

A Project Document of the Connected Work Zone Working Group

# **Connected Work Zone Implementation Guide and Standard v01.00**

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## **Task 3.1 Test Documenation Test Plan, Test Cases, and Test Procedures Task 3.3 Open Source Test Tools**

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October 29, 2025

**Revision History**

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# 1. Test Plan

## 1.1 Introduction to the Test Plan

This Test Documentation is a deliverable for Task 3.1 Test Documentation and Task 3.3 Open Source Test Tools for the *Connected Work Zone Implementation Guidance and Standard Project*. The purpose of this test documentation, consisting of a test plan, test cases, test procedures, and test tools is to document the testing required to verify system interfaces conformant with *Connected Work Zones Implementation Guide and Standard v01.00*. Hereafter, CWZ Standard.

This Test Plan has been developed in accordance with existing testing standards that define the content and processes for test documentation. The *IEEE Std 829-2008, IEEE Standard for Software and System Test Documentation*, provides a comprehensive overview of the processes and documentation for testing. IEEE Std 829-2008 specifies the form and content of test documentation, though it does not specify a required set.

The goal of Task 3.1 and Task 3.3 of the project is primarily to test and document the level of conformance to the CWZ Standard v01.00 between centers exchanging work zone information.

## 1.2 Document Identifiers

The test plan identifier provides a unique name and number for each test plan. When a test plan is tailored or adjusted to a specific test, a new unique identifier shall be identified.

The test plan identifier for this test plan is as follows:

**Test Plan Name:** CWZ Standard v01.00 Interface – Test Plan

**Test Plan Number:** TP001

## 1.3 Scope

The purpose of a data dictionary standard, such as the CWZ Standard, is to achieve interoperability across conformant system interfaces. The *IEEE Std 610™, IEEE Standard Glossary of Software Engineering Terminology*, defines an interface as a shared boundary across which information is passed. Interoperability is defined as the ability of two or more systems or components to exchange information and to use the information that has been exchanged [IEEE Std 610, p. 42].

This test plan section describes the scope, approach, resources, and schedule (time duration) of intended testing activities.

### 1.3.1 Test Items

The test item for this test plan is a CWZ Standard v01.00 system interface, provided by a system under test (SUT).

### 1.3.2 Features to be Tested

The features to be tested are the requirements described in the CWZ Standard v01.00, with a focus on mandatory features as specified in the standard.

### 1.3.3 Testing Activities, Tasks and Resources Necessary to Conduct Testing

This test plan section identifies the tasks and resources necessary to conduct testing under laboratory conditions. Please refer to *Section 1.8.1 Planned Activities and Tasks; Test Progression* and *Section 1.9 Environment/infrastructure*.

### 1.3.4 Risks Requiring Contingency Planning

There are no major risks identified requiring contingency planning. Testing covered in this test plan are for laboratory conditions.

Minor risks relating to schedule, staffing and personnel (e.g., role changes, or staff changes) are addressed. Refer to *Section 1.15 Risk(s) and Contingency(s)*.

## 1.4 References

### 1.4.1 Referenced Documents

This test plan references the following standards:

**Table 1. Referenced Standards**

| Document Name                                          | Version | Date Published |
|--------------------------------------------------------|---------|----------------|
| Connected Work Zones Implementation Guide and Standard | v01.00  | December 2024  |

### 1.4.2 Reference Informational Standards and Documents

This test plan references the following informational standards:

**Table 2. Informational Standards**

| Standard ID       | Standard Name                                              | Date Published |
|-------------------|------------------------------------------------------------|----------------|
| IEEE Std 610.12   | IEEE Standard Glossary of Software Engineering Terminology | September 1990 |
| IEEE Std 829-2008 | IEEE Standard for Software and System Test Documentation   | July 2008      |

## 1.5 Level in the Overall Sequence

This section does not apply for this test plan. It may apply in the future for project-specific testing. To update this section please see IEEE 829-2008.

## 1.6 Test Classes and Overall Test Conditions

The intent of the testing specified in this test documentation is verification of data feeds conformant with the CWZ Standard. Therefore, this test plan contains a single test class, as follows:

- Positive (or valid) testing of input values that should be processed successfully.

## 1.7 Details for this Level of Test Plan

### 1.7.1 Test Items and Their Identifiers

The test item for this test plan is a CWZ Standard v01.00 conformant system interface, provided by a SUT that includes the features as specified in Section 1.7.3 Features to be Tested.

### 1.7.2 Test Traceability Matrix

This test plan references the requirements to be verified in the Requirements to Test Case Traceability Matrix (RTCTM) listed in Appendix A.

### 1.7.3 Features to be Tested

This test plan references the mandatory requirements as specified in Table 6. Protocol Requirements List (PRL) contained in the CWZ Standard. The PRL lists all the user needs and mandatory requirements that trace to the user needs.

### 1.7.4 Features not to be Tested

The following describes features not to be tested:

- This plan does not cover testing of the inner workings of the SUT (Data Provider).
- This plan does not cover testing of any application of a CWZ Data Feed.
- This plan does not cover testing that the CWZ Data feed provides information representative of real-world conditions.
- The following business rules will not be verified. These are identified as mandatory in the PRL, but do not have specific data elements that can be verified.

| 3.2.4   | Business Rules                              |
|---------|---------------------------------------------|
| 3.2.4.1 | Event Segments Follow Lane Geometry Changes |
| 3.2.4.2 | WorkZoneRoadEvent Lanes                     |
| 3.2.4.4 | Data Source ID Referential Integrity        |

### 1.7.5 Test Approach

This test plan proposes the use of black box approach to testing. IEEE 829 defines black box as follows:

"Black box: The test inputs can be generated and the outputs captured and completely evaluated from the outside of a test item; i.e., test cases are developed from the test item specification, only without looking at the code or design." [IEEE 829-2008, Pg. 46]

The purpose of this test plan is to document the testing required to verify system interface conformance with the CWZ Standard v01.00. In general, the approach to testing involves the laboratory setup of a Test Laptop acting as a CWZ Data Feed Consumer and a SUT acting as a CWZ Data Feed provider. Figure 1 illustrates the configuration of a Test Laptop and a SUT.

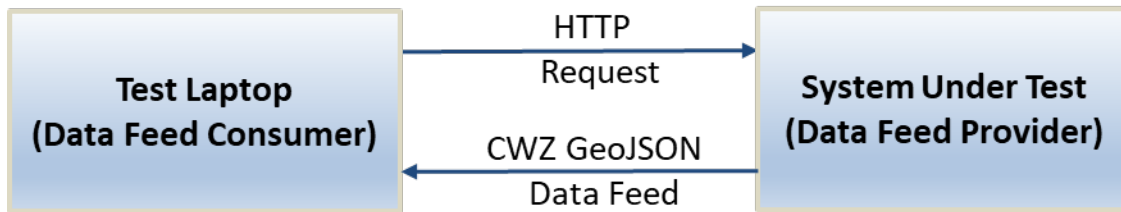


Figure 1. Configuration of Test Laptop and System Under Test

#### 1.7.6 Item Pass/Fail Criteria

It is important to note that all messaging is synchronous between the Test Laptop and the SUT. By synchronous we mean that the Test Laptop polls the SUT. The message exchanges are described as follows: an HTTP Request initiated by the Test Laptop, acting as a Data Feed Consumer, followed by the response of a CWZ GeoJSON Data Feed by the SUT, acting as a Data Feed Provider.

##### Pass/Fail Criteria for Data Requirements:

- 100% correct transmission and receipt of a CWZ GeoJSON Data Feed between the data consumer and data provider systems, as specified in the CWZ Standard.
- Testing verifies that the data content of the CWZ GeoJSON Data Feed are correct, as specified in the CWZ Standard.
- Testing verifies that the data content contains all mandatory elements, as specified in the CWZ Standard.
- Testing verifies that the structure of the data is correct, as specified in the CWZ Standard.

#### 1.7.7 Suspension Criteria and Resumption Requirements

If a test case fails, and the parties present determine that a parameter was not set properly (for example a password or username has been misspelled), or there is an error due to human error on part of the test engineer, the failed test case may be executed again. Any failed test case caused by the operator must be documented, but does not need to be included in the test failure count.

If the problem is likely caused by an anomaly that requires a software modification, the test case must remain as failed, but the testing may continue in accordance with the dependency rules specified in the test cases.

Testing is expected to take approximately one half day. If necessary, for example, testing is prolonged and there is need to correct an anomaly found in the Test Laptop or SUT, then testing may stop and resume the following day (assuming all parties agree).

For the purposes of this test plan, testing is assumed to be conducted indoors, in an office, under laboratory conditions.

#### 1.7.8 Test Deliverables

The test deliverables for the *Connected Work Zone Implementation Guidance and Standard Project* are listed below.

