



GIS STANDARDS TECHNICAL MEMORANDUM V. 3.1

To: Water Development Commission

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SUBJECT: GIS Standards Technical Memorandum Version 3.1

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1.0 Introduction

Beginning in 2018, the Wyoming Water Development Commission (WWDC) implemented standards for GIS deliverables. The purpose and goals of the standards are described in detail in the GIS Data Framework Plan (2018). In summary, these standards increase consistency and reduce duplication of effort between projects and provide a clear understanding of the data produced for projects funded by the WWDC. Standardization of the datasets is critical to effectively incorporating the data into a DSS that would be used to run scenarios to assist water resource decision making.

This document, GIS Standards Technical Memorandum version 3.1, was prepared in 2021 and details the methods, data, and available tools for meeting the standards. There are a few minor changes in this document relative to the previous version. One example is that the WDOSTRID linking field was changed slightly in version 3.1 as described in Appendix D.

A change to WWDC contract language beginning in 2020 clarified the distinction between core and auxiliary GIS datasets and how each is treated. Core GIS data includes features which fit within one of the feature classes in the geodatabase template, whether newly created or acquired from another source. All core GIS data shall be loaded into the geodatabase template and attributed according to the GIS data schema described in this document. Auxiliary GIS data include features which do not fit within one of the feature classes in the geodatabase templates, whether newly created or acquired from another source. Auxiliary data can be linked to the templates or managed separately as needed for project completion. Base datasets, such as NAIP Aerial Imagery or individual topographical maps used for backgrounds, do not need to be delivered unless requested by the project sponsor.

A WWDC project may require two separate sets of GIS data deliverables in certain circumstances. If the sponsor has GIS data in a format that differs from the WWDC format, or if GIS products would be more user-friendly for the sponsor in a different format, then deliverables will include core data in the required WWDC format described in this document, and in a format that meets the project sponsor's needs. This only applies to core GIS datasets, all auxiliary datasets may be submitted in any format, so those may be submitted in the sponsor's preferred format. This is required because the project should be completed in a way that benefits the sponsor, but the data will also be used to compile statewide datasets of core water data for the WWDC.

1.1 Recommendations for Working with these GIS Standards

1. **Attend the GIS orientation webinar prior to starting a new project.** Talk to your WWDO Project Manager about when this is offered. It is strongly recommended that the person preparing the project GIS data attend this orientation with their project manager, even if this person has attended a previous webinar.
2. **Use the project specific templates.** Geodatabase templates have been created that should be used to prepare the core datasets to meet the contractual requirements for GIS data delivered to the WWDC. These are described in section 3.0; GIS features by WWDC study type are described in Section 4.3. Carefully review your contract scope and work with your WWDO Project Manager to determine if there are any feature classes within the project-specific templates which will not be delivered.
3. **Add additional attributes as needed via linked tables in the geodatabase.** First, make sure the attribute field is not already described in another feature class or table in the geodatabase template. If this attribute field does not already appear within the existing framework, additional attributes may be

included in linked tables. Attributes should not be added, deleted or altered in feature classes. Also, update the metadata for that table to add the attribute field definition, including all coded values.

4. **Review attribute field names, data types, and domains before collecting data.** Format your GPS's data dictionary to use the correct field names and types, particularly those fields with domains, during data collection to facilitate quickly loading the data into the geodatabase template.
5. **Consolidate similar spatial features into a single feature class.** Instead of creating dozens of individual feature classes, put all points in a single feature class, and use the PrjType, StructureType, or other appropriate coded attribute field (domain values listed in Appendix A) to distinguish different types of features, e.g., valves from meters, headgates, pumps, etc. If an additional feature attribute field is needed to distinguish features, create a stand-alone geodatabase table that can link the project-specific attributes to the spatial features.
6. **Use the Load Data command in ArcCatalog** to migrate existing data feature classes in the template. Right click on a feature class in ArcCatalog and select Load. This wizard copies spatial features and migrates field values from the existing field to the template field name as long as the field types are the same (text to text or number to number). Conflation tools can also be used to migrate data into the geodatabase templates. Within ArcMap, features can be copied into the geodatabase template.
7. **Assign an edit date to *only* those features that you change.** Instead of auto filling all the features of a dataset with an edit date, only fill it if you changed it. This is important for ensuring that only updated features will be incorporated into the master geodatabase.
8. **Be sure to use the proper code when using the Field Calculator to fill a field that has a domain assigned.** Review Appendix A for a full list of domain values and descriptions.
9. **Review training webinar, this document, templates, geodatabase diagram, and GIS data at <https://water.geospatialhub.org/pages/wwdc-gis-standards>**

2.0 Standards & Formats

2.1 Metadata

The purpose of setting standards for metadata is to create data with validity. The WWDC invests funds for contractors to create new spatial data and update legacy spatial data within GIS. Metadata provides the history of each dataset allowing WWDC to understand the “who, what, when, why and where” of the data. The geodatabase templates include some default language as well as prompts for what is expected in each section and simplifies the process of completing metadata. At the end of this section an example of Esri's ArcCatalog metadata is provided to illustrate requirements for data submittal to WWDC.

Any dataset created or modified for reports delivered to WWDC must meet two simple requirements:

Self-Sufficient

The data should be able to stand on its own as a single dataset.

Is this data layer by itself usable and understandable?

Receivable

Does this data meet the requirements I would ask for to be able to use this data?

Does this data contain the needed information for me to know where it came from and what it is?

Can I deliver this data to someone and would they understand what the data could be used for?

2.1.1 Geodatabase Metadata

The metadata standard for the WWDC's spatial data is to update a minimum of five sections for the geodatabase file and for each feature class and table that is delivered to the WWDC through project studies. The following five sections are required to be updated by the data creator, or editor, and are based on the Federal Geographic Data Committee (FGDC) standards. If creating a project-specific table, add the definitions to the description section of the metadata for that table including all coded values.

GEODATABASE METADATA REQUIREMENTS

Tags	Keywords which represent the data
Summary (Purpose)	Why the data were created WWDC Project Name Geographic Extent Publication Date Coordinate System or Projection Scale
Description (Abstract)	What the data represent Details on scale and resolution Date the data represent How the data were created (including the base source used) Completeness (When needed) Define additional attributes, description and coded values in project-specific tables
Credits	Creator or editor of data
Use Limitations	Disclaimer (see below for default) <i>These GIS data were compiled from Wyoming Water Development Commission (WWDC) funded projects, Wyoming State Engineer's Office (SEO) records, and/or other sources for the use and convenience of the public. These data may not be complete or accurately represent the conditions on the ground, and no decision involving a risk of economic loss or physical injury should be made in reliance thereon. The WWDC and the Water Resources Data System (WRDS) do not endorse or recommend the use of these data for any other purpose than originally developed and are providing these data "as is," and disclaim any and all warranties, whether expressed or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose. Users of this information assume the entire risk to the use of these data and should review or consult the primary data and information sources to ascertain the reliability or usability of the information. Comprehensive water rights information is only available through researching the water rights on file with the SEO and Board of Control. The State of Wyoming and its agencies assume no liability associated with the use or misuse of this information and specifically retain sovereign immunity and all defenses available to them by law.</i>

Example of Esri's ArcCatalog Metadata

Point of Diversion File Geodatabase Feature Class

Tags

River Basin Plan, State of Wyoming, Point of Diversion, Water Rights

Summary

[Why the data were created] **[WWDC Project Name]** These data were prepared for the Wyoming Water Development Commission Framework Water Plan to provide an edge matched coverage for statewide analysis. **[Geographic Extent]** These data are an aggregation of the GIS data prepared for the seven individual Wyoming Water Development Commission River Basin Plans to cover the entire state of Wyoming. **[Publication Date]** These data were compiled in 2007. **[Coordinate system or Projection]** GCS_North_American_1983 **[Scale]** 1:24,000

Description

[What the data represent] This dataset represents surface water right record diversion locations for the irrigated lands mapped for the state of Wyoming. **[Details on scale and resolution]** Portions of the dataset were at a higher resolution of 1:10,000 where LiDAR datasets were available. **[Date the data represent]** These data are an aggregation of the GIS data prepared for the seven individual Wyoming Water Development Commission River Basin Plans produced between 1999 and 2005. **[How data were created]** Points represent the record location current location was not verified. Most often these points were located based on the Township Section Quarter and Quarter-Quarter taken from Wyoming State Engineers Office and moved to the closest surface water based on **[Base Source]** 2006 NAIP aerial photo. **[Completeness]** These points only include points of diversion greater than 10 cfs with an irrigation use type. All attribute information came from Wyoming State Engineers Office. Users working in a single river basin may wish to use the original data prepared for that basin. **[When needed: Define Added Attributes, description and coded values in project-specific tables]** A data table was created with the additional fields of substrate size and stream width. The table was linked to the RosgenClass feature class using NHDReachCode.

Credits

Jane Doe and John Smith, Brown Bear Mapp-a-lot, Inc.

Use limitations

These GIS data were compiled from Wyoming Water Development Commission (WWDC) funded projects, Wyoming State Engineer's Office (SEO) records, and/or other sources for the use and convenience of the public. These data may not be complete or accurately represent the conditions on the ground, and no decision involving a risk of economic loss or physical injury should be made in reliance thereon. The WWDC and the Water Resources Data System (WRDS) do not endorse or recommend the use of these data for any other purpose than originally developed and are providing these data "as is," and disclaim any and all warranties, whether expressed or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose. Users of this information assume the entire risk to the use of these data and should review or consult the primary data and information sources to ascertain the reliability or usability of the information. Comprehensive water rights information is only available through researching the water rights on file with the SEO and Board of Control. The State of Wyoming and its agencies assume no liability associated with the use or misuse of this information and specifically retain sovereign immunity and all defenses available to them by law.

2.1.2 Feature Level Attribute Metadata

Metadata is also captured within certain attribute fields for feature classes and tables. Feature level metadata, pertains to individual features or records and are not reflected in the metadata summary for the entire feature class or table. The purpose of this type of metadata is to track changes to individual features or records. These attribute fields must be populated when features within the core datasets in the geodatabase template are created or modified (changes in position, attributes are updated etc..). When updated properly, the metadata attribute fields provide details about which WWDC project the data is associated with, who created it, when it was created or edited, and the horizontal accuracy of that feature. When a feature is modified during a subsequent project, the fields shall be updated to reflect the project associated with the change, who modified the feature location or details, the date of the change and the current horizontal accuracy of the feature. Each of these metadata attribute fields is extremely important to allow tracing the feature back to the data source.

FEATURE LEVEL ATTRIBUTE METADATA STANDARD REQUIREMENTS

<i>Contract_ID</i>	Project Contract Number
<i>Contractor</i>	Consulting Firm who created/updated feature
<i>Creation_Edit_Date</i>	Date of creation or last edit
<i>Horizontal_Accuracy</i>	<p>Horizontal accuracy is set up as a geodatabase domain with a select set of values from which to choose. Examples of values are:</p> <ul style="list-style-type: none"> • Map Interpolated • GPS – Commercial/Recreation Grade • Surveyed <p>Users of this data will understand the accuracy of the data based on these domain values. Domain values and descriptions are contained in Appendix A.</p>

2.2 Coordinate System

The purpose of the coordinate system standard is to maintain consistency among all project data. The driving factor for a consistent coordinate system is the long-term maintenance and storage of spatial data within a master geodatabase. The WWDC requires all GIS deliverables be in a Geographic Coordinate System (GCS) based on the North American Datum 1983 (NAD83).

The Geographic Coordinate System was chosen to keep the consistency between the State Engineer’s Office (SEO) e-Permit downloadable coordinates, on which the water system dataset is based. In addition to the SEO’s data, the majority of outside data sources, such as the National Hydrography Dataset (NHD), is contained in geographic coordinates.

DETAILS OF THE REQUIRED COORDINATE SYSTEM

ARCGIS COORDINATE SYSTEM

* TYPE Geographic

* GEOGRAPHIC COORDINATE REFERENCE GCS_North_American_1983

* COORDINATE REFERENCE DETAILS

GEOGRAPHIC COORDINATE SYSTEM

WELL-KNOWN IDENTIFIER 4269

X ORIGIN -400

Y ORIGIN -400

XY SCALE 999999999.99999988

Z ORIGIN -100000

Z SCALE 10000

M ORIGIN -100000

M SCALE 10000

XY TOLERANCE 8.9831528411952133e-009

Z TOLERANCE 0.001

M TOLERANCE 0.001

HIGH PRECISION true

LEFT LONGITUDE -180

LATEST WELL-KNOWN IDENTIFIER 4269

WELL-KNOWN TEXT

```
GEOGCS["GCS_North_American_1983",DATUM["D_North_American_1983",SPHEROID["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433],AUTHORITY["EPSG",4269]]
```

3.0 Geospatial Templates, Tools, Base Layers

3.1 Geodatabase Template Downloads: Map Packages

The geodatabase templates containing core GIS datasets for the five types of WWDC projects are available for download as map packages. A map package (*.mpk) is a single, compressed file used to share an Esri ArcMap map document (*.mxd) and the associated data within that map document. The map package can also contain additional documentation to support the data and the map document. These capabilities make it the preferred method for sharing GIS projects and ensuring a consistent starting point.

MAP PACKAGES AVAILABLE FOR DOWNLOAD

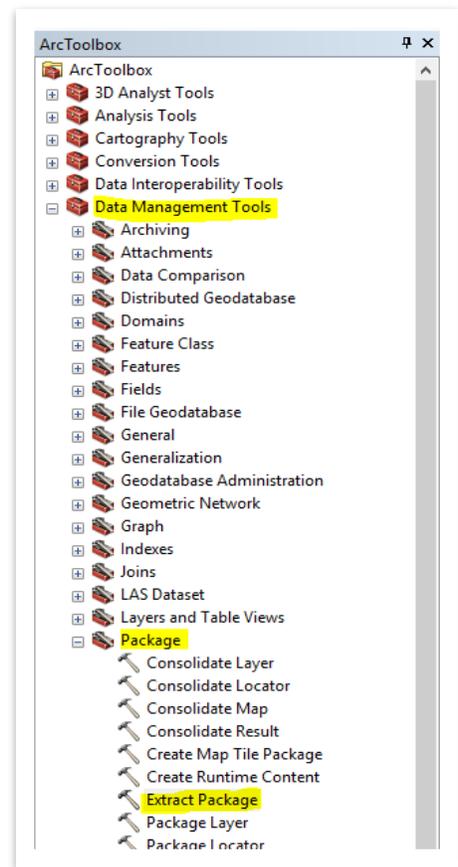
-  WDO_DrinkingWater_Template_V3.1.mpk
-  WDO_InstreamFlow_Template_V3.1.mpk
-  WDO_Irrigation_Template_V3.1.mpk
-  WDO_RiverBasin_Template_V3.1.mpk
-  WDO_Watershed_Template_V3.1.mpk

The five map packages available for download include Drinking Water Master Plan, Instream Flow Study, Irrigation Master Plan, River Basin Plan, and Watershed Study. Each map package contains one symbolized map and one template geodatabase, with core feature classes and tables specific to the project type. The map packages are supported in ArcMap versions 10.0 through 10.8. The data templates may change over time due to project sponsor and WWDC needs so it is important to download and use the most current templates at the beginning of a project. The data model and core datasets currently in use have been updated and refined based on the original recommendations from the WWDC GIS Data Framework Plan (2018). The WWDC GIS Data Framework Plan (2018) provides relevant background and information on the data model development.

Map packages were developed to provide consistency in data collection procedures and ensure end users are able to edit the data using the Esri Basic licensing (i.e., no advanced features were incorporated that require a higher-level license). Although they were designed to open in ArcMap, it is also possible to import and work with these map packages in ArcGIS Pro.

1. The map packages are available for download on the GIS Standards website (<https://water.geospatialhub.org/pages/wwdc-gis-standards>), or a link to this page can be found within the “Agency Products” section on the WWDC home page (<https://wwdc.state.wy.us>). There are two ways to open and use the map packages after download from the GIS Standards website.
 - a. Double-click the map package. Unless you have changed the default location of where your packages will be unpacked, the map package will automatically extract itself to C:\Users\username\Documents\ArcGIS\Packages and automatically open ArcMap. The ArcMap project will contain the necessary feature classes and tables that are blank and ready to be populated. The information provided later in this document will explain the details for each of the core datasets displayed within the map package.

- b. Alternatively, run the Extract Package tool in ArcToolbox from either ArcMap or ArcCatalog (see image to the right). This allows the map package to be extracted to a user-defined location. Browse to the folder and select the location to extract the files. Once the extraction is complete the user will be able to browse to the same location and open the ArcMap project (.mxd) corresponding to the version of ArcMap installed on the user's computer.



3.2 Permit Conversion Tools: Point of Diversion and Point of Use

The e-Permit GIS Conversion Tools were created to streamline the process of creating the Point of Diversion (POD) and Point of Use (POU) feature classes from the e-Permit downloaded data at a Depth I detail (see section 4.7 for detail on depth levels). Details on the use of these tools is included in Appendix C. **Please note, statewide POD and POU feature classes are currently under development by WWDC and may be available by request or via downloads.**

Toolboxes are subject to version limitations within ArcMap, so a version of Tools has been created for each 10.X version of ArcMap; the toolbox is not available for use with ArcGIS Pro. Install the file that corresponds to your installed version of ArcMap. Esri did not revise the toolbox functionality between 10.3 and 10.4, so the 10.3 toolbox version works with both 10.3 and 10.4 versions of ArcMap. The last file in the list is “e_Permit_ToolsV2”, which runs on ArcMap 10.5 - 10.8. These toolboxes are available for download from the Water and Climate Hub using the link “ArcGIS Tools” from the GIS Standards website (<https://water.geospatialhub.org/pages/wwdc-gis-standards>). The download includes a geodatabase with PLSS (Public Land Survey System) feature classes, which are required to run the tools.

