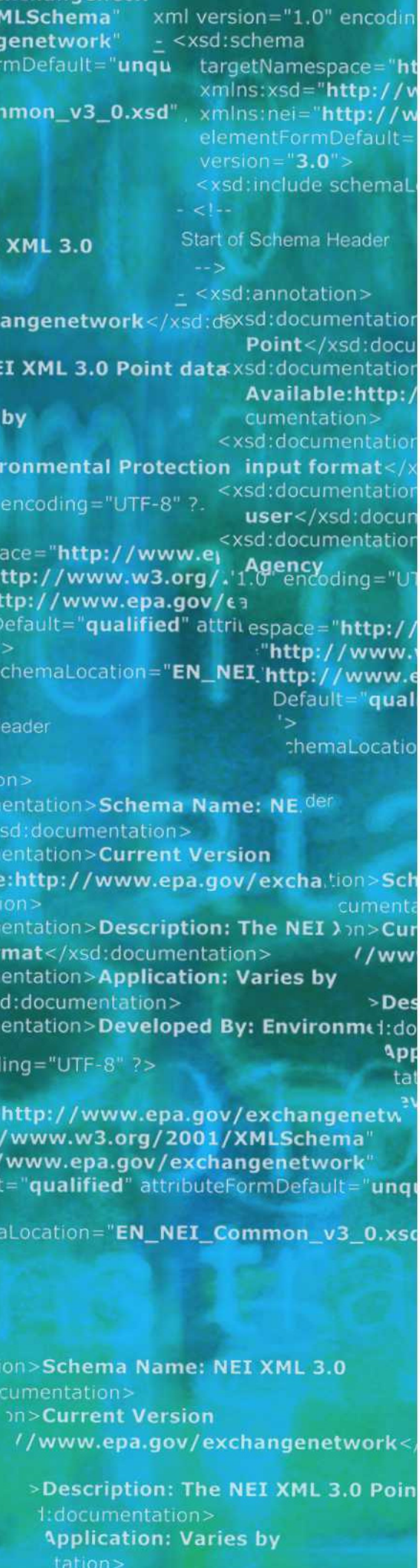

OpenNode2

WQX 2.0 Data Exchange Implementation Guide (.NET)

Revision Date: 5/29/2014

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Revision History

Date	Author	Changes	Version
7/9/2014	Windsor	Added schema Block Diagram	2.0
5/29/2014	Windsor	Updated Install Plugin section to describe pre-bundled plugin process starting with OpenNode2 v2.6	1.9
2/26/2013	Windsor	Minor correction to data service settings for Organization field.	1.8
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1/25/2012	Windsor	Added section to describe usage of WQX_DELETES table	1.6
6/30/2011	Windsor	Corrected schedule parameter to UseSubmissionHistoryTable	1.5
6/22/2011	Windsor	Added documentation for schema validation schedule parameter (.NET ON2 v1.2)	1.4
10/19/2010	Windsor	Added clarification to configuration of Submission Partner Name parameter on WQXGetInsertUpdateSubmission service	1.3
12/15/2009	Windsor	• Created a stand-alone document for .NET implementation. • Reflects changes in .NET WQX Plugin release v1.1.11. • Add support for Attached Binary Objects • Added description of submission history management	1.2
5/29/2009	Windsor	Revised to reflect standardization of plugin arguments.	1.1
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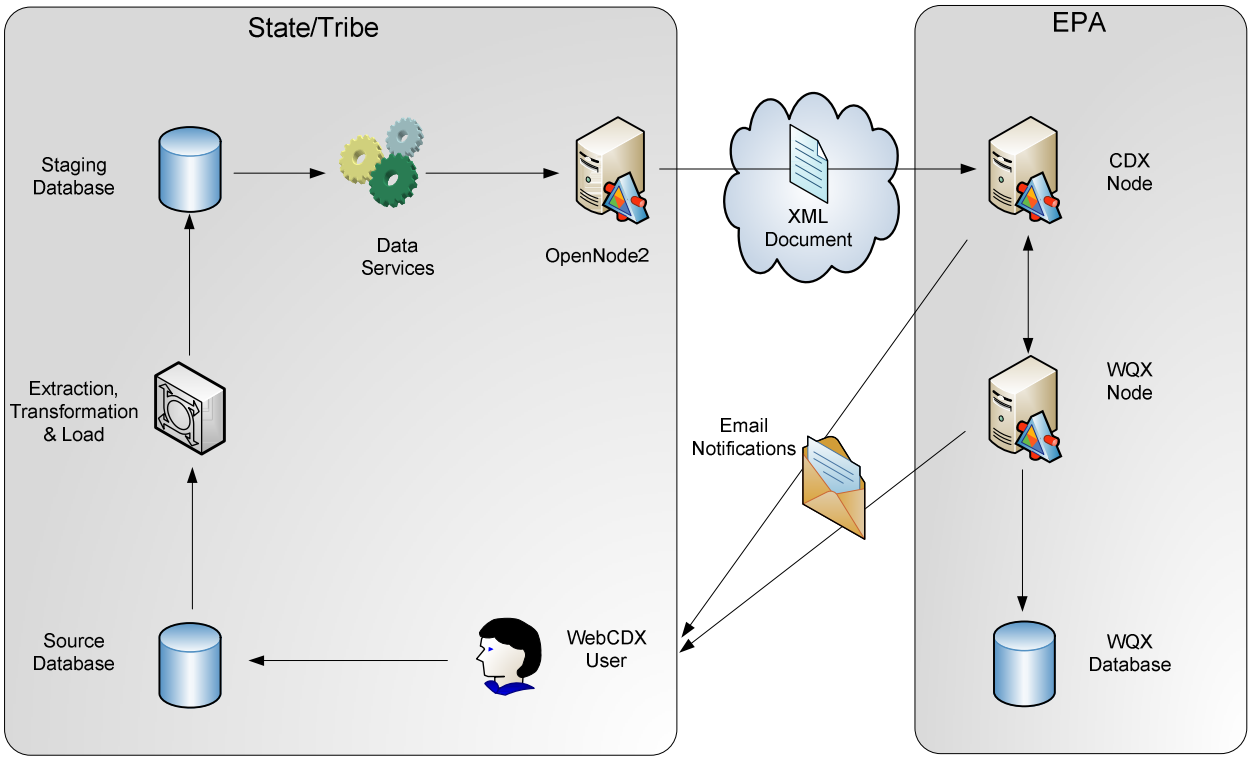
Data Exchange Overview

