CMDP Web Services LIMS Interface Control Document

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TABLE OF CONTENTS

INTRODUCTION 5

About This Document 5
A.1.1 Intended Audience 5
A.1.2 Acronyms and Definitions 5
Scope of This Document 5
System Overview 6
A.1.3 Supporting Systems and Services 6
A.1.4 Reporting Sampling Data 7
A.1.4.1 Staging of Sampling Data by Laboratories 7
A.1.4.1.1 Laboratory User Roles 8
A.1.4.1.2 Uploading XML Data 8
A.1.4.2 Lab *Preparer* Reviewing Sampling Data after LIMS Transmittal 9
A.1.4.3 Lab *Reviewer* Reviewing Sampling Data 9
A.1.4.4 Lab *Certifier* Certification and Transmittal of Sampling Data 11

CMDP WEB SERVICES 12

CMDP Web Service Overview 12
CMDP Web Service Security 13
A.1.5 Authentication 13
A.1.5.1 Description 13
A.1.5.2 Request 14
A.1.5.3 Error Response 14
A.1.6 User Organization 15
A.1.6.1 Description 15
A.1.6.2 Request 15
A.1.6.3 Response 16
CMDP Web Service Endpoints (methods) 16
A.1.7 Get User Organizations 16
A.1.7.1 Description 16
A.1.7.2 Request 16
A.1.7.3 Response 17
A.1.8 Submit Sample Results into CMDP System Using Web Services 17
A.1.8.1 Description 17
A.1.8.2 Request 17
A.1.8.3 Response 18

APPENDIX – B: SAMPLE RESULT INFORMATION FORMATS 20

Supported Sample Types 20
Source Entities 20
Sample Data Xml File Structure 21

APPENDIX – C: CMDP ORG / ROLE ASSOCIATIONS 70

LIST OF TABLES

Table 1 – List of commonly used acronyms and definitions used throughout the document 5
Table 2 – Laboratory User Roles 8
Table 3 – Authorization Request Header 14
Table 4 – Unsuccessful Authentication Scenarios 14
Table 5 – User Organization Request Header (optional) 15
Table 6 – Sample Data: Valid childNodes based on Sample Type 22
Table 7 – Sample Result Data XML Structure and data elements 22
Table 8 – Operational Data: Valid childNodes based on Sample Type 33
Table 9 – Operational Data XML Structure and data elements 34

LIST OF FIGURES

Figure 1 – Staging of Sampling Data by Laboratories 7
Figure 2 – Preparation of Sampling Data 9
Figure 3 – Review of Sampling Data 9
Figure 4 – Certification of Sampling Data 11
Figure 5 – REST API Authentication 14
Figure 6 – Overview of XML Structure for Sample Result Data 21
Figure 7 – Overview of XML Structure for Operational Data 32

REVISION HISTORY

Version Number	Date of Revision	Description of Changes	Revision Entered By
1.0	07/20/2015	CMDP Web Services LIMS Document	INDUS
1.1	08/05/2015	Updates based of Will's comments	INDUS
1.2	01/13/2016	Update documentation accordingly based on web services developed to date	INDUS
1.3	02/17/2016	Update document based on client feedback	Uyen Tran
1.4	03/02/2016	Add composite samples	Chris Durham/ Naveen Tharalla
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1.6	04/26/16	Update Appendix B - Ensure description refers to Lab Id (not Lab name)	Uyen Tran
1.6	05/05/16	Update Appendix B - Replace acuteViolationName and nonAcuteViolationName with violationTypeName in chlorineDioxideBoosterDaily and chlorineDioxideNoBoosterDaily	Uyen Tran

INTRODUCTION

ABOUT THIS DOCUMENT

The Compliance Monitoring Data Portal (CMDP) Web Services document is intended for Laboratory Information Management System (LIMS) vendors. It identifies and describes the technical process of reporting sample results to CMDP using CMDP web services.

A.1.1 Intended Audience

The intended audiences of this CMDP Web Services document are:

- EPA Product Owner responsible for CMDP and the requirements contained therein;
- LIMS vendors and their client laboratories; and,
- Team responsible for developing and maintaining the CMDP Web Services.

A.1.2 Acronyms and Definitions

Table 1 – List of commonly used acronyms and definitions used throughout the document

Acronym	Definition
EPA	Environmental Protection Agency
CMDP	Compliance Monitoring Data Portal
CROMMER	Cross-Media Electronic Reporting Rule
LIMS	Laboratory Information Management System
NPDWRs	National Primary Drinking Water Regulations
PWS	Public Water System
REST	Representational State Transfer
SDWA	Safe Drinking Water Act
SCS	Shared CROMMER Services
SDK	Software Development Kit
UI	User Interface

SCOPE OF THIS DOCUMENT

The scope of this document is strictly limited to the description of a solution aimed at providing electronic reporting of compliance sample results from laboratories and public water systems using web services. It provides details on the certification of the sample results meeting the Environmental Protection Agency's (EPA) Cross-Media Electronic Reporting Regulation (CROMERR).

The CMDP can receive and accept Sampling Data using the following methods:

- Online web-based user interface.

- Microsoft Excel based data-entry templates that can be downloaded from the CMDP home page, updated locally and then loaded into CMDP using the CMDP web application.
- CMDP web services.

This document focuses on the CMDP web service methods for reporting sample results.

None of the contents of this document supersedes the statutory requirements of the Safe Drinking Water Act (SDWA), the regulatory reporting requirements of the Code of Federal Regulations (CFR) Parts 141 or 142 (including public notification requirements), state[1] regulatory requirements, or the existing reporting relationships between the U.S. Environmental Protection Agency, primacy agencies, public water systems, and laboratories. The CMDP is information technology that facilities the electronic reporting of compliance sample results from laboratories and public water systems to primacy agencies.

SYSTEM OVERVIEW

The Compliance Monitoring Data Portal (CMDP) is a web based application, relational database, and suite of web services aimed at providing the following:

- Electronic reporting of chemical, radiological, microbiological and operational sample results from laboratories and public water systems;
- Compliance with EPA's CROMERR; and,
- Primacy agency access to view and download sample results to support compliance determinations using their state compliance databases.

A.1.3 Supporting Systems and Services

The following systems and services are necessary for LIMS-based reporting to the CMDP:

1) **Shared CROMERR Services (SCS)** – A suite of CROMERR compliant web services that support centralized
    a) Registration and Account Management
    b) Identity Management
    c) Signature Device
    d) Signature and Copy of Record Generation

2) **Laboratory Information Management System (LIMS)** – Many laboratories, or water utilities with laboratories, have acquired and are using LIMS. Laboratories can use their LIMS to report data to the CMDP electronically using web services or data exchange templates.

1 For purposes of this CMDP Web Services document, the term “state” represents a government agency with primary enforcement authority (primacy) for National Primary Drinking Water Regulations (NPDWRs) and any state-specific drinking water regulations. A “state” therefore includes a state government entity, Tribal entity or county government entity.

A.1.4 Reporting Sampling Data

The process of reporting sampling data from laboratories to CMDP goes through the following stages:

- Staging of Sampling Data By Laboratories
- Lab *Preparer* Review of and Corrections to Sample Data after LIMS Transmittal
- Lab *Reviewer* Reviewof Sample Data Job from a Preparer
- Lab *Certifier* Certification and Transmittal of a Sample Data File to a State Primacy Agency

The detailed steps for the reporting processes are illustrated and explained in the following sections.

A.1.4.1 STAGING OF SAMPLING DATA BY LABORATORIES

In this stage, data is loaded into CMDP using the following method:

- **CMDP web services –** CMDP allows laboratories to upload sampling data securely through web service. The web services are not invoked directly by a user; instead, it is called using another application such as a LIMS.

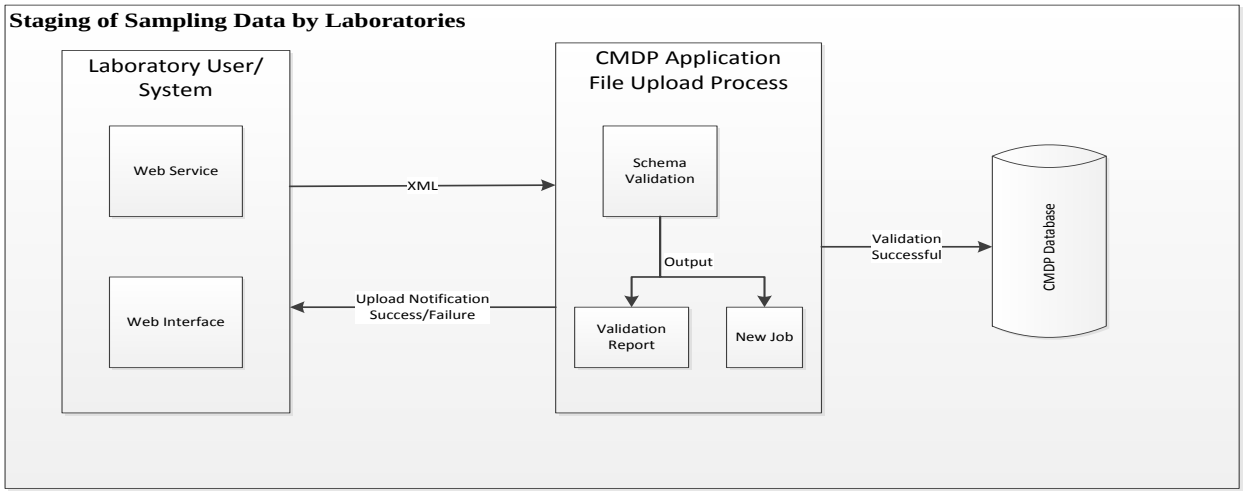

Figure 1 – Staging of Sampling Data by Laboratories

A.1.4.1.1 Laboratory User Roles

A CMDP user may have one or more roles in the CMDP. Each role has specific user permissions, which are described in the table below.

Table 2 – Laboratory User Roles

Roles	User Permissions
Lab Certifier/State Lab Submitter	A Lab user may use the built-in CMDP CROMERR services to (a) certify that sample data are valid and CROMERR-compliant (for compliance samples); (b) submit both the structured data and any attachments to the state primacy agency, and (c) generate the Copy of Record (COR) to be stored in the SCS COR database. A user in the certifier/submitter role also has the Preparer and Reviewer permissions to the CMDP as described below. *Note: A state lab submitter would submit the CMD to the state primacy agency, but would not need to call the CROMERR services; this role is defined as a Submitter to distinguish it from a Lab Certifier.*
Private or State Lab Reviewer	A user with this role may read a data prior to and after electronic signature. A user with this role cannot prepare (i.e. edit) data.
Private or State Lab Preparer	A user with this role may use the CMDP to prepare data for transmittal to the state by using the reporting and data validation features of the CMDP. A user with this role also may read data for content prior to the electronic signature.

For a complete list of all CMDP roles, including those who would not use LIMS to report to CMDP, please see Appendix – C: CMDP Org/Roles Associations.

