

Proof of Concept(POC) Toolset User Guide for V2X Enabled Work Zone Data Collection Tool

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POC Toolset User Guide

1 Utilizing the POC TMC Website

1.1 Website Location

Navigate to the website (currently hosted in an unauthenticated POC website located at https://neaeraconsulting.com/V2x_Home)

1.2 Configuration Creator

Create, edit, and publish configuration files

Configuration files hold vital work zone information

1.2.1 Creating a new configuration file

To enter a new configuration file, open the Configuration Creator page and start entering information. The name of the configuration file will be automatically created using the WorkZone Description + RoadName + “.json”

All required data will not be required to save the configuration file, but in order to publish the data the required fields must be entered

Save config file

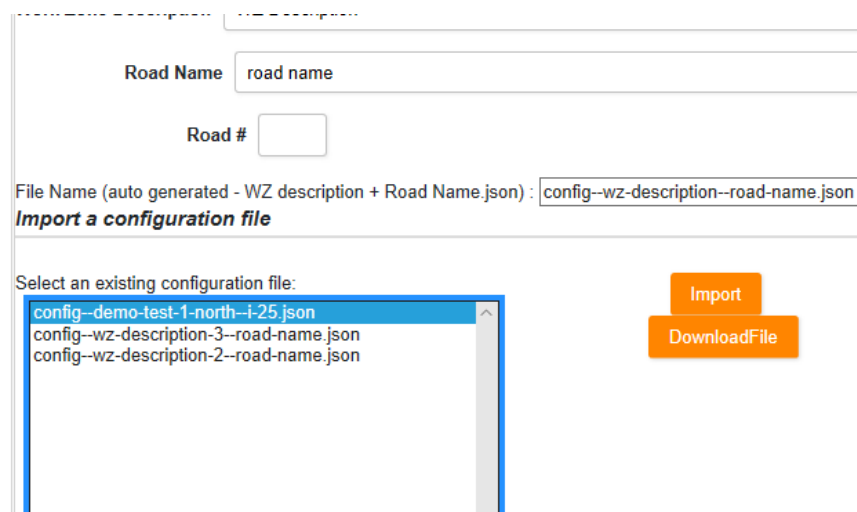
At any time, the information can be saved by selecting the save button

1.2.2 Updating a configuration file

Select config file by ID and import

1.2.2.1 Edit file

To edit a configuration file, select any file in the list, see Figure 1, and select Import



The screenshot displays the Configuration Creator web interface. At the top, there are input fields for 'Road Name' (containing 'road name') and 'Road #' (empty). Below these, a text label indicates the 'File Name (auto generated - WZ description + Road Name.json)' as 'config--wz-description--road-name.json'. A section titled 'Import a configuration file' contains a list box labeled 'Select an existing configuration file:' with three entries: 'config--demo-test-1-north-i-25.json' (highlighted), 'config--wz-description-3--road-name.json', and 'config--wz-description-2--road-name.json'. To the right of the list box are two orange buttons: 'Import' and 'DownloadFile'.

Figure 1 Edit configuration file

1.2.2.2 Save file

At any time the data can be saved by selecting the Save button option at the bottom of the configuration creator page

1.2.2.3 Configuration field descriptions

For a detailed description of each field and field types refer to Appendix A Configuration File Definitions

1.2.3 Publishing a configuration file

1.2.3.1 Import config file

Importing a configuration file will download the configuration data and populate the configuration creator fields within the webpage by selecting an item in the published configuration list and clicking Import, see Figure 2

