Statewide Water Supply Initiative Update Memorandum

DRAFT

Prepared for: Colorado Water Conservation Board
Project Title: SWSI Update

Subject: Identified Projects and Processes (IPP) Dataset Review and Recommendations
Date: June 5, 2018
To: CWCB
From: Open Water Foundation
Copy to: SWSI Team

Prepared by: Steve Malers and Kristin Swaim, Open Water Foundation
Reviewed by: Chris Kurtz and Kara Sobieski, Wilson Water Group

Table of Contents

List of Figures

List of Tables

Executive Summary

The Statewide Water Supply Initiative (SWSI) projects have resulted in "Identified Projects and Processes" (IPP) datasets for each Basin Roundtable. These datasets have been updated and used at various times as input the SWSI, Basin Implementation Plans and the Colorado Water Plan. Due to the complexity of studies, variation by basin and number of entities involved, IPP data across basins are inconsistent in content and format. The SWSI Update is reviewing handling and formatting of IPP data to ensure that useful data products can be created and analyses can be performed consistently. In particular, it is desirable to establish consistency in data and stewardship of data.

The following goals were identified in implementing a consistent method for representing and using IPP datasets:

- Review existing IPP datasets from each Basin Roundtable
- Recommend additional data fields and changes in the formatting of data
- Establish an improved workflow to facilitate maintenance and access to IPP datasets, including how to update IPP datasets and publish IPP datasets on the web
- Identify and describe potential uses of IPP datasets and required IPP data to support those uses.
- Create basic data visualizations such as web-enabled maps and graphics
- Describe how to link the IPP dataset to other datasets

IPP Dataset Content Standards

After a review of each Basin Roundtable's IPP dataset, the principal recommendation for IPP datasets is for the datasets to exist in a flat Excel file format. The term "flat" means that each line (row) of data contains one record corresponding to an IPP, with columns representing data fields. Excel is a common tool and the flat format can be maintained with minimal skill and can be used by multiple software tools.

Recommendations for required IPP dataset fields and formatting standards are listed below. Field names use underscores (rather than spaces) to ensure compatibility with software that does not handle spaces. Many of the basin IPP datasets already contain some of these fields. The exact names do not need to be matched; however, the meaning of the data field should be equivalent. Software can be used to rename the fields during processing.

Table 1. Recommended IPP dataset fields.

Field Name	Description	Section for Detailed Discussion
IPP_ID	Unique project identifier in the format of Basin-Year-Number (i.e., ARK-2015-0001) that also allows for cross-reference between datasets and use by software tools.	4.1

Field Name	Description	Section for Detailed Discussion
IPP_Name	Short description of the project.	4.1
IPP_Description	Narrative content that explains the project in greater detail.	4.2
IPP_Type or Keywords	Indicator of one or more types such as storage, ATM.	4.2
Proponent	Indicates main entity proposing/leading IPP project.	4.3
Contact	Person that can be contacted regarding the project and their affiliation.	4.3
Basin	IBCC basin where the project is located (e.g., “Arkansas”).	
Municipal_Ind_Need	Yes/no indication of whether the project meets a municipal/industrial need.	4.4
Agricultural_Need	Yes/no indication of whether the project meets an agricultural need.	4.4
Envr_Rec_Need	Yes/no indication of whether the project meets an environmental/recreational need.	4.4
Admin_Need	Yes/no indication of whether the project meets an administrative need.	4.4
Multiple_Needs	Yes/no indication of whether the project meets more than one need as described above.	4.4
WaterSource_GNIS_Name	Geographic Names Information System name of the water body that is the primary source of water for the project. This is used for readability; the WaterSource_GNIS_ID (see below) ensures a unique water source.	4.5
WaterSource_GNIS_ID	Geographic Names Information System identifier of the water body that is the primary source of water for the project.	4.5
WaterDestination	Narrative description of where the water ends up or is delivered.	4.5
Latitude	Latitude of the project’s general point location in decimal degrees.	4.6
Longitude	Longitude of the project’s general point location in decimal degrees.	4.6
Phase	Implementation phase of the project; an indication of whether the project is in the concept, planning, ongoing or completed phase (use of the term “life cycle” in	4.7

Field Name	Description	Section for Detailed Discussion
	previous drafts has been abandoned in these recommendations based on consultant team feedback, mainly due to conflicting meaning within the water resources domain).	
Estimated_Yield	How much anticipated water will the project hold or divert (average annual volume) or how much water will be kept in a stream (average flow rate). This is a high-level average annual estimate that may be refined using BIP modeling.	4.8
Yield_Units	Unit of measure for capacity; either acre-feet (AF) or cubic-feet-per-second (cfs).	4.8
Estimated_Cost	Total cost to implement the project including capital and operations and maintenance (O&M).	4.9

For many of the recommended required data fields, it may also be desirable to create a second column of the same name with the word "_Flag" added to the column name (i.e., Estimated_Cost_Flag or Yield_Flag). These columns can serve as indicators of data status as it relates to missing data. They can also be an indication of data quality and/or method of determining the data value, such as how location or yield is determined. See Section 4.10.

In SWSI 2010, some effort was put toward describing the type of IPP, such as if the project was for storage, if it contained a transbasin diversion, or if it was an agricultural transfer, among other categories. These could be important aspects of a project from which it would be desirable to create a filtered dataset. Optional fields could be added, such as "Storage_Need" or, to keep the main dataset simple, use keywords such as "storage", "transbasin diversion", or "agricultural transfer" in the IPP_Description or an IPP_Type or Keywords field. Data-processing software would be able to filter IPPs based on these keywords. Keywords need to be relevant to CWCB and Basin Roundtable uses of the data and it is recommended that CWCB staff evaluate the types of filters that might be applied to data, as well as confirming current terminology that should be used.

Other optional fields include information about the county, water district, hydrologic unit code (HUC) the project is in, as well as the sponsor of the project. Adoption of standard data fields should recognize the uses of the data (see below), while allowing for additional data fields that have meaning to the specific Basin Roundtable.

IPP Dataset Handling Workflow

It will be important to establish an improved workflow to facilitate maintenance and access to IPP datasets, which includes identifying how to publish IPP datasets on the web to facilitate coordination and SWSI Update publication. The workflow for IPP dataset processing might be similar to that in the following figure and discussion:

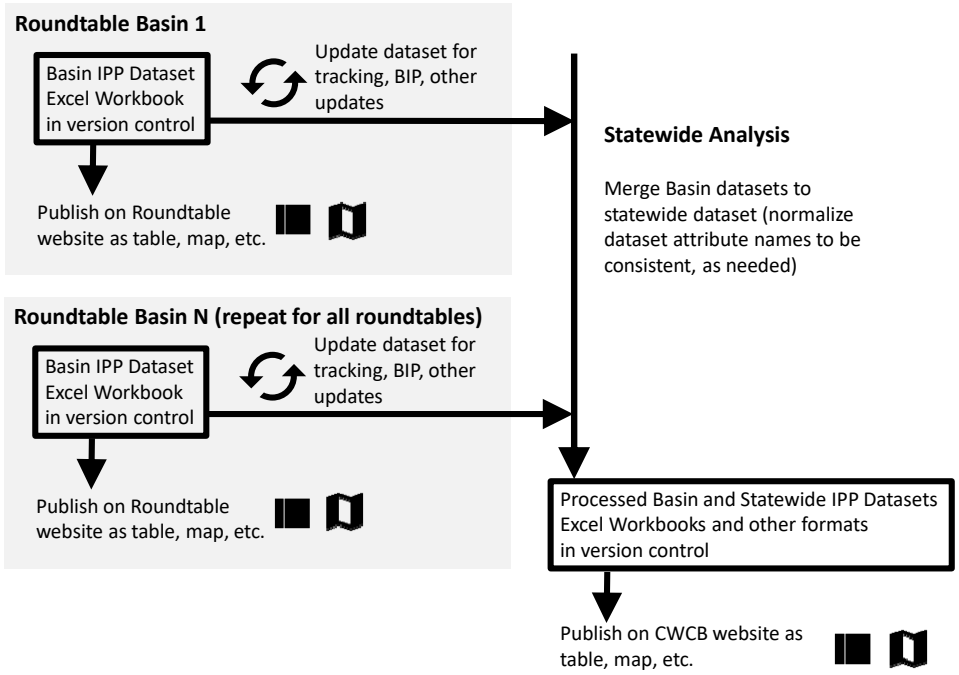


Figure 1. IPP Dataset Handling Workflow.

A description of the workflow is as follows:

1. Original basin IPP datasets are published on each Basin Roundtable's website (or the CWCB's website or the Colorado Water Plan website) in a machine-readable format such as an Excel workbook.
2. Edits to the dataset are made and noted in the "ChangeLog" tab of the Excel workbook. The edited dataset is then republished to the website, either replacing the original dataset or added as new file (perhaps with a timestamp) to indicate an updated version of the dataset. Keeping an archive of old versions is helpful given that such versions are referenced in specific versions of studies and analyses. OWF has demonstrated using version control platforms such as GitHub that track changes to electronic files and such a system could be used to track versions of the IPP dataset. Ideally, the chosen platform allows collaboration with a "gatekeeper" on edits and tracks changes and versions.
3. The dataset is processed with TSTool (or other software) to create a standardized dataset that is compatible with other basin IPP datasets. It is possible to have a link to the version-controlled TSTool command file (or other automation tool) that details how the data are processed so that the processing is transparent. The software that is used must support reading datasets from Excel worksheets, performing data manipulation such as filtering and cleaning data and outputting formats such as merged datasets and formats suitable for creating maps and tables for web publishing.
4. The standardized, statewide dataset (containing IPPs for all 9 basins) is then published to each Basin Roundtable's website, CWCB website, Colorado Water Plan website, GitHub repository and/or the Colorado Information Marketplace website in a machine-readable format to allow for statewide analysis and visualization.

5. Visualizations such as maps that use dataset attributes can be created using the statewide dataset. Filtering of data can use software that can handle sorting and filtering, such as TSTool, GIS software, Excel, databases, etc. Specific tools that are used should be based on the analysis need and skills of the data user and providing a general dataset allows for flexibility in using multiple tools as needed. Links to visualizations that utilize the IPP dataset can be provided via one of the above-mentioned websites.
6. The above input datasets and processed products can be used by Roundtables, consultants, CWCB staff, CWCB Board and IBCC members as appropriate.

IPP Dataset Products

Ultimately, the two most desirable products from this effort are a single table (or dataset or file equivalent, **see Appendix C for a draft list**) of IPPs and one or more maps of IPPs filtered by different criteria (**see Section 7 for draft maps**). With some additional processing of individual basin datasets, it will be possible to create a single, statewide dataset. However, many of the fields in the statewide dataset will not contain data unless additional data are provided by Basin Roundtables. In order to create a basic map, general location latitude and longitude coordinates are key. If this information cannot be provided or determined, more general location information can be used, such as county, water district or hydrologic unit code (HUC). However, an easing-off of data requirements (county rather than coordinates) will limit the usefulness of maps. For example, for projects that are located only to the county level, a point location can be calculated that is the centroid of the county's boundaries. If multiple projects are located in the same county, then the projects are all represented by a single point on the map. This reduces the effectiveness of the map for showing where projects are located. Most basins have provided coordinates for a subset of projects or the locations can be determined from the provided shapefiles.

Section 1: Introduction

The Statewide Water Supply Initiative (SWSI) projects have resulted in "Identified Projects and Processes" (IPP) datasets for each Basin Roundtable. IPP datasets for consumptive projects are typically lists of projects in Excel workbooks defined at varying levels of detail and may or may not include spatial data. IPP datasets for "nonconsumptive" (environment and recreation or E&R projects) typically include a spatial component because those projects often involve stream reaches. These datasets have been updated and used at various times as input to SWSI, Basin Implementation Plans (BIPs), Colorado Water Plan (CWP) and other studies. This memorandum focuses on consumptive IPP projects, although connections to E&R projects are described, for example by locating IPPs on streams using GNIS_ID and stream mile. Ongoing coordination between SWSI Update contractors can consider how best to integrate updated E&R data with IPP data.

Due to the complexity of studies, variation by basin and number of entities involved, IPP data across basins are inconsistent in content and format. The SWSI Update is reviewing handling and formatting of IPP data to ensure that useful data products can be created and analyses can be performed consistently. In particular, it is desirable to establish consistency in data and stewardship of data, as well as to confirm the most current IPP datasets. Improvements in data format, content, and handling can benefit later phases of the SWSI Update, BIP updates, and other efforts.