A.1.4.1.2 Uploading XML Data

Uploading XML data under the CMDP systems is a two-step asynchronous process:

Step 1: Simple structural validation – The CMDP application validates the XML against the approved schema and upon successful validation, a job is created and the XML is stored in the system for further processing. If the XML validation fails, XML is rejected and an exception error message is raised and returned in the response.

Step 2: Cross-referencing validations – Once the XML passes structural validation, the CMDP application will parse the XML and validate each individual record in the XML file. XML After applying the CMDP validations, the sample results and validation report associated with the job will be available for the laboratory to view in the CMDP UI. Sampling data that fails CMDP validation will not proceed, to Reviewer first, then Certifier, until corrected. The CMDP validation report provides a way for the laboratory Preparer to identify and correct the sample records containing errors. The CMDP will generate a summary that will be available to the laboratory user for review.

A.1.4.2 LAB *PREPARER* REVIEWING SAMPLING DATA AFTER LIMS TRANSMITTAL

After the samples are uploaded into CMDP using web services, a notification email will be sent to the Preparer indicating the job is ready for further processing i.e., review, certification. The notification email will contain a hyperlink that will re-direct the user to the CMDP web application to review the job. The CMDP web application will provide users with the ability to certify the job.

The laboratory *Preparer* user will login to the CMDP web application and will verify the accuracy of the data, review the validation report and make corrections as necessary before sending the job for the *Reviewer*. See *Figure 2* for a visual of the process.

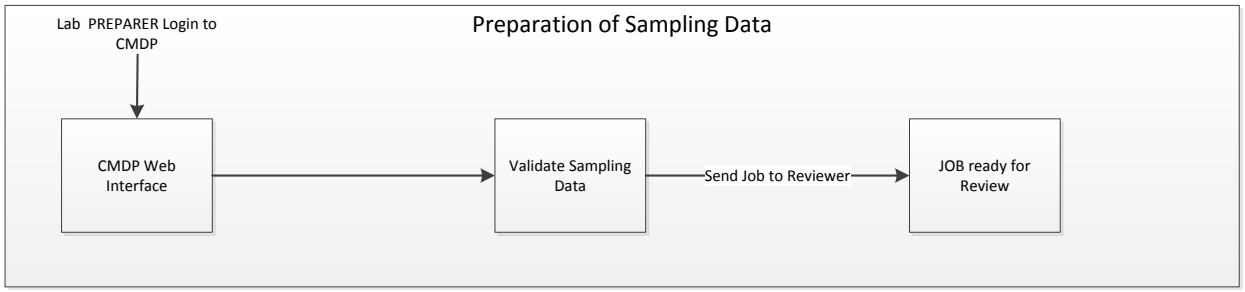

Figure 2 – Preparation of Sampling Data

A.1.4.3 LAB *REVIEWER* REVIEWING SAMPLING DATA

At this stage, the laboratory *Reviewer* user will login to the CMDP web application and will be able to verify the accuracy of the sampling data of the job submitted by the *Preparer*. If there are no errors or corrections in the file, the Reviewer may send the job to the *Certifier*. This second-level review allows for the identification of additional errors not flagged by the CMDP validation process. If the *Reviewer* finds any issues, the job can be rejected and sent back to the *Preparer* for necessary corrections. See *Figure 3* for a visual of the process.

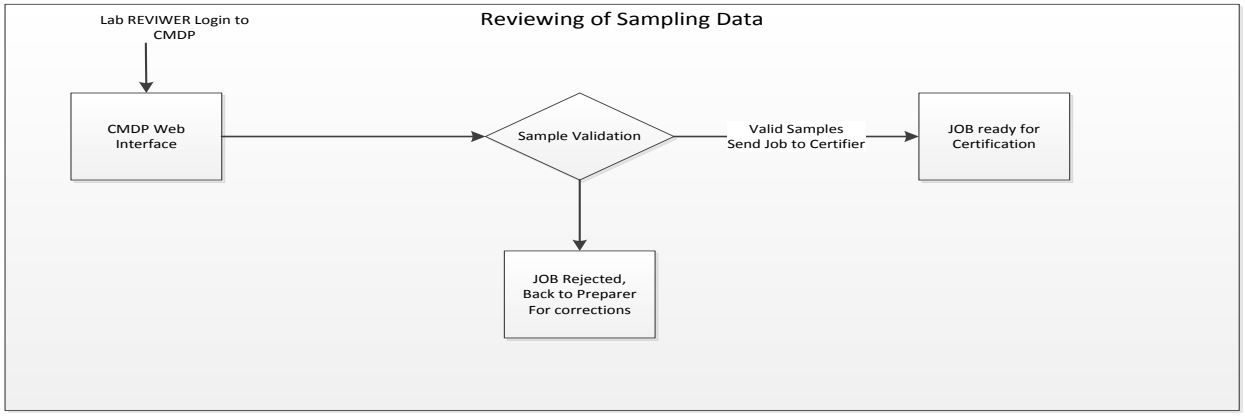

Figure 3 – Review of Sampling Data

A.1.4.4 LAB *CERTIFIER* CERTIFICATION AND TRANSMITTAL OF SAMPLING DATA

In this stage, the laboratory *Certifier* user will login to the CMDP web application and will be able to review the job submitted by the *Reviewer*. This review would identify any errors not detected by the CMDP validation scripts or by the *Reviewer*. If the *Certifier* finds any problems with the sampling data, then the job will be rejected and sent to the *Preparer* for necessary corrections. If there are no errors in the job, the Certifier may initiate the CMDP web service call to Shared CROMERR Services to sign and submit the sample results to the primacy agency. After the job is certified, the sampling data is made accessible to the associated state primacy agency for review. See *Figure 4* for a visual of the process.

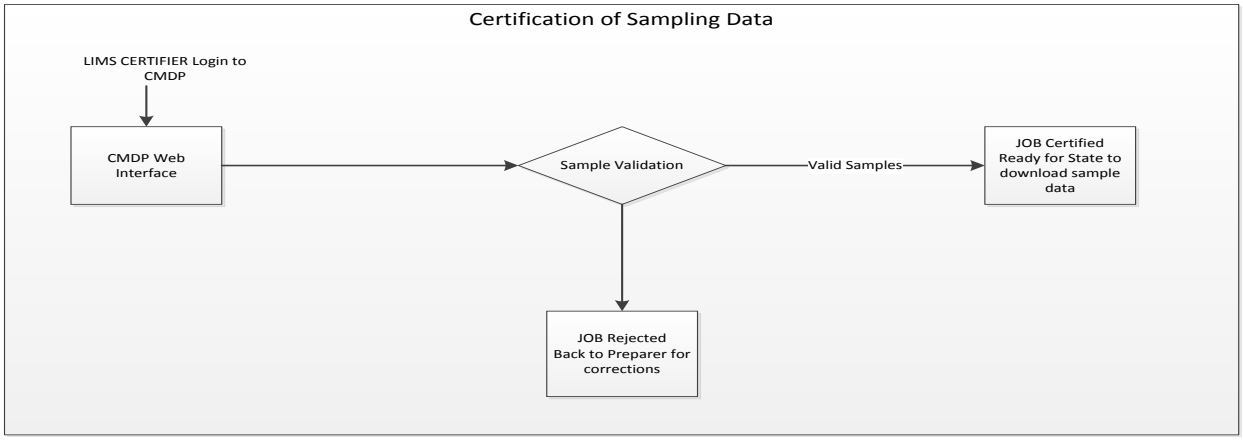

Figure 4 – Certification of Sampling Data

CMDP WEB SERVICES

CMDP WEB SERVICE OVERVIEW

The CMDP Representational State Transfer (REST) based web services are intended to be invoked from an external application like a LIMS to upload sample results into the CMDP system. The details of the process are provided in this section of the document.

Beyond this document, the CMDP Team will provide the following additional supportive information to support LIMS integration:

- XML Schema Definition (XSD) files which can be used to validate XML submissions before submitting to CMDP.
- Example XML files which can be used to test the integration of LIMS with CMDP. This will allow LIMS developers to, initially, test integration with CMDP without worrying about formatting data.
- Swagger – A specific instance of Swagger which allows a developer/consumer to understand and interact with the CMDP services without initially implementing code. Swagger is a specification surrounded by a large ecosystem of tools, which includes everything from front-end user interfaces and low-level code libraries. Developers may be particularly interested in the Swagger Code Generator project, which allows the generation of client-side code to consume the CMDP web services in a variety of coding languages.
- The Web Application Description Language (WADL) is a machine-readable XML description of HTTP-based web applications (typically REST web services). WADL models the resources provided by a service and the relationships between them. WADL is intended to simplify the reuse of web services that are based on the existing HTTP architecture of the Web. It is platform and language independent and aims to promote reuse of applications beyond the basic use in a web browser.

Once available, the CMDP Team will update this document to include various web service endpoints to support LIMS integration. At this time, the team anticipates supporting services in following environments:

- Production – The production repository for compliance monitoring related data.
- Training – The purpose of this environment is to provide a place to train users on the usage of the CMDP web application or CMDP integration with LIMS.
- Integration Test – The purpose of this environment is to provide a place for LIMS developers to test integration between their LIMS and CMDP.

CMDP Web Service Security

A.1.5 Authentication

A.1.5.1 Description

Authentication occurs as part of a single web service request, not as a separate request. The Basic Authentication mechanism provided by Spring Security was implemented for the CMDP Web Services. As part of the web service request, Security credentials are passed from the client to server via the HTTP request header which contains 'userId:password' encoded in base64.

In order to perform any operations using CMDP web services, all requests must contain the user's security credentials in the request header. Only after authentication is successful will the web request be passed to the REST API and be processed. Table 5 below illustrates the REST API Authentication process.

The Shared CROMERR Services (SCS) being used internally by CMDP and its web services to authenticate users and are still under development. Once finalized, additional authentication and role management information will be provided as an appendix to a future version of this document.

PLEASE NOTE: The security credentials (required) are part of a request, not a separate request.