- Test Plan (This document)
- Test Cases (This document)
- Test Procedures (This document)

- Test Logs (Written by Test Engineer)
- Test Incident Reports (Written by Test Engineer)
- Test Summary Report (Written by Test Engineer)

## 1.8 Test Management

### 1.8.1 Planned Activities and Tasks; Test Progression

Testing will be carried out in the sequence of steps outlined below. These steps are more fully defined in the Test Procedures:

- **Test to Fetch CWZ Data Feed.** This step verifies that a CWZ Data Feed can be downloaded from the SUT to the Test Laptop. Prior to testing, a URL for fetching the CWZ Data Feed will need to be provided.
- **Test Mandatory Requirements, Content, and Structure.** This step verifies that all the mandatory data elements conform with the CWZ Standard requirements as identified in the PRL. The JSON schema checking software will verify the structure of the data and valid content. This step will also validate any optional data elements provided in the CWZ Data Feed.
- **Generate Test Logs.** Test Logs identify start times and end times of test execution. It is important to capture the list of attendees/observers.
- **Generate Test Incident Reports.** If a test fails, then a Test Incident Report must be filled out. See Appendix C. Test Incident Report Template.
- **Generate Test Summary Report.** One Test Summary report will be generated for each CWZ Data Feed tested.

## 1.9 Environment/infrastructure

In order to conduct the testing, a set of environmental needs have been identified to ensure testing can start and progress smoothly and consistently as possible. These needs are outlined below:

### 1.9.1 Test Personnel

A list of test personnel is shown below:

- 1 funding agency test observer (FHWA)
- 1 contracting agency test observer (ITE)
- 2 test engineers – ITE Contractor
- 1 or more local agency staff
- 1 or more invited guests

### 1.9.2 Test Documentation

A list of test documentation to be present during testing:

- CWZ Standard v01.00
- Test Plan, Test Cases, Test Procedures, and Test Tools (this document)

### 1.9.3 Test Laptop

The test laptop will be configured to serve as a CWZ Data Feed consumer (e.g., an external center), and be configured to: a) receive messages from a CWZ Data Feed provider; and b) contain test software necessary to execute tests and verify conformance with the CWZ Standard requirements.

### 1.9.4 Test Software

The test laptop will be configured with test tools as listed below. See Section 2.3 Test Software and Pre-Test Activities for additional detail.

### 1.9.5 Test Facilities

Testing will be conducted virtually. The test engineer will setup a virtual meeting to allow participants to witness testing.

### 1.9.6 Network Connectivity Test Laptop to SUT

The test facility shall provide a network connection and security access for the test laptop to communicate with the SUT.

## 1.10 Responsibilities and Authority

The following roles and responsibilities apply to this set of tests:

- **FHWA (Funding Agency):** These are funding agency staff or their representatives who will witness and may provide guidance during testing.
- **ITE (Contracting Agency):** These are staff from the contracting agency, ITE. ITE is a standards development organization and steward that, together with AASHTO and NEMA, publishes and maintains the CWZ Standard.
- **ITE Contractor (Test Engineers):** These are independent evaluators, who will configure Test Software, perform and maintain log of tests (Test Log), identify anomalies, generate Test Incident Reports, provide and walkthrough test results, and generate Test Summary Reports.
- **Local Agency (Data Provider):** This is the staff member from the local agency or designated representative that will witness the test. They are responsible for providing the URL to the Test Engineers that identifies the CWZ Data Feed end point. This may also include agency staff or their contractor representatives providing and configuring the SUT, acting as a Data Provider system. They may provide guidance for resolving any issues which arise during testing and are reported as an anomaly related to the SUT in the Test Incident Report.
- **SUT Contractors (Optional):** May include representatives that developed and/or maintain the SUT.

## 1.11 Interfaces among the Parties Involved

The means of communication between the individuals participating in testing is shown in Figure 2 below. The diagram shows formal chain of command, and lines of formal communication of information between parties. The diagram illustrates the hierarchical flow of formal request and submission of documents and reports. The content of the communications may include: test documents, test reports, etc. E-mail will be the primary means of formal transfer of meeting minutes, documents, and reports. Informal communications are expected for announcement of status meetings, typically conducted via webinar/teleconferences.

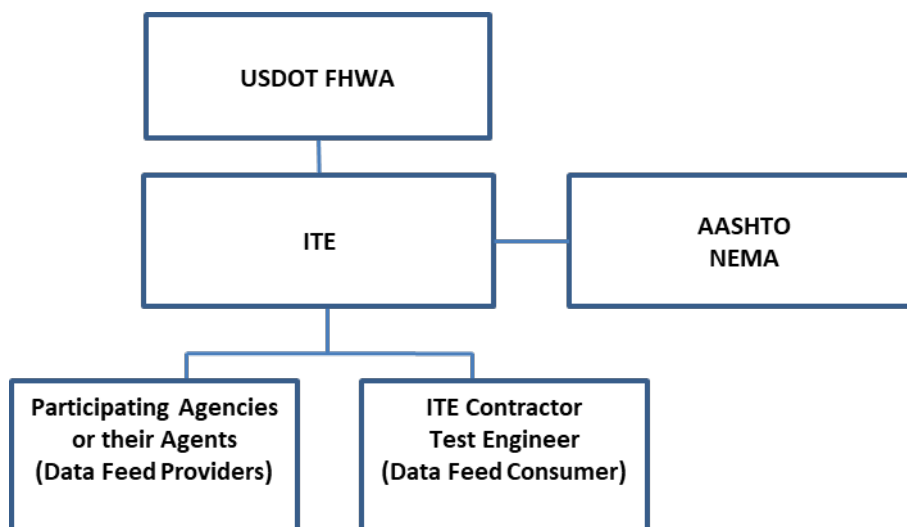


Figure 2. Relationship of Organizations Involved

## 1.12 Resources and Their Allocation

There are no additional resource needs identified beyond those described in this Test Documentation report.

## 1.13 Training

Training is expected to take approximately two hours. An outline for training is shown below:

- Project Overview
- Overview of Testing and Configuration of Test and SUT Equipment
- Overview of Software Tools to be Used to test CWZ Data Feeds
- Overview of SUT (may be provided by local agency or contractor staff)
- Walkthrough of Requirements to be Tested
- Additional Walkthrough of Facilities, Equipment, Software, and Demonstrations (as needed)

## 1.14 Schedules, Estimates, and Costs

The table below is a template that presents tasks/milestones, estimated durations, and scheduled dates for conducting testing.

Table 3. CWZ Data Feed Validation Testing Schedule

| Schedule Item                                      | Estimated Duration        | Dates                     |
|----------------------------------------------------|---------------------------|---------------------------|
| <b>CWZ Data Feed Testing Overview and Training</b> | 1 day                     | Currently expected [Date] |
| <b>CWZ Data Feed Test 1</b>                        |                           |                           |
| CWZ Data Feed Test 1 Pre-Test Activities           | 1 day                     | [Week of] or [Date]       |
| CWZ Data Feed Test 1                               | 1 day per vendor          |                           |
| Prepare CWZ Data Feed Test 1 Results               | 4 days (1 day per vendor) |                           |
| Walkthrough Test 1 Test Results<br>- Test Logs     |                           |                           |

| Schedule Item                                    | Estimated Duration        | Dates               |
|--------------------------------------------------|---------------------------|---------------------|
| - Test Incident Reports<br>- Test Summary Report |                           |                     |
| <b>CWZ Data Feed Test 2</b>                      |                           |                     |
| CWZ Data Feed Test 2 Pre-Test Activities         | 1 day                     | [Week of] or [Date] |
| CWZ Data Feed Test 2                             | 1 day per vendor          |                     |
| Prepare Test 2 Results                           | 4 days (1 day per vendor) |                     |
| Walkthrough Test 2 Test Results                  |                           |                     |
| <b>CWZ Data Feed Test N</b>                      |                           |                     |
| CWZ Data Feed Test N Pre-Test Activities         | 1 day                     | [Week of] or [Date] |
| CWZ Data Feed Test N                             | 1 day per vendor          |                     |
| Prepare Test N Results                           | 4 days (1 day per vendor) |                     |
| Walkthrough Test N Test Results                  |                           |                     |
|                                                  |                           |                     |

Note: In practice, estimated durations will depend on a number of factors including the complexity and time requirements to execute the test procedures, plus the number of test cases.

### 1.15 Risk(s) and Contingency(s)

Testing is assumed to be conducted under office/laboratory conditions, and not in a live environment. As such, the safety risks of the described in this test plan are minimal. Updates to correct anomalies with the standard or the SUT will occur outside of testing. Any anomalies identified during testing will be documented in a Test Incident Report.

### 1.16 Test Coverage

This test plan provides coverage for the mandatory requirements as defined in the CWZ Standard v01.00. If a CWZ data feed provides optional elements, verification of those elements to be conformant with the CWZ Standard will be undertaken.