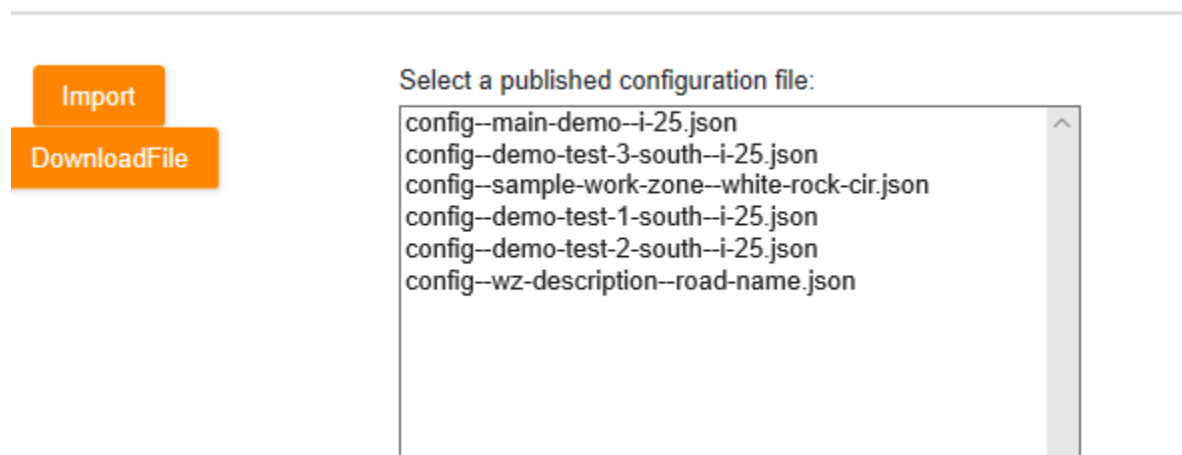


Figure 2 Import Published Configuration File

1.2.3.2 Publish config file

Publishing a configuration file will require all required fields to be populated and then move the configuration file from the in-progress to the published folders in the Cloud. By publishing the configuration file, it will allow the file to be used within the data collection tool

1.3 Upload Page

Upload work zone data ZIP archives

If the configuration files, csv and WZDx files were saved from another location (and saved as a zip file) you can select this option to upload the zip file to the published directory. Here, the files will be unzipped in the Cloud and made available in the published directory for the data collection tool to use

1.3.1 Upload work zone data

Select upload, select ZIP archive, and press upload

1.4 Verification and Visualization page

Verify and visualize mapped work zones for distribution

Work Zone Verification

Choose Work Zone to Visualize

accuracy-test-1--prairie-center-cir
accuracy-test-2--prairie-center-cir
accuracy-test-3--prairie-center-cir
accuracy-test-4--prairie-center-cir

^
v

Load Visualization



Figure 3 Work Zone Configuration

1.4.1 Load visualization of work zone

To view a visualization of the work zone, go to the Work Zone Verification page, select a workzone from the list and select load visualization. Here, 2 maps are displayed (the RSM as a pop-up) and the WZDx

1.4.1.1 RSM visualization

The RSM map will display in a pop-up window (image shown below). The RSM visualization features an information window on the left side and a map overlay on the right side. The purple dots are vehicle path data points (recorded at 10Hz), and markers indicate features marked in the work zone (reference point, lane closures and the presence of workers)

White lines indicate lane lines, and small black lines perpendicular to lane lines indicate locations of the reduced vehicle path data. Red lines, red shading and traffic cones accompany lane closures and the tapering regions surrounding them. Speed limit signs are also shown on the map next to locations where the speed limit changes, as seen in Figure 4