The purpose of this document is to provide detailed instructions for the installation and configuration of the Exchange Network Water Quality Data Exchange (WQX) data exchange on the Microsoft .NET implementation of the Exchange Network OpenNode2 (OpenNode2).

The WQX Exchange involves a periodic submittal to EPA for the purposes of updating the EPA Water Quality Exchange (WQX) database which manages ambient water quality monitoring data. The frequency and content of the each submission can be configured to meet the agency's needs based on monitoring schedules and data management practices.

The following figure illustrates the basic steps involved in the WQX data exchange. Further detail about the WQX data exchange is available in the Flow Configuration Document (FCD) published at exchangenetwork.net.



The WQX data exchange processing workflow can be briefly summarized as follows:

1. A scheduled process refreshes ambient water quality monitoring data from the State or Tribe's source database and loads it into the OpenNode2 staging database. A "changed date" identifies new, modified, or deleted records.
2. On a scheduled interval, the WQX plugin installed on OpenNode2will extract new or changed WQX data from the staging environment, serialize this into an XML document, and submit the resulting XML file to the EPA CDX Node. A separate schedule performs a similar process to submit a list of deleted records if this information is tracked in the source database.

3. The EPA CDX Node validates the XML file, and passes it to the internal EPA WQX Node. During this process, the NAAS credentials used by the State or Tribe OpenNode2 to submit the data to CDX are translated to the relevant CDX Web user credentials that has access to manage data within WQX for the organization.
4. The WQX Node parses the XML, verifies that the CDX Web user has permissions to submit data, and writes the data to the WQX database.
5. WQX sends a notification email to the CDX Web user account, notifying the user of the processing status, and any errors encountered.
6. WQX returns a file of processing messages back to the EPA CDX Node which can then be retrieved using the OpenNode2 Admin Tool.

OpenNode2 will also execute a recurring scheduled task that periodically queries the CDX Node for the status of the most recent WQX submission. This way, OpenNode2 is aware of whether the most recent submission is pending, failed, or complete. OpenNode2 will not submit another WQX file until all previous submissions are no longer pending. This ensures there is no overlap between submission attempts and processing results.

Note that the .NET WQX plugin does not currently support the Query/Solicit data services described in the WQX v2.0 FCD.

Submission History Management

The WQX staging database maintains a submission history table (WQX_SUBMISSIONHISTORY). A record is created in this table for each submission performed by OpenNode2. Each record stores the following data elements:

Field Name	Usage
PARENTID	Links to the ORG_ID in the WQX_ORGANIZATION table for which the submission was made.
SCHEDULERUNDATE	The date on which the Node Schedule was executed.
WQXUPDATEDATE	The date from which records are to be selected from the staging environment for submission to WQX. Will equal the SCHEDULERUNDATE of the last successful submission.
SUBMISSIONTYPE	Indicates whether the submission was for new and updated records or for deleted records. Values are: “Insert/Update” and “Delete”
LOCALTRANSACTIONID	The transaction ID stored in the OpenNode2 database.
CDXPROCESSINGSTATUS	The status of processing of the data submission at the CDX Node and WQX system. Values are: “Pending”, “Failed”, and “Completed”

Using Attached Binary Objects

The WQX exchange supports submission of binary object such as pictures to Projects, Monitoring Locations and Results. The plugin supports these using three dedicated staging tables, one for each node in the XML file. One of two methods can be used to attach a binary object to a submission; either insert the binary data into the staging database in the BINARYOBJECTCONTENT field, or supply a path to a location on a network file server where the document is stored. The plugin first looks in the database field. If the BINARYOBJECTCONTENT is null, then the file path is used.