## 2. Test Cases and Test Procedures

### 2.1 Introduction to the Test Cases and Test Procedures

#### 2.1.1 Role of Test Cases and Test Procedures

- This document describes test cases and test procedures for determining conformance of a CWZ Data Feed with the CWZ Standard v01.00.
- Test Cases specify **WHAT** to test. The focus of Test Cases is on data inputs and outputs, and pass/fail criteria.
- Test Procedures specify **HOW** to do the Test.
- Test Cases and Test Procedures follow a similar relationship that Requirements and Design have.

#### 2.1.2 Test Cases are Traceable to the CWZ Standard Requirements

One of the objectives of this document is to provide traceability of the proposed test cases to the CWZ Standard requirements, thus closing the loop between requirements and testing.

#### 2.1.3 Test Cases are Test Tool and Deployment Agnostic

- The test cases are written in a test tool agnostic way allowing researchers and deployers, new test tools as well as old, to be considered/used for testing.
- The test cases should be usable across a variety of deployments that may have different design details accounted for in the test procedures and test plans.

#### 2.1.4 Listing of Test Cases and Corresponding Test Procedures

Test cases and test procedures are used together to conduct tests.

**Table 4. List of CWZ Data Feed Validation Test Cases and Corresponding Test Procedures**

| Test Case           | Test-Procedure       |
|---------------------|----------------------|
| TC-CWZ-WorkZoneFeed | TP-CWZ-DataFeed-Test |
| TC-CWZ-DeviceFeed   | TP-CWZ-DataFeed-Test |

## 2.2 CWZ Data Feed Validation Test Cases

### 2.2.1 CWZ WorkZoneFeed Test Case

**Table 5. CWZ WorkZoneFeed Test Case**

| CWZ WorkZoneFeed Test Case     |                                                                                                                                                                              |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ID: TC-CWZ-WorkZoneFeed</b> | Title: CWZ WorkZoneFeed Test Case                                                                                                                                            |
| <b>Purpose:</b>                | To verify that the data access methods, format of data, message content values, and data structure of a CWZ WorkZoneFeed conforms with the CWZ Standard v01.00 requirements. |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Objective:</b>                  | The objective of this test case is to verify the system interface between a CWZ WorkZoneFeed data consumer and data provider. The test case verifies that the CWZ WorkZoneFeed message contains all the mandatory data elements, and that the data elements conform with the valid value ranges as specified in the CWZ Standard v01.00. Any optional elements provided will also be evaluated as conformant with the CWZ Standard.      |
| <b>Inputs:</b>                     | <u>Input Data Specification</u> <ul style="list-style-type: none"> <li>• URL identifying the CWZ WorkZoneFeed</li> </ul>                                                                                                                                                                                                                                                                                                                 |
| <b>Expected Outcome(s):</b>        | CWZ WorkZoneFeed can be fetched (accessed) as specified in the standard.<br><br>All CWZ WorkZoneFeed data and message structure are verified as correct, including: structure of data, and valid value of data content.<br><br><u>Output Data Specification</u> <ul style="list-style-type: none"> <li>• Appendix B.1 CWZ WorkZoneFeed Data Specification contains a complete CWZ WorkZoneFeed data specification.</li> </ul>            |
| <b>Feature Pass/Fail Criteria:</b> | <u>Data Verification Outcomes:</u> <ul style="list-style-type: none"> <li>• <b>Pass:</b> <ul style="list-style-type: none"> <li>- CWZ WorkZoneFeed is fetched and can be saved as a GeoJSON file.</li> <li>- All mandatory CWZ WorkZoneFeed data elements within the message are verified as correct.</li> <li>- Message structure of the CWZ WorkZoneFeed is correct.</li> </ul> </li> <li>• <b>Fail:</b> Any other outcome.</li> </ul> |
| <b>Preconditions:</b>              | <ul style="list-style-type: none"> <li>• A valid URL is provided that allows fetching the CWZ WorkZoneFeed.</li> </ul>                                                                                                                                                                                                                                                                                                                   |

### 2.2.2 CWZ DeviceFeed Test Case

**Table 6. CWZ DeviceFeed Test Case**

| CWZ DeviceFeed Test Case     |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ID: TC-CWZ-DeviceFeed</b> | Title: CWZ DeviceFeed Test Case                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Purpose:</b>              | To verify that the data access methods, format of data, message content values, and data structure of a CWZ DeviceFeed conforms with the CWZ Standard v01.00 requirements.                                                                                                                                                                                                                                                      |
| <b>Objective:</b>            | The objective of this test case is to verify the system interface between a CWZ DeviceFeed data consumer and data provider. The test case verifies that the CWZ DeviceFeed message contains all the mandatory data elements, and that the data elements conform with the valid value ranges as specified in the CWZ Standard v01.00. Any optional elements provided will also be evaluated as conformant with the CWZ Standard. |
| <b>Inputs:</b>               | <u>Input Data Specification</u> <ul style="list-style-type: none"> <li>• URL identifying the CWZ DeviceFeed</li> </ul>                                                                                                                                                                                                                                                                                                          |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Expected Outcome(s):</b>        | <p>CWZ DeviceFeed can be fetched (accessed) as specified in the standard.</p> <p>All CWZ DeviceFeed data and message structure are verified as correct, including: structure of data and valid value of data content.</p> <p><u>Output Data Specification</u></p> <ul style="list-style-type: none"> <li>Appendix B.2 CWZ DeviceFeed Data Specification contains a complete CWZ DeviceFeed data specification.</li> </ul>       |
| <b>Feature Pass/Fail Criteria:</b> | <p><u>Data Verification Outcomes:</u></p> <ul style="list-style-type: none"> <li><b>Pass:</b> <ul style="list-style-type: none"> <li>CWZ DeviceFeed is fetched and can be saved as a GeoJSON file.</li> <li>All mandatory CWZ DeviceFeed data elements within the message are verified as correct.</li> <li>Message structure of the CWZ DeviceFeed is correct.</li> </ul> </li> <li><b>Fail:</b> Any other outcome.</li> </ul> |
| <b>Preconditions:</b>              | <ul style="list-style-type: none"> <li>A valid URL is provided that allows fetching the CWZ DeviceFeed.</li> </ul>                                                                                                                                                                                                                                                                                                              |

## 2.3 Test Software and Pre-Test Activities

Prior to execution of a test procedure, the test engineer must install and configure test software and access the CWZ Standard JSON Schema that will be used to verify conformance of a data feed with the standard. The JSON schema (electronic file) can be accessed here: <https://github.com/ite-org/cwz>.

A brief list of possible test software is included in the table below. To the extent possible, the test software are all open source tools. In addition, where applicable, more than one alternative is provided.

**Table 7. CWZ Data Feed Test Software and Electronic Files**

| Function                                       | Software Tool and URL                                                                                                                                                                                       |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Fetch Data using HTTP</b>                   | <ul style="list-style-type: none"> <li>Python script (see Appendix D. Python Script – Fetch Data Over HTTP)</li> <li>cURL (<a href="https://curl.se/">https://curl.se/</a>)</li> <li>web browser</li> </ul> |
| <b>Visualize Feed Data on a Map (optional)</b> | <ul style="list-style-type: none"> <li>Python script (see Appendix E. Python Script – Visualize CWZ Feed on a Map)</li> <li>QGIS (<a href="https://qgis.org/">https://qgis.org/</a>)</li> </ul>             |
| <b>Validate CWZ Feed against JSON Schema</b>   | <ul style="list-style-type: none"> <li>Python script (see Appendix F. Python Script – Validate CWZ Feed Against CWZ JSON Schema)</li> </ul>                                                                 |

## 2.4 CWZ Data Feed Test Procedures

The Test Procedure Steps may be used as a template to log information to be captured during testing (i.e., Test Log). If a test fails, the test engineer must fill out a Test Incident Report (See Appendix C. Test Incident Report Template).

The CWZ Data Feed Test Procedure is shown in the table below.