The following goals have been identified in implementing a consistent method for representing and using IPP datasets:

- Review existing IPP datasets from each Basin Roundtable
- Recommend additional data fields and changes in the formatting of data
- Establish an improved workflow to facilitate maintenance and access to IPP datasets, including how to update IPP datasets and publish IPP datasets on the web
- Identify and describe potential uses of IPP datasets and required IPP data to support those uses. Important data uses include:
    - Basic data manipulation such as filtering on attributes and sorting
    - Creating maps that visualize various filtered subsets and attributes
    - Basin modeling such as including an IPP in a StateMod model
    - Performing a financial analysis
    - Creating a grant application for the IPP
    - Tracking the status of the IPP, for example to report to Roundtables, CWCB and IBCC
    - Using the IPP data for any of the methodologies used in the SWSI Update project
- Create basic data visualizations such as web-enabled maps and graphics
- Describe how to link the IPP dataset to other datasets

Section 2: Review of Existing IPP Datasets

Each Basin Roundtable has created one or more electronic files of IPP data with various data formats and levels of detail. The current version of the files in each basin has most recently been updated by a variety of entities, quite often consultants working for the Roundtables. The management of IPP electronic files as consultant deliverables on various projects has

varied, which has led to confusion. A request was made to each of the Basin Roundtables to provide the following data and information:

- Excel workbooks, spatial dataset (geodatabase, shapefile, etc.) and other electronic files. Machine-readable files were requested since derived files, such as PDFs and Word documents, are not conducive to software processing.
- Any supporting documentation describing the IPP data that is relevant and is not otherwise included in the data files, in particular "metadata" explaining the data files.
- Information about where the original data files are maintained and are available, for example Dropbox or Roundtable website.
- Short summary of the process used to create and edit the IPP dataset. For example:
    - indicate primary players at the Roundtable and consultant level (e.g., Joe Smith at consultant X, Roundtable members A, B, C)
    - process used to create/update/maintain the IPP dataset (e.g., "consultant X updated the Excel file based on input from Roundtable")
    - frequency that the dataset is updated and whether an edit history is known (e.g., "BIP added new projects using process described above" or "BIP used only projects from SWSI 2010"

Table 2 shows the dataset files received from each basin.

Table 2. IPP dataset files received from each Basin Roundtable.

Basin	IPP Dataset Filename	Date Received	Dataset Available on Website?
Arkansas	2015 04 09 Arkansas River Basin Project Database GB update 6_13_15.xls	2017-09-12	Yes, but link was broken
Colorado	Basinwide_Full_IPP_List_05_27_14.xlsx, Eagle_Region_Full_IPP_List.xlsx, Grand_Valley_Region_Full_IPP_List.xlsx, GrandCo_Full_IPP_List.xlsx, Interbasin_Reliance_Full_IPP_List_05_27_14.xlsx, MiddleCo_Region_Full_IPP_List.xlsx, Roaring_Fork_Region_Full_IPP_List.xlsx, State_Bridge_Region_Full_IPP_List.xlsx, SummitCo_Region_Full_IPP.xlsx	2017-09-26	No
Gunnison	GBIP_Simplified_Project_List_4-17-15.xlsx; GBIP_IPP_GIS.zip	2017-09-24	No
North Platte	NPBIP_IPPLists.xlsx; NPBIP_IPP_GIS.zip	2017-09-21	No
Rio Grande	Updated Tables 8-10_Project Sheet Summaries_09-11-2017.xlsx	2017-09-11	No
South Platte / Metro	Gap Analysis SPMetro HDR Phase 2.xlsx	2017-09-12	Yes, but in PDF format and incomplete
Southwest	SWBRT Draft IPP List Clean copy.xlsx; IPPs.zip	2017-09-22	Yes, but in PDF format

Basin	IPP Dataset Filename	Date Received	Dataset Available on Website?
Yampa / White	BIP_IPPs.xlsx, IPP_Point.shp, IPP_Reach.shp	2017-10-03	No

Section 3: IPP Dataset Format

The principal recommendation for IPP datasets is for the datasets to exist in a flat Excel file format. The term "flat" means that each line (row) of data contains one record corresponding to an IPP, with columns representing data fields. This recommendation is made for the following reasons:

- Excel table/worksheet can be easily reviewed, filtered, edited and processed into other forms
- Excel provides:
  - commenting ability
  - color-coding and other formatting
  - support in various software
- A table representation can be represented in various forms, including:
  - Excel
  - comma-separated-value (CSV)
  - database table
  - spatial data layer attribute table
  - web page table
- Allows public distribution in machine-readable electronic format, such as:
  - Excel file on a Roundtable website
  - dataset as part of a GitHub repository with version control (or other cloud platform that provides version tracking)
  - dataset on the Colorado Information Marketplace (CIM, data.colorado.gov)
  - CDSS Map Viewer
  - online electronic documents on CWCB website
  - distribution as email attachment
  - sharing on Google Drive, Dropbox, etc.
- Excel file format facilitates versioning the IPP list, as follows:
  - a worksheet (tab) can be added to the IPP dataset workbook to indicate "Date", "Who" and "Comment" for tracking edits to the file
  - the filename can include a date as YYYYMMDD or similar to clearly indicate versions of the IPP dataset
  - versioning software such as GitHub can be used, which removes the need to add timestamp to filename and allows milestone versions to be "tagged" for retrieval

It is recognized that some IPPs could benefit from a more complex data representation, in particular when one-to-many relationships exist or there is a need to represent spatial data. For example, an IPP may involve multiple stream reaches or have multiple beneficial uses. In this case, the data can be represented by creating additional worksheets within the main dataset file that split one-to-many data into one-to-one data without making the main dataset too convoluted or difficult to understand and interpret. Using a spatial data format

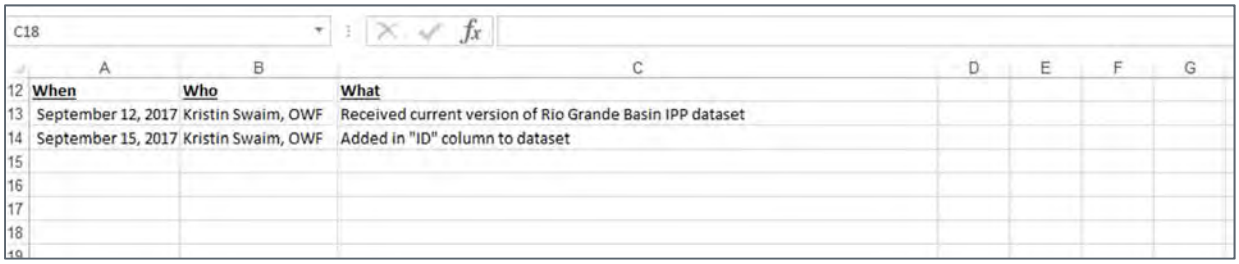
requires access to and skill with geographic information system (GIS) software, which may be a barrier for many.

The historical evidence is that it has been difficult to acquire basic consistent IPP data. Therefore, the recommended approach is to focus on the flat Excel table representation of IPP data while allowing the option of more complex formats should they be appropriate. It is logical to assume that as an IPP matures from a concept to project design and implementation and/or modeling that its data will also expand and thus require a more complex data format. For the SWSI Update, the basic information regarding IPPs is being examined for the CWCB and Basin Roundtables; all of the data associated with an IPP are not necessarily included.

All Basin Roundtables' IPP datasets exist in Excel format and some also have spatial data in Esri (ArcGIS) shapefile format. Recommendations for data formats are presented below. Recommendations for dataset fields are described in Section 4.

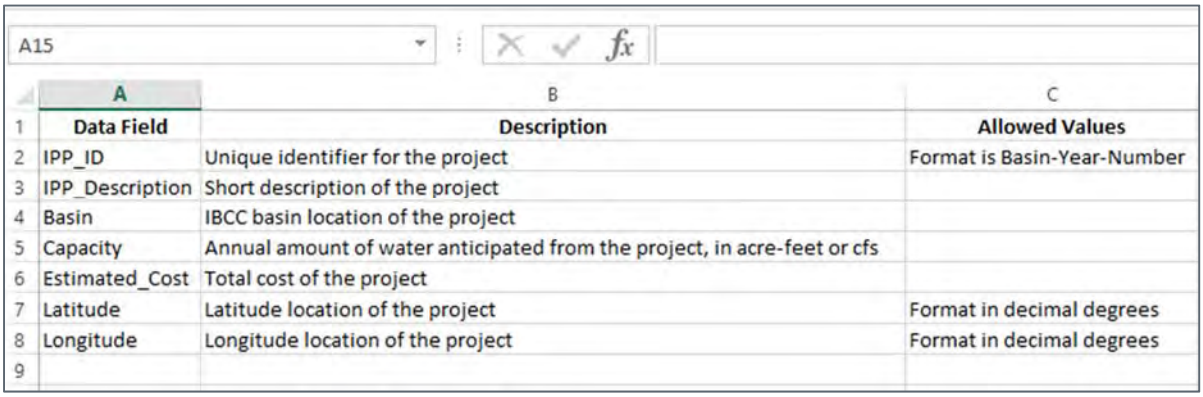
Recommendations for IPP dataset formats:

1. Each Basin Roundtable should maintain an Excel workbook file containing IPPs.
2. The name of the electronic file should reflect the date of modification. Alternatively, use version-tracking software such as GitHub that allows versions of the data file to be retrieved.
3. A worksheet in the file named "ChangeLog" or "Changes" should be added indicating the date, person and notes about the change. Note that "History" is a reserved word in Excel and cannot be used for the worksheet name. An example is shown in Figure 2.
4. A worksheet in the file named "Notes" or "ReadMe" should be added with general information, such as explanation of workbook organization.
5. A worksheet in the file named "Definitions" should be added that defines data fields. It should include descriptions of how data should be formatted and/or directions for how to fill in a particular field. An example is shown in Figure 3.
6. The main IPP list should be represented in a flat table form with columns corresponding to data fields that are discussed in subsequent sections of this document. The worksheet should be named "IPPs" or similar (to be determined with CWCB/SWSI review input).
7. Additional worksheets in the workbook can be added as appropriate, using the IPP identifier to cross-connect. However, additional sheets should not dilute the core data that should be included in the main IPP list. Examples of additional worksheets are:
    a. Definitions of terms used in the dataset list (such as project type)
    b. One-to-many data in the core dataset that include shared relationship to other worksheet(s)
    c. History of changes
    d. Optional data that will clutter up the main list but may be useful, such as more detailed contact information or information used by the Roundtable to conduct its business



When	Who	What
September 12, 2017	Kristin Swaim, OWF	Received current version of Rio Grande Basin IPP dataset
September 15, 2017	Kristin Swaim, OWF	Added in "ID" column to dataset

Figure 2. Example of a "ChangeLog" tab within the IPP workbook to indicate data edits.



Data Field	Description	Allowed Values
IPP_ID	Unique identifier for the project	Format is Basin-Year-Number
IPP_Description	Short description of the project	
Basin	IBCC basin location of the project	
Capacity	Annual amount of water anticipated from the project, in acre-feet or cfs	
Estimated_Cost	Total cost of the project	
Latitude	Latitude location of the project	Format in decimal degrees
Longitude	Longitude location of the project	Format in decimal degrees

Figure 3. Example of a "Definitions" tab within the IPP workbook to describe data fields.

Section 4: Recommendations for IPP Dataset Fields

Recommendations for potential IPP dataset fields and formatting standards are described in the subsections below. Many of the basin IPP datasets already contain some of these fields and examples from each basin are provided where appropriate. Fields are categorized according to important function and the fields within a category fall within a spectrum of required to optional. Required fields are necessary to retain basic dataset integrity and support identification and communication. Some fields are required for all data uses whereas some fields are only required for certain data uses. Optional fields are described in the context of how they will be used, but it is recognized that optional data may be difficult to obtain, or perhaps is only available after an IPP has reached a certain phase. The following categories of data fields (Table 3) are discussed in subsequent sections.

Table 3. Categories of IPP dataset fields.

Dataset Field Category	Description and Use	Section for Detailed Discussion
Project identifiers	To allow basic identification and cross-reference between datasets.	4.1
Project description	Narrative content to explain the project.	4.2

Dataset Field Category	Description and Use	Section for Detailed Discussion
Project contact / lead	At a minimum, a person that can be contacted.	4.3
Project need	Basic need indicates whether consumptive or E&R; M&I, agricultural, etc.	4.4
Water source/destination	Connects the project to administered water bodies to indicate source (depletion) and destination (the benefit).	4.5
Spatial data	Needed to create maps and perform spatial analysis.	4.6
Project phase	Implementation phase.	4.7
Project yield	How much anticipated water will the project hold or divert annually.	4.8
Other	Additional attributes that may be of interest.	4.9

Also, it is potentially useful to indicate how the project meets basin goals as stated in BIPs. Some of the basin IPP lists do this. However, to do this in a statewide dataset would mean that a standardized set of basin goals would need to be created.