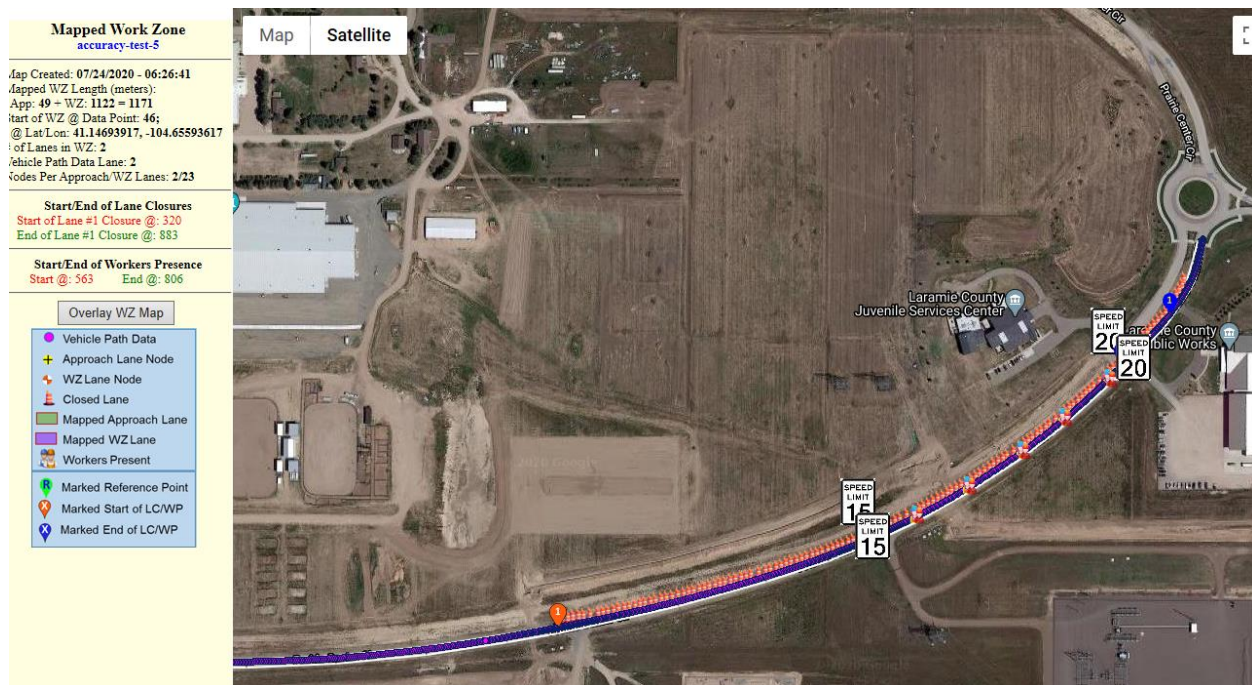


Figure 4 RSM Visualization

1.4.1.2 WZDx visualization

The WZDx visualization is overlaid on a satellite map, in the TMC website page (image below). Hover over the highlighted path to view detailed information associated with that path segment (displayed in the top center of the map) as seen on Figure 5



Figure 5 WZDx Visualization

1.4.2 Verify and publish work zone

After visualizing a work zone, verify for distribution. This will take the selected Work Zone and copy the file to a publish location within Azure and make it available

1.5 Published page

View and download published work zone data, go to the Published Work Zone Data page. Here you can select a published work zone and see the work zone in the map

Published Work Zone Data

Choose Work Zone to Download

Choose a work zone and specify messages to download

accuracy-test-1-prairie-center-cir
accuracy-test-2-prairie-center-cir
accuracy-test-3-prairie-center-cir
accuracy-test-4-prairie-center-cir

Description:
Road Name:
Start Date:
End Date:

☐ Work Zone Data Exchange message (WZDx), type = geojson
☐ XML Roadside Safety Message (RSM), type = xml
☐ Binary Roadside Safety Message (RSM), type = uper

Download Work Zone Data




Figure 6 Published Work Zone page

1.5.1 Download published work zone data

Select work zone and file types and download any of the file options for this specific published work zone

2 Utilizing the WZDC Tool

2.1 GitHub Location

Download and install the tool from <https://github.com/TonyEnglish/V2X-manual-data-collection>

2.2 Required hardware

The application required hardware:

- USB GPS (10Hz data rate)
- Laptop/tablet that can run Python

2.3 Required environment

- Internet to access the website
- Environment variables (Email debbie@neaeraconsulting.com for instructions)

2.4 Setting up the tool

The Data collection tool is currently written in Python and some additional libraries are needed to run the application

2.4.1 Python

Install the latest version of python - <https://www.python.org/downloads/>

Ensure that python is added to your system path

Install the following python libraries:

- esptool
- azure-storage-blob
- image
- wheel
- serial
- pynmea2
- zipfile
- xmltodict
- tkinter

2.4.2 Java

Install java - <http://www.java.com/getjava/>

2.5 Initializing the tool

Load configuration file, establish GPS connection, begin data collection

- Open a command prompt and go to the location of the application
- Type in: 'python WZDC_tool.py' - you should see a window appear as in Figure 7