**Table 8. CWZ Data Feed Test Procedure**

| Test Procedure                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ID: TP-CWZ-DataFeed</b>                                       | Title: CWZ Data Feed Test Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Test Case References</b>                                      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Requirements Verification Method</b>                          | Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Procedure Description</b>                                     | <p>Prior to testing, a URL defining the CWZ Data Feed endpoint must be provided.</p> <p>Message exchanges between the Test Laptop and the SUT are synchronous. The message exchanges are described as follows: an HTTP Request is initiated by the Test Laptop, acting as a Data Feed Consumer, followed by the response of a CWZ GeoJSON Data Feed by the SUT, acting as a Data Feed Provider.</p> <p>If a test procedure step fails, then a Test Incident Report must be completed.</p> |
| <b>Procedure Steps:</b>                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Step 1: Log Start Time and Date of Test</b>                   | Date:<br>Start Time:                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Step 2: Log names of participants, organization, and role</b> | Name:<br>Organization:<br>Email:<br>Role: Funding Agency / Contracting Agency / Test Engineer / Observer / Local Agency Data Provider / Invited Guest<br><br><i>{Add additional participants}</i>                                                                                                                                                                                                                                                                                         |
| <b>Step 3: Log URL identifying CWZ Data Feed endpoint.</b>       | URL:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Step 4: Document whether WorkZoneFeed or DeviceFeed</b>       | Feed Type: WorkZoneFeed / Device Feed                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Step 5a: Fetch CWZ Data Feed</b>                              | Fetch the CWZ Data Feed and save to test directory. File will be provided with Test Results.                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Step 5b: Log Outcome</b>                                      | Pass / Fail<br>Time:                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Step 6a: Verify JSON file is visualizable (optional)</b>      | Verify that the CWZ Data Feed is visualizable on a map.<br>Take a snapshot and save in test directory.<br>Snapshot will be provided with Test Results.                                                                                                                                                                                                                                                                                                                                    |

|                                               |                                                                                                                                                      |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step 6b: Log Outcome (optional)</b>        | Pass / Fail<br>Time:                                                                                                                                 |
| <b>Step 7a: Verify Mandatory Requirements</b> | Use preconfigured JSON schema validation software to verify conformance of CWZ Data Feed (GeoJSON file) against the CWZ Standard v01.00 JSON Schema. |
| <b>Step 7b: Log Outcome</b>                   | Pass/Fail<br>Time:                                                                                                                                   |
| <b>Step 8: Log End Time and Date of Test</b>  | Date:<br>End Time:                                                                                                                                   |
| <b>Generate Test Summary Report</b>           | Upon completion of this test procedure, generate a Test Summary Report documenting the results, observations, and any incidents encountered.         |
| <b>Relationship to Other Procedures:</b>      | Completion of Pre-Test activities.                                                                                                                   |
| <b>Procedure Special Requirements:</b>        | None                                                                                                                                                 |

## Appendix A. Requirements to Test Case Traceability Matrix

Table 9. Requirements to Test Case Traceability Matrix (RTCTM)

| Req ID       | Requirement                                      | Conformance | Support    | Test Case                                |
|--------------|--------------------------------------------------|-------------|------------|------------------------------------------|
| <b>3.2</b>   | <b>Architectural Requirements</b>                |             |            |                                          |
| <b>3.2.1</b> | <b>Compatibility with the WZDx Specification</b> | M           | Yes        | Not Applicable                           |
| <b>3.2.2</b> | <b>GeoJSON Data Format</b>                       | M           | Yes        | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| <b>3.2.3</b> | <b>GeoJSON Data Validation</b>                   | M           | Yes        | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| <b>3.2.4</b> | <b>Business Rules</b>                            | <b>M</b>    | <b>Yes</b> |                                          |
| 3.2.4.1      | Event Segments Follow Lane Geometry Changes      | M           | Yes        | Not tested.                              |
| 3.2.4.2      | WorkZoneRoadEvent Lanes                          | M           | Yes        | Not tested.                              |
| 3.2.4.3      | Lane Order                                       | M           | Yes        | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.2.4.4      | Data Source ID Referential Integrity             | M           | Yes        | Not tested.                              |
| 3.2.4.5      | UTC Date-Time Format Specification               | M           | Yes        | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.2.4.6      | UUID Format Specification                        | M           | Yes        | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| <b>3.3</b>   | <b>Data Exchange Requirements</b>                |             |            |                                          |
| <b>3.3.1</b> | <b>Exchange WorkZoneFeed Information</b>         |             |            |                                          |
| 3.3.1.1      | Send WorkZoneFeed Information Upon Request       | M           | Yes        | TC-CWZ-WorkZoneFeed                      |
| <b>3.3.2</b> | <b>Exchange DeviceFeed Information</b>           |             |            |                                          |
| 3.3.2.1      | Send DeviceFeed Information Upon Request         | M           | Yes        | TC-CWZ-DeviceFeed                        |
| <b>3.4</b>   | <b>WorkZoneFeed Requirements</b>                 |             |            |                                          |
| <b>3.4.1</b> | <b>Contents of WorkZoneFeed</b>                  |             |            |                                          |
| 3.4.1 a)     | feed_info                                        | M           | Yes        | TC-CWZ-WorkZoneFeed                      |
| 3.4.1 b)     | type                                             | M           | Yes        | TC-CWZ-WorkZoneFeed                      |
| 3.4.1 c)     | features                                         | M           | Yes        | TC-CWZ-WorkZoneFeed                      |
| 3.4.1 d)     | bbox                                             | O           | Yes / No   |                                          |
| <b>3.5</b>   | <b>FeedInfo Requirements</b>                     |             |            |                                          |
| <b>3.5.1</b> | <b>Contents of FeedInfo</b>                      |             |            |                                          |

| Req ID       | Requirement                          | Conformance | Support  | Test Case                                |
|--------------|--------------------------------------|-------------|----------|------------------------------------------|
| 3.5.1 a)     | publisher                            | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.5.1 b)     | contact_name                         | O           | Yes / No |                                          |
| 3.5.1 c)     | contact_email                        | O           | Yes / No |                                          |
| 3.5.1 d)     | update_frequency                     | O           | Yes / No |                                          |
| 3.5.1 e)     | update_date                          | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.5.1 f)     | version                              | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.5.1 g)     | license                              | O           | Yes / No |                                          |
| 3.5.1 h)     | data_sources                         | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| <b>3.5.2</b> | <b>Contents of FeedDataSource</b>    |             |          |                                          |
| 3.5.2 a)     | data_source_id                       | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.5.2 b)     | organization_name                    | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.5.2 c)     | contact_name                         | O           | Yes / No |                                          |
| 3.5.2 d)     | contact_email                        | O           | Yes / No |                                          |
| 3.5.2 e)     | update_frequency                     | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| 3.5.2 f)     | update_date                          | M           | Yes      | TC-CWZ-WorkZoneFeed<br>TC-CWZ-DeviceFeed |
| <b>3.6</b>   | <b>RoadEventFeature Requirements</b> |             |          |                                          |
| <b>3.6.1</b> | <b>Contents of RoadEventFeature</b>  |             |          |                                          |
| 3.6.1 a)     | id                                   | M           | Yes      | TC-CWZ-WorkZoneFeed                      |
| 3.6.1 b)     | type                                 | M           | Yes      | TC-CWZ-WorkZoneFeed                      |
| 3.6.1 c)     | properties                           | M           | Yes      | TC-CWZ-WorkZoneFeed                      |
| 3.6.1 d)     | geometry                             | M           | Yes      | TC-CWZ-WorkZoneFeed                      |
| 3.6.1 e)     | bbox                                 | O           | Yes / No |                                          |
| <b>3.6.2</b> | <b>Contents of WorkZoneRoadEvent</b> |             |          |                                          |
| 3.6.2 a)     | core_details                         | M           | Yes      | TC-CWZ-WorkZoneFeed                      |

| Req ID       | Requirement                             | Conformance | Support  | Test Case           |
|--------------|-----------------------------------------|-------------|----------|---------------------|
| 3.6.2 b)     | beginning_cross_street                  | O           | Yes / No |                     |
| 3.6.2 c)     | ending_cross_street                     | O           | Yes / No |                     |
| 3.6.2 d)     | beginning_reference_post                | O           | Yes / No |                     |
| 3.6.2 e)     | ending_reference_post                   | O           | Yes / No |                     |
| 3.6.2 f)     | reference_post_unit                     | RefPost:O   | Yes / No |                     |
| 3.6.2 g)     | is_start_position_verified              | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 h)     | is_end_position_verified                | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 i)     | start_date                              | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 j)     | end_date                                | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 k)     | is_start_date_verified                  | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 l)     | is_end_date_verified                    | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 m)     | work_zone_type                          | O           | Yes / No |                     |
| 3.6.2 n)     | vehicle_impact                          | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 o)     | location_method                         | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.2 p)     | worker_presence                         | O           | Yes / No |                     |
| 3.6.2 q)     | reduced_speed_limit_kph                 | O           | Yes / No |                     |
| 3.6.2 r)     | restrictions                            | O           | Yes / No |                     |
| 3.6.2 s)     | types_of_work                           | O           | Yes / No |                     |
| 3.6.2 t)     | lanes                                   | O           | Yes / No |                     |
| 3.6.2 u)     | impacted_cds_curb_zones                 | O           | Yes / No |                     |
| <b>3.6.3</b> | <b>Contents of DetourRoadEvent</b>      |             |          |                     |
| 3.6.3 a)     | core_details                            | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.3 b)     | beginning_cross_street                  | O           | Yes / No |                     |
| 3.6.3 c)     | ending_cross_street                     | O           | Yes / No |                     |
| 3.6.3 d)     | beginning_reference_post                | O           | Yes / No |                     |
| 3.6.3 e)     | ending_reference_post                   | O           | Yes / No |                     |
| 3.6.3 f)     | reference_post_unit                     | RefPost:O   | Yes / No |                     |
| 3.6.3 g)     | start_date                              | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.3 h)     | end_date                                | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.3 i)     | is_start_date_verified                  | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.3 j)     | is_end_date_verified                    | M           | Yes      | TC-CWZ-WorkZoneFeed |
| <b>3.6.4</b> | <b>Contents of RoadEventCoreDetails</b> |             |          |                     |