Some of the recommendations impose a new data requirement on IPP data beyond what has been asked historically. For example, it is recommended that each IPP include a "general locate" coordinate that can be used to create a map representing all IPPs. This is a fundamental data element that allows basic visualization of the number and spatial distribution of IPPs. Being able to easily create a map showing IPPs is a fundamental need to communicate the data.

Representing data in fields where multiple values may be used is a challenge. Options include using comma separated values or including separate columns for each value as in a "checkbox" style. These issues are discussed in the following sections as needed.

4.1 Project Identifiers

The use of a project identifier allows each IPP project to be uniquely identified and linked to other datasets as appropriate. Unique identifiers also minimize confusion during communication and tracking. A standard naming convention does not currently exist for IPP projects across basins; Table 4 shows the different formats used for each basin, if present. One potential option for a naming convention includes the use of the basin name abbreviation, similar to the convention used by the Arkansas Basin Roundtable. The use of a numbering system may also make it easier to keep track of the total number of projects within a basin.

Table 4. Current naming conventions for project IDs used in basin IPP datasets.

Basin	Example Naming Convention for IPP Project ID	Comment
Arkansas	ARK-2015-0001	Clear; would need to describe the significance of the year such as year when first articulated as a project.
Colorado	No ID	
Gunnison	1	Sequential, but may just be the Excel row number
North Platte	1	Sequential, but may just be the Excel row number
Rio Grande	1	Sequential, but may just be the Excel row number
South Platte / Metro	ClearCreek_UIPP_FIB	Appears to indicate the county or municipality and SWSI 2010 IPP type.
Southwest	1-SJ, 1-DM (Numbered by sub-basin)	Southwest Basin is a collection of other basins so "SJ" indicates San Juan. If this is required, perhaps use "SW-SJ" at the front.
Yampa / White	1	Sequential, but may just be the Excel row number

From experience on the South Platte BIP, it was discovered that E&R projects used identifiers that varied depending on the source of the basin. For example, sometimes the CWCB instream flow case number was used. If a third party identifier is used, then it is helpful to know the organization or scope of that identifier, such as "CWCB-theidentifier", or track in separate columns.

Recommendations:

1. "**IPP_ID**" should be a required field:
    a. Assign a unique identifier to each IPP as they are added to the IPP dataset.
    b. The form of the identifier should be Basin-Year-Number, for example "ARK-2015-0001":
        i. The basin abbreviation should be ARK, CO, GUN, MET, NP, RG, SP, SW, YW.
        ii. The year should be the 4-digit year when the IPP was added to the IPP list or originally identified in the BIP
        iii. The project number is sequential and should be padded with zeros to ensure sorting.
        iv. Using the identifier in StateMod modeling would require that the identifier is 12 characters or less. Options to achieve this are to omit dashes when using an IPP in StateMod, use two-letter basin abbreviations, or reduce the count of projects from 4 to 3 digits. A

final decision can be made as StateMod modeling for SWSI Update project is implemented.

2. "**IPP_StateMod_ID**" should be an optional field if modeling the IPP in StateMod:
    a. StateMod identifiers are currently limited to 12 characters.
    b. StateMod datasets often use Water District Identifiers (WDIDs) corresponding to HydroBase structures and water rights. In other cases, the Water District (WD) is prefixed to other model data.
    c. Using a separate identifier will allow flexibility in assigning a StateMod ID.
    d. Examples need to be provided based on SWSI Update project work.
3. "**IPP_Name**" should be a required field:
    a. Name should be a short descriptive name, similar to existing data. It may be difficult to prescribe protocols for this field.
4. Optional fields may include third-party identifiers to allow cross-reference to other datasets, such as provided by a government agency.

4.2 Project Description

The project description includes additional information to describe the project, such as a narrative that is longer than the name. There may be large variability in this data from one Roundtable to another.

Recommendations:

1. "**IPP_Description**" should be a required field:
    a. Keywords may need to be included in the description, such as "storage", "transbasin diversion", "agricultural transfer", etc. to allow for filtering of datasets. Keywords need to be relevant to CWCB and Basin Roundtable uses of the data. See Section 4.4.
2. Optional fields may include, for example:
    a. **"IPP_Type"** or **Keywords** field to indicate whether the project includes storage, ATM, etc. Keywords need to be relevant to CWCB and Basin Roundtable uses of the data. See Section 4.4.
    b. Website URL for project
    c. Name of document or file that describes the project (e.g., a planning document)

4.3 Project Proponents and Contact

Experience working with IPP data has shown that it can be difficult to track who brought forth a project and, perhaps more importantly, who can answer questions about a project and its status. The people behind a project will vary depending on its phase and various processes that are occurring. A contact might be approached to provide the status of an IPP. The following recommendations are made in order to provide basic data.

Recommendations:

1. The "**Proponents**" column should be a required field:
    a. Indicate the organization(s) that are proponents or sponsors of the project (e.g., "Northern Water").

   b. Proponents and beneficiaries may require more advanced data structure that does not fit in a flat data representation. Proponents and beneficiaries may not be identified in early IPP phases.
   c. Use of standard organization names would facilitate data management.
2. The "**Contact**" column should be a required field:
   a. Indicate a name of a person and their affiliated organization that can be contacted to provide information about the IPP.
   b. It is perhaps unnecessary to include other contact information, such as an email address, because the contact will generally be someone that is known to the Roundtable and because this would require greater upkeep of the dataset.
3. Optional fields may include, for example:
   a. "**Beneficiaries**" or "**Participants**": A list of entities that are participants in the IPP project and are benefitting from the project. Such data will require a one-to-many relationship data structure such as implemented in BNDSS IPP data sheets. Such data may not be available when the IPP is in a conceptual phase. Section 4.5 discusses the water destination, which is somewhat redundant.

4.4 Project Need Based on CWP Needs

Project need refers to the general categories of needs as described in the CWP: Municipal & Industrial, Agricultural and Environmental & Recreational. Data fields may also provide a way to easily indicate whether a project is consumptive or nonconsumptive (E&R). Additionally, projects can be classified as an Administrative Need. These are projects developed in conjunction with the Division of Water Resources or other state agencies that deal more with administration or operations as opposed to a specific project. Categorizing an IPP based on project type allows for a simple way to filter IPPs and can also be useful in mapping applications as a way to symbolize data. Table 5 indicates which basins have this data.

Table 5. Project need information provided in basin IPP datasets.

Basin	Example Naming Convention for Project Need	Comment
Arkansas	Municipal & Industrial; Agricultural; Environmental; Recreational	Each need is in its own column; an IPP that meets the need is indicated with an "X"
Colorado	Munic.; Irrig.; Dom; instream flows; nonconsumptive; recreational; consumptive; etc.	Needs are not separated into multiple columns. Format should be standardized; need is not clearly indicated but can be inferred from other data columns
Gunnison	M&I; AG; NC;	Needs are not separated into multiple columns. Format should be standardized
North Platte	None	Contains "CU Projects" and "NCNA_ER Projects" worksheets but each IPP is not clearly labeled as such

Basin	Example Naming Convention for Project Need	Comment
Rio Grande	Ag; M&I; Env/Rec	Each need is in its own column; an IPP that meets the need is indicated with an "X"
South Platte / Metro	None	Only M&I IPPs have been provided; uses categories such as Agricultural Transfer or Grow into Existing Supply
Southwest	NC; C; B (Both); "Need Addressed" column may contain Agriculture, Municipal, Aquatic habitat, Fisheries, etc.	Needs are not separated into multiple columns. Format should be standardized
Yampa / White	None	Contains "Consumptive" and "Nonconsumptive" worksheets but each IPP is not clearly labeled as such

One further consideration is whether the project has a storage component, is a transbasin diversion, is an agricultural transfer, etc. These could be important aspects of a project from which it would be desirable to create a filtered dataset. Optional fields could be added, such as "Storage_Need" or, to keep the main dataset simple, use keywords such as "storage", "transbasin diversion", or "agricultural transfer" in the IPP_Description field, or add an IPP_Type or Keywords field that contains a list of keywords that can be filtered. Data-processing software would be able to filter IPPs based on these keywords. Keywords need to be relevant to CWCB and Basin Roundtable uses of the data.

Recommendations:

1. Project need should be a required field and should be formatted as follows:
    a. "**Municipal_Ind_Need**" should be a required field and filled in with a "Yes" or "No".
    b. "**Agricultural_Need**" should be a required field and filled in with a "Yes" or "No".
    c. "**Envr_Rec Need**" should be a required field and filled in with a "Yes" or "No".
    d. "**Admin_Need**" should be a required field and filled in with a "Yes" or "No".
    e. "**Multiple_Needs**" should be a required field and filled in with a "Yes" or "No". This indicates IPPs that meet at least two of the primary needs.
    f. A value of blank or "Unknown" could also be accepted where data are incomplete.
2. Optional categories may be added, such as "**Storage_Need**", depending on the basin. Alternatively, keywords such as "storage" may be included in the IPP_Description field IPP_Type, or a Keywords field.

4.5 Water Source/Destination

An IPP's water source(s) (river name, groundwater basin name, etc.) provides spatial context and a connection to water planning and administration. It is recommended to use the GNIS (Geographic Names Information System) name and identification number where possible for surface water based IPPs. The GNIS ID was developed by the USGS and is the federal

government's official repository of domestic geographic feature names. The State of Colorado uses the GNIS ID in its Source Water Route Framework (SWRF) spatial data layer, so the addition of these data fields will allow for linking to other state datasets. An alternate location ID for groundwater based IPPs will need to be developed.

Connected to an IPP's water source is the destination of the water. Does the project deliver water to a municipality, does it divert water to a system of ditches, or does the water stay in the stream? Unlike water source, the destination can be more descriptive in nature. For example, the destination may be "City of Denver" or "Eagle River". If the destination is a stream, then the official GNIS name can be used.

It should be noted that not all water bodies are in the SWRF. Potential options are to create a new ID or to use the nearest water source that does have a GNIS ID. OWF is currently not making any recommendations regarding this issue.

Table 6 shows the level of water source information provided in each basin IPP dataset. None of the basins have information about water destination at this time.

Table 6. Water source information provided in basin IPP datasets.

Basin	Example Naming Convention for Water Source	Comment
Arkansas	Cucharas River	"Associated Waterbody" field can serve as GNIS Name
Colorado	None	
Gunnison	None	
North Platte	Illinois River	A "Water Source" field exists for some IPPs within shapefiles but is not contained in the Excel datasheet
Rio Grande	None	
South Platte / Metro	None	
Southwest	00902295; Mancos River	"GNIS_ID" and "GNIS_NAME" fields exists for some IPPs within shapefiles but are not contained in the Excel datasheet
Yampa / White	00169868; North Fork Elkhead Creek	"GNIS_ID" and "GNIS_Name" fields exists for some IPPs within shapefiles but are not contained in the Excel datasheet

Recommendations:

1. "**WaterSource_GNIS_Name**" should be a required field:
    a. GNIS Name can be found using Division of Water Resources' Map Viewer.
    b. The primary water source should be included. If the project has multiple water sources, a second worksheet can be populated that shows the additional sources.
2. "**WaterSource_GNIS_ID**" should be a required field:
    a. GNIS ID can be found using Map Viewer and Source Water Route Framework layer.

   b. The primary water source should be included. If the project has multiple water sources, a second worksheet can be populated that shows the additional sources.
3. "**WaterSource_Aquifer_ID**" and "**WaterSource_Aquifer_Name**" should be a required field for groundwater IPPs but requires additional evaluation. GNIS ID is not available for aquifers. An alternative identifier could be determined from HydroBase well permit or other data, in which case the field name should reflect the identifier type. The list of groundwater sources that are used need to be available in a published form to facilitate use. Additional evaluation is required.
4. "**WaterDestination**" should be a required field:
   a. Values can be descriptive in nature (e.g., "City of X" or "X River") to provide minimal context; no standard conventions are currently recommended but could be adopted based on more detailed review of IPP data.
   b. GNIS identifiers and names could be used for water features. However, the destination may be complex to describe, with multiple infrastructure and natural feature components. The destination value may often be assumed to be the same as the "WaterSource_GNIS_Name" field, particularly for E&R projects.

4.6 Spatial Data

Ideally, each IPP project should have a general location, such as latitude and longitude coordinates of the water source or infrastructure. Coordinate data is particularly useful in any mapping application. If this information cannot be provided or determined, more general location information can be used, such as county, water district or hydrologic unit code (HUC). However, what may seem like an easing-off of data requirements (county rather than coordinates) often results in more work later and limits usefulness of the data. Therefore, including a general location should be a requirement. Table 7 shows the level of spatial data provided in each basin IPP dataset.

Table 7. Spatial data provided in basin IPP datasets.