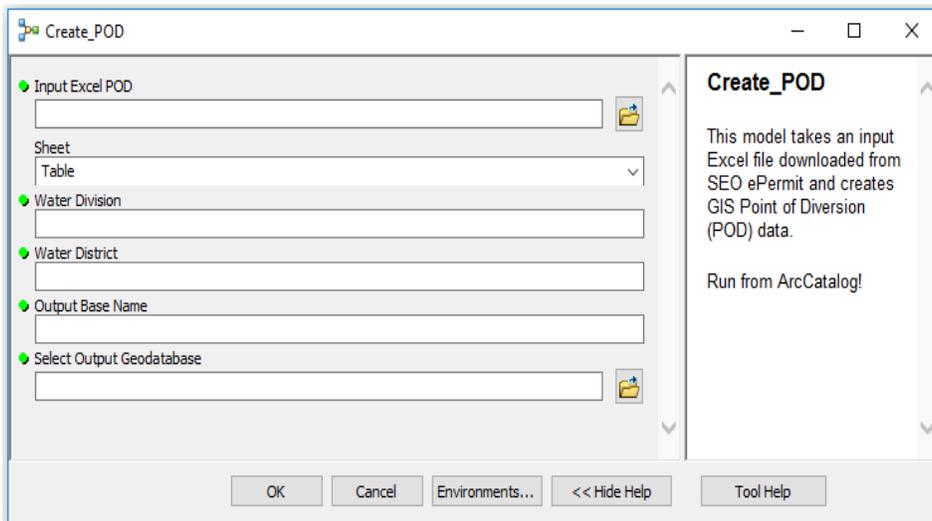
PERMIT CONVERSION TOOLBOX VERSIONS

- e_Permit_Tools10-1or2_V2.tbx
- e_Permit_Tools10-3_V2.tbx
- e_Permit_Tools10_V2.tbx
- e_Permit_ToolsV2.tbx

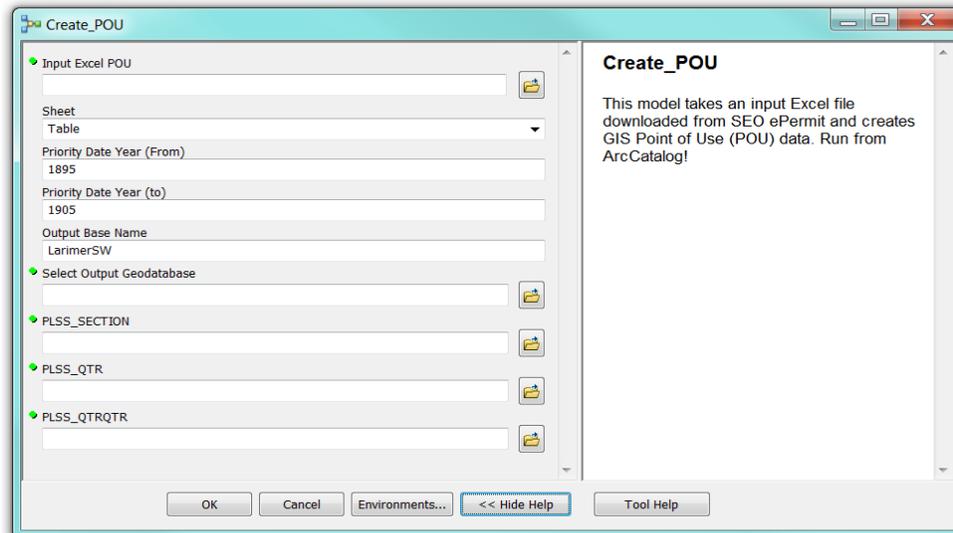
ESRI ARCGIS TOOLBOX VIEW OF THE E-PERMIT CONVERSION TOOLS:

- e_Permit_ToolsV2.tbx
 - Create_POD
 - Create_POU
 - POD sub-script

POD CONVERSION TOOL DIALOG AND INPUTS



POU CONVERSION TOOL DIALOG AND INPUTS



Use the “**Show Help>>**” function to view help comments for each field in the POD and POU tool interfaces. The “Create POU” tool requires the supplied PLSS layers from the Water and Climate Hub for proper use.

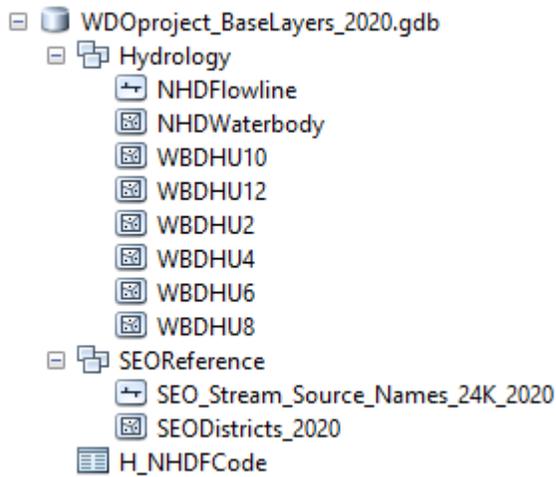
PLSS LAYERS REQUIRED BY THE POU TOOL

- [-] [Folder Icon] PermitConversion_ToolsV2
 - [-] [Database Icon] WDO_Tools.gdb
 - [-] [Database Icon] GCBD_CADNSDI_BLM_PLSS
 - [Database Icon] PLSS_QTR
 - [Database Icon] PLSS_QTRQTR
 - [Database Icon] PLSS_SECTION
 - [Database Icon] PLSSIntersected_FullPlus

Note: PLSS Data is included in e-Permit Conversion Tool Download

3.3 Common Base Datasets

A geodatabase of common base data (WDOproject_BaseLayers.gdb) is provided which includes a portion of the National Hydrography Dataset, stream names recognized by the Wyoming State Engineer’s Office, and the Wyoming State Engineer’s Office water districts. These data are intended to be used with WWDC project data as needed to provide a consistent base layer for the development of the core datasets.



4.0 Feature Mapping & Attribution

This section describes the data model, core GIS datasets, and provides detail on the types of GIS features that are normally collected through WWDC projects and how these data fit into the core datasets.

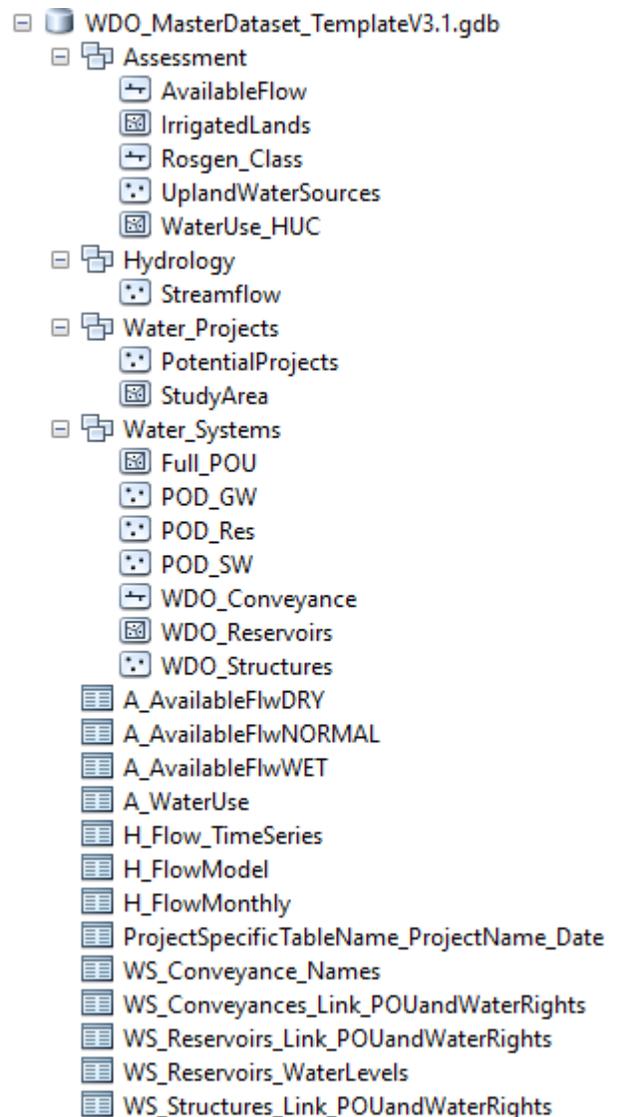
4.1 Geodatabase Structure

The figure on the right shows the master database view in ArcCatalog. Sections 4.4-4.7 provides details on each of these standardized feature classes, tables and their coded values (geodatabase domains), along with diagrams showing relationships that assist with linking the data tables together. Few projects will need to update or develop all of the listed feature classes and tables; this is why separate geodatabase templates were created for the five types of WWDC projects (Section 3.1).

Geodatabase structure does not allow tables to be stored within feature datasets (e.g., tables associated with the Assessment feature dataset to the right are not incorporated into that group; all tables are listed at the bottom). To make it clear which data tables are associated with which feature datasets, the naming conventions for the tables include a prefix corresponding to the related feature datasets as follows:

- A - Assessment Dataset
- H - Hydrology Dataset
- WP - Water Projects Dataset
- WS - Water System Dataset

These tables are provided in the geodatabase templates and have attribute fields that are likely to be included in that type of project. However, custom attributes may be necessary, in which case, the project-specific table included in the templates allow these to be added. When necessary to use the project-specific table(s), it (they) should be linked to the appropriate GIS feature class(es) and labeled with the appropriate prefix as shown above.



4.2 Working with Existing Data

Building off of existing GIS datasets is encouraged. As noted above, existing data may be core or auxiliary data depending on whether it fits within one of the feature classes in the geodatabase templates. When it is a core dataset it should be migrated from existing sources into the geodatabase template. For most projects, newly created GIS data will be core data and should be similarly migrated into the geodatabase template. Metadata must be included in all datasets that are submitted as part of the project. If the existing data do not have

metadata information from the original source, at a minimum, provide an acknowledgment of this as well as details on when and from where the data were obtained. In all core datasets, feature attributes should be populated and or verified, accuracy updated, and the four required attribute metadata fields (Section 2.1.2) updated if changes are made.

To import data into the geodatabase templates, use the Load Data command in ArcCatalog. Right click on a feature class in ArcCatalog and select Load. This wizard copies spatial features and migrates field values from the existing field to the template field name as long as the field types are the same (text to text or number to number). Conflation tools can also be used to migrate data into the geodatabase templates. Within ArcMap, features can be copied into the geodatabase template, but the attributes of the copied features will not transfer if the field names or formats do not match.

4.3 GIS Features by WWDC Study Type

This section defines core GIS datasets within each of the five standard types of WWDC planning projects. Each project will have its own unique data collection needs that likely include feature classes not in this list; those are auxiliary GIS datasets. Users should consult their scope of work and their WWDO Project Manager for specific data needs. Every project should include both the StudyArea and PotentialProjects feature classes. Note that PotentialProjects is a point layer; therefore, features that are lines or polygons will have to be converted to points to be loaded into this feature class (the original lines and/or polygon features should also be provided as a separate feature class). For line features, use the beginning, or origin, of the feature for creating the reference point and for polygons, use the centroid.

The tables below show the core feature classes by project type and an item description of what type of data should be included in that feature class. The notes column of the table includes information about any linking data tables or other information unique to that feature class. Attributes for each of these feature classes and the relates that are used to link tables are displayed in the Water Development Geodatabase Diagram (2020). Attributes that are not already part of the core datasets should not be added to a core feature class, they should be included in a separate project-specific table and linked through the appropriate attribute field. Additional details on the core feature classes, linking and data tables, and the attributes used to join them are described in Sections 4.4-4.7.

DRINKING WATER MASTER PLAN

	Item Description	Notes
PotentialProjects	Projects identified within the study area.	Projects that could be developed from study should include estimated project cost and quantity of additional water, if applicable. Project features that are lines or polygons must be converted to point features using the beginning point of lines and centroid of polygons for inclusion in this feature class – the original line and polygon feature classes should be provided separately as an Auxiliary Data Sets.
StudyArea	Outer boundary of the project study area.	
Full_POU	Points of use location of water use by quarter-quarter. Derived from e-Permit conversion tool.	Tract and lot POU records may not plot using conversion tool and may require manual update of geometry.
WDO_Conveyance	Water transmission, canals, ditches, pipelines and natural channels.	Convey_ID field used to link to POU and water rights table through linking table (Conveyances_Link_POUandWaterRights). Also links to project-specific data, such as photos, when needed.
WDO_Reservoirs	Raw water reservoirs.	Reservoir_ID field used to link to POU and water rights table through linking table (Reservoirs_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data, such as photos, when needed.
WDO_Structures	Location of major structures in a water system, including diversions, meters, headgates, dam outlets, wells, valves, water storage tanks (potable).	WDOSTRID field used to link to POU and water rights table through linking table (Structures_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data table when needed.

INSTREAM FLOW STUDY

	Item Description	Notes
AvailableFlow	Legally available water for wet, normal and dry years.	ReachCode field (from NHD) used to link to flow data for wet, normal, and dry conditions.
Streamflow	Location of stream flow gauges or modeled flow nodes.	Link to tables with time series, monthly and annual summary statistics and/or modeled data.
PotentialProjects	Instream flow reaches.	Projects that could be developed from study should include estimated project cost and quantity of additional water, if applicable. Line features must be converted to point features using the beginning point of lines for inclusion in this feature class – the original line feature class should be provided separately as an Auxiliary Data Set.
StudyArea	Outer boundary of the project study area.	
Full_POU	Points of use location of water use by quarter-quarter. Derived from e-Permit conversion tool.	Tract and lot POU records may not plot using conversion tool and may require manual update of geometry.
POD_[GW, SW Res]	Points of diversion locations for surface water, groundwater, or reservoirs derived from e-Permit conversion tool.	WR_Number field used to link to Full_POU. Also links to project-specific data table when needed. Requires cleanup in Excel prior to using conversion tool.
WDO_Conveyance	Water transmission, canals, ditches, pipelines and natural channels.	Convey_ID field used to link to POU and water rights table through linking table (Conveyances_Link_POUandWaterRights). Also links to project-specific data, such as photos, when needed.

IRRIGATION DISTRICT MASTER PLAN

	Item Description	Notes
<i>IrrigatedLands</i>	Lands currently irrigated.	
<i>Streamflow</i>	Location of stream flow gauges or modeled flow nodes.	Link to tables with time series, monthly and annual summary statistics and/or modeled data.
<i>WDO_Structures</i>	Location of major structures in a water system, including diversions, flumes, headgates, dam outlets, wells, return flow locations, pumps, culverts, water storage tanks.	WDOSTRID field used to link to POU and water rights table through linking table (Structures_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data table when needed.
<i>PotentialProjects</i>	Projects identified within the study area.	Projects that could be developed from study should include estimated project cost and quantity of additional water, if applicable. Project features that are lines or polygons must be converted to point features using the beginning point of lines and centroid of polygons for inclusion in this feature class – the original line and polygon feature classes should be provided separately as an Auxiliary Data Set.
<i>StudyArea</i>	Outer boundary of the project study area.	
<i>Full_POU</i>	Points of use location of water use by quarter-quarter. Derived from e-Permit conversion tool.	Tract and lot POU records may not plot using conversion tool and may require manual update of geometry.
<i>WDO_Conveyance</i>	Water transmission, canals, ditches, pipelines and natural channels.	Convey_ID field used to link to POU and water rights table through linking table (Conveyances_Link_POUandWaterRights). Also links to project-specific data, such as photos, when needed.
<i>WDO_Reservoirs</i>	Non-stock water reservoirs.	Reservoir_ID field used to link to POU and water rights table through linking table (Reservoirs_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data, such as photos, when needed.

RIVER BASIN PLANNING & MODELING

	Item Description	Notes
AvailableFlow	Legally available water for wet, normal, and dry years.	ReachCode field (from NHD) used to link to flow data for wet, normal, and dry conditions.
IrrigatedLands	Lands currently irrigated.	
WaterUse_HUC	Water use (amounts and use types) by watershed.	Link to data table using HUC_Number.
Streamflow	Location of stream flow gauges or modeled flow nodes within the study area.	Link to tables with time series, monthly and annual summary statistics, and/or modeled data.
PotentialProjects	Projects identified within the study area.	Projects that could be developed from study should include estimated project cost and quantity of additional water, if applicable. Project features that are lines or polygons must be converted to point features using the beginning point of lines and centroid of polygons for inclusion in this feature class – the original line and polygon feature classes should be provided separately as an Auxiliary Data Set.
StudyArea	Outer boundary of the project study area.	
Full_POU	Points of use location of water use by quarter-quarter. Derived from e-Permit conversion tool.	Tract and lot POU records may not plot using conversion tool and may require manual update of geometry.
WDO_Conveyance	Water transmission, canals, ditches, pipelines and natural channels.	Convey_ID field used to link to POU and water rights table through linking table (Conveyances_Link_POUandWaterRights). Also links to project-specific data, such as photos when needed.
WDO_Reservoirs	Non-stock water reservoirs > 100 ac-ft.	Reservoir_ID field used to link to POU and water rights table through linking table (Reservoirs_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data, such as photos when needed.
WDO_Structures	Location of major structures in a water system, including diversions, meters, headgates, dam outlets, wells, return flow locations, water storage tanks (potable).	WDOSTRID field used to link to POU and water rights table through linking table (Structures_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data table when needed.