| Req ID        | Requirement                              | Conformance | Support  | Test Case           |
|---------------|------------------------------------------|-------------|----------|---------------------|
| 3.6.4 a)      | data_source_id                           | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.4 b)      | event_type                               | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.4 c)      | related_road_events                      | O           | Yes / No |                     |
| 3.6.4 d)      | project_id                               | O           | Yes / No |                     |
| 3.6.4 e)      | road_names                               | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.4 f)      | direction                                | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.4 g)      | name                                     | O           | Yes / No |                     |
| 3.6.4 h)      | description                              | O           | Yes / No |                     |
| 3.6.4 i)      | creation_date                            | O           | Yes / No |                     |
| 3.6.4 j)      | update_date                              | O           | Yes / No |                     |
| <b>3.6.5</b>  | <b>Enumeration of LocationMethod</b>     | <b>NA</b>   |          |                     |
| <b>3.6.6</b>  | <b>Contents of RelatedRoadEvent</b>      |             |          |                     |
| 3.6.6 a)      | type                                     | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.6 b)      | id                                       | M           | Yes      | TC-CWZ-WorkZoneFeed |
| <b>3.6.7</b>  | <b>Contents of TypeOfWork</b>            |             |          |                     |
| 3.6.7 a)      | type_name                                | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.7 b)      | is_architectural_change                  | O           | Yes / No |                     |
| <b>3.6.8</b>  | <b>Contents of Lane</b>                  |             |          |                     |
| 3.6.8 a)      | order                                    | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.8 b)      | status                                   | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.8 c)      | type                                     | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.8 d)      | restrictions                             | O           | Yes / No |                     |
| <b>3.6.9</b>  | <b>Contents of Restriction</b>           |             |          |                     |
| 3.6.9 a)      | type                                     | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.9 b)      | value                                    | O           | Yes / No |                     |
| 3.6.9 c)      | unit                                     | ResValue:O  | Yes / No |                     |
| <b>3.6.10</b> | <b>Contents of CdsCurbZonesReference</b> |             |          |                     |
| 3.6.10 a)     | cds_curb_zone_ids                        | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.10 b)     | cds_curbs_api_url                        | M           | Yes      | TC-CWZ-WorkZoneFeed |
| <b>3.6.11</b> | <b>Contents of WorkerPresence</b>        |             |          |                     |
| 3.6.11 a)     | are_workers_present                      | M           | Yes      | TC-CWZ-WorkZoneFeed |
| 3.6.11 b)     | method                                   | O           | Yes / No |                     |

| Req ID        | Requirement                                    | Conformance        | Support  | Test Case         |
|---------------|------------------------------------------------|--------------------|----------|-------------------|
| 3.6.11 c)     | worker_presence_last_confirmed_date            | O                  | Yes / No |                   |
| 3.6.11 d)     | confidence                                     | O                  | Yes / No |                   |
| 3.6.11 e)     | definition                                     | O                  | Yes / No |                   |
| 3.6.11 f)     | other_method                                   | WorkerMethod:<br>O | Yes / No |                   |
| <b>3.6.12</b> | <b>Enumeration of EventType</b>                | <b>NA</b>          |          |                   |
| <b>3.6.13</b> | <b>Enumeration of WorkZoneType</b>             | <b>NA</b>          |          |                   |
| <b>3.6.14</b> | <b>Enumeration of VehicleImpact</b>            | <b>NA</b>          |          |                   |
| <b>3.6.15</b> | <b>Enumeration of RestrictionType</b>          | <b>NA</b>          |          |                   |
| <b>3.6.16</b> | <b>Enumeration of WorkTypeName</b>             | <b>NA</b>          |          |                   |
| <b>3.6.17</b> | <b>Enumeration of LaneStatus</b>               | <b>NA</b>          |          |                   |
| <b>3.6.18</b> | <b>Enumeration of LaneType</b>                 | <b>NA</b>          |          |                   |
| <b>3.6.19</b> | <b>Enumeration of UnitOfMeasurement</b>        | <b>NA</b>          |          |                   |
| <b>3.6.20</b> | <b>Enumeration of WorkerPresenceMethod</b>     | <b>NA</b>          |          |                   |
| <b>3.6.21</b> | <b>Enumeration of WorkerPresenceDefinition</b> | <b>NA</b>          |          |                   |
| <b>3.6.22</b> | <b>Enumeration of WorkerPresenceConfidence</b> | <b>NA</b>          |          |                   |
| <b>3.6.23</b> | <b>Enumeration of RelatedRoadEventType</b>     | <b>NA</b>          |          |                   |
| <b>3.7</b>    | <b>DeviceFeed Requirements</b>                 |                    |          |                   |
| <b>3.7.1</b>  | <b>Contents of DeviceFeed</b>                  |                    |          |                   |
| 3.7.1 a)      | feed_info                                      | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.1 b)      | type                                           | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.1 c)      | features                                       | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.1 d)      | bbox                                           | O                  | Yes / No |                   |
| <b>3.7.2</b>  | <b>Contents of FieldDeviceFeature</b>          |                    |          |                   |
| 3.7.2 a)      | id                                             | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.2 b)      | type                                           | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.2 c)      | properties                                     | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.2 d)      | geometry                                       | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.2 e)      | bbox                                           | O                  | Yes / No |                   |
| <b>3.7.3</b>  | <b>Contents of FieldDeviceCoreDetails</b>      |                    |          |                   |
| 3.7.3 a)      | device_type                                    | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.3 b)      | data_source_id                                 | M                  | Yes      | TC-CWZ-DeviceFeed |
| 3.7.3 c)      | device_status                                  | M                  | Yes      | TC-CWZ-DeviceFeed |

| Req ID       | Requirement                           | Conformance | Support  | Test Case         |
|--------------|---------------------------------------|-------------|----------|-------------------|
| 3.7.3 d)     | update_date                           | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.3 e)     | has_automatic_location                | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.3 f)     | road_direction                        | O           | Yes / No |                   |
| 3.7.3 g)     | road_names                            | O           | Yes / No |                   |
| 3.7.3 h)     | name                                  | O           | Yes / No |                   |
| 3.7.3 i)     | description                           | O           | Yes / No |                   |
| 3.7.3 j)     | status_messages                       | O           | Yes / No |                   |
| 3.7.3 k)     | is_moving                             | O           | Yes / No |                   |
| 3.7.3 l)     | road_event_ids                        | O           | Yes / No |                   |
| 3.7.3 m)     | reference_post                        | O           | Yes / No |                   |
| 3.7.3 n)     | reference_post_unit                   | RefPost:O   | Yes / No |                   |
| 3.7.3 o)     | make                                  | O           | Yes / No |                   |
| 3.7.3 p)     | model                                 | O           | Yes / No |                   |
| 3.7.3 q)     | serial_number                         | O           | Yes / No |                   |
| 3.7.3 r)     | firmware_version                      | O           | Yes / No |                   |
| 3.7.3 s)     | velocity_kph                          | O           | Yes / No |                   |
| 3.7.3 t)     | is_in_transport_position              | O           | Yes / No |                   |
| <b>3.7.4</b> | <b>Contents of ArrowBoard</b>         |             |          |                   |
| 3.7.4 a)     | core_details                          | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.4 b)     | pattern                               | M           | Yes      | TC-CWZ-DeviceFeed |
| <b>3.7.5</b> | <b>Contents of Camera</b>             |             |          |                   |
| 3.7.5 a)     | core_details                          | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.5 b)     | image_url                             | O           | Yes / No |                   |
| 3.7.5 c)     | is_image_url_public                   | O           | Yes / No |                   |
| 3.7.5 d)     | image_timestamp                       | ImgURL:O    | Yes / No |                   |
| 3.7.5 e)     | video_url                             | O           | Yes / No |                   |
| 3.7.5 f)     | is_video_url_public                   | O           | Yes / No |                   |
| 3.7.5 g)     | video_update_frequency                | VideoUrl:O  | Yes / No |                   |
| <b>3.7.6</b> | <b>Contents of DynamicMessageSign</b> |             |          |                   |
| 3.7.6 a)     | core_details                          | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.6 b)     | message_multi_string                  | M           | Yes      | TC-CWZ-DeviceFeed |
| <b>3.7.7</b> | <b>Contents of FlashingBeacon</b>     |             |          |                   |