Basin	Level of Spatial Data Provided	Comment
Arkansas	Latitude/Longitude coordinates, HUC, Water District, County	Coordinates are in the Excel file; no spatial files provided
Colorado	None; datasets split by "region"	
Gunnison	Points representing both consumptive and nonconsumptive IPPs; Water District	Data are in shapefiles and can be converted to Lat/Long
North Platte	Points and lines representing both consumptive and nonconsumptive IPPs	Data are in shapefiles and can be converted to Lat/Long
Rio Grande	Points representing IPPs	Data are in a .kmz file and Lat/Long can be extracted
South Platte / Metro	County	A map of IPPs summarized by county was included in the BIP but no shapefile exists

Basin	Level of Spatial Data Provided	Comment
Southwest	Points and lines representing both consumptive and nonconsumptive IPPs; County	Data are in shapefiles and can be converted to Lat/Long
Yampa / White	Points and lines representing both consumptive and nonconsumptive IPPs	Data are in shapefiles and can be converted to Lat/Long

Recommendations:

1. "**Latitude**" should be a required field for the general point location for the IPP, generally corresponding to the water source, centroid of project components, or regional centroid (such as for county-level project):
    a. Units should be decimal degrees.
    b. Use a flag column if necessary to indicate how location was determined.
2. "**Longitude**" should be a required field for the general point location for the IPP:
    a. Units should be decimal degrees.
    b. Use a flag column if necessary to indicate how location was determined.
3. Optional fields may include county, water district or hydrologic unit code (HUC). These fields may be necessary for projects that are considered basin-wide. Such information would be useful to filter and sort datasets.

4.7 Project Phase

An IPP project's phase is an indication of the status of its implementation. Is the IPP in the concept phase or has it been planned and detailed with a start year for the project? This data field is present in some of the basin IPP datasets but standard terminology should be developed to maintain consistency across datasets. Table 8 shows the terminology used in each basin, if available. A decision should be made as to whether those IPPs listed as "Completed" should be removed from IPP datasets and considered part of existing supply. For now, "Completed" projects will remain in IPP lists.

Table 8. Project phase information provided in basin IPP datasets.

Basin	Example Naming Conventions for Phase	Comment
Arkansas	Concept, Planned, Implementation Ongoing, Completed, Obsolete	Consistent use of categories
Colorado	Conceptual idea, Under Study, Study in Progress, Beginning stages of design/permitting, Water court application filed, Diligence filed, Money not yet allocated, Needs to be brought into compliance, In development, In Progress, Status pending, Off-line, Deferred, Ongoing, Issued,	Inconsistent use of categories; should be simplified

Basin	Example Naming Conventions for Phase	Comment
	In use, Underway, Trial Run completed, Feasibility Studies Completed, Completed, Decreed, Existing	
Gunnison	None	Phase indicated by worksheet name ("Planned Projects", "Completed_Ongoing"); need to add within datasheet for each IPP
North Platte	None	
Rio Grande	None	
South Platte / Metro	None	
Southwest	Investigating, Ongoing, Not Complete, Construction Completed	
Yampa / White	None	

Recommendations:

1. "**Phase**" should be a required field:
    a. Standard terminology should be used. OWF recommends the categories used by the Arkansas Basin or similar: Concept, Planned, Ongoing, and Completed.
    b. The use of Obsolete may be included but it may make more sense to eliminate IPPs considered obsolete so as to simplify datasets.
2. Optional fields to consider include:
    a. "**Online_Date**" and similar dates, indicating the date when the project is online, or other major milestones. These fields may be difficult to populate and may vary based on how each Roundtable tracks project progress. Dates may not be available for concepts and may shift for projects that are at a mature phase.

4.8 Project Yield

The average annual yield of the IPP project should be stated. The yield is uncertain given potential competition for the same water, hydrologic variability, and potential climate change impacts. However, a high-level yield estimate is useful to understand the size of project. An initial yield estimate may be omitted but should be provided once sufficient evaluation has occurred, including, for example, modeling in support of a BIP. Most municipal/industrial IPPs list yield in acre-feet. It may be necessary to have another column of data titled "Yield_Units" to distinguish yield units and to ensure that the "Yield" column only contains numeric data (e.g., the "Yield" column's values should be something like "200" and not "200 AF"). This field is somewhat contingent upon the project's phase in that IPPs that are only in the concept phase are less likely to have information on yield. Table 9 provides naming conventions for yield and the percent of IPPs that contain yield data by basin.

Currently, yield is focused on consumptive IPPs. Environmental and recreational IPPs tend to consider "yield" in terms of cubic feet per second (cfs) remaining instream and this amount can vary seasonally. The Environment and Recreation Methodology Development memo, part of the SWSI Update and released in draft form in November 2017, recommends that additional data fields related to flow should be added to the Environment and Recreation Database (E&Rdb), a database that houses E&R projects. These fields will detail if the project is flow-based or has a flow component and if flows have been identified and/or quantified. The memo states that the fields will be populated where possible as part of the SWSI Update but that it is likely that the majority of the information will be added in the next round of BIPs.

OWF recommends that yield should be included for all IPPs, anticipating that this field will be considered an important component of both consumptive and E&R projects in subsequent BIPs. Moreover, information on yield is generally needed to help estimate a project's unit water cost.

The concept of "capacity" may also be useful for IPPs such as to indicate storage or conveyance limits. However, capacity information may only be available from detailed project analysis and can be difficult to describe in a simple data form due to multiple project components. Therefore, capacity data is currently not included in IPP data recommendations.

Table 9. Yield information provided in basin IPP datasets.

Basin	Example Naming Convention for Yield	Percent of IPPs with Yield Data	Comment
Arkansas	36960	7	Consistent format used
Colorado	1,680 AF	17	Format should be standardized
Gunnison	146; 1,000-2,000 per yr.; 200-300	13	Format should be standardized
North Platte	None	0	
Rio Grande	None	0	
South Platte / Metro	2081	70	Consistent format used
Southwest	None	0	
Yampa / White	None	0	

Recommendations:

1. "**Estimated_Yield**" should be a required field to indicate average annual yield, in particular for consumptive uses:
    a. Values should consist only of numbers and not contain ranges of numbers.
2. "**Yield_Units**" should be a required field, anticipating the differences in yield depending on if the IPP is consumptive or nonconsumptive (E&R).
3. Optional fields may include:
    a. "**Capacity**" and "**Capacity_Units**" needed for modeling and project costing. However, such data are likely too detailed to be available for most IPPs.

4.9 Project Cost

The cost of the IPP project should be estimated based on capital cost and operation and maintenance (O&M). As with yield, this field is contingent upon the project's phase in that IPPs that are only in the concept phase do not tend to have a cost estimate. Cost coupled with yield provides an indication of unit cost of water supply. Table 10 provides the naming conventions for cost and the percent of IPPs that contain cost data by basin.

Table 10. Cost information provided in basin IPP datasets.

Basin	Example Convention for Cost	Percent of IPPs with Cost Data	Comment
Arkansas	$6.0M; $300K; 14500000	4	Format should be standardized
Colorado	$5000/AF; $200M	2	Format should be standardized
Gunnison	50,000,000; 125,000-205,000	28	Format should be standardized
North Platte	None	0	
Rio Grande	$19,500	50	Consistent format used
South Platte / Metro	261000000; $122,479,600	22	Format should be standardized
Southwest	None	0	
Yampa / White	None	0	

As part of the SWSI Update, the Finance Methodologies Technical Memorandum describes the development of a Water Finance Tool that will allow planners of IPP projects to estimate the cost of a project using a uniform methodology so that all projects can be compared on an "apples to apples" basis. This tool will have several modules for estimating a project's costs based on the type of project: there will be modules for reservoir construction, pipeline construction, stream restoration and irrigation ditch improvements, among others. It is anticipated that IPP project costs will be estimated or re-evaluated once the Water Finance Tool is available for use. However, the tool may only be applied to a subset of IPPs, in particular those that are well-defined. It is recommended that further coordination occur related to how the Water Finance Tool and the IPP database will integrate.

Recommendations:

1. "Estimated_Cost" should be a required field:
    a. Values should consist only of numbers and not contain ranges of numbers, M's (to indicate millions) or K's (to indicate thousands).
    b. This field may not be able to be populated until the Water Finance Tool is released, or the tool may create parallel data that needs to be joined to the IPP list during data processing.
    c. A definition for cost needs to be determined, such as normalized to a specific year, year of a study, etc.

4.10 Data Flagging Columns

For many of the recommended required data fields, it may also be desirable to create a second column of the same name with the word "_Flag" added to the column name (i.e., Estimated_Cost_Flag). These columns can serve as indicators of data status as it relates to missing data. They can also be an indication of data quality. The following conventions are proposed:

- G = Value is known/good.
- g = Value is estimated (but good). Review of this document suggested using E in this case to minimize potential for upper/lowercase character confusion. A final determination will be made when IPP datasets are updated as input to BIP updates.
- N = Value is not applicable and a blank cell is expected.
- M = Value is known to be missing in original source and therefore a blank cell indicates that a value cannot be provided.
- m = Value is estimated to be missing.
- z = Value is unable to be confirmed. A value is possible but cannot be confirmed one way or the other.
- x = An attempt has not been made to populate the cell at this time.

Single-character flags may also be followed with a number (e.g., g1) to indicate a method used to estimate or otherwise provide data. These flags would be specific to certain columns and would be described in the comments associated with the data column.

It is recommended to create data flagging columns for the following data fields given that data quality indicator and estimation method are likely needed:

- IPP_Name
- IPP_Description
- WaterSource_GNIS_Name
- WaterSource_GNIS_ID
- WaterDestination
- Latitude and Longitude (one flagging column for both)
- Phase
- Capacity
- Estimated_Cost
- Contact

Section 5: Establishing an Improved IPP Dataset Maintenance Workflow

It is important to establish an improved workflow to facilitate maintenance and access to IPP datasets, which includes identifying how to publish IPP datasets on the web to facilitate coordination and SWSI Update publication. It is understood that a considerable amount of time, effort and resources have already been put toward the development of IPP lists. Rather than suggesting that each basin revamp its dataset, it is recommended that each basin add in the missing data fields but keep existing data field names as-is if that is the recommendation of the Basin Roundtable. The Notes tab can then be used to define how data fields

correspond to the standardized IPP data fields. For example, the Colorado Basin may choose to continue using the data field name "Progress" to indicate the phase of an IPP. The Notes tab could then explain that these fields are interchangeable and could be indicated with a description, such as, "Progress = Phase". If the recommendations for IPP datasets are acceptable to Roundtables and the CWCB, then more substantial changes can occur to align all of the Roundtable datasets.

It will be necessary to do some additional processing of the datasets so they are in a standard (normalized) format that can be used to create statewide data products and visualizations. One option is to use TSTool software, which is able to read and write Excel files, and represents processing steps in text "command files". Other tools could also be used and it is recommended that the workflow should consist of transparent text instructions. This will allow for data processing to be done in a series of steps that are transparent and repeatable. Data manipulation tools may need to be implemented or enhanced to perform transformations, for example to rename fields, populate fields based on keywords, remove formatting such as dollar signs, and other manipulations. In any case CWCB staff need to be trained and able to run the processes.

A comprehensive, standardized, statewide IPP dataset containing consistent data fields should then be published on the web using Map Viewer, CIM, static websites (see an example at: http://data.openwaterfoundation.org/cdss-data-spatial-bybasin/index.html) or other options. Another option that OWF has direct experience with is GitHub, which is a version control system that provides a data management system for files. In GitHub, data are stored in repositories that are cloud-hosted. GitHub is somewhat similar to Google Drive and Dropbox. Repository hosting is free for public repositories but private repositories require payment. Regardless of the approach taken, it should be consistent with the technical capabilities of each Roundtable such as considering whether a Roundtable has its own website. Greater CWCB support of Roundtables may be appropriate, such as utilizing the State's Google Cloud Platform (GCP) to provide data-hosting website for each basin. OWF has been working with the State to utilize the GCP for a project and it would be possible, for example, to use GCP to provide data and web hosting for each Roundtable.