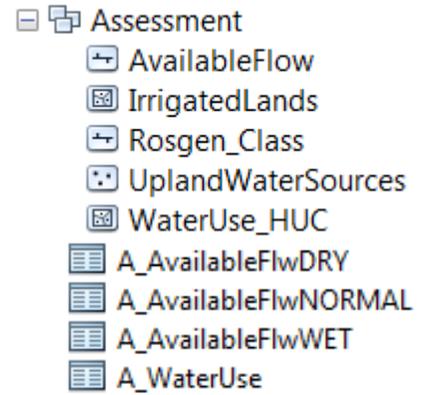
WATERSHED STUDIES

	Item Description	Notes
<i>IrrigatedLands</i>	Lands currently irrigated.	
<i>Rosgen_Class</i>	Geomorphology as Rosgen Stream Classification.	
<i>UplandWaterSources</i>	Livestock tanks and livestock reservoirs, springs.	
<i>Streamflow</i>	Location of stream flow gauges or modeled flow nodes.	Link to tables with time series, monthly and annual summary statistics and/or modeled data.
<i>PotentialProjects</i>	Projects identified within the study area.	Projects that could be developed from study should include estimated project cost and quantity of additional water, if applicable. Project features that are lines or polygons must be converted to point features using the beginning point of lines and centroid of polygons for inclusion in this feature class – the original line and polygon feature classes should be provided separately as an Auxiliary Data Set.
<i>StudyArea</i>	Outer boundary of the project study area.	
<i>Full_POU</i>	Points of use location of water use by quarter-quarter. Derived from e-Permit conversion tool.	Tract and lot POU records may not plot using conversion tool and may require manual update of geometry.
<i>WDO_Conveyance</i>	Water transmission, canals, ditches, pipelines and natural channels.	Convey_ID field used to link to POU and water rights table through linking table (Conveyances_Link_POUandWaterRights). Also links to project-specific data, such as photos, when needed.
<i>WDO_Reservoirs</i>	Non-stock water reservoirs > 100 ac-ft.	Reservoir_ID field used to link to POU and water rights table through linking table (Reservoirs_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data, such as photos, when needed.
<i>WDO_Structures</i>	Location of major structures in a water system, including diversions, meters, headgates, dam outlets, wells, return flow locations, water storage tanks (potable).	WDOSTRID field used to link to POU and water rights table through linking table (Structures_Link_POUandWaterRights). Also links to WDO_Conveyance and project-specific data table when needed.

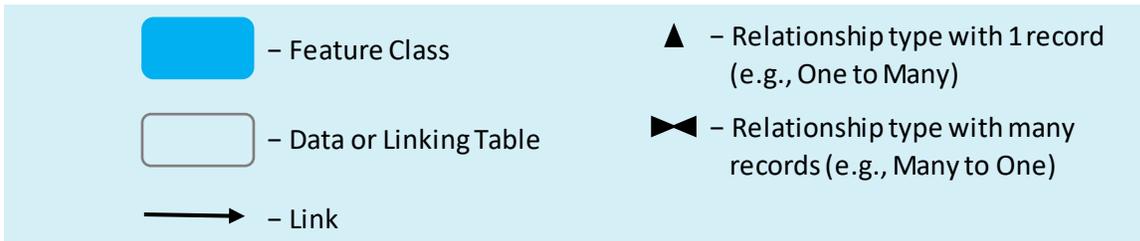
4.4 Assessment Feature Dataset

This dataset typically represents the current condition of the system or landscape being studied.

Dataset Usage: The Assessment Feature Dataset is ground assessment data used to inform reconnaissance and feasibility studies. Available flow is spatially represented by stream reaches with this dataset. On the ground feature sets include irrigated lands, upland water storage and Rosgen geomorphology.



For figures depicting links between feature classes and tables the following symbols are used:

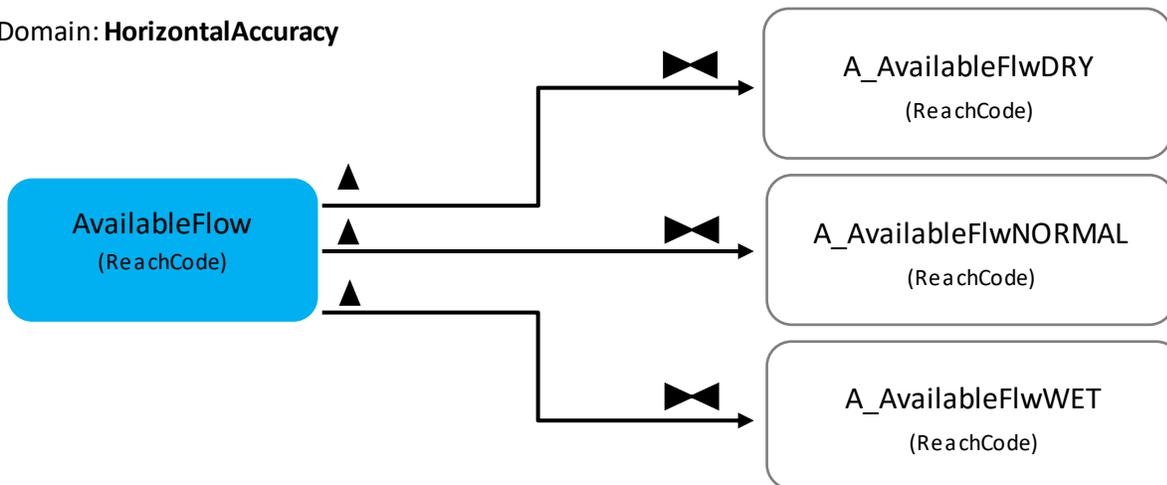


Domains are identified when present

4.4.1 Feature Class AvailableFlow: Links and Methods

AvailableFlow – This feature class contains estimates of legally available water in a given stream reach under a given hydrologic condition; wet, normal and dry. Existing sources include information found in the WWDC River Basin Plan water availability estimates.

Domain: **HorizontalAccuracy**



4.4.1.1 Table A_AvailableFlw[DRY, NORMAL, WET]: Links and Methods

A_AvailableFlw - “Available water” at a reach terminus is defined as the minimum of the physically available flow at that point and “available water” to downstream reaches. These downstream demands fall into three general categories: diversions, instream flow constraints, and compact/deed constraints. These calculations have been made on a monthly basis and annual availability is computed as the sum of monthly availabilities.

Domain: **Units**

4.4.2 Feature Class IrrigatedLands: Links and Methods

IrrigatedLands –This feature class contains lands intentionally irrigated in a given year. Irrigated lands are categorized based on irrigation status and the delivery system type used to serve these lands. Common sources used to derive these data include: WWDC - River Basin Plans, NAIP – NDVI, Landsat 8, SEO and discussions with water users. Ancillary data include water right point of use data and riparian areas.

Domains: **IrrMethod, IrrStatus, HorizontalAccuracy**

4.4.3 Feature Class Rosgen_Class: Links and Methods

Rosgen_Class – This dataset includes a geomorphic classification of perennial streams using the Rosgen system. Typically, WWDC funded projects are mapped at a Level I, but mapping at Levels II-IV may also be incorporated and identified using the “RosgLevel” attribute. Stream reaches created or edited for this feature class should correspond to NHD flowlines.

Domains: **RosgLevel, AssessType, RosgType, RiparianVeg (Alias=RiparianLeftBnk and RiparianRightBnk), HorizontalAccuracy**

4.4.4 Feature Class UplandWaterSources: Links and Methods

UplandWaterSources –This feature class contains existing conditions of springs, stock wells, stock tanks or small ponds/lakes/reservoirs. (Note that multiple use reservoirs larger than 100 acre -feet are included in WDO_Reservoirs). Common sources used to derive these data include: SEO e-Permit (surface water stock use and groundwater wells), United States Geological Survey and Wyoming State Geological Survey inventory of springs and discussions with water users. Ancillary data include aerial photos.

Domains: **UplandType, FuncStatus, RiparianVeg, HorizontalAccuracy**

Methods: Irrigated Lands Feature Class Creation

The fundamental criterion used in the identification of irrigated lands is as follows: "irrigated land is all land that can be identified as receiving water induced by the work of man." This interpretation is consistent with that used in the Upper Colorado River Compact and the North Platte River Decree (O'Grady, et al., Green River Basin Plan Technical Memorandum, 2000).

Previously delineated irrigated lands can be used as a foundation for current mapping. The best sources are WWDC River Basin Plans, WWDC Irrigation District Master Plans, and WWDC Dam and Reservoir Plans. Remotely sensed imagery from Landsat or similar resolution data sources is recommended if it characterizes the entire irrigation season and not just a single day in the season. The Irrigation Status attribute includes the following codes:

- A** - Full service irrigation (receives a full water supply)
- B** - Partial service irrigation (receives a reduced water supply due to limited water availability or the inability to provide complete field coverage)
- C** - Incidental irrigation or sub-irrigation (beneficial use resulting from incidental irrigation such as ditch seepage to areas below a canal)
- E** - Idle irrigation (lands not currently receiving water, due to nonfunctional delivery facilities or inadequate water)
- H** - Minor beneficial use (lands that receive some beneficial use on occasion such as lands served by "kick-out" ditches on ephemeral streams)
- AB** - Full and partial mix of irrigation within a single polygon

An additional ancillary data source to assist mapping irrigation includes the POU feature class. This helps target areas that are intentionally irrigated from those that may be wild vegetation. This document describes methods used to map the POU using e-Permit data. Riparian areas of non-cultivated vegetation cover should not be included in the irrigated lands layer. These areas can be eliminated using land cover datasets (National Land Cover Dataset, Landfire, etc.), aerial photos or previously delineated riparian areas from local sources. Remotely sensed imagery from Landsat or similar resolution imagery are also used to derive irrigated lands.

It is commonly recognized that all lands capable of being irrigated are not always irrigated in a given year. A number of factors influence the actual farming and irrigation practices in a given year resulting in greater or fewer acres actually being irrigated. These factors include the availability of water, local, regional and global economic conditions, severe weather and individual decisions each landowner makes with respect to the use of his/her land in a given year.

Methods: Rosgen Feature Class Creation

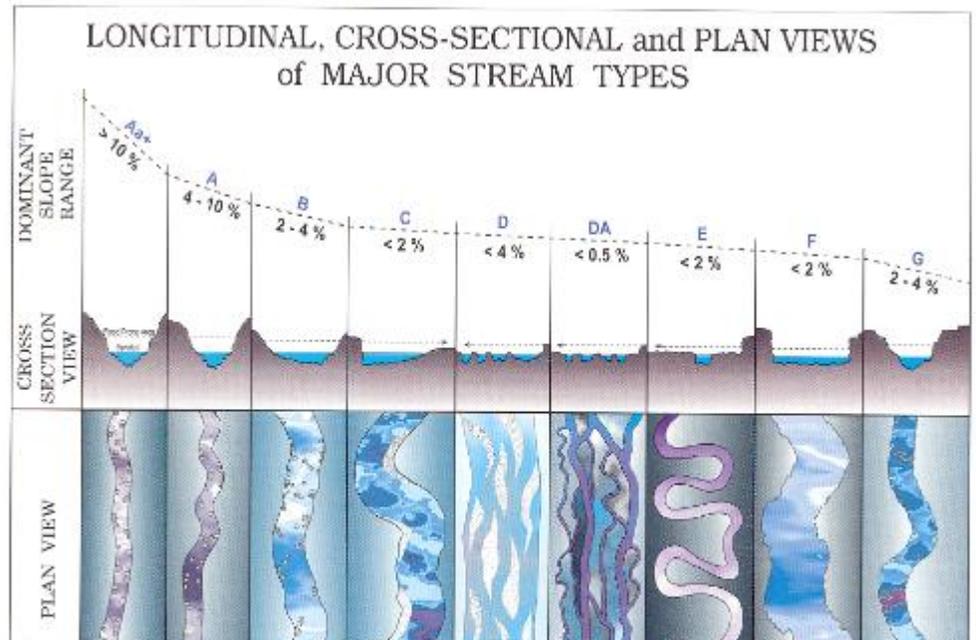
Methods as modified from the Upper North Platte Watershed Study, Anderson Consulting Engineering, Inc. (2015):

The streams evaluated are divided into reaches based upon definable geographic factors (e.g. confluences with tributaries, major road crossings, etc.) or where the geomorphic character of the stream changes. Each reach is evaluated based on channel slope, channel shape, channel patterns and valley morphology for the Level I classification.

The Level I classification effort is conducted primarily using existing information incorporated into the project GIS. Several analytical tools can be integrated into the GIS

to allow the evaluation of various geomorphic parameters. Because the digital elevation model typically used for this analysis is limited to a 10-meter grid, elevations and subsequent slope calculations are approximate. Stream alignments should be digitized using aerial photography, rather than relying on NHD stream segments, to represent the best available estimate of current channel alignment.

The purpose of the Level I geomorphic classification is to provide an inventory of the study area's overall stream morphology, character and condition. It is intended to serve as an initial assessment for use in more detailed assessments and to determine the location and approximate percentage of stream types within the basin. The results of the Level I classification can be integrated directly into the project GIS to provide a graphical "snapshot" of the basin. Based upon this initial effort, potential stream reference reaches can be identified for further study in Level II classification efforts. The end product of the Level I classification is the determination of the major stream types, A through G, for each stream segment in the study area. The Rosgen Feature Class also has attributes for higher level classification when those data are available.



MAJOR STREAM TYPES WITHIN THE ROSGEN CLASSIFICATION SYSTEM (ROSGEN, 1996)

STREAM TYPES	Aa+	A	B	C	D	DA	E	F	G
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Methods: Upland Water Sources Feature Class Creation

Typical upland water sources include reservoirs, developed springs and stock tanks. This includes all water sources utilized by livestock and/or wildlife throughout the year. Mapping of existing water sources provides valuable information for the completion of watershed management plans and also aids in determining placement of new water sources.

Use multiple years of aerial imagery to evaluate conditions by overlaying maps of reservoir sites or other features and use years that provide the highest resolution aerial photography available. This is done in order to more accurately determine the status of each feature over time and reduce error as much as possible due to dry or wet water years. Reservoirs and other features can then be classified into five categories based on functionality.

Functional – Features containing water in multiple years of photography or show no signs of physical breaches or sedimentation are determined to be functional.

Non-Functional – Features showing apparent signs of physical breach or are visibly filled with sediment are determined to be non-functional.

Ephemeral – Features where water source is ephemeral or intermittent.

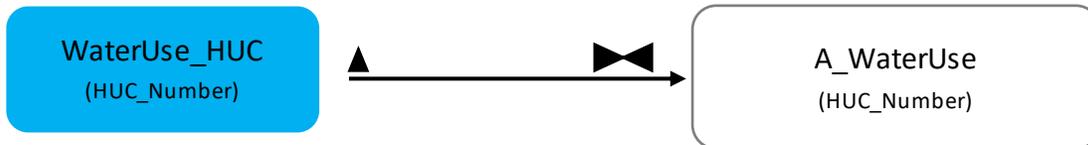
Potential - Features containing water in one year of photography or show no visible signs of damage are determined to be potential water sources.

Unknown – Function of feature is unevaluated.

4.4.5 Feature Class WaterUse_HUC: Links and Methods

WaterUse_HUC – This feature class identifies the NHD Hydrologic Unit Code (HUC) for the area in which the study was conducted; the study area chosen should coincide with a HUC. The data table A_WaterUse is linked to the feature class by the NHD HUC number.

Domain: **HorizontalAccuracy**



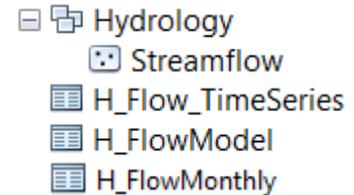
4.4.5.1 Table A_WaterUse: Links and Methods

A_WaterUse - This data table includes details on consumptive water use by type in acre-feet. It links to the **WaterUse_HUC** feature class by NHD HUC_Number. Sources are derived from WWDC River Basin Plans and SEO data.

Domain: **YearType**

4.5 Hydrology Feature Dataset

The hydrology feature dataset is intended to represent stream gauges and modeled streamflow nodes within the Streamflow feature class and streamflow statistics and flow time series data in associated tables. This is critical for the development of Watershed Studies, River Basin Plans, Instream Flow Studies and Reservoir projects.

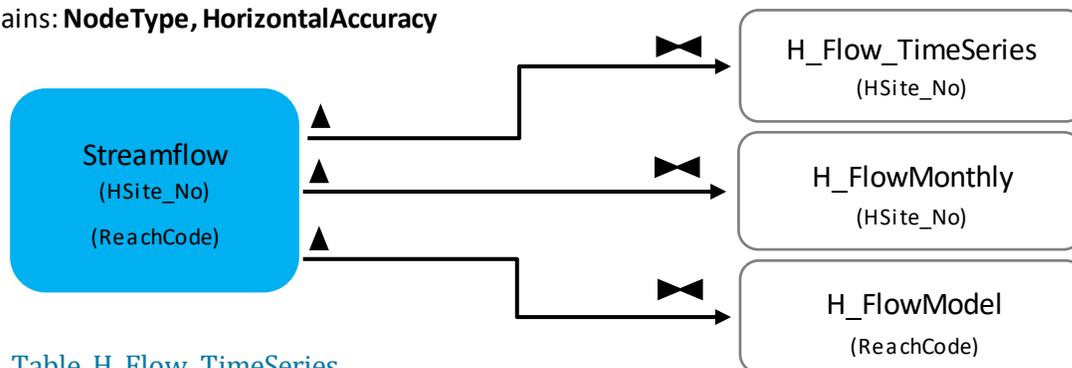


Dataset Usage: This feature dataset should be used in studies with estimated flow mapping, projects with temporary gauges installed and water modeling projects. The end user will be able to query and compare the data by having both the modeled and monitored flow data linked to the same physical location with GIS. This data will assist in calibrating the model as well as provide the end user with data for further analysis. Streamflow locations should be snapped to the National Hydrography Dataset (NHD flowline) and boundary calculations should utilize HUC boundaries and codes.