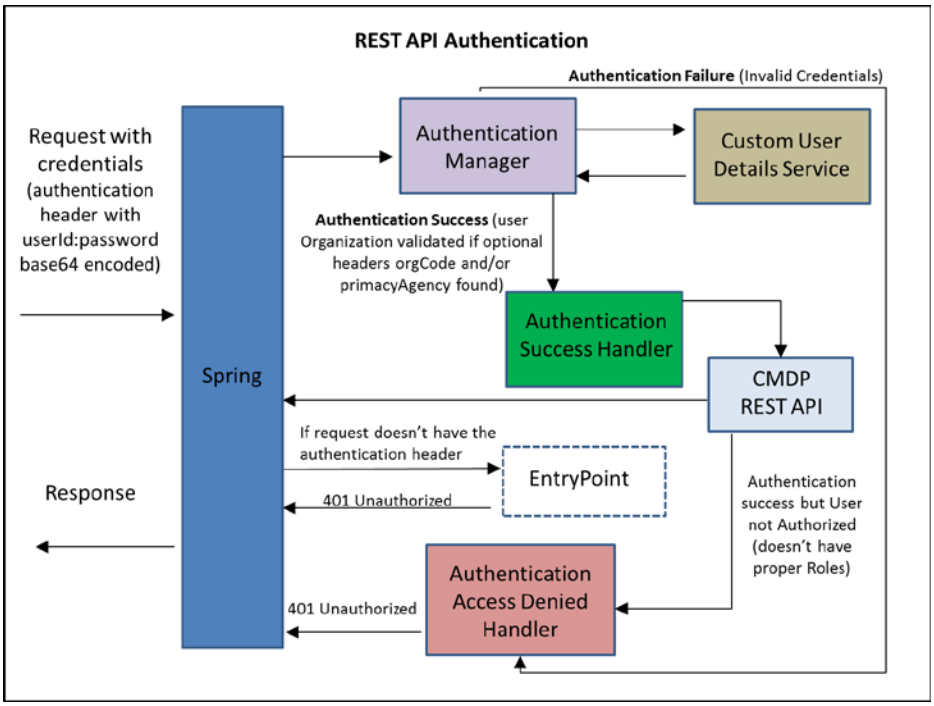

Figure 5 – REST API Authentication

Note: The following are not scenarios for a specific web service endpoint (method), but for purposes of illustrating the error responses from the authentication process that occurs as part of a request.

A.1.5.2 REQUEST

Table 3 – Authorization Request Header

Name	Required	Definition / Constraints
Authorization	Yes	SCS User Id and Password encoded in base64

Example 1 – Authorization Request Header for userA with password "password:

```
Authorization: Basic dXNlckE6cGFzc3dvcmQ=
                     userId:password encoded in base64
```

A.1.5.3 ERROR RESPONSE

If authentication is successful, the request will be processed and a response returned. If the authentication fails, then the response will raise an exception and return an error message.

Table 4 – Unsuccessful Authentication Scenarios

Scenario	HTTP Response Status Code	Response

No security credentials provided	401 Unauthorized	`<?xml version="1.0" encoding="UTF-8" standalone="yes"?>`
		`<response>`
		`<endRow>0</endRow>`
		`<errorMessage>Full authentication is required to access this resource</errorMessage>`
		`<queueStatus>0</queueStatus>`
		`<startRow>0</startRow>`
		`<status>401</status>`
		`<totalRows>0</totalRows>`
		`</response>`

Invalid Security Credentials (i.e user id not valid)	401 Unauthorized	`<?xml version="1.0" encoding="UTF-8" standalone="yes"?>`
		`<serverResponse>`
		`<response>`
		`<endRow>0</endRow>`
		`<errorMessage>Invalid User: userA</errorMessage>`
		`<queueStatus>0</queueStatus>`

		<startRow>0</startRow> <status>401</status> <totalRows>0</totalRows> </response> </serverResponse>
Valid security credentials, but User Not Authorized (based on roles)	401 Unauthorized	<?xml version="1.0" encoding="UTF-8" standalone="yes" ?> <serverResponse> <response> <endRow>0</endRow> <errorMessage>Requested resource 'https://toBeDeterminedServer/cmdp-webservice/api/submissions/sampleData' is not available for this user: stadmin. Applicable Roles for This Resource: [ROLE_WS_MODE, ROLE_LB_MODE, ROLE_LS_MODE]</errorMessage> <queueStatus>0</queueStatus> <startRow>0</startRow> <status>401</status> <totalRows>0</totalRows> </response> </serverResponse>

A.1.6 User Organization

A.1.6.1 DESCRIPTION

Users may be associated with multiple organizations in SCS. Optional request headers can be used to specify the user organization to be associated with the web service request for CMDP. If optional headers not specified, the user's default Organization is used. If specified, the user organization will be validated as part of the authentication process. Only after successful validation of the user organization will the web service request be processed.

The optional request headers for User Organization are detailed in Table 5.

A.1.6.2 REQUEST

Table 5 – User Organization Request Header (optional)

Name	Required	Definition / Constraints
orgCode	No	Organization Code
primacyAgency	No	Primacy Agency

Example 2 - Optional Request header to specify User Organization:

```
Authorization:Basic dXNlckE6cGFzc3dvcmQ=
orgCode: TX9000001
primacyAgency: TX
```

Section A.1.7 details the web service method to retrieve the list of organizations that the user is associated with in SCS.

A.1.6.3 RESPONSE

If valid, the user role and organization is updated accordingly and the request will be processed. If not valid, the web service request will not be processed and the response will raise an exception and return an error message.

Note: The following are not scenarios for a specific web service endpoint (method), but for purposes of illustrating the error responses from the authentication process for user specified Organization that occurs as part of a request.

Example 3 – Unsuccessful User Organization Scenarios

Scenario	HTTP Response Status Code	Response

Invalid Organization Code and/or Primacy Agency specified for user	401 Unauthorized	`<?xml version="1.0" encoding="UTF-8" standalone="yes"?>`
		`<serverResponse>`
		`  <response>`
		`  <endRow>0</endRow>`
		`  <errorMessage>Invalid Primacy Agency/Org Code: TestPA/TX9000000 for user: wsadmin</errorMessage>`
		`  <queueStatus>0</queueStatus>`
		`  <startRow>0</startRow>`
		`  <status>401</status>`
		`  <totalRows>0</totalRows>`
		`  </response>`
		`</serverResponse>`

CMDP WEB SERVICE ENDPOINTS (METHODS)

This section details the web service endpoints (methods).

A.1.7 Get User Organizations

A.1.7.1 DESCRIPTION

Retrieve the list of organizations the user is associated with in SCS for CMDP

A.1.7.2 REQUEST

URL: https://<TBD>/api/user/userOrganizations

HTTP Method: GET

Request Header:

```
Authorization: Basic d3NhZG1pbjpwYXNzd29yZA==
```

A.1.7.3 RESPONSE

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
<serverResponse>
  <response>
          <data>
                  <userOrganizationRef>
                          <orgCode>TX9000000</orgCode>
                          <orgId>126749</orgId>
                          <orgName>Janak1111</orgName>
                          <orgState>TX</orgState>
                          <orgType>WS</orgType>
                          <username>wsadmin</username>
                  </userOrganizationRef>
                  <userOrganizationRef>
                          <orgCode>TX9000001</orgCode>
                          <orgId>126750</orgId>
                          <orgName>Janaksaaa</orgName>
                          <orgState>TX</orgState>
                          <orgType>WS</orgType>
                          <username>wsadmin</username>
                  </userOrganizationRef>
          </data>
          <endRow>1</endRow>
          <errorMessage>SUCCESS:null</errorMessage>
          <queueStatus>0</queueStatus>
          <startRow>0</startRow>
          <status>0</status>
          <totalRows>2</totalRows>
  </response>
</serverResponse>
```

A.1.8 Submit Sample Results into CMDP System Using Web Services

A.1.8.1 DESCRIPTION

Submit sample and operational results into CMDP for an organization. The request payload will contain a string representation of the XML data to be submitted.

A.1.8.2 REQUEST

URL: https://<TBD>/ submissions/sampleData

HTTP Method: POST

Request Header:

```
Authorization: Basic d3NhZG1pbjpwYXNzd29yZA==
orgCode: TX9000001
primacyAgency: PA
```

Request Body (Payload):

```
<?xml version="1.0" encoding="UTF-8"?>
<samples>
  <sample>
          <wsId>CT0010011</wsId>
          <facilityName>DISTRIBUTION SYSTEM - WELL A</facilityName>
          <samplingPointId>MW08-A1</samplingPointId>
          <samplingLocation>slDemo</samplingLocation>
          <labSampleCd>AAB1</labSampleCd>
          <collectionDate>2015-09-29</collectionDate>
          <collectionTime>10:00</collectionTime>
          <legalEntityName>PH-0509</legalEntityName>
          <sampleTypeName>SP</sampleTypeName>
          <sampleVolumeName>100 ml</sampleVolumeName>
          <comments>Demo XML Test Microbial</comments>
          <sampleCategoryName>Microbial</sampleCategoryName>
          <sampleResultMicro>
                  <analyteName>3014</analyteName>
                  <methodName>310.3</methodName>
                  <analysisStartDt>2015-07-19</analysisStartDt>
                  <analysisStartTime>12:00:00</analysisStartTime>
                  <analysisComplDt>2015-07-19</analysisComplDt>
                  <analysisComplTime>12:30:00</analysisComplTime>
                  <name>PH-0466</name>
                  <comments>Demo Micro Test</comments>
                  <volumeAssayedName>500 ml</volumeAssayedName>
                  <apName>P</apName>
                  <count>1234</count>
                  <typeName>Tubes</typeName>
                  <resultVolumeName>1 ml</resultVolumeName>
                  <interferenceName>CNFG</interferenceName>
                  <sourceTypeName>Lake</sourceTypeName>
          </sampleResultMicro>
          <sampleResultField>
                  <analyteName>0100</analyteName>
                  <methodName>150.1</methodName>
                  <comments>Demo Micro Field Test</comments>
                  <result>222</result>
                  <uomName>pH</uomName>
          </sampleResultField>
  </sample>
</samples>
```

A.1.8.3 RESPONSE

Unsuccessful (malformed XML such as missing end tag)

HTTP Status 400 Bad Request