Using the WQX_DELETES Staging Table

The WQX data exchange allows for sending delete transactions to the WQX system[1]. The plugin's WQXGetDeleteSubmission service reads records from the WQX_DELETES staging table to create the submission file for this service.

The WQX_DELETES table is designed slightly differently from the other WQX staging tables. The table consists of five fields, each of which is described below:

RECORDID – A unique identifier for the record. It is not sent to WQX. It is only used for referential integrity purposes in the staging database.

PARENTID – A foreign key to the WQXORGANIZATION table. It is not sent to WQX. It is only used for referential integrity purposes in the staging database.

COMPONENT - Should be set to either "Project", "MonitoringLocation", "Activity", "ActivityGroup" or "BiologicalHabitatIndex". This instructs the plugin to generate an XML element for the appropriate data type to be deleted.

IDENTIFIER - Should be set to the identifier for the Component type to delete. For example, to delete a Project from WQX that has a ProjectIdentifier of "123" then set Component = "Project" and Identifer = "123".

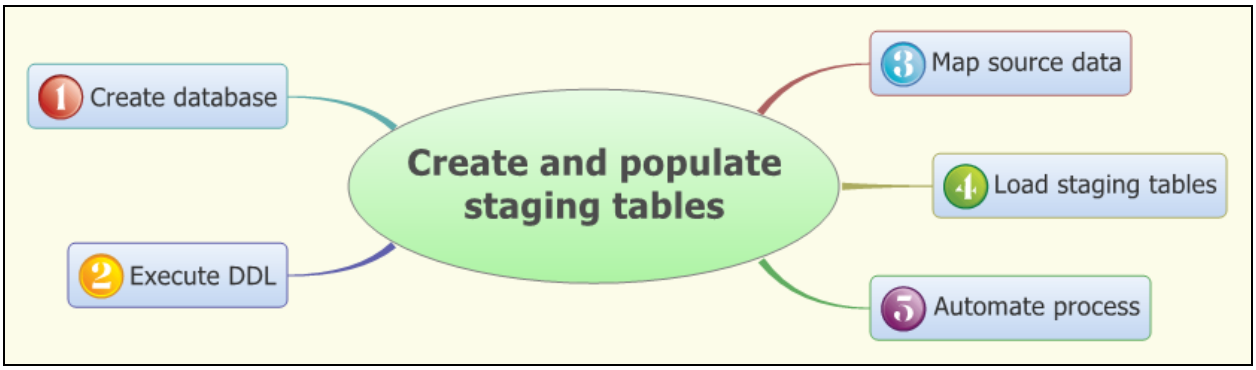
WQXUPDATEDATE – Used by the Submission History table to determine the records to send, based on the date it was added to the staging table.

[1] Please see Section 4.2 in the WQX Flow Configuration Document for more information on deleting data from WQX.

Create and Populate the WQX Staging Tables

OpenNode2 uses a plugin-based architecture to support data exchanges with EPA and other Exchange Network partners. Data must first be loaded into a set of staging tables before it can be extracted by the plugin and shared through the WQX data exchange. This section outlines the steps required to set up the WQX data exchange database staging tables.

The following figure illustrates these steps:



1. The first step is to create the staging database itself if one has not already been established to support another data exchange (typically named NODE_FLOW).
2. Once the staging database itself is created, a Database Definition Language (DDL) script included in the OpenNode2 deployment package can be executed to create the staging tables themselves that will be used to store the data being made available through the WQX data exchange.
3. With the staging environment established, data must now be mapped from the source database to the equivalent fields in the WQX staging tables. The staging tables closely reflect the structure and naming of the WQX XML schema, and it is recommended that the Data Exchange Template (DET) published at exchangenetwork.net be used to facilitate this mapping.

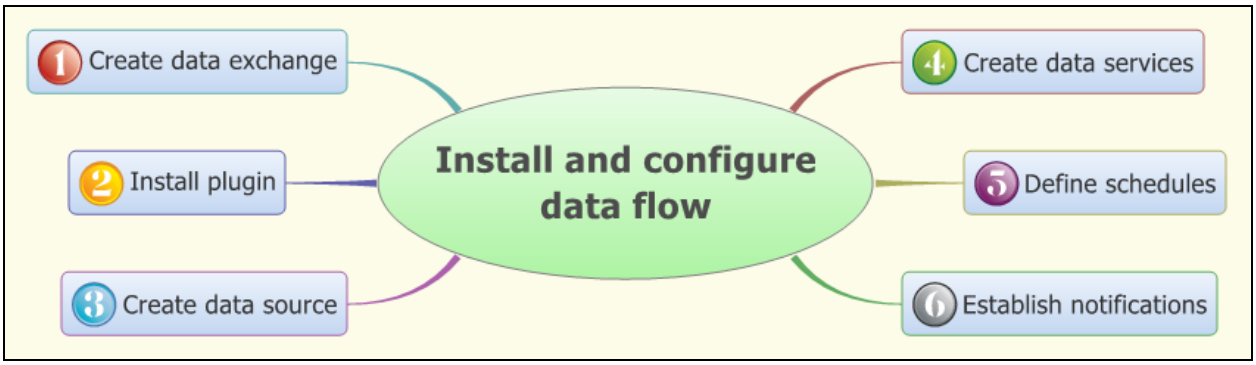
> **NOTE**
>
> *The WQX_ACTIVITY table contains a date field named WQXUPDATEDATE in the second to last column. This field must contain a date/time stamp for when the data was last updated in the source database. This field is used by OpenNode2 to determine what new or changed data has been loaded and is ready to send. There is an equivalent field in the WQX_DELETES table for the same purpose when sending deleted data, if implemented.*