4.5.1 Feature Class Streamflow: Links and Methods

Streamflow – Physical location of node or gauge. Both the HSite_No and ReachCode fields are unique IDs used to link this feature class to the data tables. HSite_No can be a stream gauge number or a project-specific value and links to the data tables H_Flow_TimeSeries and H_FlowMonthly. ReachCode is derived from the NHD stream segment in which the stream gauge or node is located and links to the data table H_FlowModel. In each table, the units field indicates whether the values are volumes (e.g., acre-feet) or flow rates (e.g., cubic-feet per second), a percentage of the average monthly or annual flow or some other unit depending on the project. The statistic field is used to indicate whether the monthly and annual values are mean, median or some other summary statistic.

Domains: **NodeType, HorizontalAccuracy**



4.5.1.1 Table H_Flow_TimeSeries

Table H_Flow_TimeSeries - Data table containing time series data collected for the study and/or real-time streamflow data. Links to Streamflow feature class by HSite_No.

Domain: **Units**

4.5.1.2 Table H_FlowMonthly

Table H_FlowMonthly – Data table containing summary values of streamflow or runoff volume by month, year and during the runoff period for one year out of the period of record. Links to a Streamflow feature class by HSite_No.

Domains: **YearType, Units**

4.5.1.3 Table H_FlowModel

Table H_FlowModel – Data table containing monthly and annual summary values for dry, normal and wet years for each stream gauge or modeled streamflow node. Links to Streamflow feature class by ReachCode.

Domains: **NodeType, Units**

Methods: Aquarius (SEOflow), State Engineer’s Office (SEO) Annual Hydrographer Reports

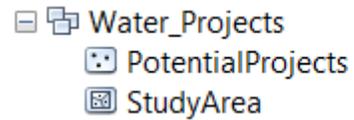
Aquarius is the real-time streamflow data provider for the SEO (seoflow.wyo.gov). Data can be viewed and downloaded for each stream gauge, one at a time, within a project area. It is important to note that there may be multiple points, each of a different data type, for a single stream gauge location which makes it difficult to view and select all of the relevant points using the mapping interface and ensure comprehensive data coverage. It is recommended to contact the SEO for a comprehensive Excel spreadsheet of stream gauges and data types within the project area. Though WWDC is mostly concerned with discharge values, there may be other data needs for a given project. If multiple data types are downloaded and used for the project, each dataset must be associated with a feature having a unique identifier in the HSite_No and ReachCode fields of the Streamflow feature class. The statistic and units attribute fields in each table will distinguish the various data types.

Formatting will be required for each downloaded dataset to fit the data into the H_Flow_TimeSeries table and link it to the Streamflow feature class. The gauge identification number will be the HSite_No value in the table and be included with each timestamp and measured value in the table. There is an attribute field in the table for comments, as needed, along with the required Contract_ID, Contractor, and Creation_Edit_Date and fields which are particularly important for being able to trace back to the report describing details on temporary stream gauge data collection.

Note: Discharge datasets may have overlapping dates and different timestamp styles (daily or hourly) when downloaded from Aquarius. Review downloaded data carefully before populating tables in the geodatabase templates to avoid repeated or dissimilar data.

4.6 Water Projects Feature Dataset

The Water Projects feature dataset includes the study area boundary and each potential project associated with a study. The potential projects feature class includes attributes about projects that are recommended to develop additional water resources.



Dataset Usage: The Water Projects feature dataset allows users to query the locations of potential projects identified in a particular study area. The end user will also be able to query the information to identify how much funding is needed to complete the potential projects.

4.6.1 Feature Class StudyArea: Links and Methods

StudyArea – The study area boundary is required for each WWDC funded project. Study areas can be as large as river basins or as small as irrigation district boundaries or the boundaries of a municipality.

4.6.2 Feature Class PotentialProjects: Links and Methods

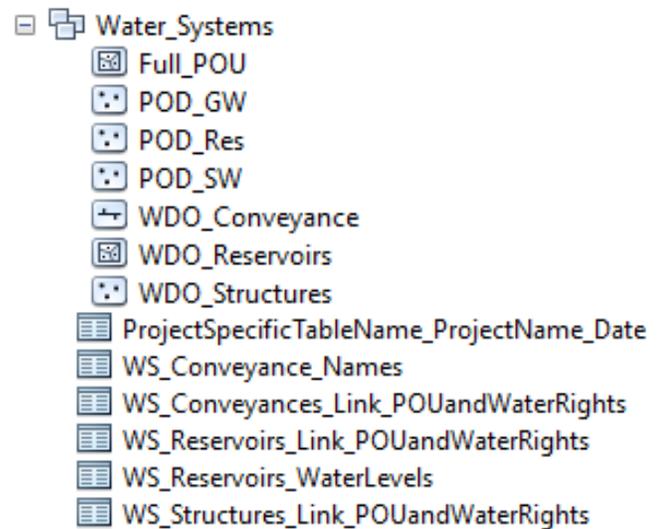
PotentialProjects – This feature class contains potential projects developed as a result of Level I and/or Level II studies. An entire project can be represented by a single point. Project features that are lines or polygons must be converted to point features using the beginning point of lines and centroid of polygons for inclusion in this feature class. The original line and polygon feature classes should be provided separately.

Domains: **PrjType, DevelopmentType, HorizontalAccuracy**

4.7 Water System Feature Dataset

Water system infrastructure is very important to the mission of WWDC and its project sponsors. Water infrastructure location, condition and size is critical to understanding how water is distributed across the landscape.

Dataset Usage: This feature dataset allows for spatial representation of diversions, wells, pipelines, water tanks, reservoirs, etc. The mapped locations within this dataset can be linked to tables with data on structural materials, efficiencies, current conditions and other data needed in the analysis of these systems. This data contains permitted water right information extracted from the SEO e-Permit system. Spatially representing this information will allow the end user to assess the permitted water rights and reference data based on areas of interest.



Because of the complexity of mapping data extracted from the e-Permit database on a large scale, including the range of different permit types for each of the feature classes in this feature dataset, different levels, or 'depths' of detail have been identified for preparation of GIS deliverables in the Water System Feature Dataset for different projects. The depth, ranging from I-III, indicates the amount of detail required for the subset of extracted e-Permit data to be mapped and also the requirements for treating individual features within the feature class. Higher level depths will require more effort to map and track the features.

Any questions on the detail or completeness of the depth should be discussed with the WWDO project manager.

e-Permit

The SEO maintains the e-Permit online water rights database, which is used to find the permitted water use and the location of infrastructure throughout the state. WWDC consultants often map out the water rights to understand sources of water, where water is used and how much is potentially used. Permit conversion tools (Section 3.2) were created to facilitate the process of creating feature classes from e-Permit downloaded data.

Depth I Mapping Detail

At Depth I mapping detail, each record from e-Permit is associated with a point or polygon on a map. Depth I mapping of feature classes results in multiple, overlapping records, each for a separate water right permit for the same structure (e.g., diversion), reservoir or conveyance. Depth II mapping detail consolidates the multiple permits associated with a single feature by linking the feature to a table that contains the water right permit information. For the points of diversion (POD) and points of use (POU) feature classes, each record has a single water right permit associated with it and these two feature classes are not mapped at a Depth II mapping level. For the other feature classes in the Water Systems feature dataset (structures, reservoirs and conveyances) there are often multiple water right permits associated with individual features and these may be mapped at a Depth II detail.

A second feature of Depth I mapping is, depending on the scope of services in the WWDC contract, the dataset may be limited to only one feature type or minimum diversion quantity (e.g., water rights >1.0 cfs). A third component of Depth I mapping is that it requires minimal data manipulation from the e-Permit download relative to Depth II and III detail. Depth I mapping detail requires only basic data clean up (removal of expired, missing or known erroneous data). The locations of points in Depth I mapping should be viewed with some caution because this process is automated and does not include extensive review of the location accuracy of the output; often the coordinates are based on the centroid of a section or quarter section. The main advantage of this approach is to link directly to POU data without going through a linking table. This can be very helpful for a sponsor that just wants to click on a point and see all the lands that receive water from it.

Depth I Feature Classes

- **POD** – This dataset represents the Points of Diversion; each record will have a water right and associated permit information included.
- **POU** – This dataset represents the generalized water right Points of Use created from the Wyoming State Engineer's Office e-Permit database; each record will have a water right and associated permit information included.
- **Structures** – This dataset represents diversions, wells, meters, spillways, water storage tanks, etc.; each water right associated with a structure will have a separate record at Depth I mapping detail.
- **Reservoirs** – This dataset represents raw water storage greater than 100 acre-feet of capacity; each water right associated with a reservoir will have a separate record at Depth I mapping detail.
- **Conveyance** – This dataset represents facilities designed to transport water from its source to the point of use and within the distribution system, where applicable; each water right associated with a conveyance feature will have a separate record at Depth I mapping detail.

Depth II Mapping Detail

At Depth II mapping detail, records for multiple water right permits associated with individual structures, reservoirs and conveyances in Depth I mapping detail are consolidated to become one record in the feature class with details for each water right stored in a separate table. These individual features are linked to this water rights table with and to the POU feature class using unique ID values and linking tables. Each feature class (structures, reservoirs and conveyances) can also be linked to project-specific tables containing additional attribute data such as ground conditions, photos, etc. The benefit of this consolidation is to allow for associated data to be queried and summarized for individual diversion structures and reservoir locations. Reviewing a single diversion allows users to see all of the permits that are attached to it including the number of permits, total permitted diversion amounts for that location and all of the points of use locations for that single diversion. Depth II mapping is necessary to facilitate river basin modeling and an important component of development of the decision support system.

Depth II Feature Classes

- **Structures** – This dataset represents diversions, wells, meters, spillways, water storage tanks, etc.; each structure will be linked to all water rights associated with it via a linking table to the water rights table and can also be linked to the POU feature class.

- **Reservoirs** – This dataset represents raw water storage greater than 100 acre-feet of capacity; each reservoir will be linked to all water rights associated with it via a linking table to the water rights table and can also be linked to the POU feature class.
- **Conveyance** – This dataset represents facilities designed to transport water from its source to the point of use and within the distribution system, where applicable; each conveyance will be linked to all water rights associated with it via a linking table to the water rights table and can also be linked to the POU feature class.

Methods: Linking Table Creation

Linking tables allow for a single feature to be linked to many records, such as water rights and points of use and are required in Depth II mapping. Linking tables need to be reviewed carefully when existing data are used due to additions, deletions and other changes to the water right permits.

All WWDC linking tables contain a similar set of four fields. Two of the four fields are from the feature class and the other two fields are from the water right. The feature class fields are the unique ID of the feature and the primary name used for the feature. The water right fields are the water right permit, CR or OR number and the supplied name from the water right for the feature. The names are used to verify the link. Because features in e-Permit often have multiple names, differences in names don't necessarily indicate an error; however, any differences can be used to flag records that need additional review. Further, the linking tables are related to the water right via its WR_Number.

Depth III Mapping Detail

Depth III mapping detail is characterized by an increased focus on accuracy of the spatial location of each feature. Depth III mapping is important for the POU feature class and requires a review of SEO mylar ditch and petition maps. Depth III mapping also requires that irrigated lands and service areas be linked to the diversions supplying water to the irrigation systems as well as relevant water right permit information. Diversion locations must be at least mapping grade GPS accuracy for Depth III mapping detail. Diversion type, efficiency, model and construction details are also required.

4.7.1 Feature Class: POD_[SW, GW, Res]: Links and Methods

POD_[GW, SW, Res] – These datasets represent the points of diversion feature classes; there is a separate feature class for groundwater, surface water and reservoir points of diversion. Each record in the e-Permit water rights database has a point on a map including multiple points for separate water rights associated with a single diversion location. These feature classes include many attributes (see Water Development Geodatabase Diagram V3 - 2020); most of which are retained from the e-Permit download. The POD feature classes can be linked to the POU feature class using the WR_Number field. **This feature class will require frequent updating and will always be incomplete; up-to-date, comprehensive water rights information is only available through researching the water rights on file with the State Engineer's Office and Board of Control.**



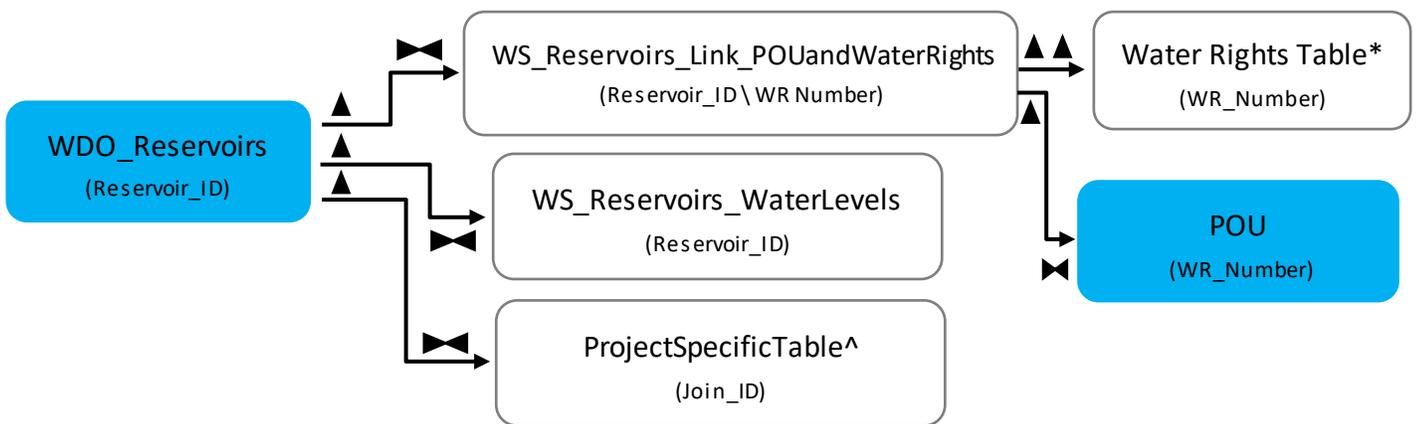
4.7.2 Feature Class: Full_POU: Links and Methods

Full_POU – This dataset represents the water right points of use created from data downloads from the State Engineer's Office e-Permit database. It is generated by using the permit conversion tools (Section 3.2 and Appendix C) but output from the tool needs to be investigated to clean up duplicate adjudicated permit records and unmapped or mislocated records. Water right information is generalized to the PLSS, specifically a section, quarter or quarter-quarter depending on the information from the e-Permit records. The boundaries for these features come from the BLM's Cadastral National Spatial Data Infrastructure (CADNSDI) publication data set for a rectangular and non-rectangular PLSS dataset. It is important to note the water right may apply to only a portion of the section, quarter or quarter-quarter to which it is mapped. **This feature class will require frequent updating and will always be incomplete; up-to-date, comprehensive water rights information is only available through researching the water rights on file with the State Engineer's Office and Board of Control.**

4.7.3 Feature Class WDO_Reservoirs: Links and Methods

WDO_Reservoirs (not including stock water tanks) – This dataset contains existing conditions of open water storage. This dataset includes attributes from the NHD waterbodies layer with additional attributes retained from e-Permit. This feature class is linked to the WS_Reservoirs_Link_POUandWaterRights table using the Reservoir_ID field and this can be linked to the Water Rights Table to provide additional information for those water rights that are associated with the reservoir feature.

Domains: **StorageType, Condition (Alias=ReservoirCondition), HorizontalAccuracy**



*Not included in the geodatabase templates. The table is generated through the e-Permit conversion tool described in Section 3.2 and Appendix C.

^ The project-specific table should be customized for a project; fields that are not part of the core dataset are added to this table as needed. Examples include photo links, historical information, field observations, etc.

4.7.3.1 Linking Table WS_Reservoirs_Link_POUandWaterRights: Links and Methods

WS_Reservoirs_link_POUandWaterRights – This linking table connects a single reservoir feature to its associated water right permits. Reservoir_ID is the linking field to the feature class WDO_Reservoirs. Reservoir_ID is a unique ID that is found in NHD Waterbodies or created at time of feature creation. This table can then be linked to a Water Rights Table to provide more detailed information about individual water rights or it can be linked to the POU feature class.