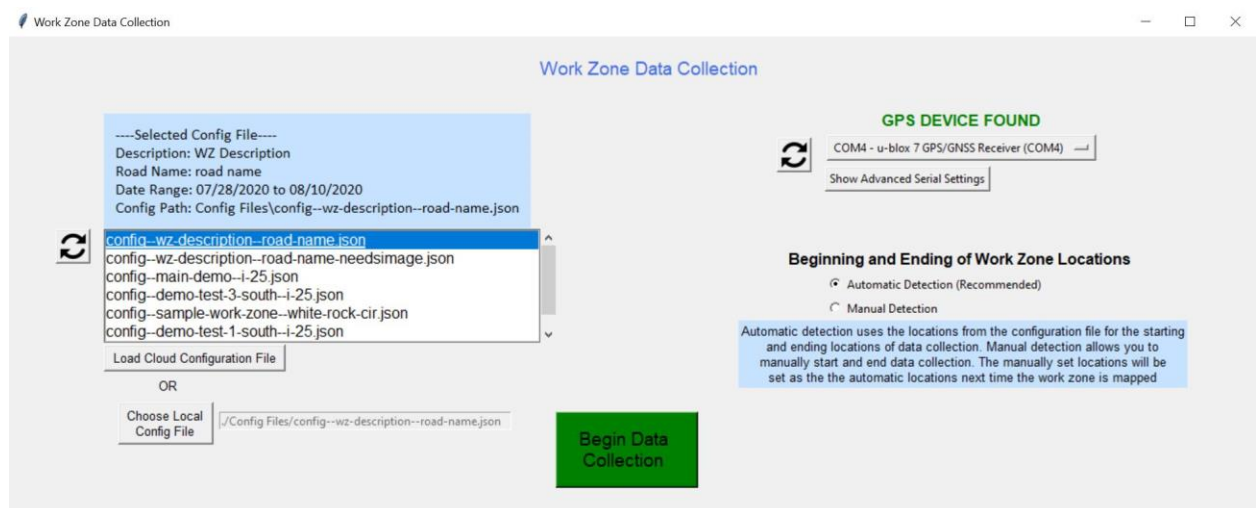


Figure 7 Initialize data collection tool

2.5.1 Loading a configuration file

You have a choice to load a configuration file from the cloud or local to your own device

2.5.1.1 Cloud

Select an item in the list and select Load Cloud Configuration File

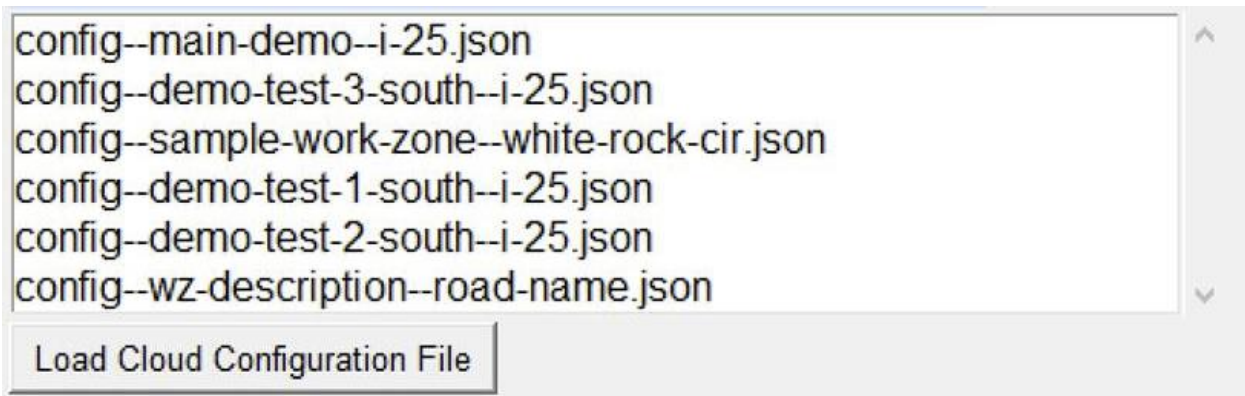


Figure 8 Import Configuration file from the Cloud(Azure)

