    h. If the path shown needs to be modified to better show the correct route of the trip, click on the path in the area where an edit is required. A white circle will appear. Drag the circle to adjust the path as needed. Make as many adjustments as needed to represent the best sketch of the trip.

i. Do not attempt to edit the path in areas where it passes through a parking lot or along private roads. Focus only editing the primary path on the road. Sections of the path that passes through parking lots/private property are refined later in this process.

j. Click on three dots next to the map name and select Export to KML/KMZ and select the correct shape layer.

k. Check “Export as KML, not KMZ” and then Download.

l. Depending on Google Earth’s settings, Google Earth automatically launches or may need to be opened.

3. Open Google Earth
    a. Depending on a computer’s settings:
        1. Google Earth may automatically launch and KML file displays, or
        2. It may be necessary to open Google Earth and then open the KML file in the computer’s download folder.
    b. In each of these cases, the KML file should automatically appear under My Places or Temporary Places.
    c. Right click on small blue globe left of the layer created.
    d. Select Copy or, from the top navigation menu, select Edit>Copy.
4. Return to the **ImportExport** file and **shapes** tab
    a. In column A, go to a blank row.
    b. Double left click and type **7** (Paste KML/GPX line...).
    c. Enter the name of the shape_id for this trip. Make sure this name matches shape_id either previously entered or to be entered in the **trips** tab.
    d. The points, and their coordinates, that establish the shape will appear, along with the sequence of the points and the distance between each point.
5. To replace or update an existing shape
    a. Follow steps 1 through 4b.
    b. After the 7 is entered, a dialog box will appear asking if you are replacing or updating a shape_id. Agree that this process will replace prior data and cannot be undone by selecting OK twice.

Table 14.1 provides sample data, as well as additional explanatory information for the **shapes** tab.

Table 14.1 shapes Tab

Field	shape_id	shape_pt_lat	shape_pt_lon	shape_pt_sequence	shape_dist_traveled
Sample Data	16NeahBaytoForks	48.368574	-124.624979	1	0
	16NeahBaytoForks	48.368565	-124.625208	2	0.010
Public Facing	No	No	No	No	No
Required/Optional	**Required**	**Required**	**Required**	**Required**	Optional
Format	Text	Latitude in decimal degrees accurate to six decimal places.	Longitude in decimal degrees accurate to six decimal places.	Number	Number
Notes	Each shape may consist of hundreds, or even thousands, of points. Each point is assigned the same shape_id.	Each data point consists of a set of coordinates (latitude and longitude).	Each data point consists of a set of coordinates (latitude and longitude).	The "sequence" establishes the points location along the shape. Values must increase along the trip but do not need to be consecutive.	The distance traveled is the distance from the first point on the shape. The first point will always have a value of "0".

14.2. Check Distance from Shape to Stops

1. To check that the trip shape has a point within 30 meters/100 feet of stops serviced by the trip and for any other shape errors, go to the **ImportExport** file.
    a. Open the **trips** tab
    b. Double left click inside a data row with the trip shape_id to be checked.
    c. Say Yes to Export trip.
    d. Select 2 and click on OK.
    e. Select OK again.
    f. The **stop_times** tab will automatically display that trip and shape. Check column P for any comments/errors. If no comments/errors appear, the process is complete. If a comment or error needs to be addressed, immediately follow the next set of steps.
2. Go to Google Earth.
    a. Right click on Temporary Places and Paste (control+V).
    b. The shape is entered and includes three sublayers (Line, Point and Stops). All should have a check in the adjacent box.

c. Double click on stops where distance errors are noted. Corrections can be made by either moving one of the pins (representing a point on the trip shape) closer to the stop or by adding a new point near the stop. But first, right click on the path near the stop in question and select properties. Ignore the white box/field that opens. If necessary, move it away from the area to be worked on.
    1. To move a point or pin along the line, click on the pin. When the color changes from red to blue, drag it closer to the stop.
    2. To add a point, click on any red dot on the path near the stop. When it turns blue, add a point after that one and then drag it to a location within 100 feet of the stop. It is recommended the pin be located just ahead of the bus stop pin.
    3. When a stop is used multiple times through a trip group, the first pass through the stop must be the lowest number on the shape_points, the second pass through the stop must be the next highest value, etc.
d. Once the corrections are made, in the left menu, right click on the globe next to the trip corrected and select copy.

3. Return to the **ImportExport** file
    a. Open **shapes** tab
    b. Go to a blank row.
    c. Double left click and type **7** (Paste KML/GPX line...).
    d. Enter the exact name of the trip shape_id.
    e. Reply yes to replacing data.
    f. The points, and their coordinates, that establish the shape_id will appear, along with the sequence of the points and the distance between each point.