```
[Empty]
```

Successful


```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<serverResponse>
  <response>
          <data>
                  <job>
                          <jobId>1117</jobId>
                  </job>
          </data>
          <endRow>0</endRow>
          <errorMessage>SUCCESS:XML Submission Accepted</errorMessage>
          <queueStatus>0</queueStatus>
          <startRow>0</startRow>
          <status>0</status>
          <totalRows>1</totalRows>
  </response>
</serverResponse>
```

APPENDIX – B: SAMPLE RESULT INFORMATION FORMATS

Sampling information submitted to CMDP will be delivered in the XML format.

SUPPORTED SAMPLE TYPES

Type	Type ID (2 Chars)	Description
SampleResult	SD	
OperationalResult	OD	

SOURCE ENTITIES

Source entity is the entity that reports the samples to State.

Source Entity Name	Source Entity Code (2 Chars)	Description
Laboratory	LB	

SAMPLE DATA XML FILE STRUCTURE

This section provides details for the Sample Data XML File Structure.

Please Note: Both Sample Result and Operational Data can be submitted in one XML file. For illustrative purposes, Sample Result and Operational Data are presented in separate figures, Figure 6 – Overview of XML Structure for Sample Result Data and Figure 7 – Overview of XML Structure for Operational Data.

SAMPLE RESULT DATA

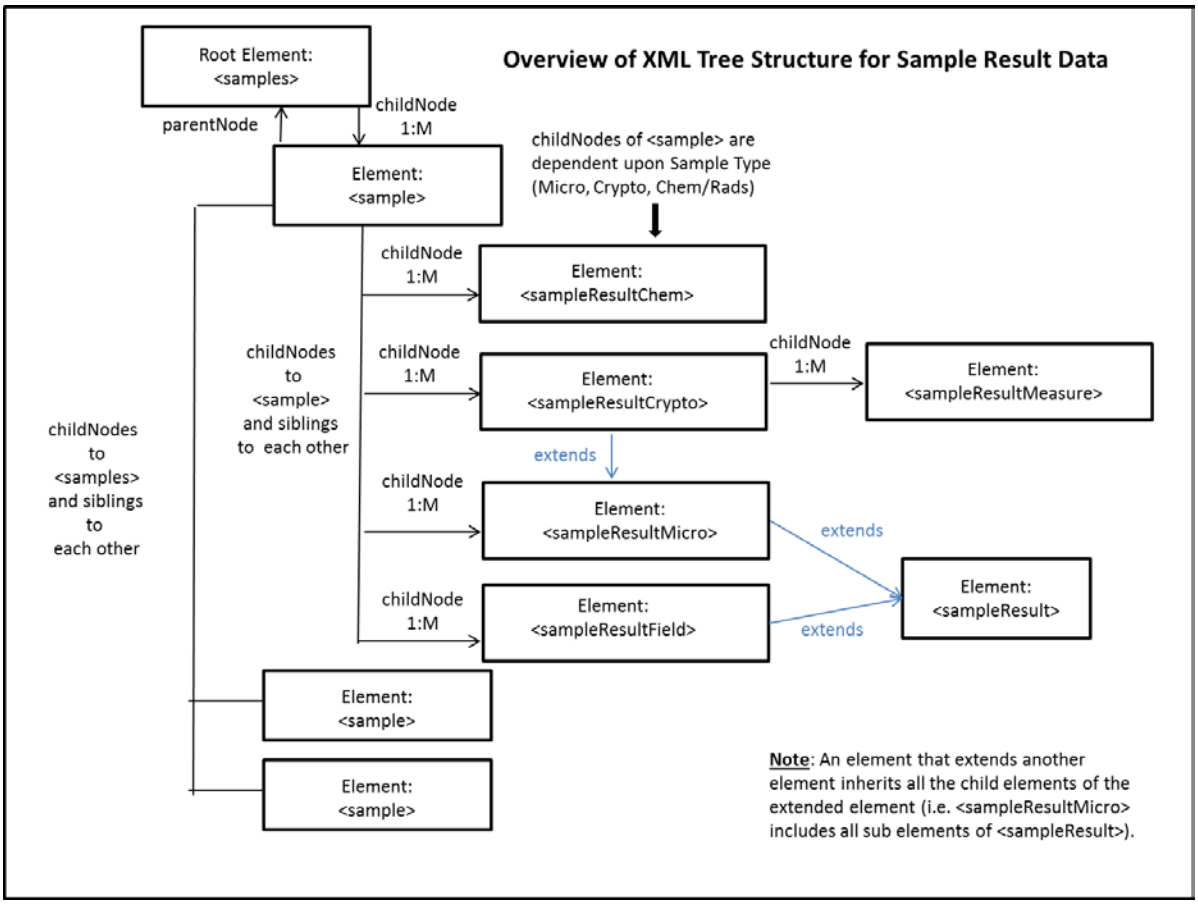

Figure 6 – Overview of XML Structure for Sample Result Data

The childNode(s) for sample data are dependent upon the Sample Type (Micro, Chem/Rads, Crypto). Table 6 – Sample Data: Valid childNodes based on Sample Type details the valid childNodes based on Sample Type.

Table 6 – Sample Data: Valid childNodes based on Sample Type

Type	childNode (Element)
Microbial	sampleResultMicro sampleResultField
Chem/Radionuclides	sampleResultChem sampleResultField
Cryptosporidum	sampleResultCrypto >sampleResultMeasure sampleResultField

Table 7 – Sample Result Data XML Structure and data elements

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
samples	samples	XML Root Element			
>sample	sample				
	wsId	string	R	9 chars – first 2 chars for state code and next 7 chars for water system ID	Water System ID: Federal ID assigned to the water system
	facilityName	string	R	Alphanumeric - 40 chars	State Assigned Facility ID
	samplingPointId	string	R	Alphanumeric - 40 chars	State Assigned Sampling Point ID
	samplingLocation	string	O	Alphanumeric - 250 chars	Free Form Text
	labSampleCd	string	R	Alphanumeric - 80 chars	Laboratory assigned Sample ID
	collectionDate	string	R	Date format: MM/DD/CCYY	Collection Date
	collectionTime	string	O	Time format: 00:00	Collection Time

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	legalEntityName	string	R	Alphanumeric - 40 chars	Reporting Laboratory ID
	sampleTypeName	string	R	Submit Code (i.e. RT) [**Code] - [Description]**: (**Microbial /ChemsRads**) **RT** - Routine **RP** - Repeat **TG** - Triggered **CO** - Confirmation **SP** - Special **BB** - Batch Blanks **FB** - Field Blanks **PE** - Performance Evaluation **SB** - Shipping Blanks **ST** - Split Blanks **MR** - Maximum Residence Time **MS** - Matrix Spike [**Code] - [Description]**: (**Cryptosporidium**) **RT** - Field (i.e., Routine) **MS** - Matrix Spike **SP** - Special **PE** - Performance Evaluation **BB** - Batch Blanks **FB** - Field Blanks **SB** - Shipping Blanks **ST** - Split Blanks	Sample Type – expected value is the **Code**
	sampleVolumeName	string	O	100 ml 200 ml 300 ml	Sample Volume

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				400 ml 500 ml 1 liter	
	comments	string	O	Alphanumeric - 250 chars	Comments
	repeatLocationName	string	**C**	Original Site Downstream Upstream Source Alternative (RTCR) Other (TCR)	Req'd if is Sample Type is Repeat Repeat Location
	originalLabSampleCd	string	R	Alphanumeric - 80 chars	Req'd if is Sample Type is Repeat/Triggered/Confirmation Original Laboratory assigned Sample ID
	sampleCategoryName	string	R	Microbial Chem/Radionuclides Cryptosporidium	Sample Category
sampleResult	[none]				Element that is extended by other elements.
	analyteName	string	R	**NOTE**: Valid values cannot be listed due to the large size of possible values (which is also dependent upon user primacyAgency) Analyte Codes for Sample Field only: **1013** - Free Chlorine Residual	Analyte Code

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				1012 - Total Chlorine Residual **1996** - Temperature **0100** - Turbidity **1925** - pH	
	methodName	string	O	**NOTE**: Valid values cannot be listed due to the large size of possible values (which is also dependent upon user primacyAgency). Valid values are also dependent upon Analyte/Parameter (sampleResult.analyteName)	Method Code
	analysisStartDt	string	O	Date format: MM/DD/YYYY	Analysis Start Date
	analysisStartTime	string	O	Time format: 00:00	Analysis Start Time
	analysisComplDt	string	O	Date format: MM/DD/YYYY	Analysis Completed Date
	analysisComplTime	string	O	Time format: 00:00	Analysis Completed Time
	name	string	O	Alphanumeric - 80 chars	Analyzing Laboratory Id
	comments	string	O	Alphanumeric - 250 chars	
	volumeAssayedName	string	O	1 ml 5 ml 10 ml 100 ml 400 ml 500 ml	Volume Assayed –(Microbial and ChemsRads) Per – (Cryptosporidium)
>>sampleResultChem	sampleResultChem				

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	See {sampleResult}			Extends {sampleResult} therefore all elements of sampleResult included.	
	notDetected	boolean	R	true false	Was Analyte Detected?
	result	decimal	O	Precision 7, Scale 4 [000.0000]	Result Value
	resultUomName	string	O	degree C LANG NTU pH units umho/cm TON Color Units mg/L ug/L ng/L pCi/L mF/L	Result Unit of Measure
	standardDeviation	decimal	O	Precision 9, Scale 2 [0000000.00]	Standard Deviation
	reportingLevel	decimal	O	Precision 7, Scale 4 [000.0000]	Reporting Limit

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				degree C LANG NTU pH units umho/cm TON Color Units mg/L ug/L ng/L pCi/L mF/L	
	reportingLevelUomName	string	O		Reporting Limit Unit of Measure
>>sampleResultMicro					
	apName	string	R	Submit Code (i.e. A) **[Code] - [Description]:** A - Absent P - Present	Analyte found?
	count	int	O	Precision 7, Scale 0 [0000000]	Bacteria count in the sample
	typeName	string	O	Colonies Tubes Most probable Number	Units – Microbial Occysts - Cryptosporidium
	resultVolumeName	string	O	1 ml 5 ml 10 ml 100 ml 400 ml 500 ml	Volume

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				1 liter 100 liter 10 Gal 100 Gal 400 Gal	
	interferenceName	string	O	**CNFG** - Confluent Growth **TNTC -** Turbid Culture - no gas **TCNG -** Too Numerous to Count	
	filteredVolExaminedName	String	O	**Y** – Yes **N** - No	Was 100% of filtered volume examined (Cryptosporidium)
	sourceTypeName	string	O	Flowing stream Lake Reservoir GWUDI	Source Type
>>sampleResultCrypto	sampleResultCrypto				
	See {sampleResultMicro}			Extends {sampleResult} therefore all elements of sampleResultMicro included.	
>>sampleResultField	sampleResultField				
	See {sampleResult}			Extends {sampleResult} therefore all elements of sampleResult included.	
	result	decimal	R	Precision 7, Scale 2 [00000.00]	Result

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	uomName	string	R	**1013** - Free Chlorine Residual: mg/l **1012** - Total Chlorine Residual: mg/l **1996** - Temperature: F C **0100** - Turbidity: NTU **1925** - pH: ph	Result Unit Of Measure **NOTE**; Valid value depends on Parameter Value (sampleResult.analyteName)
>>>sampleResultMeasure	sampleResultMeasure				**SampleResultMeasure is a child embedded inside SampleResultMicro(Cryptosporidium)**
	measureName	string	R	Submit Code (i.e. A) **[Code] - [Description]:** **SAMPLE VOL FILTER** - Sample Volume Filtered **SAMPLE VOL SPIKE** - Sample Volume Spiked **#OOCYSTS SPIKE** - Number of Oocysts Spiked **#FILTER USE** - Number of filters used **PACK PELLET VOL** - Packed Pellet Volume **#OOCYSTS** - Number of oocysts **#OOCYSTS CLC** - Calculated number of oocysts per volume	Measure Code

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				VOL RESSP C - Volume of resuspended concentrate **VOL RESSP CP** - Volume of resuspended conc. processed	
	result	decimal	R	Precision 9, Scale 2 [0000000.00]	

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				G L mL G L mL N N G L mL SAMP VOL SLIDE Org/100mL Org/l G L mL G L	
	uomName	string	R	mL	

OPERATIONAL DATA XML FILE STRUCTURE

This section provides details for the Operational Data XML File Structure. Figure 7 – Overview of XML Structure for Operational Data depicts the overall XML Tree structure of the Operational Data submission. As previously mentioned, please note that both Sample Result and Operational Data can be submitted in one XML file.

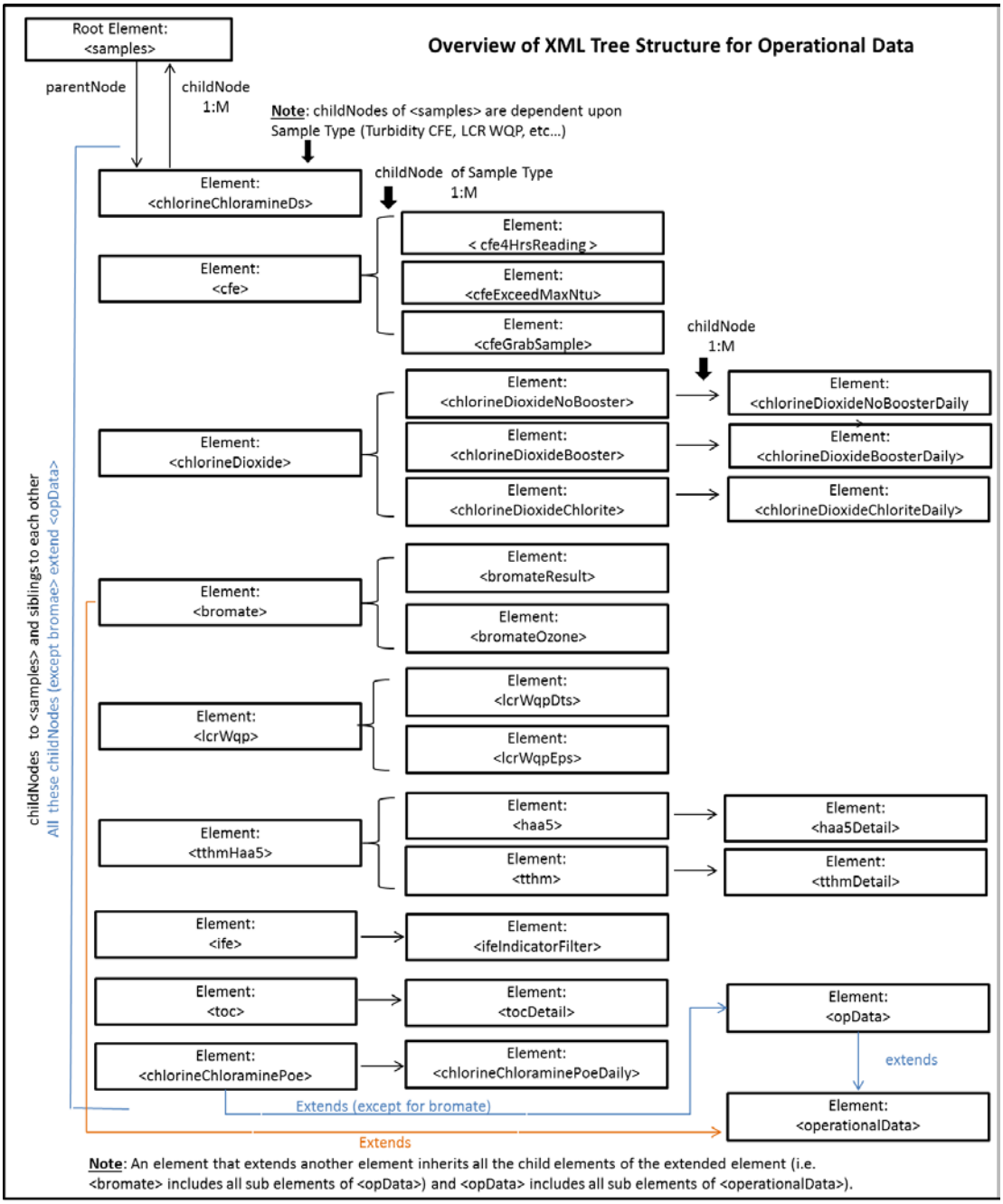

Figure 7 – Overview of XML Structure for Operational Data

The childNode(s) for Operational data are dependent upon the Sample Type (i.e. Turbidity CFE, Turbidity IFE, LCR WQP, etc…). Table 8 – Operational Data: Valid childNodes based on Sample Type details the valid childNodes based on Sample Type.