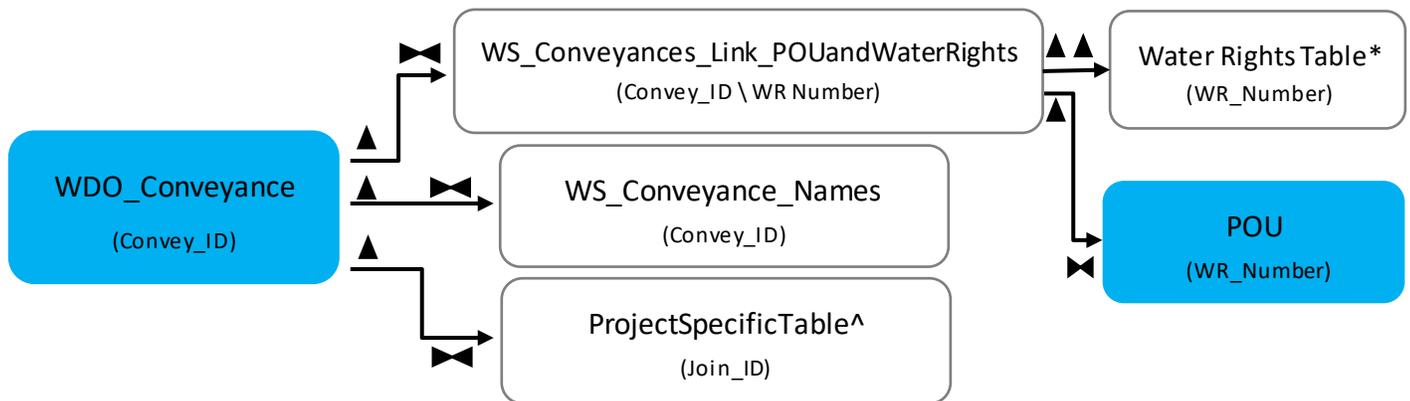
4.7.3.2 Table WS_Reservoirs_WaterLevels

WS_Reservoirs_WaterLevels – This data table contains water levels in a reservoir for the months March-October and is linked the WDO_Reservoirs feature class using the Reservoir_ID field.

4.7.4 Feature Class WDO_Conveyance: Links and Methods

WDO_Conveyance - Conveyances represent facilities, such as canals, ditches, pipelines and natural channels designed to transport water from its source to the point of use and within the distribution system, where applicable. GIS features can be digitized from imagery, mapped in the field using GPS, found in municipal “as-built” plans or found on permit maps in the State Engineer’s Office. The horizontal accuracy attribute should be populated to reflect this detail. *See Appendix D for Convey_ID field creation details.*

Domains: **Condition (Alias=ConveyanceCondition), FacilityType, HorizontalAccuracy, Seepage**



*Not included in the geodatabase templates. The table is generated through the e-Permit conversion tool described in Section 3.2 and Appendix C.

^ The project-specific table should be customized for a project; fields that are not part of the core dataset are added to this table as needed. Examples include photo links, historical information, field observations, etc.

4.7.4.1 Linking Table WS_Conveyances_Link_POUandWaterRights: Links and Methods

WS_Conveyances_link_POUandWaterRights – This linking table connects a single conveyance feature to its associated water right permits. Convey_ID is the linking field to the feature class WDO_Conveyance. Convey_ID is a unique ID that is created at time of feature creation (see Appendix D for details). This table can then be linked to a Water Rights Table to provide more detailed information about individual water rights or it can be linked to the POU feature class.

4.7.4.2 Table WS_Conveyance_Names: Links and Methods

WS_Conveyance_Names – The SEO e-Permit database often includes multiple names for individual conveyances or names that differ from maps or other data sources (e.g. different spelling); therefore, this table is used to capture any additional or associated names for WDO_Conveyance features. This table connects to the feature class using the unique ID Convey_ID.

Methods: Conveyance Feature Class Creation

One of the major datasets within the water systems is the conveyances, which includes irrigation ditches, canals, natural water courses, and pipelines. A conveyance can be any feature that transports water to a location from a water source. In addition to reviewing data from previous WWDC projects, conveyance system features may also be found in the NHD, the SEO's linen plats, as-built plans, and water right permit maps. All of these sources should be used in conjunction with the latest aerial photos to map and attribute conveyances.

The SEO's linen plats are scanned (<https://sites.google.com/a/wyo.gov/seo/documents-data/linenplats>) but not horizontally accurate and can contain ditches that were permitted but never built. However, they are good for assisting with naming features that are observable with aerial photos. The plats are organized by township and range. The first page of each township plat includes a general ditch map followed by a plat with surface water rights and finally a plat with groundwater rights.

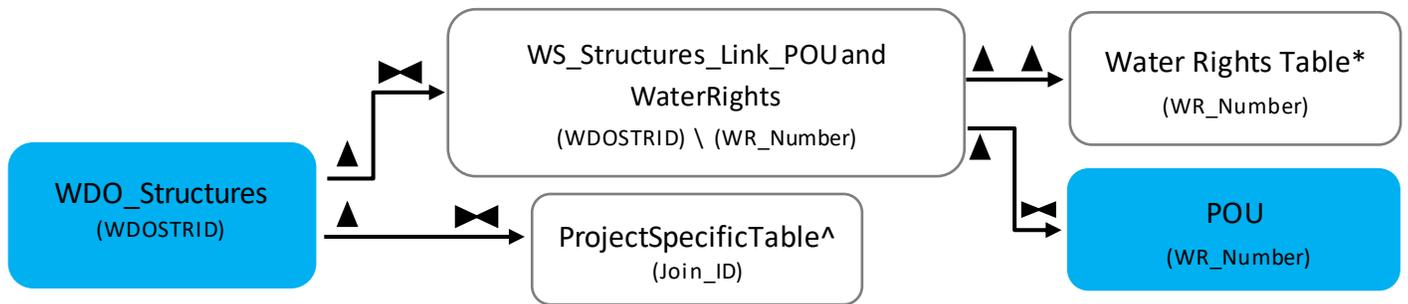
The most accurate source of conveyance mapping is the surveyed ditch maps available from the State Engineer's Office Surface Water Division and petition maps from the Board of Control. These maps are often available digitally but need to be georeferenced and features mapped into the GIS in order to be used.

4.7.5 Feature Class WDO_Structures: Links and Methods

WDO_Structures – This dataset includes water infrastructure point features that are part of irrigation, reservoir and drinking water systems. Features include diversions, wells, meters, spillways, water storage tanks and other important structures as determined by the WWDC and project sponsors.

The WDOSTRID is a unique ID in the WDO_Structures feature class that is used to link to SEO water rights and POU features through the linking table WS_Structures_link_POUandWaterRights. WDOSTRID is also used to link to project specific data tables. See Appendix D for **WDOSTRID** field creation details.

Domains: **Condition (Alias=StructureCondition) StructureType, HorizontalAccuracy**



*Not included in the geodatabase templates. The table is generated through the e-Permit conversion tool described in Section 3.2 and Appendix C.

^ The project-specific table should be customized for a project; fields that are not part of the core dataset are added to this table as needed. Examples include photo links, historical information, field observations, etc.

4.7.5.1 Linking Table *WS_Structures_Link_POUandWaterRights*: Links and Methods

WS_Structures_link_POUandWaterRights – This linking table connects a single structure to its associated water right permits. WDOSTRID is the linking field to the feature class WDO_Structures. This table can then be linked to a Water Rights Table to provide more detailed information about individual water rights or it can be linked to the POU feature class.

Appendices

[Appendix A. Domain Values and Descriptions](#)

[Appendix B: e-Permit Water Rights Search Guidelines provided by State Engineer's Office \(2017\)](#)

[Appendix C. Use of POU and POD e-Permit Conversion Tools](#)

[Appendix D. Unique ID \(WDOSTRID and Convey ID\) Creation](#)

[Appendix E. References](#)

Appendix A. Domain Values and Descriptions

Description and codes as of March 22, 2021. For a full understanding of the geodatabase and all its relationships, see the Water Development Geodatabase Diagram V.3 (2020) at <https://water.geospatialhub.org/pages/wwdc-gis-standards>

AssesType - Domain

DomainName	AssesType
Description	Method of assessment used for Rosgen channel type
FieldType	String
Domain Type	CodedValue

Code	Name
A	Field assessed
B	LiDAR
C	Aerial photos
D	Other (explained in comments)

ChannelMaterials - Domain

DomainName	ChannelMaterials
Description	Dominant substrate materials using Rosgen classification
FieldType	String
Domain Type	CodedValue

Code	Name
1	Bedrock
2	Boulders
3	Cobble
4	Gravel
5	Sand
6	Silt/clay

Condition - Domain

DomainName	Condition
Description	Existing state of repair or development
FieldType	String
Domain Type	CodedValue
Alias(es)	StructureCondition, ReservoirCondition, ConveyanceCondition

Code	Name
Exists	Existing, functional feature
Unknown	Status not known
Disrepair	Used but in need of work
Unusable	Built but not in use
Abandoned	No longer in use

DevelopmentType - Domain

DomainName	DevelopmentType
Description	Development Type - new water supply or rehabilitation or both
FieldType	String
Domain Type	CodedValue

Code	Name
1	New supply
2	Rehabilitation
3	New supply and rehab

FacilityType - Domain

DomainName	FacilityType
Description	Water facility type
FieldType	String
Domain Type	CodedValue

Code	Name
P	Pipeline
O	Open ditch/canal
OL	Open lateral
PL	Pipe lateral
N	Natural watercourse

FuncStatus - Domain

DomainName	FuncStatus
Description	Current condition of facility to supply water
FieldType	String
Domain Type	CodedValue

Code	Name
NF	Non-functional
F	Functional
Eph	Ephemeral or intermittent
Potn	Potential
Unk	Unknown

HorizontalAccuracy - Domain

DomainName	HorizontalAccuracy
Description	Horizontal accuracy of data
FieldType	String
Domain Type	CodedValue

Code	Name
GPS1	GPS Survey Grade: Accuracy typically <1 inch
GPS2	GPS Differential Grade (sub-meter units): Accuracy typically <1 meter
GPS3	GPS Commercial/Recreation Grade: Accuracy typically >15 feet
DIGA1	Digitized from Aerial - <6-inch resolution: Accuracy <12 inch
DIGA2	Digitized from Aerial - 6 inch to 1-meter resolution: Accuracy 12 inches to 2 meters
DIGA3	Digitized from Aerial - >1-meter resolution: Accuracy >2 meters
DIGT	Digitized from Topo: Accuracy +/- 40 feet (USGS 24k series)
SEC	PLSS Section: Accuracy 640 acres
QTR	PLSS Quarter: Accuracy 160 acres
QTR2	PLSS Quarter-Quarter: Accuracy 40 acres
QTR4	PLSS Quarter-Quarter-Quarter-Quarter: Accuracy 10 acres
HIS	Historical Drawing: Accuracy Not Applicable
UNK	Unknown

IrrMethod - Domain

DomainName IrrMethod
Description Method used for irrigation
FieldType String
Domain Type CodedValue

Code	Name
FL	Flood
P	Pivot
O	Other
M	Multiple irrigation methods
UK	Unknown

IrrStatus - Domain

DomainName IrrStatus
Description Irrigation use at time of assessment
FieldType String
Domain Type CodedValue

Code	Name
A	Full service irrigation
B	Partial service irrigation
C	Incidental irrigation or sub-irrigation
E	Idle irrigation
H	Minor beneficial irrigation
AB	Full and partial mix of irrigation

NodeType - Domain

DomainName	NodeType
Description	Streamflow or runoff feature type
FieldType	String
Domain Type	CodedValue

Code	Name
G	Gauge
D	Diversion
TR	Tributary inflow
O	Other node
WS	Watershed estimate of runoff

PrjType - Domain

DomainName	PrjType
Description	Type of potential project water project as defined by Water Development Office
FieldType	String
Domain Type	CodedValue

Code	Name
1	Dam/Spillway
2	Reservoir
3	Groundwater Wells
4	Roads/Culverts/Bridges (Describe in comments)
5	Transmission Pipelines
6	Water Storage Tanks
7	Pump Stations
8	Disinfection Facilities
9	SCADA System
10	Pump
11	Municipal Meters/Valves/Hydrants (Describe in comments)
12	Electrical Power
13	Water Treatment Facilities
14	Wastewater Projects
15	Intake/Diversion (Municipal or Irrigation)
16	Canal/Ditch New or Repair
17	Canal/Ditch Lining

18	Canal/Ditch Piping
19	Irrigation Headgates/Turnouts
20	Irrigation Metering
21	Spring Development
22	Wetland Development
23	Solar Platforms
24	Windmills
25	Center pivots
26	Stock water trough
27	Fencing
28	Hydropower Projects
29	Fish Passage
30	Recreation
31	Environmental Enhancement
32	Flood Control
33	Erosion Control
34	Multiple benefits (Describe in Comments)
35	Other (Describe in Comments)

RiparianVeg - Domain

DomainName RiparianVeg
Description Riparian vegetation condition
FieldType String
Domain Type CodedValue
Alias(es) RiparianLeftBnk, RiparianRightBank

Code	Name
NA	Not applicable
B	Bare ground
G	Grasses
Low	Little riparian vegetation <10%
Partial	Partial riparian vegetation
Full	Significant riparian vegetation > 70%

RosgLevel - Domain

DomainName	RosgLevel
Description	Describes Rosgen classification level I-IV
FieldType	String
Domain Type	CodedValue

Code	Name
I	Level 1 classification
II	Level 2 classification
III	Level 3 classification
IV	Level 4 classification

RosgType - Domain

DomainName	RosgType
Description	Rosgen channel type
FieldType	String
Domain Type	CodedValue

Code	Name
Aa+	Very steep, deeply entrenched, debris transport, torrent streams. Entrenchment ratio <1.4; W/D ratio <12; Sinuosity 1.0-1.1; Slope >0.10.
A	Relatively steep channels that form in hadwater areas as well as within bedrock canyons. Entrenchment ratio <1.4; W/D ratio <12; Sinuosity 1.0-1.2; Slope 0.04-0.10.
B	Tend to form downstream of headwater channels, in areas of moderate slope, moderate entrenchment, and stable channel boundaries. Entrenchment ratio <1.4-2.2; W/D ratio >12; Sinuosity >1.2; Slope 0.02-0.039.
C	Characterized by relatively low slopes, meandering planforms, and pool/riffle sequences. Channels tend to occur in broad alluvial valleys; typically associated with broad floodplain areas. Entrenchment ratio >2.2; W/D ratio >12; Sinuosity >1.2; Slope <0.02.
D	Braided Channels have longitudinal and transverse bars. Very wide channel with eroding banks. Slope <0.04; W/D ratio >40.
DA	Anastomizing (multiple channels) narrow and deep with extensive well vegetated floodplains and associated wetlands. Entrenchment ratio >2.2; W/D ratio highly variable; Sinuosity highly variable; Slope <0.005.
E	Form as single threads with defined, accessible floodplain areas. The fine-grained, vegetation-reinforced banklines allow for the development of steep banks, very sinuous planforms, and relatively deep, U-shaped channel cross sections. Entrenchment ratio >2.2; W/D ratio <12; Sinuosity >1.5; Slope <0.02.
F	Typically have relatively low slopes (<2%), similar to C and E channel types. Entrenched, so floodplain is quite narrow relative to channel width. Entrenchment ratio <1.4; W/D ratio >12; Sinuosity >1.2; Slope <0.02.
G	Narrow, steep entrenched gullies. G-Type channels typically have high bank erosion rates and a high sediment supply. Channel degradation and sideslope rejuvenation processes are typical. Entrenchment ratio <1.4; W/D ratio <12; Sinuosity >1.2; Slope 0.02-0.039.

Seepage - Domain

DomainName Seepage
Description Observed seepage assessment
FieldType Double
Domain Type CodedValue

Code	Name
0	Not assessed
1	No evidence of channel seepage is present.
2	Some evidence of channel seepage is present. Usually indicated by presence of large trees/brush or other riparian vegetation downhill from channel. Also indicated by areas with highly alkaline soils on the surface.
3	Evidence of channel seepage is present. In addition to the aforementioned vegetation, surface water is present and visible outside the channel.

StorageType - Domain

DomainName StorageType
Description Water storage type
FieldType String
Domain Type CodedValue

Code	Name
SW	Surface water reservoir
L	Lake/pond
ASR	Aquifer storage and recovery facility
TR	Treatment reservoir

SWPP – Domain

DomainName StuctureType
Description Will project request Small Water Project funding?
FieldType Integer
Domain Type CodedValue

Code	Name
Y	Yes
N	No

StructureType - Domain

DomainName StructureType
Description Type of water infrastructure features
FieldType Integer
Domain Type CodedValue

Code	Name
1	Diversion
2	Check
3	Headgate/Turn-out
4	Weir
5	Dam
6	Culvert
7	Meter
8	Pump
9	Siphon
10	Vent
11	Undershot
12	Spillway
13	Outlet - water
14	Drop
15	Splitter
16	Well
17	Bridge
18	Water Tank
19	Valve
20	Pipe
21	Other-see comments
22	Lined
23	Fire Hydrant
24	Manhole
25	Pressure Relief Valve (PRV)

Units - Domain

DomainName Units
Description Units used in streamflow statistic
FieldType String
Domain Type CodedValue

Code	Name
AF	acre-feet
CFS	cubic feet per second
Percent	percent of average

UplandType - Domain

DomainName UplandType
Description Upland water source type
FieldType String
Domain Type CodedValue

Code	Name
WT	Well Tank
T	Tank
P/R	Pond/Reservoir
G	Guzzler
O	Other
SP	Spring

YearType - Domain

DomainName YearType
Description Year Type: Dry, Wet or Average
FieldType String
Domain Type CodedValue

Code	Name
D	Dry
W	Wet
Av	Average
No	Normal
Miss	Data Missing

Appendix B: e-Permit Water Rights Search Guidelines provided by State Engineer's Office (2017)

Section A: Brief background on water rights in Wyoming

Wyoming water law dates back to territorial days and is based on the doctrine of prior appropriation. Under this doctrine, the first person to put the water to beneficial use has the first right, meaning, "first in time is first in right." Therefore, water rights in Wyoming are regulated by priority date.