4. Once the mapping is complete, a database routine should be developed to populate the tables in the staging database using the mapping prepared during the earlier step. This should be a repeatable process that will empty and replace all of the data in the staging tables, or a procedure that will incrementally add, update and remove data as it changes in the source system.
5. Once the data extract process has been developed, it should be automated to execute on a regular schedule as appropriate to the needs of the organization for submissions to EPA.

Install and Configure the WQX Data Exchange

This section describes the steps required to install and configure the WQX data exchange on the Microsoft .NET implementation of the OpenNode2 using the Node Administration Web application (Node Admin).

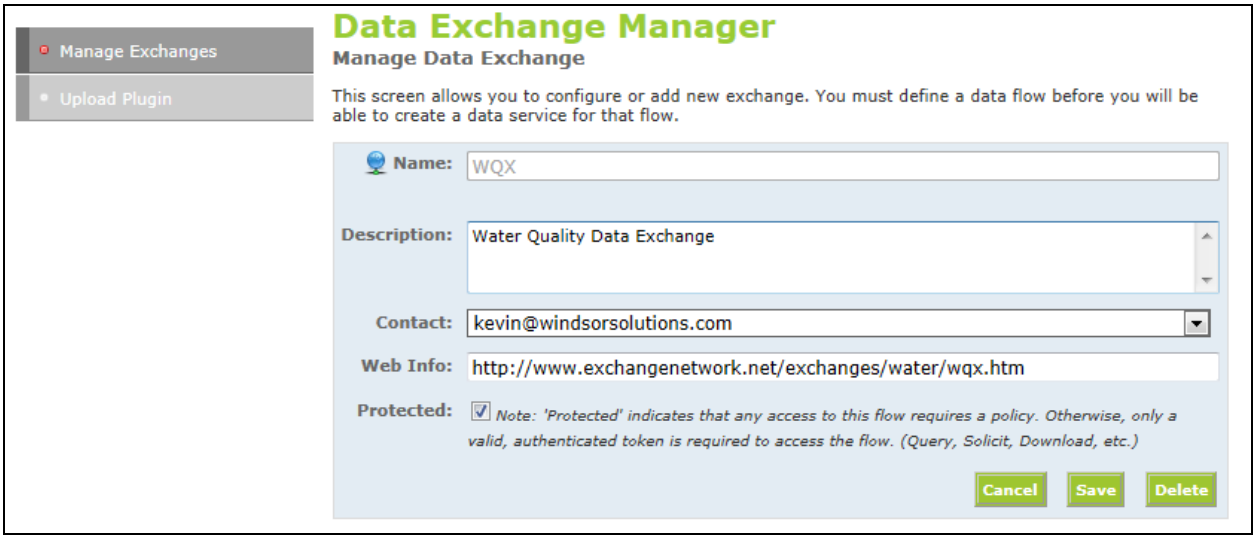
The following figure illustrates these steps:



Create the WQX Data Exchange

The first step is to create the WQX data exchange using the Node Admin Web application.

1. After logging into the Node Admin, click the **Exchange** tab on the top navigation bar.
2. Click the **Add Exchange** button. The Manage Data Exchange screen will be displayed as follows:



3. Type "WQX" in the **Name** field.
4. Type a short description in the **Description** field.

5. Select a user account name from the **Contact** drop down box. Contacts are populated with all accounts that have been set up on the OpenNode2. See the **Security** tab for a list of available accounts.
6. In the **Web Info** field, enter a URL where more information can be found about the WQX exchange. It is recommended that the following URL be used for this purpose http://www.exchangenetwork.net/exchanges/water/wqx.htm.
7. It is recommended that the **Protected** box be checked. This will limit external access to the WQX data services. External access should not be required at this time given the current purpose of this flow is solely as a means of data submission to EPA.
8. Click the **Save** pushbutton to save the data exchange to the OpenNode2 metadata database.