2.5.1.2 Local File

Select the choose Local Config file button and browse to your own .json file to import



Figure 9 Import Configuration File from local file storage

2.5.2 Detecting/connecting to GPS device

Plug in USB GPS device and refresh the app (Refresh button next to GPS menu)

To ensure GPS connection, plug in the GPS before starting the application. If you plug in the GPS device after the application has already started, simply refresh the GPS menu. You can select on advanced serial connection settings and see the Baud rate and data rate for the GPS

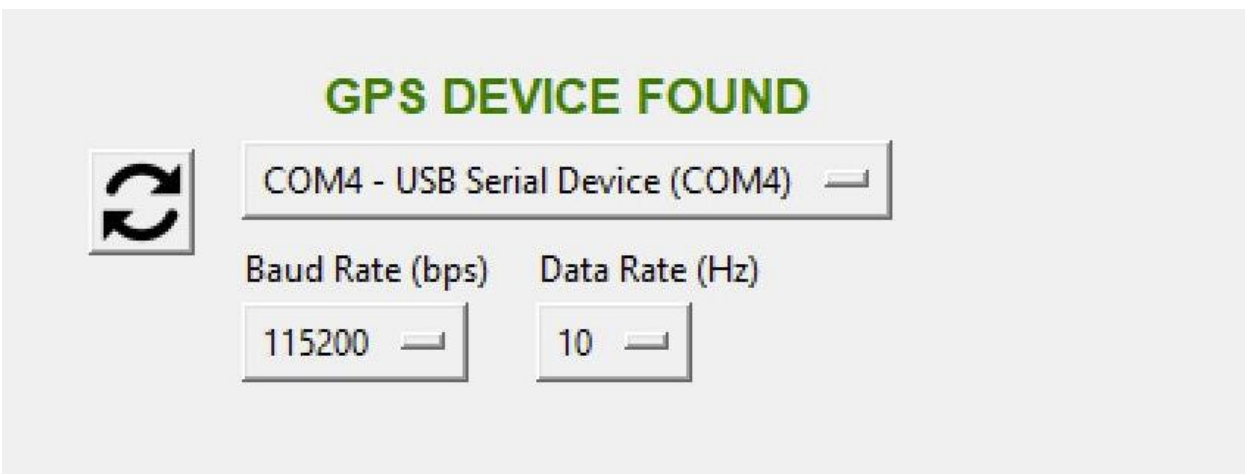


Figure 10 Connecting GPS

2.5.3 Beginning and Ending of WZ Detection Method

There are two modes of detecting the start/end points of the work zone and starting/ending data collection. The primary method is automatic detection; This method utilized the start/end locations saved in configuration file to begin/end data collection. The secondary method is manual detection, in which the user manually marks the start and end of the work zone/data collection. These manually marked locations will be saved in the configuration file for use in automatic detection the next time that specific work zone is driven/mapped

2.6 Collecting vehicle path data

At the start of the data collection the application will show this screen (and show the correct number of lanes as defined in your configuration file) as in Figure 11