Surface water

Surface water rights are assigned a specific flow rate of water at the headgate; this is typically 1 cubic foot per second (cfs) per 70 acres of irrigated land. Permits are issued for: 1) diverting water through ditches or pipelines, 2) storage in reservoirs, 3) enlargements to existing ditch or storage facilities, 4) instream flow purposes, 5) temporary industrial water hauls, and 6) weather modification.

For surface water rights, an applicant obtains a permit from the State Engineer and then proceeds to establish the water right by applying the water to beneficial use in accordance with the terms of the permit. A proof of appropriation is submitted to the State Board of Control to initiate adjudication procedures in accordance with Wyoming statutes and state regulations.

Groundwater

Groundwater rights are assigned an instantaneous volumetric rate in gallons per minute (gpm) and an annual volumetric quantity in acre-feet (acft). Groundwater developments include (to name a few): water wells, springs for domestic and stock watering use (for 25 gpm or less), geothermal developments, certain excavations developed during mining and/or construction activities, and for coalbed methane extraction activities.

The use of groundwater is not administered in exactly the same manner as is the use of surface water. Prior to commencement of construction of a groundwater development, a permit to appropriate groundwater must be obtained from the State Engineer. Upon completion of construction, application of the water to beneficial use, and submission of proper documents, a field inspection is conducted by Groundwater personnel and a proof is presented to the State Board of Control for adjudication. Not all groundwater permits are required to be adjudicated; domestic, stock, test and temporary use permits are exempt.

Adjudications and changes

The State Board of Control is a quasi-judicial body with sole jurisdiction over adjudication, administration and amendments of water rights in Wyoming. The adjudication procedure involves a field inspection of the water right to ensure that the water is being put to a beneficial use as specified under the permit. Amendments or corrections of unadjudicated permits are generally accomplished by petition to the State Engineer. For more information about Board of Control documentation associated with the status of a water right, see [Section C](#).

Section B: Water right data sources

Bulk SEO permit data can be downloaded electronically from three sources: Tab Books, e-Permit and scanned linen plat maps.

Tab Books

Tab Books are a tabulated catalog of adjudicated surface and groundwater rights (and unadjudicated stock reservoirs) organized by SEO Division. Surface water rights are shown under the heading of the stream from which a diversion is made (according to the best information available). Groundwater rights are organized by SEO District and county.

e-Permit

Water right data can also be obtained online via the SEO's web-based e-Permit database (<http://seoweb.wyo.gov/e-Permit/Common/Login.aspx>). This relational database of existing permits displays information based on filter search parameters that can display data affiliated with a permit's Point of Diversion (POD) and data affiliated with a permit's Point of Use (POU).

Linen Plats

Information from linen plats represent indexed adjudicated water rights that may be useful for general reference of ditch names and locations. These maps are organized by township and show adjudicated records and permitted irrigation acreages by section. The first page of each Township map includes a general ditch map followed by surface water rights and finally groundwater rights. Scanned copies are available on the SEO website (<https://sites.google.com/a/wyo.gov/seo/documents-data/linenplats>). It is important to note that these scans should be considered provisional data products and subject to revision because they are continuously updated as new adjudications occur.

Section C: Water right nomenclature

Documentation

See [Section F](#) for discussion about how to interpret key data fields associated with this documentation for large-scale data analysis.

- Permit number = The unique identifier assigned to a water right.
- Certificate of Appropriation (CR) = The official Board of Control document which provides all pertinent adjudication information for a water right.
- Order Record (OR) = These Board of Control documents are created for new adjudications and petition actions that seek to change or amend an adjudicated water right. ORs are not available on e-Permit at this time (although a few are used when no CR is available to attach other Board of Control documents).
- Amended Certificate = These are certificates issued on an order record precipitated by a petition to amend or replace an original CR. They are also issued for appropriations and court decrees that were

never issued an original certificate. e-Permit searches performed for proof documents will direct users to the CR or OR, not to the proof document itself.

- **Proof**= Documents used to verify the beneficial use of water within the terms of the permit as part of the adjudication process.

Status

Water right status is important for large-scale data analysis because some inactive records may need to be removed from a dataset (e.g. – canceled permits) and/or some data may need to be reconciled to remove duplication. While point of diversion (POD) status will generally be the same as point of use (POU) status in an e-Permit data download, there are several important distinctions to note that are discussed in this section.

Point of Diversion (POD) status

Status descriptions for water right data in an e-Permit POD data download are described below. POD records with a status that generally should be removed from a dataset are marked below with an asterisk "*" (see [Section E](#) for discussion about data sorting).

- **Fully Adjudicated** = A determination by the SEO Board of Control that water has been and is being beneficially applied to the land to the extent and means set out in the permit. The adjudication process culminates in the issuance of a Certificate of Appropriation (reflected as a Certificate Record (CR)). See [Section D](#) for how to interpret certificate record data fields.
- **Partially adjudicated** = A portion of the water right under a permit has been put to beneficial use and verified through the adjudication process. This applies to surface water permits only.
- **Complete** = All permit documentation has been submitted and processed by the SEO; this usually represents a current permit. This does *not* necessarily represent a permit that has been adjudicated.
- **Incomplete** = A permit has been issued but the permit has not been adjudicated. A water right is considered incomplete until all required notices are received in an acceptable form.
- **Unadjudicated** = This status is only used for groundwater permits where adjudication is required (domestic and stock are exempt) and for which all documentation has been received pending a field inspection.
- **Abandoned*** = An adjudicated permit for surface water or groundwater that has either 1) not been used for five successive years (when water is available to satisfy the right) and has been submitted and verified through the statutory procedure to be declared abandoned, or 2) the water right holder has requested abandonment of the water right. This status will only be seen on a record associated with a Certificate Record and not on a permit record, except on a well permit.
- **Canceled*** = A permit that has been canceled prior to adjudication.
- **Expired*** = A permit that has exceeded the time limit for completion therefore active status has been revoked. (These types of permits may be reinstated through a specific SEO process).

Point of Use (POU) status

There are some differences in the meaning of a water right's status under a POU dataset. The information can be found under the column header "POUStatus" in the POU dataset. Adjudicated POU records will be listed as "Adjudicated" (as opposed to "fully adjudicated" in a POD download). Differences also apply to expired,

eliminated and abandoned water right statuses associated with POU records. As such, these records should be removed from a POU dataset:

- Abandoned – This represents a *portion* of a permit that has been abandoned and confirmed through statutory requirements under Board of Control abandonment procedures.
- Expired – Some records correspond with permits that have been partially adjudicated (see discussion on irrigated acreage in [Section G](#)).
- Eliminated – This represents a *portion* of a permit that has been eliminated through a Board of Control action.

Supply type

- Original supply = The first water supply for an irrigation water right. In most cases, surface water original supply is limited by statute to 1 cfs per 70 acres at any given time; groundwater supply is limited to what the well can produce.
- Secondary supply = Surface water stored in a reservoir with documentation that attaches a reservoir permit to specific lands. Records for this supply type receive the same priority date of the reservoir to which it is attached.
- Supplemental supply = Surface water applied to lands for which a surface water appropriation already exists. The total amount of water under both the original and supplemental supply shall not exceed 1 cfs per 70 acres at any given time.
- Additional supply = Groundwater applied to lands for which an original groundwater and/or surface water appropriation already exists. Additional supply only applies to water rights with irrigation as a beneficial use.

Territorial water rights

Another special category of water rights to consider are territorial water rights. Prior to statehood in 1890, a water right could be established by a procedure predicated on the use of water and the filing of a claim with territorial officials. Water rights with priority dates before 1890 are termed “territorial” water rights.

The water right numbers displayed in e-Permit for a territorial water right actually represent its proof number because permits were not issued prior to statehood. Additionally, territorial water rights are located based on Township/Range/Section (PLSS) information only (i.e. - not with latitude/longitude coordinates) unless the certificate was part of a Board of Control petition. Typically, there is only a map to represent the POD or POU when there has been a petition involving these water rights.

Section D: Overview of e-Permit data fields

The following attributes are key features that are important for large-scale data analysis. Detailed e-Permit water right search instructions can be found on the SEO website (<http://seo.wyo.gov/regulations-instructions>). Note that POD and POU datasets provide information that represent different attributes of a water right; each requires a slightly different search method as described in [Section E](#).

Excel column headers

The e-Permit datasets are downloaded into an Excel file. The attributes of primary concern for large -scale data analysis are:

- Permit Number = Listed under “WR Number” column
- Certificate or Order Record Number = Listed under “WR Number” column
- Point of Diversion = Coordinates captured in the “Latitude” and “Longitude” columns; PLSS also available under “Township/Range/Section/QQ” columns from a point of diversion dataset download.
 - For older groundwater permits, latitude and longitude were automatically generated by the e-Permit system and represent the centroid of the Quarter-Quarter.
 - For all groundwater permits granted on or after April 1, 2006, GPS coordinates are required.
- Point of Use = PLSS available under “PLSS” and “Township/Range/Section/QQ” columns; available only through a POU data download.
- Facility Name = Listed under “FacilityName”
- Permitted beneficial use = Listed under “Uses” column
- Appropriation = Listed under “Appropriation” column
 - For permits with uses other than irrigation, units are cfs (surface water) or gpm (groundwater).
 - For reservoir storage permits, units are in acre-feet (AF).
- Acreage = Listed under “Acres” column for irrigation water rights regardless of source type.
- Supply type = Listed under “SupplyType” column
- Capacity = Listed under “Total Capacity (AF/Yr)” and represents the total permitted capacity for a reservoir supply permit; available only through a POD data download.
 - It is best to disregard “Active/Inactive Capacity (AF)” or “Size of Reservoir (AF).” An explanation of these capacities can be found by consulting the scanned permit.

e-Permit syntax

The most common categories that are important for large-scale data analysis are listed below:

- Permit Prefixes (i.e.- X[permit number].#X)
 - P = Permit
 - T = Territorial water right
 - C = Court awarded water right
 - Y = Federal award (includes federal reserved water rights)
 - CR = Certificate Record
 - OR = Order Record
- Permit Suffixes (i.e.- X[permit number].#X)
 - D = Ditch
 - E = Enlargement
 - R = Reservoir
 - S = Stock Reservoir
 - F = Instream Flow
 - W = Well Permit

- - = Unknown (usually with territorial water rights)
- P = Stock or domestic groundwater well with a priority date prior to May 24, 1969
- G = Well Registration
- C = Well Statement of Claim
- Certificate Records
 - “CR CC##/###” for ditch certificates
 - “CR CR##/###” for reservoir certificates
 - “CR [CA or CB]##/###” for other surface water permits, typically with territorial water rights
 - CR UW##/### for groundwater well certificates
- Beneficial Uses
 - A guide to e-Permit syntax is available for reference on the SEO website under the “Home” dropdown menu (<http://seo.wyo.gov/home>).

Section E: How to download large-scale water rights data

There are two approaches to downloading large quantities of water rights data. The first approach is using the Excel-formatted SEO Tabulation of Adjudicated Water Rights (“Tab Book”) data from e-Permit. The second approach is a full download of all water rights (regardless of status) from e-Permit.

Electronic Tab Book data

When logged into e-Permit, go to the “Reports” tab and select Board of Control under the “Type” drop-down menu.

Because the Tab Book data represent adjudicated water rights, it is safe to assume that the appropriation, acreage, location of the point of diversion, and CR numbers represent accurate permit data. The CRs from this list correspond directly to a permit number on the same row (which is not readily apparent from an e-Permit data download). Below is an example of a raw data download from the Division 4 Surface Water Tab Book:

	A	B	C	D	E	F	G	H	I	J
1										
2		Tabulation of Adjudicated Water Rights of the State of Wyoming- Water Division Number IV, Surface Water June 2016								
3		Permit No.	Facility Name	Appropriator	Priority	Use	C.F.S./AF	Acre	HG LOC	Proof No. CR NO.
4		T8599.0-	MYERS IRRIGATING DITCH	MYERS LAND AND LIVESTOCK COMPANY;	05/01/1862	IRR_SW	4.000	280	014N - 119W	8599 CR CC2:
5		T8600.0-	PIPE LINE STEAM PUMP PLANT AND UNION PACIFIC RAILROAD COMPANY;		12/31/1869	IRR_SW, RAI	0.600	4.5	013N - 120W	8600 CR CC2:
6			(Point of diversion and means of conveyance changed to the Evanston Pipeline, 31-14-119, April 18, 1934. Point of diversion and means of conveyance changed to 12-13-20. P							
7		T8601.0-	BARTLETT IRRIGATING DITCH ACT CI SARAH FADDIS;		10/01/1871	IRR_SW	0.500	35	016N - 121W	8601 CR CC2:
8			(Point of diversion and means of conveyance changed from 25-16-121, to the Chapman Canal, 36-16-121, February 15, 1990.)							
9		T8602.0-	BARTLETT IRRIGATING DITCH ACT CI ENOCH TURNER J;		10/01/1871	IRR_SW	0.940	66	016N - 121W	8602 CR CC2:
10			(Point of diversion and means of conveyance changed from 25-16-121, to the Chapman Canal, 36-16-121, February 15, 1990.)							
11		T8603.0-	S. P. DITCH ACT JOHN SIMS DITCH	ROCKY MOUNTAIN COAL AND IRON COMF	12/07/1871	IRR_SW	2.280	160	015N - 120W	8603 CR CC2:
12			(Point of diversion changed to 7-15-120, April 16, 1930. Point of diversion and means of conveyances changed to the John Sims Ditch, diverting in the same section, township &							
13		T8604.0-	KNODER DITCH	MYERS LAND AND LIVE STOCK COMPANY;	12/31/1872	IRR_SW	2.780	195	013N - 120W	8604 CR CC2:
14		T8605.0-	BEAR RIVER CANAL	DAVID REES;	12/31/1874	DOM_SW, IRR_SW, STO	22.980	1609	018N - 120W	8605 CR CC2:
15			(Includes irrigation of lands in Utah.)							
16		T8608.0-	EVANSTON WATER DITCH	BEAR RIVER DEVELOPMENT COMPANY;	03/28/1875	IRR_SW	7.160	501.19	014N - 120W - 01 - SESE	CR CC2:
17			(Also 4 c.f.s. for municipal purposes for Town of Evanston. This 4 c.f.s. is evidently a duplication of the 4 c.f.s. adjudicated under Evanston Water Supply Ditch, which was origi							

Some pointers to improve efficiency when sorting Tab Book data in Excel include:

1. Sort water right records into categories of basins/tributaries of interest.
2. Combine all data for a water right into one row (i.e. create new attribute fields for description and stream source) and filter by attribute.

- Download the tabulation book in the Excel format that does not include comments for easier data management.

Data from e-Permit

At this time, the e-Permit database is limited to producing 10,000 records per query. Since basin-wide bulk data queries may result in many more than 10,000 records, the following steps outline useful parameters to follow to ensure as many records as possible are captured. Do not click “Search” until all of the following five steps are completed.

Step 1: Under “Location Parameters” tab -- Indicate the appropriate SEO Division and Districts of interest. A key to SEO Division and District boundaries can be found on the SEO’s Board of Control web page: <http://seo.wyo.gov/agency-divisions/board-of-control>. The data can also be searched by Stream Name, but since there are many duplicate stream source names throughout the state, this should only be done if a Water Division is also selected. A screenshot of what a location parameters query looks like follows:

Step 2: Under “WR Number or Facility Name” tab – After selecting location parameters, Select “Permit” under Water Right Number Type and check boxes for both “Point of Diversion or Well Details” and “Include Point of Use Details.”

Step 3: (optional): Under “Water Right Parameters”, select the Diversion Type, Water Right Status, or Primary Beneficial Use of water right.

Step 4: Click the Search button. This will produce a table showing the water right permits and how many were found.

Step 5: To generate the report click on “Export Excel” to obtain the data in Excel format. The first tab will display the point of diversion details:

WRID	CertNum	Priority	PriorityDate	Summary	Company	FirstName	LastName	FacilityName	Uses	Twn	Rng	Sec	Qtr-Qtr	Survey Ty	Total Flow	Total dep	StaticWat	Well Log	Str
869	P1007.0W	08/07/196		Cancelled		MATT & M	FAILONI	FAILONI # IRR_GW		022N	118W	29	NE1/4NE1		700				
983	P100914.0	11/13/199		Complete		DEAN J	NELSON	BLUE SPRU DOM_GW		026N	119W	22	NW1/4SE1		25	70.00			40

The second tab will display the point of use details:

WRID	CertNum	PermitNum	Priority	PriorityDate	Summary	FullName	Company	FirstName	LastName	LANDOWI	FacilityName	Uses	PLSS	POUPM	POUTNS	POURNG	POUSEC	POUQTR	PO
888		P1007.0W	08/07/196		Cancelled	MATT & I		MATT & M	FAILONI		FAILONI # IRR_GW		06 022N	06	022N	118W	33	NW	SW
888		P1007.0W	08/07/196		Cancelled	MATT & I		MATT & M	FAILONI		FAILONI # IRR_GW		06 022N	06	022N	118W	33	SW	NW

Section F: Reconciling water right data

The following section describes how to initiate data reconciliation with the following goals:

- **Step 1:** Capture the most up-to-date information for a water right;
- **Step 2:** Identify and remove duplicate records; and
- **Step 3:** Improve data analysis efficiency.

Step 1: Compare Tab Book fully adjudicated water rights with e-Permit records and remove any duplicates.

The best place to start reconciling e-Permit data is to compare Tab Book adjudicated water right information with e-Permit data. This is because if a water right has been proofed through the adjudication process, the most accurate information will be captured in the CR record (not necessarily in the permit record).