Install the WQX Plugin

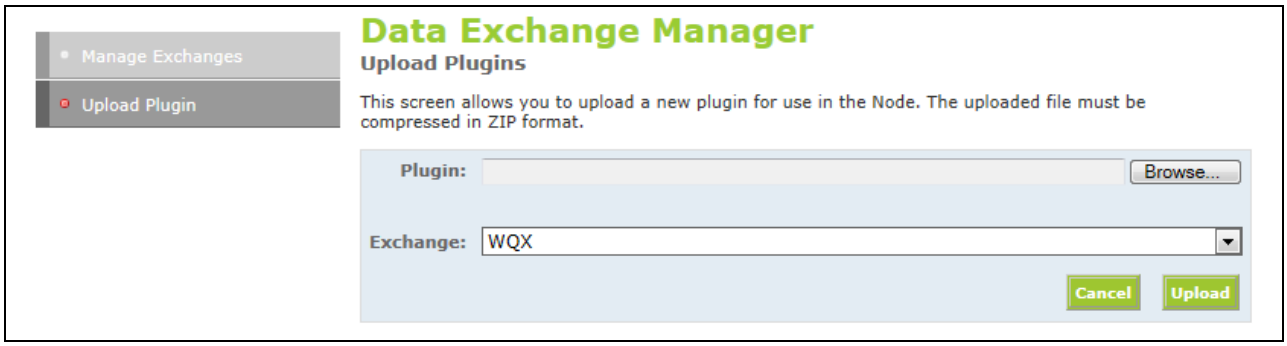
Once the data exchange has been created, the next step is to upload the WQX plugin into the OpenNode2 plugin repository.

Note: If you are using OpenNode2 v2.6 or higher, this step is not necessary. Starting with v2.6, all plugins are pre-installed with the OpenNode2 software installation package. By creating the exchange above, the plugin will automatically be loaded and associated with the exchange. To validate that the plugin was installed automatically, follow the steps below:

1. From the **Exchange** tab, scroll down the list of installed data exchanges until the WQX exchange is located.
2. Click the **Add Service** button located just beneath the WQX data exchange record. If the Implementer drop down box is not empty, then the plugin has been installed successfully.

If the steps above reveal that the plugin is not installed, perform the following steps to install it.

1. Navigate to the plugin directory in the **Plugins\[Flow Name]\[version number]** directory included with the OpenNode2 installation files.
2. Create a new zip file containing the two Windsor.Node2008.WNOSPlugin.[Flow name].dll and .pdb files.
3. Click the **Exchange** tab on the top navigation bar.
4. Click the **Upload Plugin** section on the left navigation bar. The Upload Plugin screen will be displayed as follows:



5. Click the **Browse** button which is located to the right of the **Plugin** field.
6. Locate and select the compressed (zipped) file containing the code component for the WQX plugin you created in Step 2 above.
7. Select the data exchange name "WQX" that you created during the previous step from the **Exchange** dropdown box.
8. Click the **Upload** button to upload the plugin.

The newly uploaded plugin code will be placed in the OpenNode2 plugin repository. Any previous plugin versions will be retained in the repository but won't be accessible through the Node Admin. Only the latest version of any one plugin is made available during the next step to establish data services.

Create the WQX Data Services

Data services are distinct functions provided by a plugin to support a given data exchange. In the case of the WQX flow, there are three specific data services provided by the plugin:

- WQXGetInsertUpdateSubmission
- WQXGetDeleteSubmission
- WQXGetStatus

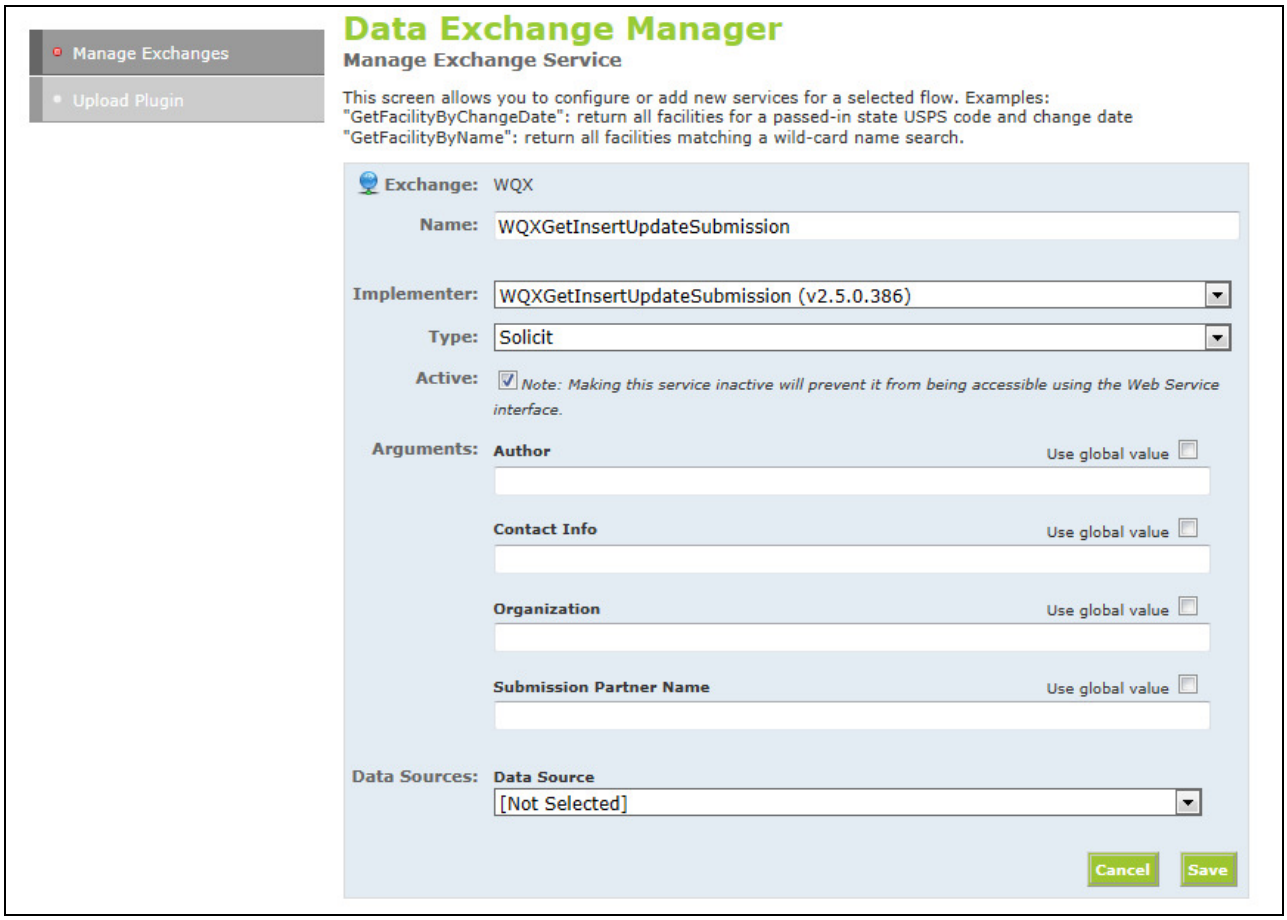
Each of these data services must be created and configured before they can be accessed through the OpenNode2.

WQXGetInsertUpdateSubmission

This data service will retrieve new or updated records from the staging database according to a set of input runtime parameters (see later section on defining schedules) and will generate an XML file containing the required data. An important input parameter is the WQX Update Date. The plugin will only select records from the staging tables where the WQXUPDATEDATE field on the WQX_ACTIVITY staging table is equal to or later than the input date.

This data service can only be executed if there are no currently un-processed transactions logged in the WQX_SUBMISSIONHISTORY table. Transaction information will be recorded in the same table for subsequent processing purposes.

3. From the **Exchange** tab, scroll down the list of installed data exchanges until the WQX exchange is located.
4. Click the **Add Service** button located just beneath the WQX data exchange record. The following page will be displayed to allow a new data service to be added.



5. In the **Name** field, type "WQXGetInsertUpdateSubmission".
6. From the **Implementer** drop down box, select the appropriate value for this data service.

   Note: When the implementer is selected, several additional arguments will appear. The Node Admin application will obtain these properties directly from the WQX plugin.

7. From the **Type** drop down box, select how you wish to make the services available. The options available will be obtained from the plugin by the Node Admin. Select "Solicit".
8. Enable the service by checking the **Active** checkbox.
9. Based on the selection made from the implementer drop-down menu, the Node Admin will determine what argument and data source requirements the plugin has and will refresh the page to display the relevant data entry fields as follows:

   i. For the argument labeled **Author**, type the text to be entered in the "Author" element of the XML Header that will wrap the XML file to be created by the service. Alternatively if a global variable has been set up to provide this value, check the Use Global Value checkbox and select the variable name from the drop down box that appears in place of the textbox.

   ii. For the argument labeled **Contact Info**, type the text to be entered in the "Contact Info" element of the XML Header that will wrap the XML file to be created by the service. As above, a global argument may be used.

iii. For the argument labeled **Organization** field, type the name of the organization, for example "New York Department of Environmental Conservation"[2].

iv. For the argument labeled **Submission Partner Name**, type the name of the partner as defined in the OpenNode2 Configuration tab that describes Network Partner settings. This text must match exactly the name of the partner set up in the Network Partner section of the configuration. This value determines which partner the service will submit to. It is the service itself that submits the results to the given partner, not the accompanying schedule.

> **NOTE**
>
> *Do not use a global value for this setting and do not insert a node URL in this field. Both approaches will not work! The value must match the exact text of a configured Network Partner.*

10. Set the **DataSource** to the data source that connects to the WQX staging tables.
11. Click the **Save** button to save the service.

WQXGetDeleteSubmission

This data service will retrieve deleted records from the staging database according to a set of input runtime parameters (see later section on defining schedules) and will generate an XML file containing the required data. An important input parameter is the WQX Update Date. The plugin will only select records from the WQX_DELETES table where the WQXUPDATEDATE field is equal to or later than the input date.