Table 8 – Operational Data: Valid childNodes based on Sample Type

Type	childNode (Element)
Turbidity CFE	cfe cfe4HrsReading cfeExceedMaxNtu cfeGrabSample
Turbidity IFE	ife ifeIndicatorFilter
Chlorine Dioxide and Chlorite	chlorineDioxide chlorineDioxideNoBooster >chlorineDioxideNoBoosterDaily chlorineDioxideBooster >chlorineDioxideBoosterDaily chlorineDioxideChlorite >chlorineDioxideChloriteDaily
Chlorine and Chloramines Entering DS	opDataClChloraminePoe >chlorineChloraminePoeDaily
Chlorine and Chloramines in DS	chlorineChloramineDs

Type	childNode (Element)
LCR WQP	lcrWqp >lcrWqpDts >lcrWqpEps
Total Organic Carbon	toc >tocDetail
Ozone Treatment (Bromate)	bromate >bromateResult >bromateOzone
TTHM and HAA5	tthmHaa5 >haa5 >>haa5Detail >tthm >>tthmDetail

Table 9 – Operational Data XML Structure and data elements

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
samples	samples	XML Root Element			
operationalData	[none]				This element is extended by other elements.
	wsId	string	R	9 chars – first 2 chars for state code and next 7 chars for water system ID	Water System ID: Federal ID assigned to the water system
	facilityName	string	R		Facility Name: Name given to the water system facility

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
					(Not valid for LCR samples)
	sampleType	string	R	Turbidity CFE Turbidity IFE Chlorine Dioxide and Chlorite Chlorine and Chloramines Entering DS Chlorine and Chloramines in DS LCR WQP Total Organic Carbon Generic Sample Type Ozone Treatment (Bromate) TTHM and HAA5	Sample Category
opData	[none]				This element is extended by other elements.
	See {operationalData}			Extends {operationalData} therefore all elements of opData included.	
	samplingPointId	string	R	Alphanumeric - 40 chars	Sampling Points within the Facility (Not valid for CFE, IFE, Chlorine Chlormine DS , TOC and LCR Samples)
	mntrgPeriodMonth	int	R	Integer value representing month (i.e. 1=Jan, 2=Feb, 3=March, etc…) quarter value (13 = Q1 , 14 = Q2 , 15 = Q3 , 16 = Q4)	Monitoring Period Month (TOC and TTHM are Quarterly)

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	mntrgPeriodYear	int	R	Format: CCYY Valid Values 2011 through current Year	Monitoring Period - Year
>chlorineChloramineDs	chlorineChloramineDs				
	See {opData}			Extends {opData} therefore all elements of opData included.	
	quarterlyRunningAnnualAvg	decimal	O	Precision 5, Scale 3 [00.000]	Quarterly Running Annual Average Only applies to: March, June, September or December
	mrdlViolationName	string	O	Yes No	MRDL Violation?
	numMeasurement	int	O	Precision 5, Scale 0 [00000]	Number of Measurements
	monthlyAvg	decimal	O	Precision 5, Scale 3 [00.000]	Monthly Average
	noOfMsrDetectedMtDSResi	int	O	Precision 5, Scale 0 [00000]	Number of Measurement Detected DS Residual
	pctMtDSResiReq	decimal	O	Precision 3, Scale 3 [.000]	% Meeting DS Residual Requirement
	preMonthPctMtDSResiReq	decimal	O	Precision 3, Scale 3 [.000]	Previous Month % Meeting DS Residual Requirement
>cfe	cfe				
	See {opData}			Extends {opData} therefore all elements of opData included.	
	monthlyHrsOperation	int	O	Precision 5, Scale 0 [00000]	Monthly hours of operation
	totalReq	int	O	Precision 5, Scale 0 [00000]	Total Number of CFE Turbidity measurements required
	totalTaken	int	R	Precision 5, Scale 0 [00000]	Total number of CFE Turbidity measurements taken during the month*
	totalTakenLessThanIeswtr	int	R	Precision 5, Scale 0 [00000]	Total <= 0.3 NTU in measurements taken

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	readingExceedMaxNtuAllowedName	string	R	Y - Yes N - No	Did any Turbidity CFE reading during the month exceed the maximum NTU allowed?
	lessThan015Ntu95pctMsrName	string	R	O - Not Reporting for LT2 Y - Yes N - No	Was the CFE turbidity <= 0.15 NTU in at least 95% of the measurements of the month?
>cfeExceedMaxNtu	cfeExceedMaxNtu				
	occurredDt	string	R	Date format: MM/DD/CCYY Must be within Reporting/Monitoring Period.	Date
	turbidity	decimal	R	Precision 5, Scale 3 [00.000]	Turbidity (NTU)*
	occurredTime	string	O	Time format: HH:MM Default value: 00:00	Time
	duration	decimal	O	Precision 5, Scale 2 [000.00]	Duration (0.1 hour)
>cfeGrabSample	cfeGrabSample				
	day	int	R	Valid day based on month	Day
	totalHrsFiltering	decimal	R	Precision 5, Scale 2 [000.00]	Total Hours Filtering (in Operation)*
	maxTurbidity	decimal	R	Precision 5, Scale 3 [00.000]	Maximum Turbidity*
	minTurbidity	decimal	O	Precision 5, Scale 3 [00.000]	Minimum Turbidity
	avgTurbidity	decimal	O	Precision 5, Scale 3 [00.000]	Average Turbidity
	gsTotalNumResult	int	O	Precision 5, Scale 0 [00000]	Grab Sample Reports – Total Number of Results
	gsTotalResultExceed	int	O	Precision 5, Scale 2 [000.00]	Grab Sample Reports - # of Results Exceeding Max NTU
	cmTotalHrResultRecorded	decimal	O	Precision 5, Scale 2 [000.00]	Continuous Monitoring Report – Total Hours Results Were Reported
	cmTotalHrResultExceed	decimal	O	Precision 5, Scale 2 [000.00]	Continuous Monitoring: Total Hours Results Exceed Max NTU*
>cfe4HrsReading	cfe4HrsReading				

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	day	int	R	Valid day based on month	Day
	firstReading	decimal	O	Precision 5, Scale 3 [00.000]	12:00 AM or 1st Reading*
	secondReading	decimal	O	Precision 5, Scale 3 [00.000]	4:00 AM or 2nd Reading*
	thirdReading	decimal	O	Precision 5, Scale 3 [00.000]	8:00 AM or 3rd Reading*
	fourthReading	decimal	O	Precision 5, Scale 3 [00.000]	12:00 PM or 4th Reading*
	fifthReading	decimal	O	Precision 5, Scale 3 [00.000]	4:00 PM or 5th Reading*
	sixthReading	decimal	O	Precision 5, Scale 3 [00.000]	8:00 PM or 6th Reading*
	rawTurbidity	decimal	O	Precision 5, Scale 3 [00.000]	Raw Turbidity (once per day)*
	hrsOperation	decimal	O	Precision 5, Scale 2 [000.00]	Hours of Operations
>chlorineDioxide	chlorineDioxide				
	See {opData}			Extends {opData} therefore all elements of opData included.	
	name	string	R	**NOTE**: Valid values cannot be listed due to possible values being dependent upon user	Reporting Lab Id
	reportingCTValueName	string	O	Y - Yes N - No	Also Reporting for CT Values for LT2ESWTR (Toolbox reporting requirements)?
>chlorineDioxideNoBooster	chlorineDioxideNoBooster				
	daysUseClDioxide	int	O	Precision 5, Scale 0 [00000]	Number of Days where Chlorine Dioxide was used
>>chlorineDioxideNoBoosterDaily	chlorineDioxideNoBoosterDaily				
	day	int	R	Valid day based on month	Day
	resultPoe	decimal	R	Precision 5, Scale 3 [00.000]	Result at POE (mg/L)
	exceedMrdlName	string	R	Y - Yes N - No	Does the Routine exceed the MRDL (0.8 mg/L)?*

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	exceed2ConsecDailyName	string	C Federally conditionally required	Y - Yes N - No	If Exceeded MRDL were two consecutive daily samples exceeded?
	firstSample	decimal	C Federally conditionally required	Precision 5, Scale 3 [00.000]	1st Sample @First Customer (mg/L)
	secondSample	decimal	C Federally conditionally required	Precision 5, Scale 3 [00.000]	2nd Sample @1st Customer (mg/L) + 6 hours
	thirdSample	decimal	C Federally conditionally required	Precision 5, Scale 3 [00.000]	3rd Sample @1st Customer (mg/L) + 12 hours
	violationTypeName	string	C Federally conditionally required	Acute Non Acute No Violation	Violation Type
	notifyStateName	string	O	Y - Yes N - No	Notify State?
	notifyPublicName	string	O	Y - Yes N - No	Notify Public?

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	lt2Temperature	decimal	C Federally conditionally required	Precision 3, Scale 1 [0.00]	LT 2Temperature
	lt2Concentration	decimal	C Federally conditionally required	Precision 5, Scale 3 [00.000]	LT 2Concentration
	lt2ContactTime	decimal	C Federally conditionally required	Precision 5, Scale 3 [00.000]	Contact Time
	lt2CtValue	decimal	C Federally conditionally required	Precision 5, Scale 3 [00.000]	LT2 CT Value
	lt2RatioAchieved	decimal	C Federally conditionally required	Precision 6, Scale 3 [000.000]	LT2 Ratio Achieved
	lt2TTReqMetToolboxCrd	string	C Federally conditionally required	Y - Yes N - No	LT2 Was TT requirement met for toolbox credit (Y/N)?

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
>chlorineDioxideBooster	chlorineDioxideBooster				
	daysUseClDioxide	int	O	Precision 5, Scale 0 [00000]	Number of Days where Chlorine Dioxide was used
>>chlorineDioxideBoosterDaily	chlorineDioxideBoosterDaily				
	day	int	R	Valid day based on month	Day
	resultPoe	decimal	R		Routine ClO2 Daily Result at POE (mg/L)*
	exceedMrdlName	string	R	Y - Yes N - No	Does the Routine exceed the MRDL (0.8 mg/L)?*
	exceed2ConsecDailyName	string	C Federally conditionally required	Y - Yes N - No	If Exceeded MRDL were two consecutive daily samples exceeded?
	firstSample	decimal	C Federally conditionally required	Precision 5, scale 3 [00.000]	1st Sample @ First Customer (mg/L)*
	secondSample	decimal	C Federally conditionally required	Precision 5, scale 3 [00.000]	2nd Sample @ Average Residence Time Location (mg/l)*