| Req ID        | Requirement                              | Conformance | Support  | Test Case         |
|---------------|------------------------------------------|-------------|----------|-------------------|
| 3.7.7 a)      | core_details                             | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.7 b)      | function                                 | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.7 c)      | is_flashing                              | O           | Yes / No |                   |
| 3.7.7 d)      | sign_text                                | O           | Yes / No |                   |
| <b>3.7.8</b>  | <b>Contents of HybridSign</b>            |             |          |                   |
| 3.7.8 a)      | core_details                             | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.8 b)      | dynamic_message_function                 | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.8 c)      | dynamic_message_text                     | O           | Yes / No |                   |
| 3.7.8 d)      | static_sign_text                         | O           | Yes / No |                   |
| <b>3.7.9</b>  | <b>Contents of LocationMarker</b>        |             |          |                   |
| 3.7.9 a)      | core_details                             | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.9 b)      | marked_locations                         | M           | Yes      | TC-CWZ-DeviceFeed |
| <b>3.7.10</b> | <b>Contents of MarkedLocation</b>        |             |          |                   |
| 3.7.10 a)     | type                                     | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.10 b)     | road_event_id                            | O           | Yes / No |                   |
| <b>3.7.11</b> | <b>Contents of TrafficSensor</b>         |             |          |                   |
| 3.7.11 a)     | core_details                             | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.11 b)     | collection_interval_start_date           | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.11 c)     | collection_interval_end_date             | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.11 d)     | average_speed_kph                        | O           | Yes / No |                   |
| 3.7.11 e)     | volume_vph                               | O           | Yes / No |                   |
| 3.7.11 f)     | occupancy_percent                        | O           | Yes / No |                   |
| 3.7.11 g)     | lane_data                                | O           | Yes / No |                   |
| <b>3.7.12</b> | <b>Contents of TrafficSensorLaneData</b> |             |          |                   |
| 3.7.12 a)     | lane_order                               | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.12 b)     | road_event_id                            | O           | Yes / No |                   |
| 3.7.12 c)     | average_speed_kph                        | O           | Yes / No |                   |
| 3.7.12 d)     | volume_vph                               | O           | Yes / No |                   |
| 3.7.12 e)     | occupancy_percent                        | O           | Yes / No |                   |
| <b>3.7.13</b> | <b>Contents of TrafficSignal</b>         |             |          |                   |
| 3.7.13 a)     | core_details                             | M           | Yes      | TC-CWZ-DeviceFeed |
| 3.7.13 b)     | mode                                     | M           | Yes      | TC-CWZ-DeviceFeed |

| Req ID | Requirement                                     | Conformance | Support | Test Case |
|--------|-------------------------------------------------|-------------|---------|-----------|
| 3.7.16 | Enumeration of ArrowBoardPattern                | NA          |         |           |
| 3.7.17 | Enumeration of FieldDeviceType                  | NA          |         |           |
| 3.7.18 | Enumeration of FieldDeviceStatus                | NA          |         |           |
| 3.7.19 | Enumeration of FlashingBeaconFunction           | NA          |         |           |
| 3.7.20 | Enumeration of HybridSignDynamicMessageFunction | NA          |         |           |
| 3.7.21 | Enumeration of MarkedLocationType               | NA          |         |           |
| 3.7.22 | Enumeration of TrafficSignalMode                | NA          |         |           |
| 3.8    | Direction Requirements                          |             |         |           |
| 3.8.1  | Enumeration of Direction                        | NA          |         |           |
| 3.9    | BoundingBox Requirements                        |             |         |           |
| 3.9.1  | Contents of BoundingBox                         | O           |         |           |

## Appendix B. Test Case Data Specifications

### B.1 CWZ WorkZoneFeed Data Specification

Table 10. CWZ WorkZoneFeed Data Specification

| Data Concept Name |                   |                        |                     |      | Mandatory/<br>Optional | Data<br>Concept ID |
|-------------------|-------------------|------------------------|---------------------|------|------------------------|--------------------|
| feed_info         |                   |                        |                     |      | M                      | 5.2.1.1            |
|                   | publisher         |                        |                     |      | M                      | 5.3.1.1            |
|                   | contact_name      |                        |                     |      | O                      | 5.3.1.2            |
|                   | contact_email     |                        |                     |      | O                      | 5.3.1.3            |
|                   | update_frequency  |                        |                     |      | M                      | 5.3.1.4            |
|                   | update_date       |                        |                     |      | M                      | 5.3.1.5            |
|                   | version           |                        |                     |      | M                      | 5.3.1.6            |
|                   | license           |                        |                     |      | O                      | 5.3.1.7            |
|                   | data_sources      |                        |                     |      | M                      | 5.3.1.8            |
|                   |                   | data_source_id         |                     |      | M                      | 5.3.2.1.1          |
|                   |                   | organization_name      |                     |      | M                      | 5.3.2.1.2          |
|                   |                   | contact_name           |                     |      | O                      | 5.3.2.1.3          |
|                   |                   | contact_email          |                     |      | O                      | 5.3.2.1.4          |
|                   |                   | update_frequency       |                     |      | M                      | 5.3.2.1.5          |
|                   |                   | update_date            |                     |      | M                      | 5.3.2.1.6          |
| type              | FeatureCollection |                        |                     |      | M                      | 5.2.1.2            |
| features          |                   |                        |                     |      | M                      | 5.2.1.3            |
|                   | id                |                        |                     |      | M                      | 5.4.1.1            |
|                   | type              | Feature                |                     |      | M                      | 5.4.1.2            |
|                   | properties        |                        |                     |      | M                      | 5.4.1.3            |
|                   |                   | core_details           |                     |      | M                      | 5.4.2.1.1          |
|                   |                   |                        | data_source_id      |      | M                      | 5.4.2.3.1          |
|                   |                   |                        | event_type          |      | M                      | 5.4.2.3.2          |
|                   |                   |                        | related_road_events |      | O                      | 5.4.2.3.3          |
|                   |                   |                        |                     | type | M                      | 5.4.2.5.1          |
|                   |                   |                        |                     | id   | M                      | 5.4.2.5.2          |
|                   |                   |                        | project_id          |      | O                      | 5.4.2.3.4          |
|                   |                   |                        | road_names          |      | M                      | 5.4.2.3.5          |
|                   |                   |                        | direction           |      | M                      | 5.4.2.3.6          |
|                   |                   |                        | name                |      | O                      | 5.4.2.3.7          |
|                   |                   |                        | description         |      | O                      | 5.4.2.3.8          |
|                   |                   |                        | creation_date       |      | O                      | 5.4.2.3.9          |
|                   |                   |                        | update_date         |      | O                      | 5.4.2.3.10         |
|                   |                   | beginning_cross_street |                     |      | O                      | 5.4.2.1.2          |
|                   |                   | ending_cross_street    |                     |      | O                      | 5.4.2.1.3          |

| Data Concept Name |          |                            |                                         | Mandatory/<br>Optional | Data<br>Concept ID |
|-------------------|----------|----------------------------|-----------------------------------------|------------------------|--------------------|
|                   |          | beginning_reference_post   |                                         | O                      | 5.4.2.1.4          |
|                   |          | ending_reference_post      |                                         | O                      | 5.4.2.1.5          |
|                   |          | reference_post_unit        |                                         | C                      | 5.4.2.1.6          |
|                   |          | is_start_position_verified |                                         | M                      | 5.4.2.1.7          |
|                   |          | is_end_position_verified   |                                         | M                      | 5.4.2.1.8          |
|                   |          | start_date                 |                                         | M                      | 5.4.2.1.9          |
|                   |          | end_date                   |                                         | M                      | 5.4.2.1.10         |
|                   |          | is_start_date_verified     |                                         | M                      | 5.4.2.1.11         |
|                   |          | is_end_date_verified       |                                         | M                      | 5.4.2.1.12         |
|                   |          | work_zone_type             |                                         | O                      | 5.4.2.1.13         |
|                   |          | vehicle_impact             |                                         | M                      | 5.4.2.1.14         |
|                   |          | location_method            |                                         | M                      | 5.4.2.1.15         |
|                   |          | worker_presence            |                                         | O                      | 5.4.2.1.16         |
|                   |          |                            | are_workers_present                     | M                      | 5.4.2.10.1         |
|                   |          |                            | method                                  | O                      | 5.4.2.10.2         |
|                   |          |                            | worker_presence_last_<br>confirmed_date | O                      | 5.4.2.10.3         |
|                   |          |                            | confidence                              | O                      | 5.4.2.10.4         |
|                   |          |                            | definition                              | O                      | 5.4.2.10.5         |
|                   |          |                            | other_method                            | C                      | 5.4.2.10.6         |
|                   |          | reduced_speed_limit_kph    |                                         | O                      | 5.4.2.1.17         |
|                   |          | restrictions               |                                         | O                      | 5.4.2.1.18         |
|                   |          |                            | type                                    | M                      | 5.4.2.8.1          |
|                   |          |                            | value                                   | O                      | 5.4.2.8.2          |
|                   |          |                            | unit                                    | O                      | 5.4.2.8.3          |
|                   |          | types_of_work              |                                         | O                      | 5.4.2.1.19         |
|                   |          |                            | type_name                               | M                      | 5.4.2.6.1          |
|                   |          |                            | is_architectural_change                 | O                      | 5.4.2.6.2          |
|                   |          | lanes                      |                                         | O                      | 5.4.2.1.20         |
|                   |          |                            | order                                   | M                      | 5.4.2.7.1          |
|                   |          |                            | status                                  | M                      | 5.4.2.7.2          |
|                   |          |                            | type                                    | M                      | 5.4.2.7.3          |
|                   |          |                            | restrictions                            | O                      | 5.4.2.7.4          |
|                   |          | impacted_cds_curb_zones    |                                         | O                      | 5.4.2.1.21         |
|                   |          |                            | cds_curb_zone_ids                       | M                      | 5.4.2.9.1          |
|                   |          |                            | cds_curb_api_url                        | M                      | 5.4.2.9.2          |
|                   | geometry |                            |                                         | M                      | 5.4.1.4            |
|                   | bbox     |                            |                                         | O                      | 5.4.1.5            |
| bbox              |          |                            |                                         | O                      | 5.2.1.4            |