The workflow for IPP dataset processing might be similar to the following (Figure 4 and discussion below):

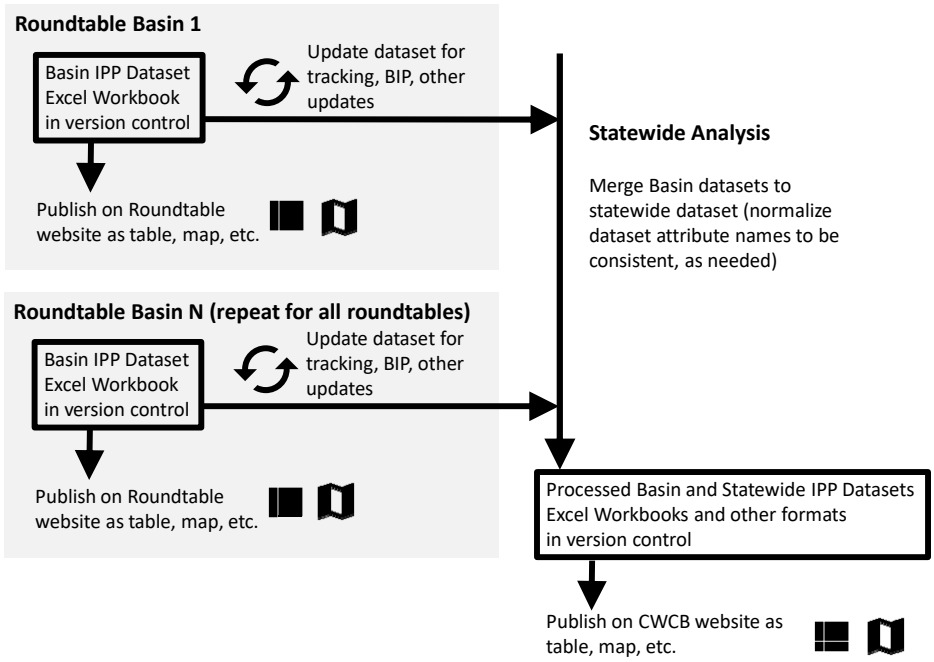


Figure 4. IPP Dataset Handling Workflow.

1. Original basin IPP datasets are published on each Basin Roundtable's website (or the CWCB's website or the Colorado Water Plan website) in a machine-readable format such as an Excel workbook.
2. Edits to the dataset are made and noted in the "ChangeLog" tab of the workbook. The edited dataset is then republished to the website, either replacing the original dataset or added as new file (perhaps with a timestamp) to indicate an updated version of the dataset. Keeping an archive of old versions is helpful given that such versions are referenced in specific versions of studies and analyses. OWF has been evaluating using platforms such as GitHub that track changes to electronic files and such a system could be used to track versions of the IPP dataset. Ideally, the chosen platform allows collaboration with a "gatekeeper" on edits and tracks changes and versions.
3. The dataset is processed with TSTool (or other software) to create a standardized dataset that is compatible with other basin IPP datasets. It would be possible to have a link to the TSTool command file that details how the data are processed so that the processing is transparent. The software that is used must support reading datasets from Excel worksheets, performing data manipulation such as filtering and cleaning data and outputting formats such as merged datasets and formats suitable for creating maps and tables for web publishing.
4. The standardized dataset (containing IPPs for all 9 basins) is then published to each Basin Roundtable's website, CWCB website, Colorado Water Plan website, GitHub repository and/or the Colorado Information Marketplace website in a machine-readable format to allow for statewide analysis and visualization.
5. Visualizations such as maps that use dataset attributes can be created using the statewide dataset. Links to example visualizations that utilize the IPP dataset will be provided via one of the above-mentioned websites.

6. The above input datasets and processed products can be used by Roundtables, consultants, CWCB staff, CWCB Board and IBCC members as appropriate.

Section 6: Uses of the IPP Dataset

The availability of the required data fields will support several uses of IPP datasets. The following list is based on OWF's understanding of data uses, but additional uses can be evaluated to determine whether the recommended IPP data fields will support that use. SWSI Update activities to integrate with the Colorado Water Plan and provide results through Data Dissemination task will leverage IPP datasets and data products.

6.1 Maps

The addition of general location coordinate data for each IPP will allow for all IPPs to be easily located on maps. Then, a user interested in a particular basin or region can quickly determine the IPPs in that area and find more information. Another advantage of mapping IPPs is that IPPs can be symbolized in different ways. For example, IPPs could be color-coded based on project type (municipal, environmental, etc.), phase, or whether the project includes an ATM component. IPP symbols could be sized based on capacity or cost. The required data fields are:

- IPP ID
- Latitude/Longitude
- IPP Description

Additional fields that will help to symbolize the data include:

- Needs fields (Municipal & Industrial, Agricultural, Environmental & Recreational)
- Water Source GNIS Name and ID
- Phase
- Capacity
- Cost
- IPP Description filtered by keywords such as "storage" or "transbasin diversion", or a separate IPP_Type or Keywords field (or equivalent)

6.2 Filtered Lists

It will be possible to create filtered, customized datasets and provide as maps, Excel files, and other formats for use in analysis and visualizations. For example, the IPP dataset can be filtered by basin, project need, phase, etc. By including the GNIS ID for each IPP, it will be possible to examine all of the IPPs for a particular stream. Filtered datasets can be created as new derived datasets, or the full dataset can be made available and filtering can occur using tools, such as a website or desktop software tools. IPPs with limited data can be filtered out to remove "noise" or can be the focus of evaluation to understand the extent of incomplete data.

6.3 Water Allocation Models (StateMod)

Using the IPP identifier and the estimated capacity, it should be possible to incorporate IPPs into water allocation models such as StateMod. The required data fields are:

- The recommended **IPP_StateMod_ID** (12-character limit) identifier connects the general IPP dataset to StateMod model.
- Capacity of structures (capacity is a hard limit on storage or conveyance whereas the project yield will consider the operation of the project over time).
- Additional description of water source and destination locations, operating rules, etc., necessary to describe the IPP within the StateMod dataset.

Additional StateMod data will be defined based on detailed review of the IPP. It is likely that only major IPPs will be modeled as a scenario in StateMod.

Section 7: Example Data Visualizations/Products

An example set maps detailing IPPs across the state and for each basin are shown in Figure 5 – 13. The IPPs shown on these maps are based on the best available data associated with the latest BIPs or more recent update. When available, the provided latitude and longitude was used; however, in many cases it was required to estimate a location. The procedures for estimating locations can be found in Appendix B. In some cases, a location for a IPP was not provided because it would have involved too much "guess work". For this example set of maps only consumptive (e.g. agricultural, municipal, etc.) and multi-purpose/multi-use projects are shown. A list of all consumptive and multi-purpose/multi-use IPPs is provided in Appendix C Note, additional thematic maps can be produced by using other IPP data, such as project phase, location accuracy, yield or cost, if data are available. The data can be used to color code or size the points accordingly.

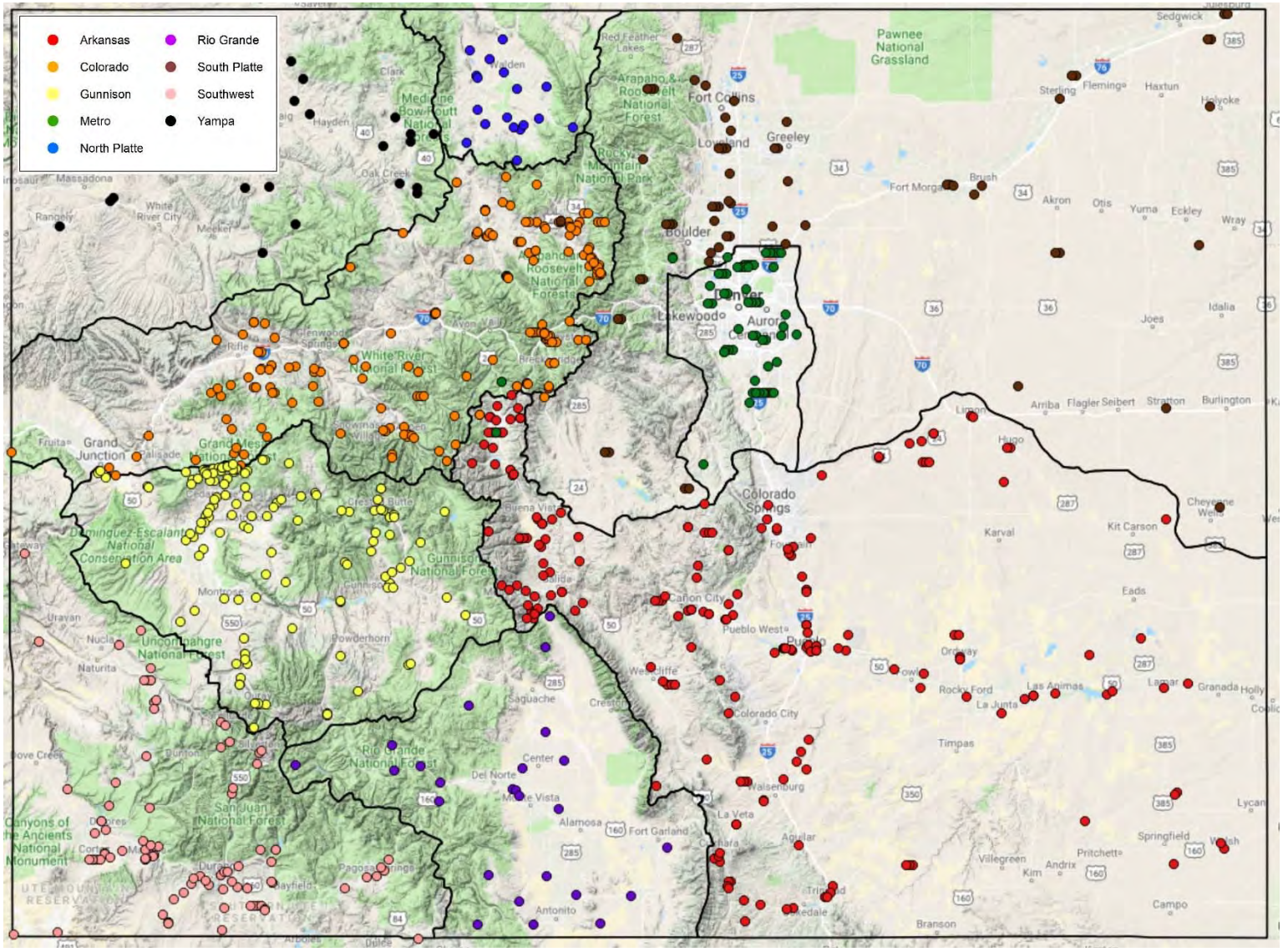


Figure 5. Statewide map of IPPs shown with basin boundaries.