	thirdSample	decimal	C Federally conditionally	Precision 5, scale 3 [00.000]	3rd Sample @ Maximum Residence Time Location (mg/l)*

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
			required		
	violationTypeName	string	C Federally condition ally required	Acute Non Acute No Violation	Violation Type
	notifyStateName	string	O	Y - Yes N - No	Notify State?
	notifyPublicName	string	O	Y - Yes N - No	Notify Public?
	lt2Temperature	decimal	O	Precision 3, scale 1 [00.0]	LT2 Temperature
	lt2Concentration	decimal	C Federally condition ally required	Precision 5, scale 3 [00.000]	LT2 Concentration
	lt2ContactTime	decimal	C Federally condition ally required	Precision 5, scale 3 [00.000]	LT2 Contact Time
	lt2CtValue	decimal	C Federally condition ally required	Precision 5, scale 3 [00.000]	LT2 CT Value

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	lt2RatioAchieved	decimal	C Federally conditionally required	Precision 6, Scale 3 [000.000]	LT2 Ratio Achieved
	lt2TTReqMetToolboxCrd	string	C Federally conditionally required	Y - Yes N - No	LT2 Was TT requirement met for toolbox credit
>chlorineDioxideChlorite	chlorineDioxideChlorite				
	totalNumSample	int	R	Precision 5, Scale 0 [00000]	Total number of samples taken in the last 3 months
	numMclViolation	int	R	Precision 5, Scale 0 [00000]	Number of MCL Violations for the Month
	monthlyArithmeticAvg	decimal	R	Precision 5, Scale 3 [00.000]	Monthly Arithmetic Average (DS 3-sample sets)
	name	string	O	Alphanumeric - 80 chars	Analyzing Lab Id (if not reporting lab)
>>chlorineDioxideChloriteDaily	chlorineDioxideChloriteDaily				
	day	int	R	Valid day based on month	
	resultPoe	decimal	R	Precision 5, scale 3 [00.000]	Routine ClO2 Daily Result at POE (mg/L)*
	rexceedMrdlName	string	R	Y - Yes N - No	Does the Routine exceed the MRDL (0.1 mg/L)?*
	firstSample	decimal	O	Precision 5, scale 3 [00.000]	1st Sample @ First Customer (mg/L)*
	secondSample	decimal	O	Precision 5, scale 3 [00.000]	2nd Sample @ Avg. Residence Time Location(mg/L)*

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	thirdSample	decimal	O	Precision 5, scale 3 [00.000]	3rd Sample @ @ Avg. Residence Time Location(mg/L)*
	avgSampleSet	decimal	R	Precision 5, scale 3 [00.000]	Average of 3 Sample Set*
	avgSampleSetExceedMclName	string	R	Y - Yes N - No	Does 3-Sample Average Exceed Chlorite MCL (1.0 mg/L)
	notifyStateName	string	O	Y - Yes N - No	Notify State?
	notifyPublicName	string	O	Y - Yes N - No	Notify Public?
>bromate	bromate				
	See {opData}			Extends {opData} therefore all elements of opData included.	
	reportingLabName	string	O	Alphanumeric - 80 chars	Reporting Lab Id
	quarterlyBromateRaa	decimal	O	Precision 5, Scale 3 [00.000]	Quarterly Bromate RAA Applies only to March, June, September, Decem
	totalNumSampleTaken	int	O	Precision 5, Scale 0	Total number of samples taken Applies only to March, June, September, Decem
	reportingCtValueName	string	O	Y - Yes N - No	Also Reporting for CT Values for LT2ESWTR (Toolbox reporting requirements)?
>>bromateResult	bromateResult				
	resultDt	string	R	Date format: MM/DD/CCYY	Date should be within the Reporting Period.
	name	string	O	Alphanumeric - 80 chars	Laboratory Id of lab that performed the analysis
	sampleCd	string	O	Alphanumeric - 20 chars	Lab Sample ID

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	notDetected	boolean	R	True False	Not Detected
	result	decimal	C Federally condition ally required	Precision 5, scale 3 [00.000]	Result
	resultUomName	string	C Federally condition ally required	mg/L ug/L degree C LANG mF/L ng/L NTU pH units umho/cm pCi/L TON Color Units	UOM
	reportingLimit	decimal	C Federally condition ally required	Precision 5, scale 3 [00.000]	Reporting Limit

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	reportingLimitUomName	string	C Federally conditionally required	mg/L ug/L degree C LANG mF/L ng/L NTU pH units umho/cm pCi/L TON Color Units	Reporting Limit UOM
	methodName	string	O	List of Methods used by selected Laboratory. **NOTE**: Valid values cannot be listed due to the large size of possible values	Analysis Method Name
	analysisStartDt	string	O	Date format: MM/DD/CCYY	Analysis Start Date
	analysisStartTime	string	O	Time format: HH:MM Default value: 00:00	Analysis Start Time
	analysisComplDt	string	O	Date format: MM/DD/CCYY	Analysis Complete Date
	analysisComplTime	string	O	Time format: HH:MM Default value: 00:00	Analysis Complete Time
>>bromateOzone	bromateOzone				
	day	int	R	Valid day based on month	Day
	temperature	decimal	O	Precision 3, scale 1 [00.0]	Temperature
	concentration	decimal	O	Precision 5, scale 3 [00.000]	Concentration

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	contactTime	decimal	O	Precision 5, scale 3 [00.000]	Contact Time
	ctValue	decimal	O	Precision 5, scale 3 [00.000]	CT Value
>lcrWqp	lcrWqp				
	See {opData}			Extends {opData} therefore all elements of opData included.	
>>lcrWqpDts	lcrWqpDts				
	collectionDate	string	R	Date format: MM/DD/CCYY Must be within Reporting Period.	Collection Date*
	collectionTime	string	O	Time format: HH:MM Default value: 00:00	Collection Time
	facilityName	string	O		Facility Name: Name given to the water system facility
	samplingPointId	string	R	Alphanumeric - 40 chars	Sampling Points within the Facility
	analyteCd	string	R	Submit Code **Code] - [Name]**: **1925** - pH **1064** - Conductivity **1996** - Temperature **1927** - Alkanality Total **1044** - Orthophosphate **1049** - Silica **1019** - Calcium **1919** - Calcium	Analyte/Parameter Code and Name*
	measureValue	decimal	R	Precision 5, scale 3 [00.000]	Result

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	measureUomName	string	R	uG/L pH Unit Degree Celsius MG/L uMHO/cm	Units of Measure*
	name	string	O	Alphanumeric - 80 chars	Analyzing Lab Id (if not reporting lab)
	labSample	string	O	Alphanumeric - 100 chars	Lab Sample ID
	analysisDate	string	O	Date format: MM/DD/CCYY	Analysis Date
	methodName	string	O	List of Methods used by selected Laboratory. **NOTE**: Valid values cannot be listed due to the large size of possible values	Analysis Method Name
	collectedBy	string	O	Alphanumeric - 50 chars	Collected By
	comments	string	O	Alphanumeric - 250 chars	Comments
>>lcrWqpEps	lcrWqpEps				
	collectionDate	string	R	Date format: MM/DD/CCYY Must be within Reporting Period.	Collection Date*
	collectionTime	string	O	Time format: HH:MM Default value: 00:00	Collection Time
	facilityName	string	O		Facility Name: Name given to the water system facility
	samplingPointId	string	R	Alphanumeric - 40 chars	Sampling Points within the Facility

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	analyteCd	string	R	Submit Code **Code] - [Name]**: **1925** - pH **1064** - Conductivity **1996** - Temperature **1927** - Alkanality Total **1044** - Orthophosphate **1049** - Silica **1019** - Calcium **1919** - Calcium	Analyte/Parameter Code and Name*
	measureValue	decimal	R	Precision 5, scale 3 [00.000]	Result
	measureUomName	string	R	uG/L pH Unit Degree Celsius MG/L uMHO/cm	Units of Measure*
	name	string	O	Alphanumeric - 80 chars	Analyzing Lab Id (if not reporting lab)
	labSample	string	O	Alphanumeric - 100 chars	Lab Sample ID, Assigned ID
	analysisDate	string	O	Date format: MM/DD/CCYY	Analysis Date
	methodName	string	O	List of Methods used by selected Laboratory. **NOTE**: Valid values cannot be listed due to the large size of possible values	Analysis Method Name
	collectedBy	string	O	Alphanumeric - 50 chars	Collected By
	comments	string	O	Alphanumeric - 250 chars	Comments
>tthmHaa5	tthmHaa5				

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	See {opData}			Extends {opData} therefore all elements of opData included.	
	reportingLabName	string	O		Reporting Laboratory Id
>tthm	tthm				
	numSampleTaken	int	O	Precision 5, Scale 0 [00000]	Number of TTHM samples taken
	quarterlyLocationalRaa	decimal	O	Precision 5, Scale 3 [00.000]	TTHM Locational RAA
	lraaMclViolated	string	O	Y - Yes N - No	Was LRAA MCL violated?
>>tthmDetail	tthmDetail				
	tthmDt	string	R	Date format: MM/DD/CCYY	Date should be within the Reporting Period
	name	string	O	Alphanumeric - 80 chars	Analyzing Lab Id (if not reporting lab)
	sampleCd	string	O	Alphanumeric - 20 chars	Sample ID, Assigned ID
	notDetected	boolean	R	True False	Not Detected
	result	decimal	O	Precision 5, scale 3 [00.000]	Result
	resultUomName	string	C Federally conditionally required	MG/L UG/L NG/L	Result UOM
	reportingLimit	decimal	C Federally conditionally required	Precision 5, Scale 3 [00.000]	Reporting Limit

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	reportingLimitUomName	string	C Federally conditionally required	MG/L UG/L NG/L	Reporting Limit UOM
	methodName	string	O	List of Methods used by selected Laboratory. **NOTE**: Valid values cannot be listed due to the large size of possible values	Analysis Method Name
	analysisStartDt	string	O	Date format: MM/DD/CCYY	Analysis Start Date
	analysisComplDt	string	O	Date format: MM/DD/CCYY	Analyst Complete Date