## B.2 CWZ DeviceFeed Data Specification

Table 11. CWZ DeviceFeed Data Specification

| Data Concept Name |                   |                        | Mandatory/<br>Optional | Data Concept<br>ID |
|-------------------|-------------------|------------------------|------------------------|--------------------|
| feed_info         |                   |                        | M                      | 5.5.1.1            |
|                   | publisher         |                        | M                      | 5.3.1.1            |
|                   | contact_name      |                        | O                      | 5.3.1.2            |
|                   | contact_email     |                        | O                      | 5.3.1.3            |
|                   | update_frequency  |                        | M                      | 5.3.1.4            |
|                   | update_date       |                        | M                      | 5.3.1.5            |
|                   | version           |                        | M                      | 5.3.1.6            |
|                   | license           |                        | M                      | 5.3.1.7            |
|                   | data_sources      |                        | M                      | 5.3.1.8            |
|                   |                   | data_source_id         | M                      | 5.3.2.1.1          |
|                   |                   | organization_name      | M                      | 5.3.2.1.2          |
|                   |                   | contact_name           | O                      | 5.3.2.1.3          |
|                   |                   | contact_email          | O                      | 5.3.2.1.4          |
|                   |                   | update_frequency       | M                      | 5.3.2.1.5          |
|                   |                   | update_date            | M                      | 5.3.2.1.6          |
| type              | FeatureCollection |                        | M                      | 5.5.1.2            |
| features          |                   |                        | M                      | 5.5.1.3            |
|                   | id                |                        | M                      | 5.5.2.1.1          |
|                   | type              | Feature                | M                      | 5.5.2.1.2          |
|                   | properties        |                        | M                      | 5.5.2.1.3          |
|                   |                   | core_details           | M                      | 5.5.2.2            |
|                   |                   | device_type            | M                      | 5.5.2.2.1          |
|                   |                   | data_source_id         | M                      | 5.5.2.2.2          |
|                   |                   | device_status          | M                      | 5.5.2.2.3          |
|                   |                   | update_date            | M                      | 5.5.2.2.4          |
|                   |                   | has_automatic_location | M                      | 5.5.2.2.5          |
|                   |                   | road_direction         | O                      | 5.5.2.2.6          |
|                   |                   | road_names             | O                      | 5.5.2.2.7          |
|                   |                   | name                   | O                      | 5.5.2.2.8          |
|                   |                   | description            | O                      | 5.5.2.2.9          |
|                   |                   | status_messages        | O                      | 5.5.2.2.10         |
|                   |                   | is_moving              | O                      | 5.5.2.2.11         |
|                   |                   | road_event_ids         | O                      | 5.5.2.2.12         |
|                   |                   | project_id             | O                      | 5.5.2.2.13         |
|                   |                   | reference_post         | O                      | 5.5.2.2.14         |

| Data Concept Name |  |                                     |                          | Mandatory/<br>Optional | Data Concept ID |
|-------------------|--|-------------------------------------|--------------------------|------------------------|-----------------|
|                   |  |                                     | reference_post_unit      | C                      | 5.5.2.2.15      |
|                   |  |                                     | make                     | O                      | 5.5.2.2.16      |
|                   |  |                                     | model                    | O                      | 5.5.2.2.17      |
|                   |  |                                     | serial_number            | O                      | 5.5.2.2.18      |
|                   |  |                                     | firmware_version         | O                      | 5.5.2.2.19      |
|                   |  |                                     | velocity_kph             | O                      | 5.5.2.2.20      |
|                   |  |                                     | is_in_transport_position | O                      | 5.5.2.2.21      |
|                   |  | if device_type = ArrowBoard         |                          |                        |                 |
|                   |  | pattern                             |                          | M                      | 5.5.2.3.2       |
|                   |  | if device_type = Camera             |                          |                        |                 |
|                   |  | image_url                           |                          | O                      | 5.5.2.4.2       |
|                   |  | is_image_url_public                 |                          | O                      | 5.5.2.4.3       |
|                   |  | image_timestamp                     |                          | C                      | 5.5.2.4.4       |
|                   |  | video_url                           |                          | O                      | 5.5.2.4.5       |
|                   |  | is_video_url_public                 |                          | O                      | 5.5.2.4.6       |
|                   |  | video_update_frequency              |                          | O                      | 5.5.2.4.7       |
|                   |  | if device_type = DynamicMessageSign |                          |                        |                 |
|                   |  | message_multi_string                |                          | M                      | 5.5.2.5.2       |
|                   |  | if device_type = FlashingBeacon     |                          |                        |                 |
|                   |  | function                            |                          | M                      | 5.5.2.6.2       |
|                   |  | is_flashing                         |                          | O                      | 5.5.2.6.3       |
|                   |  | sign_text                           |                          | O                      | 5.5.2.6.4       |
|                   |  | if device_type = HybridSign         |                          |                        |                 |
|                   |  | dynamic_message_function            |                          | M                      | 5.5.2.7.2       |
|                   |  | dynamic_message_text                |                          | O                      | 5.5.2.7.3       |
|                   |  | static_sign_text                    |                          | O                      | 5.5.2.7.4       |
|                   |  | if device_type = LocationMarker     |                          |                        |                 |
|                   |  | marked_locations                    |                          | M                      | 5.5.2.8.2       |
|                   |  |                                     | type                     | M                      | 5.5.2.9.1       |
|                   |  |                                     | road_event_id            | O                      | 5.5.2.9.2       |
|                   |  | if device_type = TrafficSensor      |                          |                        |                 |
|                   |  | collection_interval_start_date      |                          | M                      | 5.5.2.10.2      |
|                   |  | collection_interval_end_date        |                          | M                      | 5.5.2.10.3      |
|                   |  | average_speed_kph                   |                          | O                      | 5.5.2.10.4      |
|                   |  | volume_vph                          |                          | O                      | 5.5.2.10.5      |
|                   |  | occupancy_percent                   |                          | O                      | 5.5.2.10.6      |
|                   |  | lane_data                           |                          | O                      | 5.5.2.10.7      |
|                   |  |                                     | lane_order               | M                      | 5.5.2.11.1      |
|                   |  |                                     | road_event_id            | O                      | 5.5.2.11.2      |
|                   |  |                                     | average_speed_kph        | O                      | 5.5.2.11.3      |

| Data Concept Name |          |                                |                   | Mandatory/<br>Optional | Data Concept<br>ID |
|-------------------|----------|--------------------------------|-------------------|------------------------|--------------------|
|                   |          |                                | volume_vph        | O                      | 5.5.2.11.4         |
|                   |          |                                | occupancy_percent | O                      | 5.5.2.11.5         |
|                   |          | if device_type = TrafficSignal |                   |                        |                    |
|                   |          | mode                           |                   | M                      | 5.5.2.12.2         |
|                   |          | if device_type = RoadsideUnit  |                   |                        |                    |
|                   |          | message_types                  |                   | O                      | 5.5.2.13.2         |
|                   | geometry |                                |                   | M                      | 5.5.2.1.4          |
|                   | bbox     |                                |                   | O                      | 5.5.2.1.5          |
| bbox              |          |                                |                   | O                      | 5.5.1.4            |

## Appendix C. Test Incident Report Template

### Summary

Date anomaly discovered

Context

Description of anomaly

Including whether pertains to:

CWZ Standard v01.00

CWZ GeoJSON Data Feed

Test Software

SUT Software

Operator Error

Impact

Originator's assessment of urgency

Immediate

Software fix

Update project documentation

Operator Training

Testware fix

Outside vendor/Third Party

Eventual

Software fix

Update project documentation

Operator Training

Testware fix

Outside vendor/Third Party

Deferred

Fix in later release

Waiver requested (reference)