15. GTFS Flex Workaround

Until Google and other trip planners allow flexible on-demand services to be published with the forthcoming GTFS-Flex specifications, GTFS Builders offers an easy workaround to ensure these services are seen on trip planners. The following details how to build a "flex workaround" solution within the current constraints of "fixed and timed" schedules required by Google and other trip planners. Additional support and a demonstration of the explanations provided in this section are available in the *Demand Response Services* **video.**

1. Create a simple "workaround route" on the agency website. The route can consist of a few stops (4 to 8 stops) and include as few as one trip per day or even one trip per week. The "workaround route" must be shown on the agency website and it must indicate on the website that riders are not required to call-in to travel using the "workaround route." As described above in *Section 8.3 Generate a Schedule for Agency Website*, a simple schedule can be created using the **Schedule Generator** file and copied onto the agency website.
2. Data related to this route, along with any other agency fixed routes, are entered into the **ImportExport** file using the instructions provided in *Sections 1 through 14* above. In the **Schedule Generator** file, **Schedules_V3** tab, "**2**" must be entered in the pickup_type and drop_off_type columns for the "workaround route" to indicate the rider must phone the agency to arrange pickup and drop-off. For the trip plan to show riders where the flexible route will pick-up them up or drop-off them off, a shape_id must be included to define the path between stops.
3. Assuming, Google is selected for one of the agency's preferred trip planners, sign up and, as instructed, include a link to the simple "Workaround" route. Agree that services do not require a reservation.
4. Once launched, the agency can then enter details for continuous_pick-up and drop-off, as well as rider must call for a pick-up.

16. Trip Planners and GTFS Feed

There are many trip planners that GTFS data can be consumed by or published. Google, Apple, Bing, CityMapper, Google, Moovit and the TransitApp are examples. Each has its own set of instructions and requirements. Additional support and a demonstration of the explanations provided in this section are available in this **video**.

Often an agency will publish the fully valid GTFS .zip file at the agency's website with a URL and these trip planning services can "ping" or check that URL daily and publish updated data. There are also feed registries that connect an agency's data to all trip planners that "ping" or check that URL and make the feed publicly available. If an agency does not want the feed hosted at its website, National RTAP offers this service. To learn more, visit **GTFS Builder Support**.

Google Inc. requires a signed license agreement. This *Trip Planner Licensing Agreements* video found **here** provides an explanation of the low-risk terms detailed in the agreement. Other trip planners may request a simple email from an agency confirming they can publish agency's GTFS data. Contact information for a few sample feed registries and trip planners are listed below:

Apple	transit_contact@group.apple.com
Bing	bingmapstransit@microsoft.com
CityMapper	https://citymapper.com/contact
Google Transit/ Google Maps	https://support.google.com/transitpartners/answer/1111481, https://support.google.com/transitpartners/contact/agency_participate
Moovit	https://moovit.com/contact-us/
National Transit Map	https://www.bts.gov/national-transit-map/how-participate
Rome2Rio	https://help.rome2rio.com/en/support/tickets/new
TransitApp	http://transitapp.com
Transitfeeds	Open Mobility Data: https://transitfeeds.com
TransitLand feed registry	https://www.transit.land

This list is not endorsed by National RTAP but may ease an agency's ability to enhance their riders' experience with multiple platforms or channels for trip planning. National RTAP understands that there may be additional services offered by some of these companies, however the basic trip planning should be offered at no cost to the agency. National RTAP does not guarantee or require any agency to use these services or qualify their services.

Appendix

GTFS Builder Check List

National RTAP GTFS Builder Checklist

Agency Name: _____ Staff Contact: _____

Task	Guidebook Section	Time Estimate	Begin Task Date	End Task Date	Notes
REQUIRED TASKS					
If Google Transit is the preferred trip planner, confirm the agency can agree to the Google Licensing Agreement.		60 min.			
Download Google Earth Desktop to the PC for this project	1	15 min.			
Configure project folder for macros	1	10 min.			
Complete the ImportExport tabs: agency, calendar, calendar dates and routes	2,3,4,5	60 min.			
Determine if agency bus stop coordinates are available from other organizations. If so, obtain them.	6	30 min.			
If not, identify bus stop coordinates from MyMaps and/or Google Earth.	6	60 min.			
Enter bus stop coordinates from MyMaps or Google Earth or file into the ImportExport stop tab.	7	20 min.			
Complete the Schedule Generator file Schedules_V3 tab by entering timetable/schedule, stop by stop.	8	30 min. (per route)			
Complete the ImportExport tab: feed_info.	10	5 min.			
OPTIONAL TASKS					
In the ImportExport file complete the transfers tab.	13	5 min.			
In the ImportExport file complete the fares and fare_attributes tabs.	13	20 min.			
Using MyMaps or other tools, create trip shapes.	14	20 min. (per shape)			
Copy the shape files into the ImportExport shapes tab (by trip)	14	10 min.			
Confirm the shape_id is entered in the Schedules_V3 tab	14	5 min.			
REQUIRED TASKS					
In the Schedule Generator file, using the macro generate stop_times and trips data.	8	2 min.			
Copy/paste data in the stop times & trips tabs in Schedule Generator into the similarly named ImportExport file tabs.	9	2 min.			
If shapes were created, calculate distance between stops and shape.	14	10 min.			
In the ImportExport file, using the macro, generate GTFS text files.	10	2 min.			
Compress (.zip) the text files.	12	2 min.			
Validate the .zip & resolve all errors/evaluate warnings	12	10 min.			
Upload fully valid GTFS .zip to trip planner	16	10 min.			

For further technical assistance, please contact National RTAP either by email (support@nationalrtap.org) or by phone (888-589-6821). These contacts can also be used to provide input on this document. Constructive feedback is appreciated and used to improve the process for future users of GTFS Builder.