	analysisComplTime	string	O	Time format: HH:MM Default value: 00:00	Analysis Complete Time
>>haa5	haa5				
	numSampleTaken	int	O	Precision 5, Scale 0 [00000]	Number of HAA5 samples taken
	quarterlyLocationalRaa	decimal	O	Precision 5, Scale 3 [00.000]	HAA5 Locational LRAA
	lraaMclViolated	string	O	Y - Yes N - No	Was LRAA MCL violated?
>>haa5Detail	haa5Detail				
	haa5Dt	string	R	Date format: MM/DD/CCYY	Date should be within the Reporting Period
	name	string	O	Alphanumeric - 80 chars	Analyzing Lab Id (if not reporting lab)
	sampleCd	string	O	Alphanumeric - 20 chars	
	notDetected	boolean	R	True False	Not Detected
	result	decimal	O	Precision 5, scale 3 [00.000]	Result
	resultUomName	string	O		Result UOM

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	reportingLimit	decimal	O	Precision 5, scale 3 [00.000]	Reporting Limit
	reportingLimitUomName	string	O		Reporting Limit UOM
	methodName	string	O	List of Methods used by selected Laboratory. **NOTE**: Valid values cannot be listed due to the large size of possible values	Analysis Method Name
	analysisStartDt	string	O	Date format: MM/DD/CCYY	Analysis Start Date
	analysisComplDt	string	O	Date format: MM/DD/CCYY	Analysis Complete Date
	analysisComplTime	string	O	Time format: HH:MM Default value: 00:00	Analysis Complete Time
>ife	ife				
	See {opData}			Extends {opData} therefore all elements of opData included.	
	combinedPopServedName	string	R	Submit Code **[Code] - [Name]**: **lessthan10k** - Less than 10,000 **morethan10k** - Greater or Equal to 10,000	Combined Population Served
	indFilterEffluent	string	R	Y - Yes N - No	Q1: Did you monitor each individual filter effluent continuously and record measurements at least every 15 minutes (or combined filter effluent for systems with two filters)?

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	contMntrgRestored14Days	string	C Federally conditionally required	Y - Yes N - No O - NA	**<u>If combinedPopServedName lessthan10k</u>**: Q2: If IFE continuous monitoring was interrupted, was continuous monitoring restored in 14 days or fewer (Y/N)? If No, please contact your State or Primacy Agency for required additional data.
	contMntrgRestored5Days	string	C Federally conditionally required	Y - Yes N - No	**<u>If combinedPopServedName morethan10k</u>**: Q2: If IFE continuous monitoring was interrupted, was continuous monitoring restored in 5 working days or fewer? If No, please contact your State or Primacy Agency for required additional data.
	contMntrgRecEquipOffline	string	R	Y - Yes N - No	Q3: Did your system conduct grab sampling or manual recording every 4 hours while continuous monitoring equipment was offline?

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	exceed1Ntu2Consec	string	R	Y - Yes N - No	**<u>If combinedPopServedName lessthan10k</u>**: Q4: Did any individual filter exceed 1.0 NTU in two consecutive measurements taken 15 minutes apart? If yes complete the table and indicate required follow-up action status (report cause if known). [IFE Event Type 'A'] **<u>If combinedPopServedName morethan10k</u>**: Q4: Did any individual filter exceed 1.0 NTU in two consecutive measurements taken 15 minutes apart? If yes, complete the table and indicate required follow-up action status (i.e. filter profile). [IFE Event Type 'A']
	exceed1Ntu2Consec3Mth	string	R	Y - Yes N - No	Q5: Did any individual filter exceed 1.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of three consecutive months? If yes complete the table and indicate required follow-up action status (i.e. Individual Filter Self-Assessment - IFSA). [IFE Event Type 'B']

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	exceed2Ntu	string	R	Y - Yes N - No	**<u>If combinedPopServedName lessthan10k</u>**: Q6: Did any individual filter exceed 2.0 NTU in two consecutive measurements taken15 minutes apart at any time in each of two consecutive months? If yes complete the table and indicate required follow-up action status (i.e. Comprehensive Performance Evaluation - CPE). [IFE Event Type 'C'] **<u>If combinedPopServedName morethan10k</u>**: Q6: Did any individual filter exceed 1.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each of three consecutive months? If yes, complete the table and indicate required follow-up action status (i.e. Individual Filter Self-Assessment - IFSA). [IFE Event Type 'C']
	exceed05Ntu	string	C Federally condition ally required	Y - Yes N - No	**<u>If combinedPopServedName morethan10k</u>**: Q5: Did any individual filter exceed 0.5 NTU in two consecutive measurements taken 15 minutes apart at the end of the first four hours of continuous operation after the filter has been backwashed, or

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
					otherwise taken offline? If yes, complete the table and indicate required follow-up action status (i.e. filter profile). [IFE Event Type 'B']
	creditUsingToolboxOption	string	O	Y - Yes N - No	Are you seeking credit for using toolbox option for IFE performance?
	greatThan03Ntu2ConsecName	string	C Federally conditionally required	Y - Yes N - No	Was IFE turbidity >0.3 NTU in two consecutive readings 15 minutes apart during the month at any filter?
	lessThan015Ntu95pctMsrName	string	R	Y - Yes N - No	Was IFE turbidity <= 0.15 NTU in at least 95% of the measurements for the month at each filter?
>>ifeIndicatorFilter	ifeIndicatorFilter				
	filterNum	string	R	Alphanumeric	Filter Number
	indFilterEventName	string	R	A B C D (If combinedPopServedName is greater or equal to 10,000)	Individual Filter Event*
	exceedingTriggerDate	string	R	Date format: MM/DD/CCYY	
	exceedingTriggerTime	string	O	Time format: HH:MM Default value: 00:00	
	turbidity	decimal	R	Precision 5, Scale 3 [00.000]	Turbidity (NTU)*
>>chlorineChloraminePo	chlorineChloraminePoe				

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
e					
	See {opData}			Extends {opData} therefore all elements of opData included.	
	samplingLocation	string			Sampling Location
	waterSourceDisplay	string	R	FSW - Filtered Surface Water USW - Unfiltered Surface Water GW - Groundwater	Filtering/Water Source
	minDisinfectResidualReq	decimal		Precision 5, Scale 3 [00.000]	Minimum Disinfectant Residual Req. at Sampling Location
	numMeasureBelowMinimum	int		Precision 5, Scale 0 [00000]	Number of Measurements Below Minimum
	usingChlorine	string	C Federally conditionally required	Y - Yes N - No	Using Chlorine? (Y/N)
>>chlorineChloraminePoeDaily	chlorineChloraminePoeDaily				
	day	int	R	Valid day based on month	Day
	operationStatusName	string	R	On Off	Operation Status
	minResidual	decimal	C Required if Minimum Residual < Minimum Required	Precision 5, Scale 3 [00.000]	Minimum Residual Measured

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	residualMeasuredName	string	R	Free Total Combined	Type of Residual Measured*
	duration	decimal	C Required if Minimum Residual < Minimum Required	Precision 5, scale 2 [000.00]	Duration < Minimum Residual (hours)+
	stateNotifyDt	string	C Required if Minimum Residual < Minimum Required	Date Format: MM/DD/CCYY	Date State Notified+
	ph	decimal	R	Precision 4, scale 1 [000.0]	pH*
	temperature	decimal	C Required if Minimum Residual at Entry Point is less than Fed Min Required	Precision 3, scale 1 [00.0]	Temperature (C) * (Unfiltered Surface Water)

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	disinfectConcentration	decimal	C Federally conditionally required	Precision 5, scale 3 [00.000]	Disinfectant Concentration (C) in mg/l* (Unfiltered Surface Water)
	effDisinfectContactTime	decimal	C Required if Minimum Residual at Entry Point is less than Fed Min Required	Precision 5, scale 3 [00.000]	Effective Disinfectant Contact Time (T)* (Unfiltered Surface Water)
	requiredCt	decimal	C Required if Minimum Residual at Entry Point is less than Fed Min Required	Precision 5, scale 3 [00.000]	Required CT (min x mg/L) (Unfiltered Surface Water)

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	minActualCt	decimal	C Required if Minimum Residual at Entry Point is less than Fed Min Required	Precision 5, scale 3 [00.000]	CT Achieved (CT calc) (Unfiltered Surface Water)
	ct999	decimal	C Federally condition ally required	Precision 5, scale 3 [00.000]	CT99.9 (Unfiltered Surface Water)
	sumAll	decimal	C Required if Minimum Residual at Entry Point is less than Fed Min Required	Precision 5, scale 3 [00.000]	Sum of all CTcalc/CT99.9 at the first customer* (Unfiltered Surface Water)

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	achievedInactivationName	string	C Required if Minimum Residual at Entry Point is less than Fed Min Required	Yes No	Achieved Inactivation? (Unfiltered Surface Water)
	comments	string	O	Alphanumeric - 250 chars	Comments
>toc	toc				
	See {opData}			Extends {opData} therefore all elements of opData included.	
	name	string	R	Alphanumeric - 80 chars	Analyzing Lab Id (if not reporting lab)
	raaComputedQuarterly	decimal	C Enabled only for March, June, Septembe r and December	Precision 5, Scale 3 [00.000]	RAA of Monthly TOC Removal Ratios