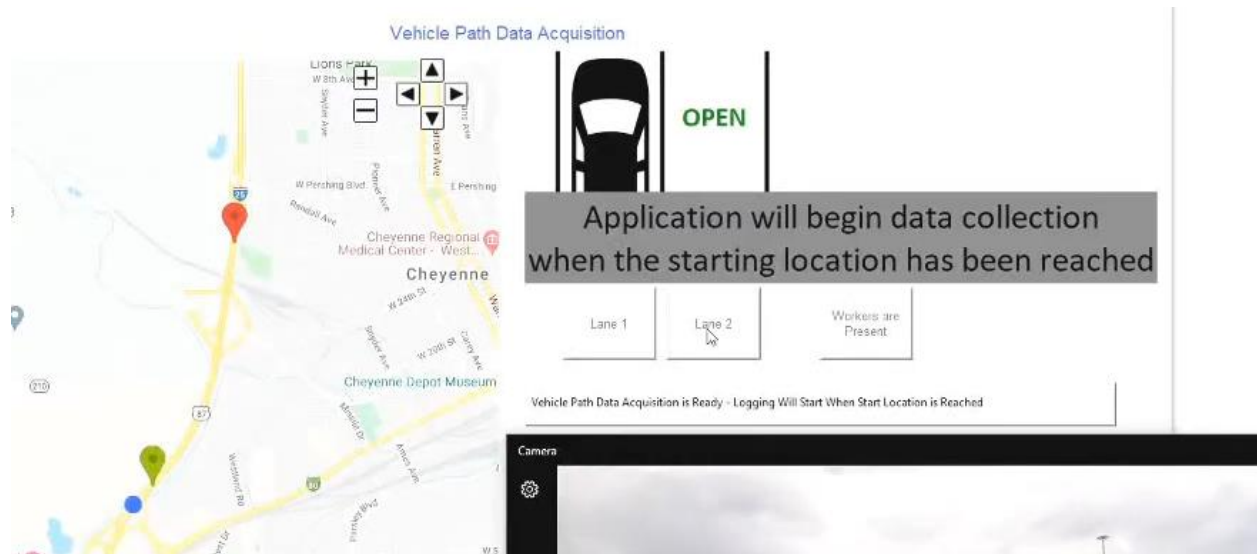


Figure 11 Collecting vehicle path data

The GPS will start collecting data once you have passed the starting point, and should show this notification as in Figure 12

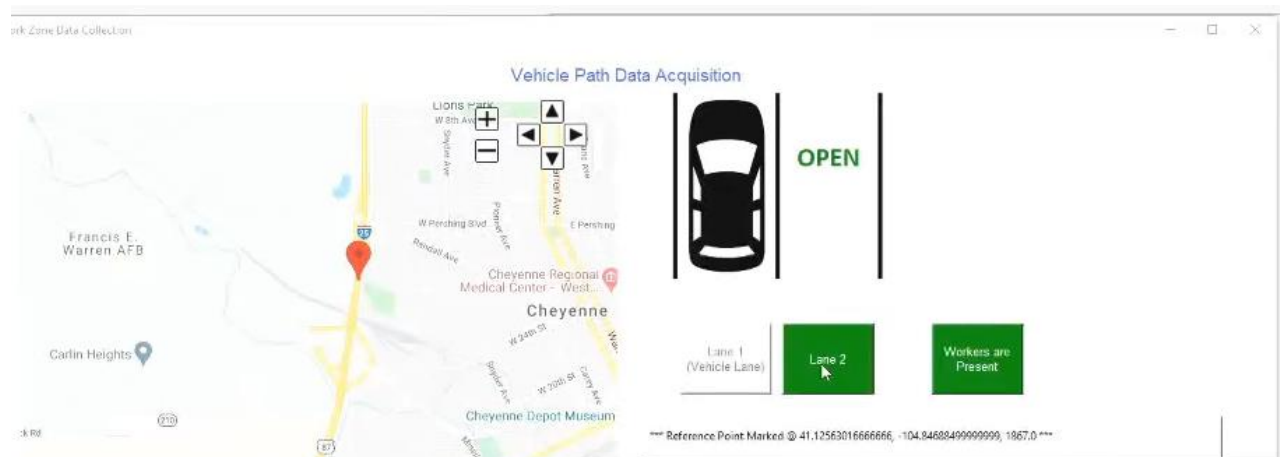


Figure 12 Data collection start configuration

2.6.1.1 Mark features

Features to mark:

- Lane Closures
- Workers Present
- Lane opening

Once you pass the starting location and data collection starts, you may start marking work zone features

To mark a lane closure/opening, simply click the button labeled 'Lane #'. Mark a lane as closed when the lane starts tapering to closed. Mark a lane as open when the lane starts tapering to open

To mark the presence/lack of workers, toggle the 'Workers are present'/'Workers no longer present' button

Once the GPS collection has started (passed the start reference point) you may select any of these features as you drive through the work zone