To help visualize how data are displayed differently, below is a screenshot of the data fields for two different permits from an electronic Tab Book download (in gray), a POD e-Permit download (in blue) and a POU e-Permit download (in green).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	AJ
1	TAB BOOK DOWNLOAD																	
2	Tabulation of Adjudicated Water Rights of the State of Wyoming- Water Division Number IV, Surface Water June 2016																	
3	Permit No.	Facility Name	Appropriator	Priority	Use	C.F.S/AF	Acres	HG LOC	Proof No.	CR NO.								
4	P2193.0D	LOWHAM NO. 2 DITCH	ELIZA LOWHAM;	06/19/1899	IRR_SW	0.780	55	012N - 115	8878	CR CC28/267								
5	(Adjudicated as from Branch of Mill Creek.)																	
6	P2194.0D	LOWHAM NO. 3 DITCH	ELIZA LOWHAM;	06/19/1899	IRR_SW	0.640	45	012N - 115	8879	CR CC28/268								
7	(Adjudicated as from Branch of Mill Creek.)																	
8	ePERMIT POD SEARCH RESULTS																	
9	WRPODID	WR Number	PriorityDate	PriorityText	Summary	WRStatt	Company	FirstName	LastName	FacilityNa	Uses	TwN	Rng	Sec	Qtr-Qtr	Survey	Total Flow(CFS)/ Appropriation (GPM)	
10	631722	P2193.0D	06/19/1899	06/19/1899	Fully Adjudicated			MICHAEL	LOWHAM	Lowham D	IRR_SW	012N	119W	08	NW1/4N		0.78	
11	5016059	CR CC28/267	06/19/1899	06/19/1899	Fully Adjudicated			ELIZA	LOWHAM	LOWHAM	IRR_SW	012N	119W	07	SE1/4NE A		0.78	
12	631737	P2194.0D	06/19/1899	06/19/1899	Fully Adjudicated			MICHAEL	LOWHAM	Lowham D	IRR_SW	012N	119W	06	NW1/4S		0.64	
13	5016062	CR CC28/268	06/19/1899	06/19/1899	Fully Adjudicated			ELIZA	LOWHAM	LOWHAM	IRR_SW	012N	119W	06	NW1/4S A		0.64	
14	ePERMIT POU SEARCH RESULTS																	
15	WRID	CertNum	PermitNum	PriorityDate	PriorityText	Summary	FullName	Company	FirstName	LastNam	LANDO	Faciliti	Use: PL	SS	POUPM	POUTNS	...	Acres
16	630261		P2193.0D	06/19/1899	06/19/1899	Fully Adju	MICHAEL		MICHAEL	LOWHAN		Lowh: IRR_06 012N	06		012N		20	
17	630261		P2193.0D	06/19/1899	06/19/1899	Fully Adju	MICHAEL		MICHAEL	LOWHAN		Lowh: IRR_06 012N	06		012N		5	
18	630261		P2193.0D	06/19/1899	06/19/1899	Fully Adju	MICHAEL		MICHAEL	LOWHAN		Lowh: IRR_06 012N	06		012N		25	
19	630261		P2193.0D	06/19/1899	06/19/1899	Fully Adju	MICHAEL		MICHAEL	LOWHAN		Lowh: IRR_06 012N	06		012N		5	
20	2503465	CR CC28/267	CR CC28/267	06/19/1899	06/19/1899	Fully Adju	ELIZA LC		ELIZA	LOWHAN		LOWH IRR_06 012N	06		012N		20	
21	2503465	CR CC28/267	CR CC28/267	06/19/1899	06/19/1899	Fully Adju	ELIZA LC		ELIZA	LOWHAN		LOWH IRR_06 012N	06		012N		25	
22	2503465	CR CC28/267	CR CC28/267	06/19/1899	06/19/1899	Fully Adju	ELIZA LC		ELIZA	LOWHAN		LOWH IRR_06 012N	06		012N		5	
23	2503465	CR CC28/267	CR CC28/267	06/19/1899	06/19/1899	Fully Adju	ELIZA LC		ELIZA	LOWHAN		LOWH IRR_06 012N	06		012N		5	
24	630275		P2194.0D	06/19/1899	06/19/1899	Fully Adju	MICHAEL		MICHAEL	LOWHAN		Lowh: IRR_06 012N	06		012N		35	
25	630275		P2194.0D	06/19/1899	06/19/1899	Fully Adju	MICHAEL		MICHAEL	LOWHAN		Lowh: IRR_06 012N	06		012N		10	
26	2503466	CR CC28/268	CR CC28/268	06/19/1899	06/19/1899	Fully Adju	ELIZA LC		ELIZA	LOWHAN		LOWH IRR_06 012N	06		012N		10	
27	2503466	CR CC28/268	CR CC28/268	06/19/1899	06/19/1899	Fully Adju	ELIZA LC		ELIZA	LOWHAN		LOWH IRR_06 012N	06		012N		35	

Given these differences, Tab Book permit number and CR number can be used as the first step to guide the reconciliation between permit number records and CR records. Since this will only apply to adjudicated water rights, it is best to use data from the CR rows and eliminate the corresponding permit record data. This step will remove the chances for double-counting total acreage (POU) or appropriation (POD) data. Be sure to retain permit number and capture it somewhere in the CR record. Additionally, facility names/names of the applicants may not match up word-for-word; using CR data will be the way to capture the most up-to-date information.

To do this: After downloading from e-Permit, filter out “Fully Adjudicated” in the WR Status field. From the fully adjudicated records, delete any records with a WR Number that does NOT begin with “CR” or “OR”. These permits have been adjudicated and are duplicates of the Certificate Record. If any record is fully adjudicated, the Certificate Record information supersedes the permit.

Step 2: Remove inactive permit information from the e-Permit datasets

Retain records with the following POD status:

- *Fully adjudicated* – These permit records and corresponding CRs or ORs are already accounted for using Step 1.
- *Complete*
- *Incomplete*
- *Blank* – Water right status has not been captured in e-Permit; these should be considered active.
- *Unadjudicated* – This is old nomenclature for incomplete water rights; not many of these water rights will be in the system but if encountered, they should be considered active.
- *Partially adjudicated* – These records (surface water permits only) will still need to be manually reconciled to remove duplicates. This may require using e-Permit to view the scanned permit.

Discard the following water rights with these POD statuses:

- *Cancelled* -- Note that records with this status could be reinstated; for the purposes of analysis do not include them.
- *Abandoned* – Same as above.
- *Expired* – Same as above

The data from these fields represent the information removed from an adjudicated water right; the adjudicated portion will show up under a permit with status marked as “complete” (if verified by SEO staff) or “Fully adjudicated” (if awaiting verification). Note that technically this information could be reinstated at any time but for the purposes of analysis, do not include.

Step 3: Filter remaining e-Permit data

In the e-Permit dataset, there is no easy method to match CRs/ORs with the correct permits without manual verification. Below are ideas to help with sorting data. Some additional, general pointers are discussed in the next section.

- *Additional filtering* -- Some records could match up by additional parameters (such as priority date, facility name, appropriator name, beneficial use, etc.). Filtering data to match these attributes could help find duplicate records.
- *Diversion duplication* -- The POU dataset contains a single record for each Township/Section/Division. The “Appropriation” Field duplicates the entire diversion amount for each record and should not be used for analysis.
- *Domestic and stock water permits* – Adjudication is not required by statute for permits for these types of uses; many basins have a large number of these permits, therefore a separate data analysis may be beneficial.
- *Determining changes*– If changes have occurred since the last dataset was downloaded from e-Permit, under “Water Right Parameters” select “>” in “Last Edit Date” and input the date of previous download. The search results will only return records that have been modified after the last edit date.

Section G: Other important considerations

Wyoming’s water rights system inherently presents complexities when it comes to interpreting permit information. This section describes some important considerations while reviewing water rights data. For structures with complex operations or several associated permits, or for permits with many changes or little to no available data, it may be necessary to consult with SEO technical staff.

Enlargements

- An enlargement water right must be obtained when a permitted facility is used to convey water from the same source to a new area(s) of use. Enlargements are also used to add a new use to an existing water right (not including reservoirs); groundwater permits can be enlarged for additional use types, point of use locations, volumetric quantity and flow rate.
- Enlargements will result in multiple POD e-Permit records that will overlap for the same point of diversion or well. More information on enlargement regulations is available on the SEO website: (<https://sites.google.com/a/wyo.gov/seo/applications-forms>).

Verification

- The SEO is in the process of verifying permit documentation in e-Permit for all of its surface water records and adjudicated groundwater rights. Due to the large volume of permit records on file with the SEO, not all have been through the verification process. Surface water records for ditches and all reservoirs have been verified, whereas enlargements are in process as of May 2019.
- Accordingly, the permit status indicated under the POD or POU record may vary depending on whether or not permit documentation has been verified. Generally speaking once a permit or CR is verified by SEO staff, POU data that have been eliminated or abandoned will be deleted from the dataset. Also, once a POU is adjudicated, it will be deleted from the Permit and only show up on the CR.

Facility names

- In some cases facility names may not be unique and therefore may not match a facility location.
- Additionally, these structures may have been recorded at different locations but stored under the same Facility Name, or may represent laterals off of the facility. If this occurs, it will be necessary to double check e-Permit maps and/or consult with SEO staff to reconcile.

Supply type

- *Secondary supply permits* – Since this type of permit is what ties the original reservoir supply permit to the land, the POU appropriation indicates acreage. Secondary permits are not required to include specific areas of irrigation. POU's may overlap for secondary permits if the associated acreage is also served by an original or supplemental supply permit.
- *Supplemental supply permits* – The POU will and should overlap for supplemental permits.

Water right status

- *Abandoned or cancelled permits* – Since some surface water permits may be reinstated over time, it may be of use to develop an approach and criteria for cataloguing that includes abandoned or cancelled permits in the dataset. Potential criteria may include consideration of permit date, a defined permitted acreage/water right threshold, water rights for lands without a current water right, and/or the length of time in which the water right was last put to beneficial use.

Irrigated acreage

- *For adjudicated permits* – The most up-to-date number of acres irrigated is captured under a permit's certificate record. Be aware that petitions often modify existing appropriations, so all CRs for a water right should be examined.
- *For partially adjudicated permits* -- The total amount of a permit minus what has been adjudicated will be captured under POU's marked as "Expired."

SEO e-Permit Reference Table of Values

Unique Identifiers	Common e-Permit Number Prefixes	Common e-Permit Suffixes	POD Location	POU Location	Common Beneficial Uses	Supply Types
Permit Number	Permit (P)	Ditch (D)	Latitude/ Longitude	PLSS only	Domestic (DOM)	Original
Certificate Record No. (CR)	Territorial (T)	Enlargement (E)	PLSS		Irrigation (IRR)	Secondary (Reservoirs)
Order Record No. (OR)	Court Awarded (C)	Reservoir (R)			Stock Water (STK)	Supplemental
	Federal Award (Y)	Stock Reservoir (S)			Industrial (IND)	Additional (Groundwater)
		Instream Flow (F)			Municipal (MUN)	
		Well (W)			Miscellaneous (MISC)	
		Unknown (-)			Reservoir Supply (RES)	
		Pre-1969 wells (P)			Commercial (COM)	

Permit Status	Surface water	Groundwater	Acceptable for Data Analysis?	Reference Data Associated with this Record Type
Fully Adjudicated	x	x	Yes	CR/OR
Partially Adjudicated	x	x	Yes	Permit or CR/OR
Complete	x	x	Yes	Permit
Blank	x	x	Yes	Permit or CR/OR
Incomplete	x	x	Yes	Permit
Unadjudicated	x	x	Yes	Permit
Abandoned	x	x	No	CR
Canceled	x	x	No	Permit
Expired	x	x	No	Permit
Eliminated	x	x	No	CR

Appropriation Type	Unit of measurement	Limitations
Surface water	cfs	1 cfs per 70 acres
Groundwater	gpm	
Reservoir storage	AF	
Reservoir supply capacity	AF/year	
Irrigation permits	Acres	40 ac. Quarter-Quarter; 640 ac. Section

Appendix C. Use of POU and POD e-Permit Conversion Tools

Methods for Preparing Data for and Running Conversion Tools

Please note, statewide POD and POU feature classes are currently under development by WWDC and may be available by request or via downloads.

Step 1: Downloading Water Right Data from e-Permit

Downloads from e-Permit contain the state of Wyoming's water right permits, including expired, canceled or abandoned permits. These data download in a Microsoft Excel format with a maximum of 10,000 permit records (as of 2019). There are multiple methods to limit record searches to under 10,000; the suggested method is downloading based on water right type (Groundwater, Spring Water, etc.) and Priority Date.

The permit data contains Point of Diversion and Point of Use data. The Point of Diversion data is the default data set on the e-Permit search interface. Appendix B includes e-Permit Water Rights Search Guidelines provided by the SEO to assist in understanding the contents of e-Permit and Tab Books. It also contains some suggested methods to download bulk data.

Including Point of Use Details is NOT recommended as the system will only provide 10 POU records per POD record. POU records should be searched and downloaded without POD information. See the instructions below for specifics on how to download each type of record.

Point of Diversion (POD)

Point of Diversion data comes with Latitude/Longitude coordinates that in many cases represents the centroid of a section, or section quarter-quarter (North American Datum 1983). Log into the SEO's e-Permit system and Search for water rights selecting the following fields in each tab:

- Choose Search Option: **Find Water Rights (Detailed)**
- TAB: **WR NUMBER OR FACILITY NAME**
 - Point of Diversion (POD): Check "**Point of Diversion or Well Details**" Do NOT check "Include Point of Use Details." The output of this search is limited to 10 records per permit. One section could have as many as 16 records if it is recorded down to the quarter-quarter level, as many irrigation rights are.
- TAB: **LOCATION PARAMETERS**
 - Select from drop down
 - **WATER DIVISION:**
 - **DISTRICT:**
 - You will need to download each District separately for the "Study Area" in which you are working
 - **The selection in this tab may need to be adjusted to download less than 10,000 water right records (the maximum Excel export size). This equates to 400 "pages" in e-Permit.**
- TAB: **WATER RIGHT PARAMETERS**
 - At a minimum, divide the download by the following Diversion Types:
 - **Reservoir Storage** (units: acre-feet, "AF")

- **Stream Diversion** (units: cubic feet per second, “CFS”)
 - **Ground Water** (units: gallons per minute, “GPM”)
 - **Spring diversion** (units: cubic feet per second, “CFS”)
- For POD records, these data sets must be downloaded individually due to the different units of measurement in each Diversion Type (AF, CFS or GPM).
- The downloaded dataset will contain three worksheets in an Excel format:
 - Tab “Table”: POD Water right records
 - Tab “Table 1”: Water right record count
 - Tab “Table 2”: Water right grid count

Point of Use (POU)

Point of Use comes in GCDB (Geographic Coordinate Data Base). GCDB uses section/township/range and can give descriptions down to the quarter or quarter-quarter, or Government Lot and/or Tract, if applicable. The GCDB layer is part of the Permit Conversion Tools provided by the WWDC to be used by the consultant. A specially formatted version is used by the POD and POU tools. Log into the SEO’s e-Permit system and Search for Water Rights selecting the following fields in each tab:

- Choose Search Option: **Find Water Rights (Detailed)**
- TAB: **WR NUMBER OR FACILITY NAME**
 - Point of Use (POU): Check “**Point of Use Details**” box. Needs to be run separate from POD in order to get accurate downloads and work with the tools.
- TAB: **LOCATION PARAMETERS**
 - Select from drop down, **County or Township and Range**
- TAB: **WATER RIGHT PARAMETERS**
 - At a minimum, divide the download by Priority Dates. This may need to be adjusted **to download less than 10,000 water right records (the max Excel export size). This equates to 400 “pages” in e-Permit.**
- The downloaded dataset will contain three worksheets in an Excel format:
 - Tab “Table”: POD Water right records, this table is the only one needed by the Tool.
 - Tab “Table 1”: Water right record count
 - Tab “Table 2”: Water right grid count
- The POU output needs to be edited in Excel before it will work with the Tool
 - Add new field “POUQTR,” and populate it using the two right characters of the Qtr-Qtr field. In the new field, create a REPLACE function [=REPLACE(RIGHT([Qtr-Qtr cell ID],5),3,3,"")]. Note: Qtr-Qtr cell ID in the function will need to be edited to reflect the corresponding row and cell number (i.e. S2).
 - Edit fields so there are no spaces, no special characters, and field types are properly formatted.
 - Change Field Name Qtr-Qtr to QtrQtr
 - Change Field Name Survey Type, Survey Number, Survey Suffix to Survey
 - Change the field type of “Acres” to a number instead of a general or text field
 - The downloaded excel file needs to be resaved as a 97-2003 Workbook .xls worksheet

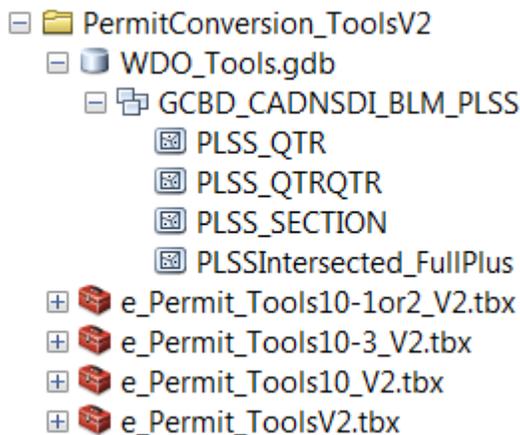
- Please note that the Latitude and Longitude fields included with the POU excel file are the location of the POD, not the POU.

Step 2: Open tools in ArcCatalog and add inputs to dialogue box

Use the “**Show Help>>**” function in the Tool for information on all inputs.