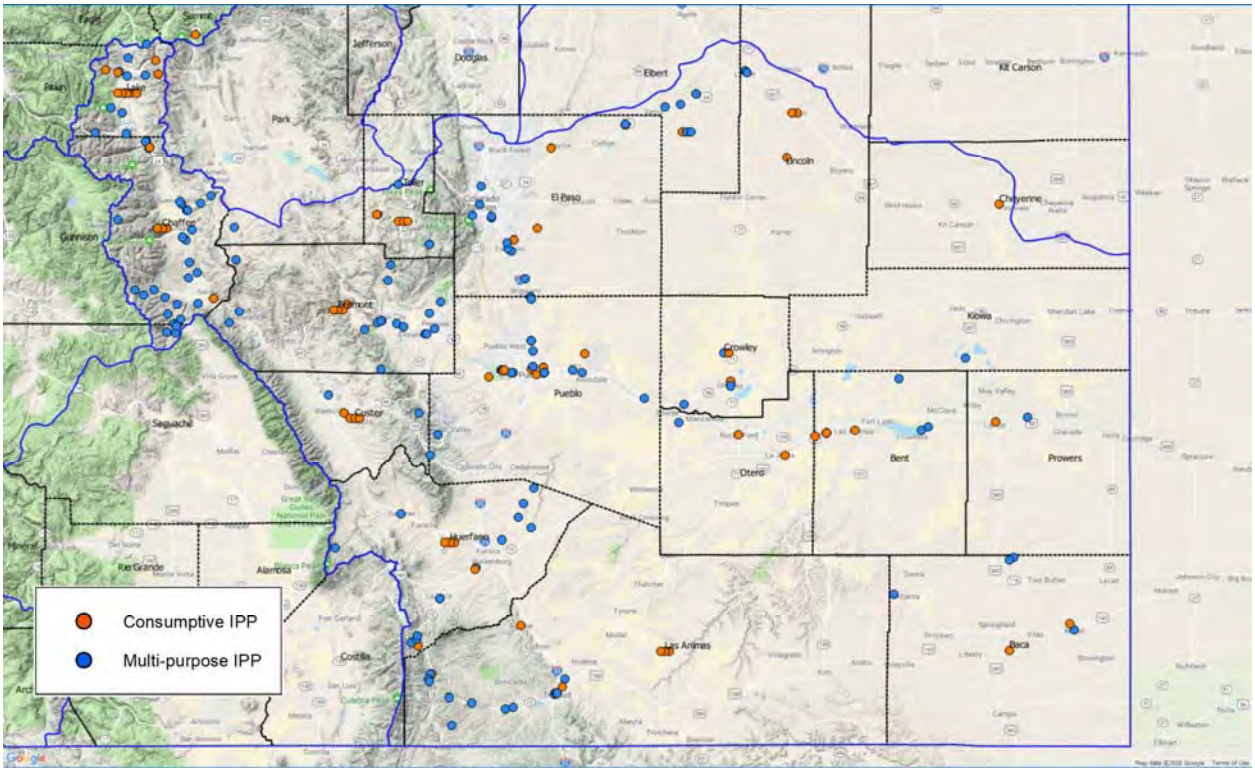


Figure 6. Arkansas Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

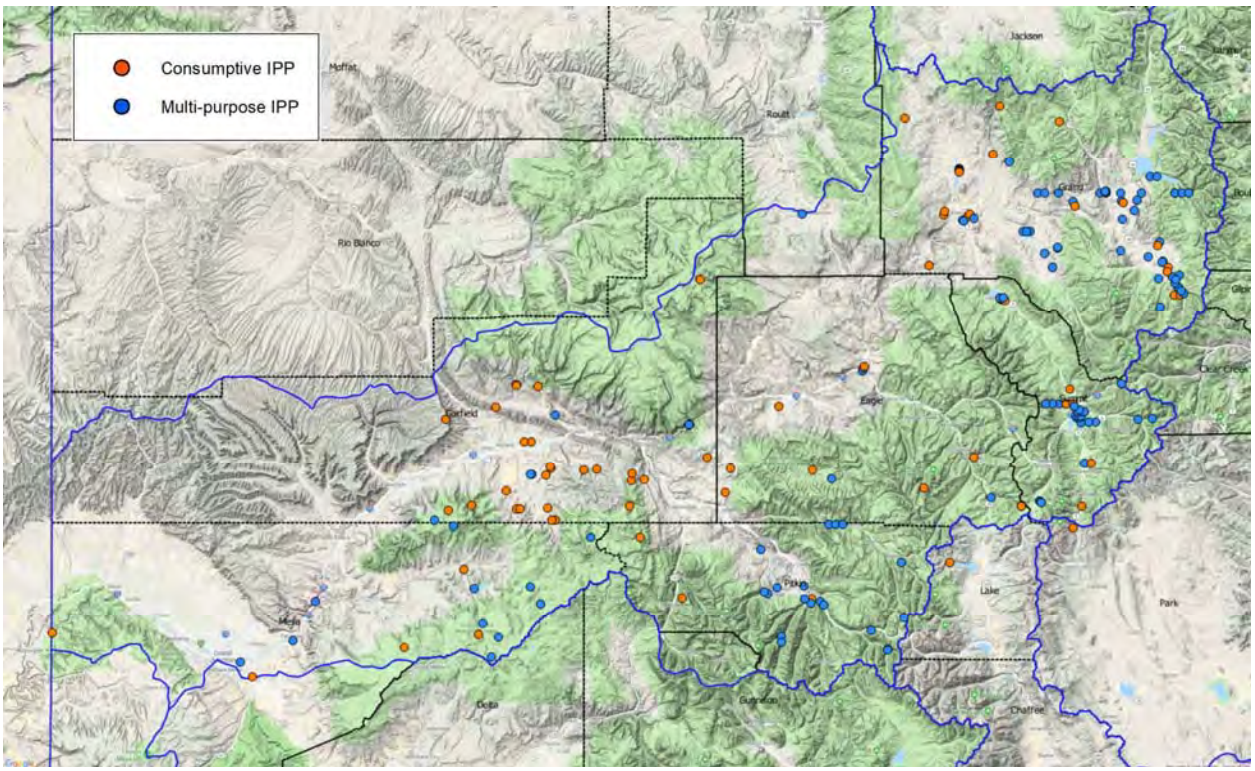


Figure 7. Colorado Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

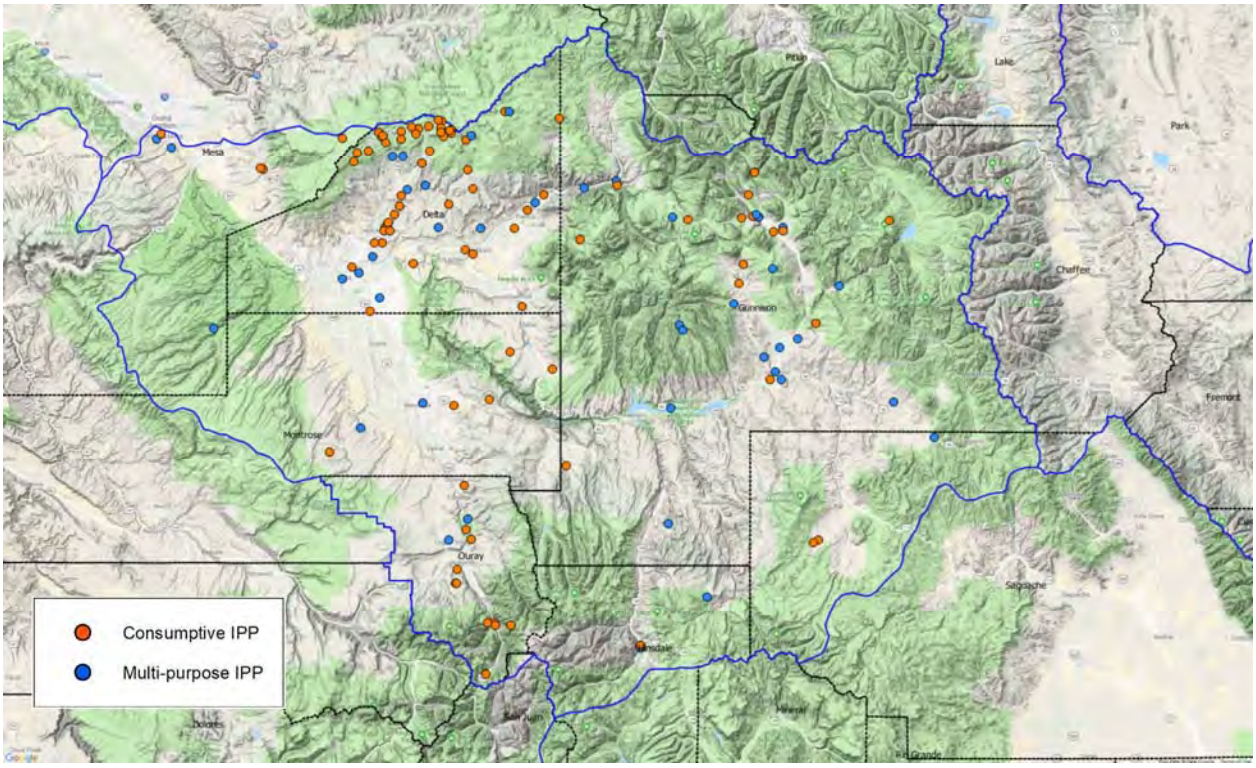


Figure 8. Gunnison Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

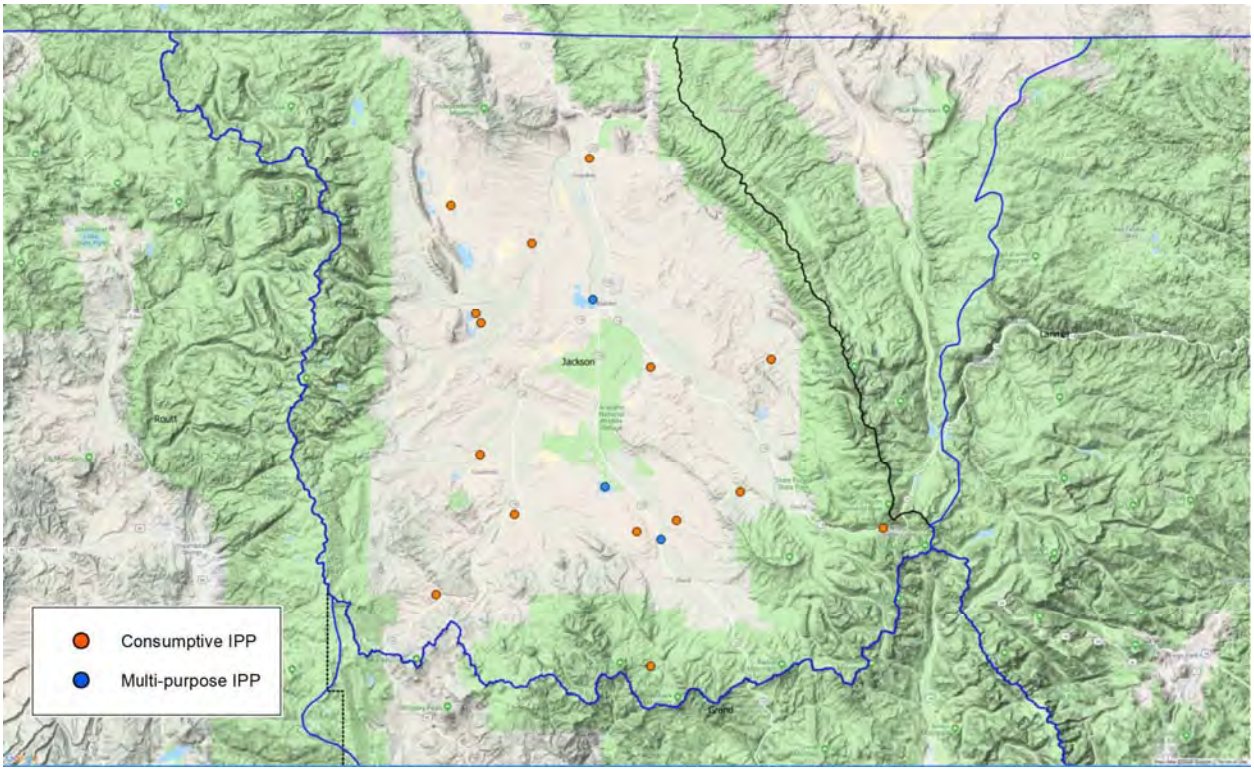


Figure 9. North Platte Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

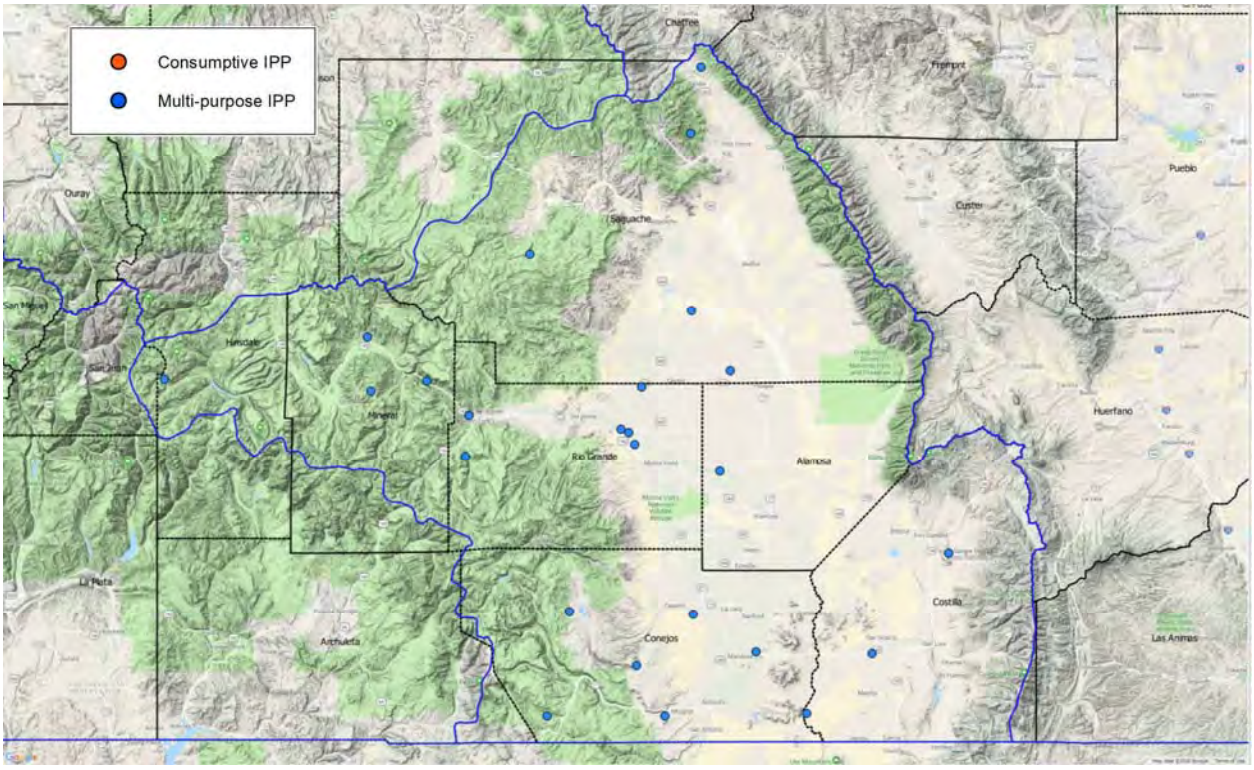


Figure 10. Rio Grande Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

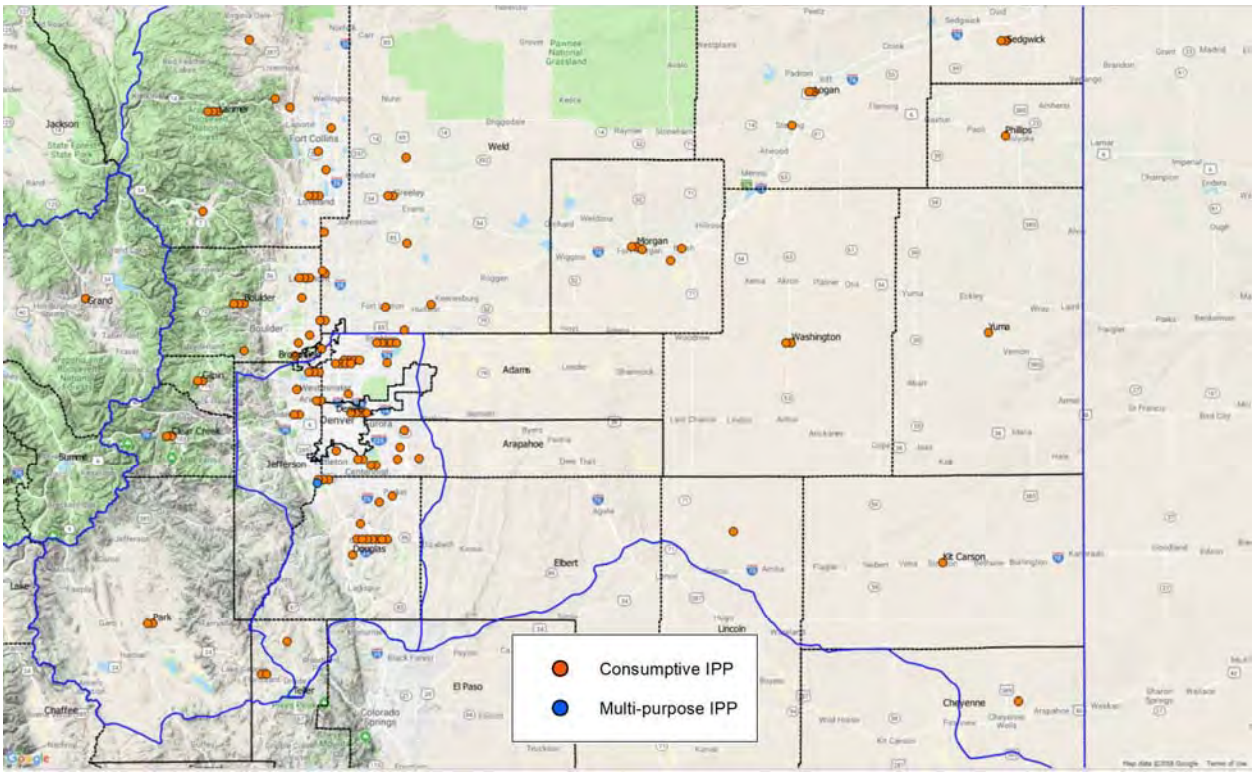


Figure 11. South Platte/Metro Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

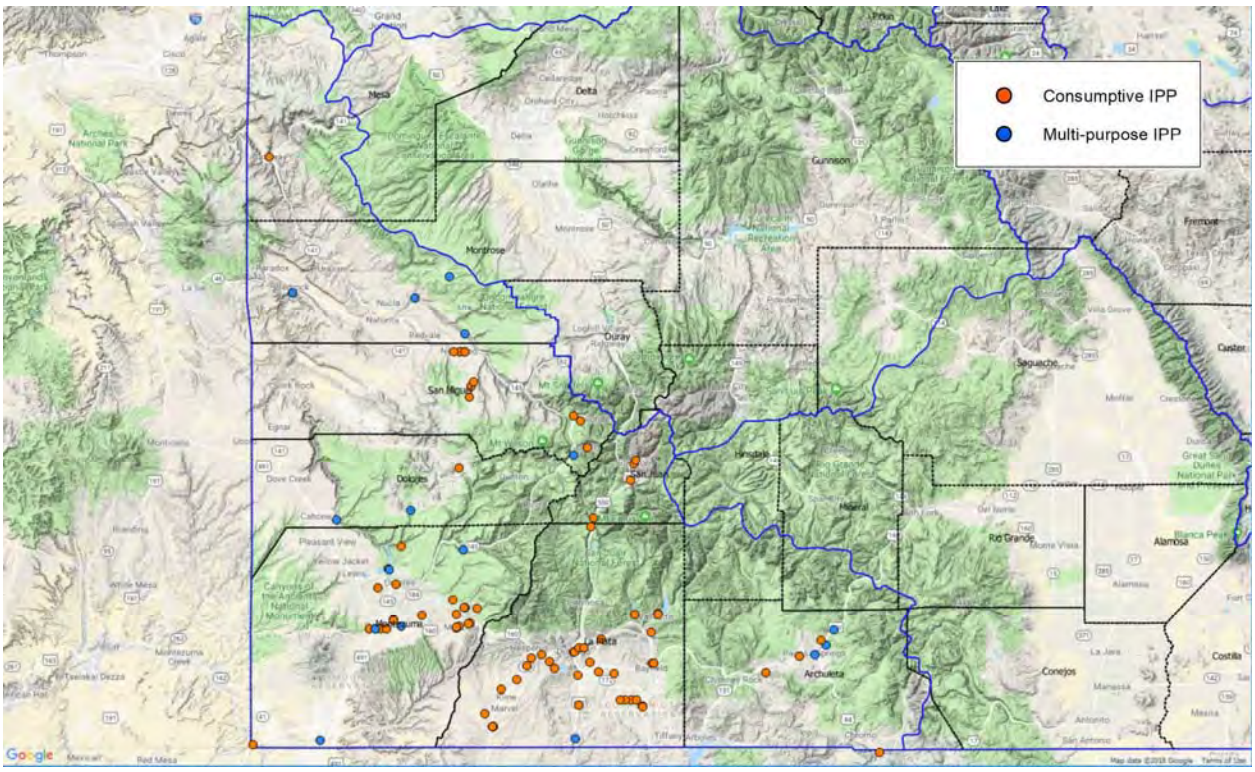


Figure 12. Southwest Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

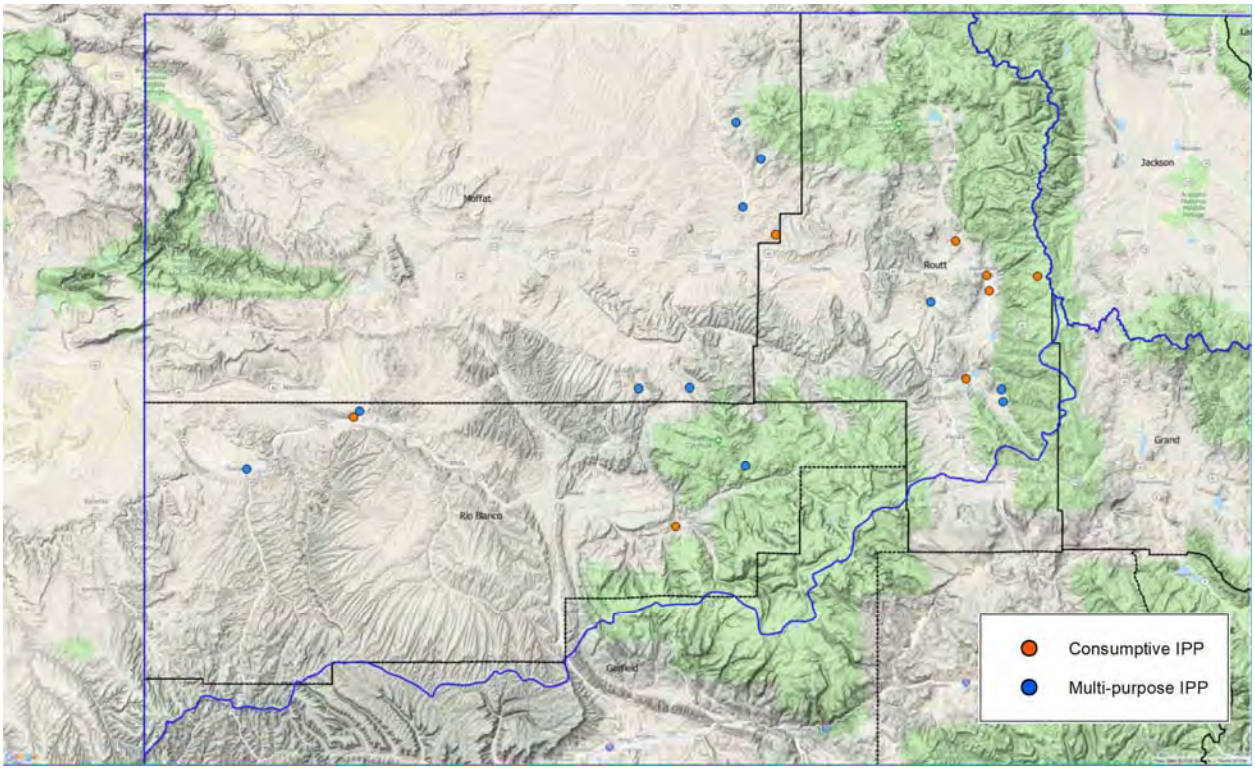


Figure 13. Yampa/White/Green Basin Consumptive and Multi-Purpose/Multi-Use BIP IPPs

Section 8: Linking the IPP Dataset to Other Datasets

The IPP dataset has the potential to be linked to other datasets, for example:

- StateMod – the IPP ID can be used as the node identifier in StateMod modeling (12-character limit).
- Source Water Route Framework (SWRF) – the SWRF contains a shapefile of points representing confluences of tributaries to streams with an attribute table that provides the GNIS ID and name of the tributary and also the GNIS ID and name of the stream to which the tributary joins. Using this information, it would be possible to determine all of the IPPs associated with an entire watershed, not just a single river. This information could assist with stream management planning.
- CWCB Grant programs - WSRF and Water Plan Grant applications could be updated to contain a question that asks if there is an IPP ID for the project.

Section 9: Summary of Recommendations

9.1 General Recommendations