2.6.1.2 End of Work Zone

The End of the Work Zone will be defined as the end of the data collection. This will happen automatically (as defined in the configuration file) and will notify the user on the screen that the data collection has completed

2.7 Uploading mapped work zone data

After the data collection has been completed, the application will automatically process the data and try to upload the files to the Azure file storage location. The user will be notified by the Processing Data image on the screen as show in Figure 13



Figure 13 Processing Data Confirmation

If there is an internet connection is available, the application will automatically upload the data to the Azure file storage location. If no internet is available once an internet connection is established just select the upload button. If you wish to upload at a later time, close the application and manually upload the work zone (**Section 1.3.1**)



Figure 14 Upload Data file option

Appendix A Configuration File Definitions

Table 1 Configuration file definitions

JSON Tag	Field Type	Description
DateCreated	DateTime	Date and time of file creation in UTC
feed_info_id	String (GUID)	Unique WZDx feed identifier
GeneralInfo	Sequence	General information
Description	String	Work zone description
RoadName	String	Road name
Roadnumber	String	Road Number
Direction	Enumeration	Direction
BeginningCrossStreet	String (optional)	Beginning cross street
EndingCrossStreet	String (optional)	Ending cross street
BeginningMilePost	Decimal (optional)	Beginning milepost
EndingMilePost	Decimal (optional)	Ending milepost
EventStatus	Enumeration (optional)	Event status
TypesOfWork	List	Types of work list
WorkType	Enumeration (optional)	Type of work
Is_Architectural_Change	Boolean (optional)	Will result in structural change?
LaneInfo	Sequence	Lane-based information
NumberOfLanes	Integer	Number of lanes
AverageLaneWidth	Decimal	Average lane width (meters)
ApproachLanePadding	Decimal (optional)	Lane padding of approach region (meters)
WorkzoneLanePadding	Decimal (optional)	Lane padding of wz (meters)
VehiclePathDataLane	Integer	Driven lane
Lanes	List	List of lanes
LaneNumber	Integer	Lane number
LaneType	Enumeration	Lane type
LaneRestrictions	List	Lane restrictions list
RestrictionType	Enumeration (optional)	Type of restriction
RestrictionValue	Decimal (optional)	Value of restriction
RestrictionUnits	Enumeration (optional)	Units of restriction value
SpeedLimits	Sequence	Speed limits
NormalSpeed	Integer	Normal speed limit (mph)
ReferencePointSpeed	Integer	Speed limit at start of wz (mph)
WorkersPresentSpeed	Integer	Speed limit when workers present (mph)
CauseCodes	Sequence	
CauseCode	Integer	Cause code
SubCauseCode	Integer	Sun cause code
Schedule	Sequence	

StartDate	DateTime	Date and time of file creation in UTC
StartDateAccuracy	Enumeration	Accuracy of start date
EndDate	DateTime	Date and time of file creation in UTC
EndDateAccuracy	Enumeration	Accuracy of end date
DaysOfWeek	List	Days of the week that the work zone is active
Location	Sequence	
BeginningLocation	Sequence	Location of beginning of wz
Lat	Decimal	Latitude (Deg.)
Lon	Decimal	Longitude (Deg.)
Elev	Decimal (optional)	Elevation (meters, WGS-84)
BeginningAccuracy	Enumeration	jpo-wzdx(beginning_accuracy)
EndingLocation	Sequence	Location of end of wz
Lat	Decimal	Latitude
Lon	Decimal	Longitude
Elev	Decimal (optional)	Elevation (meters, WGS-84)
EndingAccuracy	Enumeration	jpo-wzdx(ending_accuracy)
metadata	Sequence	Metadata for WZDx
wz_location_method	Enumeration	Wz location verification method
lrs_type	String	Linear referencing method
location_verify_method	String	Method used to verify accuracy of locations
datafeed_frequency_update	String	WZDx feed update frequency
timestamp_metadata_update	DateTime	Metadata update timestamp
contact_name	String	WZDx feed contact name
contact_email	String	WZDx feed contact email
issuing_organization	String	WZDx feed issuing organization