No fix

No problem found

Waiver requested (reference)

Fix not justifiable

Fix not identifiable

Obsolete

Description of the corrective action

Status of the anomaly

Conclusions and recommendations

## Appendix D. Python Script – Fetch Data Over HTTP

This method fetches data over HTTP using the *requests* library. Edit the *url* variable before running this script.

```
import requests

# URL of the resource you want to fetch
url = "https://example-agency-website.com/data-feed"
json_filename = "agency_cwzfeed.json"

# Send GET request
response = requests.get(url)

# Check if request succeeded
if response.status_code == 200:
    data = response.json() # parse JSON response
    print("Success! Here's the data:")
    print(data)
    # save the data locally to a file called "output.json"
    with open(json_filename, "w", encoding="utf-8") as f:
        f.write(response.text)
else:
    print(f"Request failed with status {response.status_code}")
```

## Appendix E. Python Script – Visualize CWZ Feed on a Map

This python script uses the *folium* library. The script uses a JSON file as an input and outputs an HTML file that overlays the JSON file data on a map. This script requires an internet connection.

```
import folium
import json

# Path to your JSON or GeoJSON file
json_filename = "agency_cwzfeed.json"

# Starting map center (latitude, longitude) and zoom level
map_center = [40.0, -100.0] # roughly center of the U.S.
zoom_level = 5

# Output HTML file
output_map = "map_overlay.html"

# load data
with open(json_filename, 'r') as f:
    data = json.load(f)

# create map
m = folium.Map(location=map_center, zoom_start=zoom_level, tiles="OpenStreetMap")

# add data layer
folium.GeoJson(data, name="Overlay Data").add_to(m)

# save map
m.save(output_map)
print(f"Map saved to {output_map}")
```

## Appendix F. Python Script – Validate CWZ Feed Against CWZ JSON Schema

This python script uses the *jsonschema* library to validate a CWZ feed against the CWZ JSON schema. It outputs a JSON file that reports whether the feed passes the validation and lists any validation errors.

Ensure the correct *schema\_url* value is being used before running the script.

```
import argparse, json, time
from typing import Tuple, Any, Dict, Set
import requests
from requests.exceptions import RequestException
from referencing import Registry, Resource
from jsonschema import FormatChecker, validators

# edit the following variables as needed
json_filename = "agency_cwzfeed.json"
output = "validation_report.json"
schema_url = "https://raw.githubusercontent.com/ite-
org/cwz/refs/heads/main/schemas/1.0/WorkZoneFeed.json"
# uncomment the following if validating against the Device Feed Schema
# schema_url = "https://raw.githubusercontent.com/ite-
org/cwz/refs/heads/main/schemas/1.0/DeviceFeed.json"

# advanced variables
timeout = (10, 30) # (connect, read) seconds
max_retries = 3
max_errors = 200

# function checks if s is a url
def is_url(s: str) -> bool:
    return isinstance(s, str) and (s.startswith("http://") or
s.startswith("https://"))

# recursively collect external $ref URIs from a schema dict
def collect_ref_uris(node: Any, out: Set[str]):
    if isinstance(node, dict):
        if "$ref" in node and is_url(node["$ref"]):
            out.add(node["$ref"])
        for v in node.values():
            collect_ref_uris(v, out)
    elif isinstance(node, list):
        for v in node:
            collect_ref_uris(v, out)
```

```

# fetch a url with json data several times, printing progress if verbose
def http_get_json(url: str, timeout: Tuple[int, int], retries: int, verbose:
bool):
    last_err = None
    for attempt in range(1, retries + 1):
        try:
            if verbose:
                print(f"[fetch] {url} (attempt {attempt}/{retries})", flush=True)
            r = requests.get(url, timeout=timeout)
            r.raise_for_status()
            return r.json()
        except RequestException as e:
            last_err = e
            if verbose:
                print(f"[warn] fetch failed: {e}", flush=True)
            time.sleep(min(2 ** attempt, 8)) # wait longer between retries
    raise last_err

# loads json, whether from url or local file f
def load_json(source: str, timeout: Tuple[int, int], retries: int, verbose:
bool):
    if is_url(source):
        return http_get_json(source, timeout, retries, verbose)
    else:
        with open(source, "r", encoding="utf-8") as f:
            return json.load(f)

# build a registry with an in-memory cache dict so each URL is fetched once
def build_registry_with_cache(timeout: Tuple[int, int], retries: int, verbose:
bool) -> Tuple[Registry, Dict[str, Resource]]:
    cache: Dict[str, Resource] = {}

    def retrieve(uri: str) -> Resource:
        # each schema is only downloaded once per run
        if uri in cache:
            return cache[uri]
        data = http_get_json(uri, timeout, retries, verbose)
        # retrieved schemas are stored in memory as Resource objects
        res = Resource.from_contents(data)
        cache[uri] = res
        return res

    return Registry(retrieve=retrieve), cache

```

```

# scan the schema, find every external $ref, pre-download them once into cache
def prefetch_refs(schema: Dict[str, Any], registry: Registry, cache: Dict[str,
Resource], timeout: Tuple[int, int], retries: int, verbose: bool):
    uris: Set[str] = set()
    collect_ref_uris(schema, uris)
    # do a shallow prefetch here; nested refs will be cached on first access
    for uri in sorted(uris):
        if uri not in cache:
            try:
                if verbose:
                    print(f"[prefetch] {uri}", flush=True)
                data = http_get_json(uri, timeout, retries, verbose)
                cache[uri] = Resource.from_contents(data)
            except Exception as e:
                # Don't fail prefetch – let validator attempt later and report a
clean error.

                if verbose:
                    print(f"[warn] prefetch failed for {uri}: {e}", flush=True)

def main():
    ap = argparse.ArgumentParser(description="Validate one JSON file against a
JSON Schema (with remote $ref prefetch + cache).")
    ap.add_argument("--verbose", action="store_true", help="Print progress
messages")
    ap.add_argument("--no-prefetch", action="store_true", help="Skip prefetch
step and fetch refs on-demand only")
    args = ap.parse_args()

    # load the json schema and data
    try:
        if args.verbose: print("[load] schema", schema_url, flush=True)
        schema = load_json(schema_url, timeout, max_retries, args.verbose)

        if args.verbose: print("[load] data", args.data, flush=True)
        with open(json_filename, "r", encoding="utf-8") as f:
            instance = json.load(f)
    except Exception as e:
        out = {"overall_pass": False, "error": f"Failed to load: {e}"}
        txt = json.dumps(out, indent=2)
        with open(output, "w", encoding="utf-8") as fo: fo.write(txt)
        print(txt)

    # prefetch $ref URIs for registry and initialize validator
    try:

```

```

        if args.verbose: print("[init] building registry", flush=True)
        registry, cache = build_registry_with_cache(timeout, max_retries,
args.verbose)

        if not args.no_prefetch:
            if args.verbose: print("[init] prefetching $ref URIs", flush=True)
            prefetch_refs(schema, registry, cache, timeout, max_retries,
args.verbose)

            if args.verbose: print("[init] creating validator", flush=True)
            # choose correct json draft version based on $schema
            Validator = validators.validator_for(schema)
            # validate schema itself
            Validator.check_schema(schema)
            # FormatChecker() enables checks like format: "email"
            validator = Validator(schema, format_checker=FormatChecker(),
registry=registry)

            if args.verbose: print("[run] validating...", flush=True)
            # stream all errors and sort by JSON path for readable output
            errors = sorted(validator.iter_errors(instance), key=lambda e: e.path)

            # output for validation runtime error
            except Exception as e:
                out = {"overall_pass": False, "error": f"Validation runtime error: {e}"}
                txt = json.dumps(out, indent=2)
                with open(output, "w", encoding="utf-8") as fo: fo.write(txt)
                print(txt)

            # output for pass
            if not errors:
                out = {"overall_pass": True, "path": json_filename, "status": "PASS"}

            # output for validation fail
            else:
                out = {"overall_pass": False, "path": json_filename, "status": "FAIL",
"errors": []}
                for err in errors[: max(1, max_errors)]:
                    path_str = "$" + "".join([f"[{p}]" if isinstance(p, int) else f".{p}"
for p in err.absolute_path])
                    out["errors"].append(f"{path_str}: {err.message}")
                if len(errors) > max_errors:
                    out["errors"].append(f"... and {len(errors) - max_errors} more errors
(increase max-errors to see all).")

```

```
# format output report
txt = json.dumps(out, indent=2, ensure_ascii=False)
# save to file
with open(output, "w", encoding="utf-8") as fo: fo.write(txt)
if args.verbose: print(f"[done] wrote report -> {output}", flush=True)
# print to console
print(txt)

if __name__ == "__main__":
    main()
```