Required Inputs

- Excel e-Permit input files.
 - Follow the e-Permit downloading procedures (Per Step 1 above. See Also Appendix B for more information).
 - **Excel files from e-Permit must be saved as 97-2003 versions even though they have an .xls extension. This must occur to allow the tool to navigate to and find the files.**
- Three PLSS input layers are formatted and supplied for use with the POU tool. They are included with the Permit Conversion Tool download on the Water and Climate Hub. The Bureau of Land Management’s (BLM) PLSS input layers are critical for the tool to run successfully!



Managing Outputs

- It is suggested a “working” geodatabase be used for outputs, and only place final products in Geodatabase templates as some editing is needed. Any file geodatabase can be used for the Output Geodatabase, however the tool runs faster on a local drive.

Step 3: Remove duplicates and irrelevant records for your study

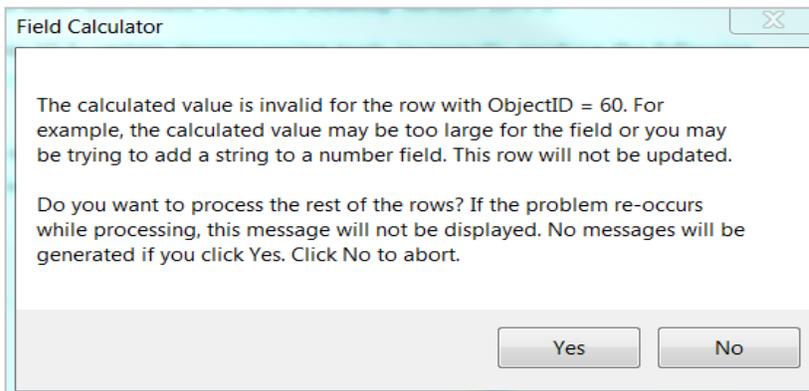
- Delete water right records whose quantities are below the mapping threshold needed for the project.
- Remove records with cancelled, abandoned, or expired status from the Excel tables. If using the Permit Conversion Tools, these records are automatically removed in the POU/POD feature class output.
- Delete permit (P) records that have been fully adjudicated, e.g., converted to Certificate Records (CR) or Order Records (OR).

- After downloading the PODs from e-Permit in Excel, filter for “Fully Adjudicated” in the WR Status field.
- From the fully adjudicated records, delete any records with a WR Number that does NOT begin with “CR” or “OR.” These are the permits that have been adjudicated and duplicated in the information provided under the Certificate Record or Order Record.
- Partially adjudicated permits (surface water only) – These records will still need to be manually reconciled to remove duplicate flow or acreage counts. This may require using e-Permit to view the scanned permit and understand what portion has been adjudicated.

Step 4: Run the Permit Conversion Tools

Notes on POD and POU outputs:

- A bug in ArcGIS Desktop 10.5, may cause the following error message when running the tool. This error will not affect the output of the tool. This error has been addressed in ArcGIS Desktop Version 10.5.1.
 - BUG-000102024 - In ArcGIS Desktop 10.5-7, certain geoprocessing tools incorrectly produce the following warning message, "WARNING001102: You must have at least the ArcEditor License to run this tool with the specified data."
- A bug in ArcGIS Desktop 10.7 may launch a hidden dialog box behind ArcCatalog when you get this message in the geoprocessing window, “Empty value for ObjectID=[].” Hit yes on the dialog box to continue processing.



- The tools will automatically input the date for you in the data outputs. However, this date in the output is based off the day the tool was run, not the date of download. It is recommended to run the tool on downloaded data as soon as possible to keep the date correct.
- The POD tool converts some fields to numeric field types to allow for statistical calculations.
- Outputs have an auto formatted name
 - (POD or POU) + Output Base Name + Water Division + Water District + (FC or Table or Error Table)
 - Example: POD_BASENAME_00_0000_FC
- **These tools are unable to express POU down to tracts and lots, due to different ways tracts and lots are written in datasets. Tract and lot data are retained in the Survey Field (of the _ErrorTable or _FC) but not used to map POU.**
 - POU data in the _ErrorTable containing tracts and lots should be plotted manually into the _FC (as needed) to map POU output data to the tract and lot.

- The GIS features (_FC) are converted to points (POD) and polygons (POU). These layers created by the tool already have some unneeded data removed, such as Abandoned, Expired and Cancelled records. Also some POU records may show an active POU but the POD is listed as inactive. These records will have to be manually addressed.
- The Tables (_Tables) created by the tool contain every entry downloaded from e-Permit.
- The Layer outputs may still contain permits that have received a Certificate Record. These permits will have to manually be removed to prevent duplication of data (see Step 3 and Appendix B).
- The Error Tables contain all records that did not get created in the feature class (FC). This includes removed records like Abandoned, Expired, and Cancelled as well as records that fail PLSS formatting and records outside of Wyoming. The POU_Table will have fewer records than the sum of the POU_FC plus the POU_Error Table due to the multiple records created in the _FC for the lots/tracts.

Suggested method for pulling permitted amounts and permitted acres for e-Permit data:

- There may be multiple POU records for a single Permit or Certificate Record number. To find the total permitted acreage, summarize the PermitNum field in the POU layer table and choose SUM on the Acres_Number field as the summary statistic.
 - **Note:** Never summarize the Appropriation field in the POU table as this field value represents the total amount for the permit, not the amount allocated to the quarter-quarter in that section.
- To display Amount (cfs, gpm, acft) and Acres permitted in a linked water right table, first summarize on the POD layer and POU layer table data based on the permit field and use the "Sum" function on the permitted amount (cfs, gpm, acft in the POD layer) or acres amount (in the POU layer). Join both amount and acres to the linking table (WS_Structures_Link_POUandWaterRights) using the permit field and then run "Summarize" on the WDOSTRID field with amount and acres as outputs. This will allow the data to be directly linked to the features showing all permitted amounts and acres for that feature.
 - **Note:** Caution is needed in summarizing surface rights associated with a reservoir. These units are sometimes in acre-feet instead of cfs. A possible fix is to convert the acre-feet number to cfs and indicate in the "Comment" field this was done.

Disclaimer on POD and POU Tools:

The POD and POU Tools are intended to save time creating GIS data from SEO e-permit data. These tools do a superficial attempt at cleaning the data with removal of Abandoned, Expired and Cancelled Records. The outputs of these tools cannot be seen as direct inputs into models or other data analysis. These tools are merely meant to get all users to the same starting point with useable fields populated and points/polygons created.

Manual Procedures for Replicating e-Permit Conversion Tool Output

Note: The manual procedures presented here provide a detailed breakdown of the steps the tool is following.

Prepare e-Permit Water Rights

User will have to download and add/adjust fields prior to displaying data spatially.

Step 1: Remove duplicates and irrelevant records (for more information see Appendix B)

- Delete water right records whose quantities are below the mapping threshold needed for the project.
- Remove records with cancelled, abandoned, or expired status.
- Delete records that have been converted to Certificate Records (adjudicated). Only keep the adjudicated record. After downloading the PODs from e-Permit Excel file, filter for “Fully Adjudicated” in the WR Status field. From the fully adjudicated records, delete any records with a WR Number that does NOT begin with “CR” or “OR”. These are the permits that have been adjudicated and duplicated in the information provided under the Certificate Record.
- Partially adjudicated (surface water rights only) – These records will still need to be manually reconciled to remove duplicate flow or acreage counts. This may require using e-Permit to view the scanned permit.

Step 2: Combine and format downloaded water right data

If you downloaded multiple SEO Districts then combine each diversion type into one spreadsheet. DO NOT combine different ‘diversions’; they contain a different unit of measurement in the same column under “Appropriation” (e.g.— cfs or gpm).

Add the following fields and complete the information:

- POD Sheets
 - DateDownloaded
 - WaterDivison
 - WaterDistrict
- POU Sheets
 - DateDownloaded
 - WaterDivision
 - WaterDistrict
 - QTRQTR_CLEAN: Populate this field by removing ¼ from the POUQTRQTR

Step 3: Creating Point Feature Classes

- Within ArcGIS, import the tables from the Excel documents for each diversion type for both its Points of Diversion and Points of Use.
- You will need to create a Point of Diversion “feature class from XY table” from the Points of Diversion table.

There should be three types of features for each Diversion Type:

- Points of Diversion: *points*
 - These points will be displayed spatially and can be edited as needed.
- Points of Diversion: *table*
 - This dataset is used as an unedited reference and a linking table for some features.
- Points of Use: *table*

- This table is used to create the Points of Use polygons. After creating the Points of Use polygons, the table will no longer be needed.

The Points of Diversion: *points* and the Points of Use: *polygons (after creation)* can be edited and is used to display data. The Points of Diversion: *table* is a reference and linking table and should not require editing.

Attaching Points of Use to PLSS Layer

This step requires multiple inputs prior to creating the point of use polygons as the PLSS layer and the Point of Use: *table* needs to be prepared prior to creating the polygons. At this time, unneeded data could also be removed from the Point of Use: *table* and Point of Diversion: *points* before being displayed spatially (this process is described and explained separately in Step 3 below).

Step 1: Preparing the Cadastral National Spatial Data Infrastructure (NSDI)

If the PLSS base layer was not provided by WWDC, download the Cadastral National Spatial Infrastructure (NSDI) dataset from the BLM. Point of Use data comes in various sizes, therefore, the “PLSSIntersected” layer is needed in order to create Section, Quarter and Quarter-Quarter feature class data layers.

Note: WWDC has these three datasets prepared for use when creating the points of use polygons. If these datasets were not provided, contact your WWDC representative. If the three data layers were provided, go to Step 2.

Using “PLSSIntersected”, three layers will be created:

- A PLSS layer to the Section
- A PLSS layer to the Quarter
- A PLSS layer to the Quarter-Quarter

Note: It makes the process faster if the PLSS layer is clipped to a buffered project area prior to adding fields and/or manipulating the data.

To “PLSSIntersected Layer” add the following fields and populate using *Field Calculator (ArcGIS)*:

Field Name	Formula in ArcGIS Field Calculator
PLSS_SECTION	[TWNHPNO]&[TWNHPDIR]&[RANGENO]&[RANGEDIR]&[FRSTDIVNO]
PLSS_QTR	[TWNHPNO]&[TWNHPDIR]&[RANGENO]&[RANGEDIR]&[FRSTDIVNO]&[QSEC]
PLSS_QTRQTR	[TWNHPNO]&[TWNHPDIR]&[RANGENO]&[RANGEDIR]&[FRSTDIVNO]&[QQSEC]

Step 2: Prepare the e-Permit Water Right Point of Use: *table* _____

This table is created from the e-Permit Water Right Download described in the above section. This process will need to be completed on each Point of Use dataset, to allow the dataset to properly link to the PLSS layer.

To the Points of Use: *table*, add and populate the following Fields using *Field Calculator (ArcGIS)*:

Field Name	Formula in ArcGIS Field Calculator
PLSS_SECTION	[POUTNS]&[POURNG]&[POUSEC]
PLSS_QTR	[POUTNS]&[POURNG]&[POUSEC]&[POUQTR]
PLSS_QTRQTR	[POUTNS]&[POURNG]&[POUSEC]&[QTRQTR_CLEAN*]

* This field was created in Excel after the download and described in earlier directions.

After populating all Fields (Section, Quarter and Quarter-Quarter), remove or correct data created by Field Calculator (ArcGIS).

This is done by using ArcGIS “Select by Attributes” and then filling in selected entries using Field Calculator with the formula Field = “[blank]”. The goal is to have only one entry for all created fields. Data remaining in more than one field will result in duplicated data.

Remove the extra and incorrect data using the following rules:

- For all entries with complete quarter-quarter data remove any filled in PLSS_QTR and PLSS_SECTION data
- For all entries with [All] listed for quarter-quarter remove any filled in PLSS_QTRQTR data
- For all entries with [All] listed for quarter-quarter BUT not [All] listed for quarter, remove PLSS_QTRQTR and PLSS_SECTION data
- For all entries with [All] listed for quarter, remove any filled in PLSS_QTR and PLSS_QTRQTR data
- For all entries missing quarter data, remove PLSS_QTRQTR and PLSS_QTR data
- For all entries missing quarter-quarter data BUT quarter data is NOT missing, remove PLSS_QTRQTR and PLSS_SECTION data
- For all entries with 000 or other invalid section numbers, remove any filled in PLSS_QTR and PLSS_QTRQTR data
- For all entries with 000 or other invalid section numbers, replace PLSS_SECTION with INVALID and review per project guidelines
- For all entries missing Section data, replace PLSS_SECTION with MISSING and review per project guidelines

After correcting and removing data, each data point should only have one field of PLSS_SECTION, PLSS_QTR and PLSS_QTRQTR filled in. These three fields should contain valid data or MISSING/INVALID in PLSS_SECTION if relevant.

Note: Some INVALID PLSS_SECTIONS may contain data in the PLSS e-Permit field and some segmented e-Permit data will not match the SEO combined PLSS field. Some Points of Use will be missing the PLSS information completely or have “filler” information that is not useful.

- The section number may have 000 (Sections are numbered 01 to 36)
- PLSS data may be missing completely from e-Permit

Step 3: Attaching Point of Use: *table* to PLSS Layer

This step describes the procedure for creating PLSS layers for each complete data set of Section, Quarter and Quarter-Quarter. The three data layers for each Point of Use will be combined to create a final Point of Use Layer to represent each Diversion Type.

Using the Make Query Table tool in ArcGIS, join each created PLSS layer (PLSS_SECTION, PLSS_QTR, PLSS_QTRQTR) to Point of Use: *table* by the corresponding created and filled in fields. Using this tool accurately accounts for the one-to-many relationship between the PLSS layer and the POU table.

Export Data from the joined PLSS layers to create a new layer only containing the Section/Quarter/Quarter-Quarter that have a Point of Use water right.

Merge all three (Section, Quarter, and Quarter-Quarter) to create one layer that contains all the Point of Use for the Diversion Type.

Optional: Downloading the Tabulation of Adjudicated Water Rights (Tab Book)

Tab Books can also be downloaded from e-Permit and used as a reference for the water right diversion data. In e-Permit, under the Reports tab at the top of the page (next to Search), Tab Books can be found. Download in Excel to link to "Downloaded Water Right Data." Tab Books describe adjudicated water rights and are a convenient cross-reference to be used in conjunction with e-Permit. However, they do not reflect any unadjudicated water rights or water rights in the process of being updated. For more information on using Tab books for water rights see Appendix B, Section E.

Appendix D. Unique ID (WDOSTRID and Convey_ID) Creation

Creating ID values

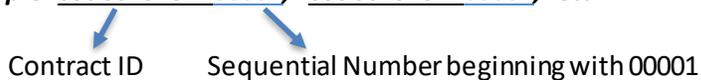
Tracking features and preparing data for modeling input requires the features to have a unique ID. Previously, the creation of the WDOSTRID unique ID values for the WDO_Structures feature class required four distinct parts (eleven digits) and an optional letter included at the end to identify individual features (Wyoming Water Development Office 2019). This method was time consuming, particularly for large project areas.

The original method for creating unique ID values for features in WDO_Structures included three primary goals; (1) standardize the naming process (2) facilitate input into modeling software (3) retain some information in the ID value that would help identify and understand the feature. Meeting the last of these goals was the most time intensive for creating each unique ID. It is not essential to retain identifying information in the ID field, only that the value is unique among features in the same dataset. Therefore, a new simplified version of creating WDOSTRID values is outlined below. This method will retain the first two primary goals of standardization by creating a unique ID for the WDO_Structures feature class that is also consistent with how the data is entered into modeling software.

The new WDOSTRID number will be a unique alphanumeric code that is created by using the ContractID value of the project (beginning with 05SC029...) plus a sequential number starting with 00001 that increases incrementally as new features are added to the master geodatabase. The WDOSTRID value will be used to link features in the WDO_Structures feature class to tables as described in Section 4.7 of this document and shown in the Water Development Geodatabase Diagram (2020).

Convey_ID is the unique identifier used in the WDO_Conveyance feature class and it will be developed using the same format as the WDOSTRID by using the ContractID value of the project (beginning with 05SC029...) plus a sequential number starting with 00001 that increases incrementally as new features are added to the master geodatabase. The Convey_ID value will be used to link features in the WDO_Conveyance feature class to tables as described in Section 4.7 of this document and shown in the Water Development Geodatabase Diagram (2020).

ID Example: 05SC029751700001, 05SC029751700002, etc.


Contract ID Sequential Number beginning with 00001

WDOSTRID and Convey_ID values will not be changed once assigned to a feature. In future projects, the location, spatial orientation or even some attributes of existing features may be updated, but the ID value will remain the same.

Appendix E. References

Anderson Consulting Engineering, Inc. (2015). *Upper North Platte Watershed Study*. Prepared for Wyoming Water Development Commission.

Lowham Walsh (2017). *Owl Creek Watershed Study and Management Plan*. Prepared for Wyoming Water Development Commission.

O'Grady, et al. (2000). *Green River Basin Plan Technical Memorandum*. Prepared for Wyoming Water Development Commission.

Trihydro Corporation (2018). *GIS Data Framework Plan*. Prepared for Wyoming Water Development Commission.

Wyoming Water Development Office (2019). *GIS Standards Technical Memorandum V.2*. Prepared for Wyoming Water Development Commission.

Wyoming Water Development Office (2020). *GIS Standards Technical Memorandum V.3*. Prepared for Wyoming Water Development Commission.

Wyoming Water Development Office (2020). *Water Development Geodatabase Diagram V.3*. Prepared for Wyoming Water Development Commission.