Transaction information will again be recorded in the WQX_SUBMISSIONHISTORY for subsequent processing purposes.

This data service should only be used if your organization retains information about deleted "Project", "MonitoringLocation", "Activity", "ActivityGroup" or "BiologicalHabitatIndex" records that can be determined during the process of populating the staging tables.

1. Repeat these steps to set up the equivalent delete service, setting the **Name** field to "WQXGetDeleteSubmission", and selecting the appropriate value from the **Implementer** drop down box.
2. Click the **Save** button to save the service.

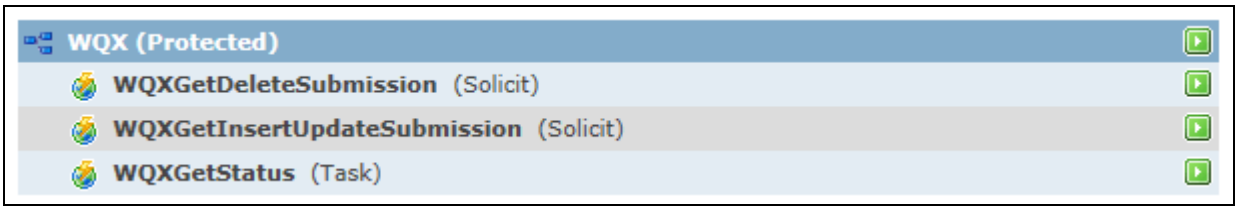
WQXGetStatus

This data service will contact EPA CDX to retrieve the status of any WQX transaction submitted for a provided organization identifier. This information will be used to update the WQX_SUBMISSIONHISTORY for subsequent processing purposes by the other two data services.

1. Repeat these steps to set up the WQXGetStatus service, setting the **Name** field to "WQXGetStatus", and selecting the appropriate value from the **Implementer** drop down box. The **Author**, **Contact Info**, and **Organization** fields will not appear for this service.
2. Click the **Save** button to save the service.

The **Manage Exchanges** page for the WQX data exchange should appear as follows:

[2] Note that this field is not intended to be used to provide the WQX organization identifier assigned to the State or Tribe by EPA.



Define Data Exchange Schedules

Scheduled jobs can be configured in the OpenNode2 to perform automated tasks such as submitting data to external partners or processing received files.

The WQX data exchange requires three schedules to be established using the OpenNode2 Node Admin, two to initiate the submission of data from the staging tables to the EPA WQX database and a third to check the status of pending submissions.

Create WQXGetInsertUpdateSubmission Schedule

This schedule will be used to execute WQXGetInsertUpdateSubmission data service to retrieve new or updated data from the staging database to be sent to EPA. The schedule will fail if there are any current un-processed transactions logged in the WQX_SUBMISSIONHISTORY table.

1. From the **Schedules** tab, click the **Add Schedule** button.
2. Type "WQXGetInsertUpdateSubmission" in the **Name** field.
3. Enable the schedule by clicking the **Active** checkbox.
4. Select "WQX" from the **Exchange** dropdown list.
5. Set the start date to the first date when you wish the schedule to run. If the date is equal to the current or a past date, the schedule will execute immediately upon saving.
6. Set the end date to some point in the distant future.
7. Set the frequency to the data submission interval agreed between the State or Tribe and the EPA WQX program. Typically this is monthly.
8. In the **Data Source** area, check the radio button labeled **Results of local service execution**.
9. In the **From** dropdown box, select the value "WQXGetInsertUpdateSubmission". This informs the schedule to use the selected WQX service as the data source for the submission.
10. In the **Additional Parameters** area, click the **By Name** radio button. Click the control to add one or more runtime parameters. Add the parameters that match how your organization wishes to submit data using the table below as a guide:

Name	Req'd?	Value/Format	Usage/Notes
OrganizationIdentifier	Yes	99XXXXX	The Org ID to be used in the submission Header. Also governs SELECT logic on WQX_ORGANIZATION table.
UseSubmissionHistoryTable	No	true OR false	Indicates whether the submission will be recorded in the

			Submission History table. Useful for testing. Defaults to true if not supplied.
WQXUpdateDate	No	MM/DD/YYYY	Applies a date filter on the WQXUPDATEDATE field greater than or equal to the date supplied. Used to send only a subset of activity data.
AddHeader	No	true OR false	Indicates whether or not to add a Header to the submission. Defaults to true if not supplied.
ValidateXml	No	true OR false	Indicates whether or not to perform schema validation before submittal. If the submission does not pass schema validation, the transaction will be set to "Failed" and the submission will not be performed. Defaults to false if not supplied.

11. In the **Result Process** area, check the radio button labeled **None.** The service will be responsible for submitting the data to the network partner provided to the during service configuration. This enables the service to quit if no data is found or if a previous submission has not yet been processed by the network partner.
12. Click the **Save** button to save the schedule.

Create WQXGetDeleteSubmission Schedule

This schedule can be used to execute WQXGetDeleteSubmission data service to retrieve information about deleted "Project", "MonitoringLocation", "Activity", "ActivityGroup" or "BiologicalHabitatIndex" records from the staging database to be sent to EPA.