The recommended data fields to be included within IPP datasets are shown in Table 11. The presence of these data fields within each current basin IPP dataset is indicated, although existing column names do not correspond exactly with recommended names. The exact names do not need to be matched; however the meaning of the data field should be equivalent. Software can be used to rename the fields during processing. OWF recommends the use of underscores in field names to ensure compatibility with GIS software such as ArcGIS, although fields can be renamed to support specific software. To gain the most usefulness from IPP data, these fields (and associated data) should be added to current IPP datasets.

Other recommendations include the following, which were discussed in previous sections:

1. The IPP list should be maintained as an Excel file; the file's name should reflect the date of modifications.
2. Add comments to data column names that clearly define the data to be added in the column.
3. Standardize the naming convention for the IPP_ID column. It is recommended to include the basin name in the ID, such as in the Arkansas Basin IPP dataset.
4. Standardize the categories used to describe the phase of the IPP; 4-5 categories should be adequate.
5. Decide whether IPPs listed as "Completed" should be removed from the dataset and considered part of existing supply.
6. Create a Notes workbook tab that serves as the metadata for the dataset.
7. Create a ChangeLog workbook tab to indicate any modifications to the dataset.

Table 11. Recommended IPP data fields and presence of fields in current basin IPP datasets.

Data Field/Column*	Arkansas	Colorado	Gunnison	North Platte	Rio Grande	South Platte / Metro	Southwest	Yampa / White
IPP_ID	X		X	X	X	X	X	X
IPP_Name	X	X	X	X	X	X	X	X
IPP_Description	X	X	X	X			X	X
Basin						X		
Municipal_Ind_Need	X	X	X		X		X	
Agricultural_Need	X	X	X		X		X	
Envr_Rec_Need	X	X	X	X	X		X	X
Admin_Need					X			
Multiple_Needs	X	X	X		X		X	
WaterSource_GNIS_Name								
WaterSource_GNIS_ID								
WaterDestination								
Latitude	X		X	X			X	X
Longitude	X		X	X			X	X
Phase	X	X	X				X	
Yield	X	X	X			X		
Yield_Units	X	X	X			X		
Estimated_Cost	X	X	X		X	X		
Contact	X		X			X	X	
Proponents	X	X	X		X	X	X	X
Other Potential Fields:								
IPP_Type *or* Keywords	X	X				X		
IPP_StateMod_ID								
County	X						X	
Water_District	X		X					
HUC	X							

*Column names may need to be revised pending further discussion with Basin Roundtables or their consultants.