	raaAlternativeComplCriteria	decimal	C Federally condition ally required	Precision 5, Scale 3 [00.000]	RAA for Alternative Compliance Criteria

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	numPairedSamples	int	C Enabled only for March, June, September and December		# of Paired Samples/Quarter*
	stateCalculateRaa	string	R	Y - Yes N - No	State Calculates RAAs for DBP Precursors (Y/N)?
	complianceName	string	R	Y - Yes N - No	Is the system in compliance with the enhanced coagulation or enhanced softening percent removal requirements in 40 CFR 141.135(b)?
	month1ArithmeticAvgPct	decimal	O	Precision 5, Scale 2 [000.00]	Month 1 Arthmetic Average % Reduction of TOC
	month2ArithmeticAvgPct	decimal	O	Precision 5, Scale 2 [000.00]	Month 2 Arthmetic Average % Reduction of TOC
	month3ArithmeticAvgPct	decimal	O	Precision 5, Scale 2 [000.00]	Month 3 Arthmetic Average % Reduction of TOC
>>tocDetail	tocDetail				
	tocDt	string	R	Date format: MM/DD/CCYY Cannot be a future date	Date*
	rawWaterToc	decimal	R	Precision 5, Scale 2 [000.00]	Raw Water TOC*
	checkRawLessThan2Name	string	R	Yes No	Check Raw <=2.0*
	rawWaterAlkalinity	decimal	O	Precision 5, Scale 2 [000.00]	Raw Water Alkalinity*

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	finishedWaterToc	decimal	R	Precision 5, Scale 2 [000.00]	Finished Water TOC
	step1ReqTocRemovalPct	decimal	C Federally conditionally required	Precision 5, Scale 2 [000.00] Must be between 0 and 100	Step 1 Req. TOC Removal %
	step1ActualTocRemovalPct	decimal	C Federally conditionally required	Precision 5, Scale 2 [000.00] Must be between 0 and 100	Step 1Actual TOC Removal %
	step1Ratio	decimal	C Federally conditionally required	Precision 4, Scale 2 [00.00]	Step 1 RemovalRatio
	altComp	int	O	Precision 3	RAA for Alternative Compliance Criteria
	altRatioAssigned	decimal	C Federally conditionally required	Precision 5, Scale 2 [000.00]	Alt. Ratio Assigned
	step2ReqTocRemovalPct	decimal	O	Precision 5, Scale 2 [000.00] Must be between 0 and 100	Step 2 Req. TOC Removal %
	step2ActualTocRemovalPct	decimal	O	Precision 5, Scale 2 [000.00] Must be between 0 and 100	Step 2 Actual TOC Removal %

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	step2Ratio	decimal	O	Precision 4, Scale 2 [00.00]	Step 2 RemovalRatio
	step2RemovalAchievedName	string	O	Yes No	Removal Achieved (Y/N)?
	comments	string	O	Alphanumeric - 250 chars	Comments

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
samples	samples	XML Root Element			
compositeSample	compositeSample				
	compositeSampleId	R			Lab assigned Composite Sample ID
	compositeDate	R			Composite Sample Date
	samplePurposeName			Submit Code (i.e. RT) [**Code] - [Description]**: **FS** -Field Surveillance **SS** -Sanitary Survey	
	sampleVolumneName			100 ml 200 ml 300 ml	

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				400 ml 500 ml 1 liter	
	Name	R			Laboratory ID
>individualSample	individualSample				
	wsId	string	R	9 chars – first 2 chars for state code and next 7 chars for water system ID	Water System ID: Federal ID assigned to the water system
	facilityName	string	R	Alphanumeric - 40 chars	State Assigned Facility ID
	samplingPointId	string	R	Alphanumeric - 40 chars	State Assigned Sampling Point ID
	samplingLocation	string	O	Alphanumeric - 250 chars	Free Form Text
	labSampleCd	string	R	Alphanumeric - 80 chars	Laboratory assigned Sample ID
	collectionDate	string	R	Date format: MM/DD/CCYY	Collection Date
	collectionTime	string	O	Time format: 00:00	Collection Time
	legalEntityName	string	R	Alphanumeric - 40 chars	Reporting Laboratory ID
	sampleTypeName	string	R	Submit Code (i.e. RT) [**Code] - [Description]**: (**Microbial /ChemsRads**) **RT** - Routine **RP** - Repeat **TG** - Triggered **CO** - Confirmation **SP** - Special	Sample Type – expected value is the **Code**

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				BB - Batch Blanks **FB** - Field Blanks **PE** - Performance Evaluation **SB** - Shipping Blanks **ST** - Split Blanks **MR** - Maximum Residence Time **MS** - Matrix Spike [**Code] - [Description]**: (**Cryptosporidium**) **RT** - Field (i.e., Routine) **MS** - Matrix Spike **SP** - Special **PE** - Performance Evaluation **BB** - Batch Blanks **FB** - Field Blanks **SB** - Shipping Blanks **ST** - Split Blanks	
	sampleVolumeName	string	O	100 ml 200 ml 300 ml 400 ml 500 ml 1 liter	Sample Volume
	comments	string	O	Alphanumeric - 250 chars	Comments
	repeatLocationName	string	**C**	Original Site Downstream Upstream Source Alternative (RTCR)	Req'd if is Sample Type is Repeat Repeat Location

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				Other (TCR)	
	originalLabSampleCd	string	R	Alphanumeric - 80 chars	Req'd if is Sample Type is Repeat/Triggered/Confirmation Original Laboratory assigned Sample ID
	sampleCategoryName	string	R	CompositeSample	Sample Category
>compositeSampleResult	compositeSampleResult				
	analyteName	string	R	**NOTE**: Valid values cannot be listed due to the large size of possible values (which is also dependent upon user primacyAgency)	Analyte Code
	methodName	string	O	**NOTE**: Valid values cannot be listed due to the large size of possible values (which is also dependent upon user primacyAgency)	Method Code
	analysisStartDt	string	O	Date format: MM/DD/YYYY	Analysis Start Date
	analysisStartTime	string	O	Time format: 00:00	Analysis Start Time
	analysisComplDt	string	O	Date format: MM/DD/YYYY	Analysis Completed Date
	analysisComplTime	string	O	Time format: 00:00	Analysis Completed Time
	name	string	O	Alphanumeric - 80 chars	Analyzing Laboratory Id
	comments	string	O	Alphanumeric - 250 chars	

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
	volumeAssayedName	string	O	1 ml 5 ml 10 ml 100 ml 400 ml 500 ml	Volume Assayed –(Microbial and ChemsRads) Per – (Cryptosporidium)
	notDetected	boolean	R	true false	Was Analyte Detected?
	result	decimal	O	Precision 7, Scale 4 [000.0000]	Result Value
	resultUomName	string	O	degree C LANG NTU pH units umho/cm TON Color Units mg/L ug/L ng/L pCi/L mF/L	Result Unit of Measure
	standardDeviation	decimal	O	Precision 9, Scale 2 [0000000.00]	Standard Deviation
	reportingLevel	decimal	O	Precision 7, Scale 4 [000.0000]	Reporting Limit

XML Element	XML Element Name	Data Type	Required (R), Optional (O), Conditional (C), Generated (G)	Format/Valid Values	Description
				degree C LANG NTU pH units umho/cm TON Color Units mg/L ug/L ng/L pCi/L	
	reportingLevelUomName	string	O	mF/L	Reporting Limit Unit of Measure

The section below details fields and format related to Sample Data (Microbial, Chemical\Rads and Cryptosporidium). The Labs will have to generate the Sample Data in XML format using the definitions detailed in the section below before pushing it to CMDP.

APPENDIX – C: CMDP ORG / ROLE ASSOCIATIONS

CMDP Org / Role Associations			
Org Type and Roles for SCS	**Requires ESA and E-Signature?**	**Requires LexisNexis?**	**Org Type and Role Descriptions**
Commercial/Private Laboratory (Org Type = Laboratory)			A private lab that performs sample analysis and reporting for water utilities
Private Lab CMDP Administrator	No	**Yes**	Sponsors other private lab staff roles
Private Lab Certifier	**Yes**	**Yes**	Certifies and e-signs sample results and submits to State Primacy Agencies
Private Lab Reviewer	No	No	Reviews draft files prepared by the Lab Preparer
Private Lab Preparer	**No**	**No**	Enters data and uses data validations to ensure data quality
Water Utility (Org Type = Public Water System)			Treats and supplies potable water to consumers.
PWS CMDP Administrator	No	**Yes**	Sponsors other PWS staff roles
PWS Certifier	**Yes**	**Yes**	Certifies and e-signs sample results and submits to State Primacy Agencies

CMDP Org / Role Associations

Org Type and Roles for SCS	Requires ESA and E-Signature?	Requires LexisNexis?	Org Type and Role Descriptions
PWS Reviewer	No	No	Reviews draft files prepared by the PWS Preparer
PWS Preparer	No	No	Enters data and uses data validations
State Laboratory (Org Type = State Laboratory)			State laboratory that performs sample analysis and reporting for water systems
State Lab CMDP Administrator	No	**Yes**	Sponsors other state lab staff roles
State Lab Submitter	**No**	No	Submits sample results to State Primacy Agencies
State Lab Reviewer	No	No	Reviews draft files prepared by the State Lab Preparer
State Lab Preparer			Enters data and uses data validations
State Primacy Agency (Org Type = State)			Manages state drinking water program data to support state decision making regarding noncompliance and enforcement
State CMDP Administrator	No	**Yes**	Approves all Sponsors (CMDP Administrators for State Labs, PWSs, and Labs) wanting to report to his or her Primacy Agency; approves State Compliance Officers for his or her own state primacy agency

CMDP Org / Role Associations

Org Type and Roles for SCS	Requires ESA and E-Signature?	Requires LexisNexis?	Org Type and Role Descriptions
State Compliance Officer	No	No	Read only access to data in CMDP