1. Repeat these steps to set up the equivalent WQXGetDeleteSubmission schedule. Change the **Name** to "WQXGetDeleteSubmission" and select the "WQXGetDeleteSubmission" service before saving. All other information should remain the same as above.

Create WQXGetStatus Schedule

This schedule will be used to execute WQXGetInsertUpdateSubmission data service to update the WQX_SUBMISSIONHISTORY table with the status of any un-processed submission transactions at EPA CDX.

1. Repeat these steps to set up the GetStatus service for execution. Change the **Name** to **WQXGetStatus** and select the **WQXGetStatus** service before saving. All other information should remain the same as above.
2. In the **Additional Parameters** area, click the **By Name** radio button. Click the  control to add the single runtime parameter as follows:

Name	Req'd?	Value/Format	Usage/Notes
OrganizationIdentifier	Yes	99XXXXX	The Org ID to be used in the submission Header. Also governs SELECT logic on WQX_ORGANIZATION table.

The three WQX schedules are now set up correctly to manage the data flow. Please see the OpenNode2 Administration User Guide for more information on scheduling data exchanges.

Contact CDX to Establish Exchange Settings

Contact the EPA STORET group (STORET@epamail.epa.gov) and ask them to perform the following tasks:

1. Authorize the OpenNode2 runtime (operator) NAAS account to submit to the WQX data exchange on the EPA CDX.
2. Map the OpenNode2 runtime NAAS account to your WQX organization identifier (ORG_ID).

Establish Email Notifications

If desired, the Node administrator may create NAAS accounts for one or more staff members and create notifications for the any OpenNode2 events related to the WQX data exchange. Please see the OpenNode2 Administration User Guide for more information on setting up notifications.

Operating the WQX Data Exchange

This section describes the typical steps required to operate the WQX data exchange on the Microsoft .NET implementation of the OpenNode2 using the Node Administration Web application (Node Admin).

EPA CDX Processing

For the WQX data flow, the test EPA CDX Node is primarily only used to confirm first-time submissions to EPA. The test CDX Node can also be used to validate submitted XML documents. XML documents submitted to the test CDX Node will not necessarily be processed correctly by WQX.

In order to actually validate submitted data against the latest WQX business rules, submissions should be made to the production EPA CDX Node. Since data submitted to the production CDX Node will be routed to the production WQX import processor, when testing, submissions the organization id "WQXTEST" should be specified. This will cause WQX to return a normal processing report but data will not be loaded into the final production environment. Once the processing report has been verified and all business rules are met, the submission can be repeated with the correct organization id.

Submission Process

1. Execute the appropriate data extraction routines to populate the OpenNode2 staging database with the required information from the source database.
2. Using the OpenNode2 Admin application click on the **Schedules** tab.
3. Navigate to the **WQXGetInsertUpdateSubmission** schedule created earlier.
4. Click the  icon to display the schedule details.
5. Click the **Save and Run Now** button to save the schedule.
6. The schedule will begin to execute immediately.
7. When schedule execution completes, click on "Show Last Run Info" to view the results of the execution.
8. Click on the  icon to view detailed information about the submission transaction.
9. Click on the 

icon to determine the state of processing of the submitted file at EPA. The following status values are used by EPA:

Received	= Processing not yet started by CDX
Completed	= Successfully processed at CDX and WQX
Pending	= Still processing at CDX
Processing	= Still being processed by WQX
Failed	= Error occurred at CDX or WQX

10. Once the Endpoint Status field is "Completed" or "Failed", click on the 

icon to retrieve processing information from EPA.
11. A compressed file will be downloaded that will include multiple files including the original XML submission itself.

a. Validation Results – includes XML validation errors identified by CDX.

b. Processing Results – includes business rule errors identified by WQX.

12. Review the processing information and take action as necessary to correct data or resolve errors in the data extraction procedure.
13. Repeat the submission and validation process as necessary.
14. In addition to reviewing and confirming the Processing Reports returned by the EPA WQX database loading procedures, data submitted to production WQX can also be reviewed in the EPA STORET Data Warehouse which is fed from WQX on a weekly basis each Wednesday night.

    a. Go to the STORET Data Warehouse at http://www.epa.gov/storet/dw_home.html

    b. Click on Stations Download or Results Download.

    c. Enter the Org ID and search for data.

WQXGetStatus Data Service

It is very important that the WQXGetStatus schedule be created as described earlier in this document. This schedule performs a distinctly different function to that described in step 9) above. This scheduled task should be configured to execute on a recurring basis to periodically query the CDX Node for the status of the most recent WQX submission and to update the WQX_SUBMISSIONHISTORY table. OpenNode2 uses this information to determine whether the most recent submission is pending, failed, or complete. OpenNode2 will not submit another WQX file until all previous submissions are no longer pending. This ensures there is no overlap between submission attempts and processing results.

Appendix A Staging Table Block Diagram