9.2 Basin-Specific Recommendations

Excel and spatial data layer files for each basin's IPPs were reviewed to understand existing data and to identify how to update the data while minimizing BRT effort. The following sections summarize recommendations for transitioning the existing IPP datasets to recommended form. Any updates should seek to retain existing data and improve ability to maintain and use data for SWSI, BIP, and the Colorado Water Plan.

9.2.1 Arkansas Basin

The following recommendations are made for the Arkansas Basin IPP dataset:

- Use whole numbers to estimate cost of an IPP, rather than using "M" to represent millions of dollars or "K" to represent thousands of dollars.
- Add in the following fields and populate with data: Admin_Need, WaterSource_GNIS_Name, WaterSource_GNIS_ID, WaterDestination. (Associated Waterbody field may be able to fill the WaterSource_GNIS_Name field).

9.2.2 Colorado Basin

The following recommendations are made for the Colorado Basin IPP dataset:

- Create a unique identifier for each project, in the format of Basin-Year-Number. Sub-basin could possibly be indicated in the Basin portion of the ID.
- The "Projects, Policies and Process" column should be split to create the IPP_Name and IPP_Description fields.
- Use whole numbers to estimate cost of an IPP, rather than using "M" to represent millions of dollars or "K" to represent thousands of dollars.
- Do not include units in the Capacity field (i.e., remove "AF" from the numbers).
- Consolidate the number of categories used to describe project phase to 4-5 categories and use the terminology consistently.
- Add in the following fields and populate with data: Municipal_Ind_Need, Agricultural_Need, Envr_Rec_Need, Admin_Need, WaterSource_GNIS_Name, WaterSource_GNIS_ID, WaterDestination, Latitude, Longitude, Contact.

9.2.3 Gunnison Basin

The following recommendations are made for the Gunnison Basin IPP dataset:

- Create a unique identifier for each project, in the format of Basin-Year-Number.
- Split up the project need types (municipal, agricultural, etc.) into multiple columns.
- Do not use ranges in the Estimated_Cost field. Instead use the maximum number or an average.
- Do not use ranges in the Capacity field. Instead use the minimum number or an average. Also do not include other text, such as "per year".
- Add in the following fields and populate with data: Admin_Need, Multiple_Needs, WaterSource_GNIS_Name, WaterSource_GNIS_ID, WaterDestination, Latitude, Longitude, Phase.

9.2.4 North Platte Basin

The following recommendations are made for the North Platte Basin IPP dataset:

- Create a unique identifier for each project, in the format of Basin-Year-Number.
- Use the worksheet names ("CU Projects", "NCNA_ER Projects") to create Municipal_Ind_Need, Agricultural_Need and Envr_Rec_Need data fields.
- Add in the following fields and populate with data: Admin_Need, Multiple_Needs, WaterSource_GNIS_Name, WaterSource_GNIS_ID, WaterDestination, Phase, Capacity, Capacity_Units, Estimated_Cost, Latitude, Longitude, Contact.

9.2.5 Rio Grande Basin

The following recommendations are made for the Rio Grande Basin IPP dataset:

- Create a unique identifier for each project, in the format of Basin-Year-Number.
- Add in the following fields and populate with data: IPP_Description, WaterSource_GNIS_Name, WaterSource_GNIS_ID, WaterDestination, Phase, Capacity, Capacity_Units, Latitude, Longitude, Contact.

9.2.6 South Platte / Metro Basins

The following recommendations are made for the South Platte / Metro Basin IPP dataset:

- Create a unique identifier for each project, in the format of Basin-Year-Number.
- Provide a more detailed description of the IPP.
- Separate consumptive uses between municipal or agricultural (or both).
- Add in the following fields and populate with data: WaterSource_GNIS_Name, WaterSource_GNIS_ID, WaterDestination, Phase, Latitude, Longitude.

9.2.7 Southwest Basin

The following recommendations are made for the Southwest Basin IPP dataset:

- Create a unique identifier for each project, in the format of Basin-Year-Number. Sub-basin could possibly be indicated in the Basin portion of the ID.
- Split the Description field so that the IPP_Name and IPP_Description fields can be filled in.
- Edit the NC/C/B (Nonconsumptive, Consumptive, Both) field so that the Municipal_Ind_Need, Agricultural_Need, Envr_Rec_Need and Multiple Needs fields can be filled in.
- Standardize the terminology used for project phase.
- Move the GNIS ID and GNIS Name information from shapefiles into the Excel file to fill the WaterSource_GNIS_Name and WaterSource_GNIS_ID data fields.
- Add in the following fields and populate with data: WaterDestination, Latitude, Longitude, Capacity, Capacity_Units, Estimated_Cost.

9.2.8 Yampa / White Basin

The following recommendations are made for the Yampa/White Basin IPP dataset:

- Create a unique identifier for each project, in the format of Basin-Year-Number.
- Add an IPP_Description field for consumptive use projects.

- Move the GNIS ID and GNIS Name information from shapefiles into the Excel file to fill the WaterSource_GNIS_Name and WaterSource_GNIS_ID data fields.
- Add in the following fields and populate with data: Municipal_Ind_Need, Agricultural_Need, Envr_Rec_Need, Admin_Need, Multiple_Needs, WaterDestination, Latitude, Longitude, Phase, Capacity, Capacity_Units, Estimated_Cost, Contact.

Appendix A: Current Basin IPP Dataset Formats

This appendix provides images of the Excel workbook for of each basin's IPP dataset to illustrate existing data fields in the "flat" representation of IPP data. These examples were created from the Excel files that were provided at the start of the IPP data review summarized in Section 2.

ID	Arkansas Basin Project ID	Project Title	Need or Challenge	Project Description	Project Status	Project Proponent	Associated Waterbody
1	ARK-2015-0001	CSWD Cucharas River Bank Intake Structure	Municipal Water Supply Gap CSWD.	Appropriate water right, conduct permitting and construct facilities for Cucharas River bank intake.	Planned	CSWD	Cucharas River
2	ARK-2015-0002	Cucharas Mountain Resort Storage	Water storage for summer recreation and winter snow making at Cucharas Mountain Resort (CSWD).	Transfer water right, permitting, and construct facilities.	Planned	CMR, CSWD	Cucharas River
3	ARK-2015-0003	South Baker Creek Reservoir	Municipal water storage shortage Cucharas SWD.	Acquisition, construction, permitting, and adjudication of South Baker Creek Reservoir.	Planned	CSWD	Cucharas River, South Baker Creek
4	ARK-2015-0004	Huerfano River Futile Call Administration Model and Gages	Timely futile call administration on Huerfano and Cucharas Rivers.	Transit or futile call model development as requested by DEO and HCWCD.	Planned	DEO, HCWCD	Huerfano River, Cucharas River

Alamosa	Baca	Bent	Chaffee	Cheyenne	Costilla	Crowley	Custer	Douglas	Eagle	El Paso	Elbert	Fremont	Gunnison	Huerfano	Kiowa	Kit Carson	Lake	Las Animas	Lincoln	Otero	Park	Pitkin	Prowers	Pueblo	Saguache	Summit	Teller
														X													
														X													
														X													

County(s)	Validated Project (Not an Obsolete or Completed Project)	Solution	Plan of Action	MASTER NEEDS LIST	Needs Identified in BIP	Meets Min. IPP Requirements	Proponent	Intends to Meet Needs by 2050	2015 BIP IPP LIST (Yes/No)
Huerfano	Yes	Initiate water right application, permit, design, and construct facilities.	Authorization of activities to implement by public body.	Yes	Yes		Yes		No
Huerfano	Yes	Initiate water right application, permit, design, and construct facilities.	Authorization of activities to implement by public body.	Yes	Yes		Yes		No
Huerfano	Yes	Initiate project description.	Authorization of activities to implement by public body.	Yes	Yes		Yes		No

Project Classification (List from Review Steps)	FUTURE TASK NOT FOR BIP	Municipal & Industrial	Agricultural	Storage	Environmental	Recreational	Water Quality	Watershed Health	Conservation / Efficiency	Instream Flow (ISF)	Multi-Benefit (to Populated)	Project Type
Master Needs List		X										Municipal & Industrial
Master Needs List		X		X	X	X					X	Municipal & Industrial; Storage; Environmental; Recreational; Multi-Benefit
Master Needs List		X		X	X	X			X		X	Municipal & Industrial; Storage; Environmental; Recreational; Conservation/Efficiency; Multi-Benefit

Figure A1. Screenshots of Arkansas Basin IPP dataset (2015 04 19 Arkansas River Basin Project Database GB update 6_13_15.xls, "All Input List" worksheet).

	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ
1	Project Location: Latitude (##.#######)	Project Location: Longitude (##.#######)	Subregion	Water Conservancy District	Arkansas Basin HUC	CO Division of Water Resources District No.	Input Provided By (List or Name)	Applicant	Original Project ID (From Input Information)	Project Contact
2	37.332049	-105.096323		Huerfano County Water Conservancy District	110200060401	16	S. White H-P Projects			CSWCD; Art Pi
3	37.345076	-105.126966		Huerfano County Water Conservancy District	110200060401	16	S. White H-P Projects			CSWCD; Art Pi
4	37.355602	-105.105012		Huerfano County Water Conservancy District	110200060401	16	S. White H-P Projects			CSWCD; Art Pi

	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB
1	Contact ID	Contact Organization	Contact Phone	Contact Email	Project Website	Partners	Partners Contact	Estimated Cost	Basin Funds Requested	Statewide Funds Requested	Total Funds Requested
2	erce					CSWD		$6.0M			
3	erce					CSWD		$4.0M			
4	erce					CSWD		$9.5M			

	CC	CD	CE	CF	CG	CH	CI	CJ	CK
1	Estimated Completion Date	BRT Sponsor	CWCB Approved	Location Description	Project Category	Project Type	Basin Goals Met	Multi Basin	Attributes Identified by BRT
2	Est 2022	Sandy White					M1, M2		
3	Est 2025	Sandy White					S1, S3, M2		
4	Est 2018	Sandy White					S1, S3, M1, M2, NC1, NC2, NC3, NC5, NC6, NC7		

	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW	CX
1	Benefit	Project Protections	Constraints and Challenges	SWSI 2010 Type	Annual Firm Yield	New Active Storage	COMID	Segment ID	Project Location ID	BNDSS IPP Category	BNDSS IPP Type	Project Note or Comment	Other
2			HB1041?; 404? USFS-SUP? DEO/SEO										
3			HB1041?; 404? USFS-SUP? DEO/SEO										
4			HB1041?; 404? USFS-SUP? DEO/SEO										

Figure A1 continued.

	A	B	C
1	Projects, Policies and Process	Beneficiary	Project Sponsor
2			
3	ERMOU Project The ERMOU Joint Use Water Project (ERMOU Project) derives from the 1998 Eagle River MOU among East and West Slope water users for development of a joint use water project in the Eagle River basin that minimizes environmental impact, is cost effective, technically feasible, can be permitted by local, state and federal authorities, and provides 20,000 acre feet per year (AFY) average annual yield for East Slope use, 10,000 AFY firm dry year yield for West Slope use, and 3,000 AF of reservoir capacity for Climax Molybdenum Co. The ERMOU Project is proposed as a cooperative alternative to construction of the Homestake II Project in the Holy Cross Wilderness. The ERMOU Project will utilize conditional water rights held by the ERMOU Parties and a yet-to-be determined combination of gravity diversion, storage, pumping, and/or groundwater infrastructure to develop the contemplated project yield. ERMOU Parties include: Cities of Aurora and Colorado Springs; Eagle Park Reservoir Company (consisting of the Colorado River Water Conservation District, Eagle River	ERMOU Parties	ERMOU Parties
4	Red Cliff Project (Iron Mountain)		CRWCD
5	Fryingpan Project		

	D	E	F	G	H	I	J	K
1	Data Sources	Region (of Project)	Proposed (AF, CFS, other)	Existing (AF, CFS, other)	Cost	Progress	Basin Importance	Nonconsumptive Benefits
2	EAGLE REGION							
3	ERMOU Parties	(Upper) Eagle Region	20,000 AFY average annual yield for Cities, 10,000 AFY firm dry year yield for the Reservoir Co., 3,000 AF storage space for Climax	2500	$5000/AF	Ongoing	High	
4	ERMOU Project	Eagle Region	60,000 AF					
5	ERMOU Project	Eagle Region						

Figure A2. Screenshots of Colorado Basin IPP dataset (Eagle_Region_Full_IPP_List.xlsx).

	L
1	Comments (Opportunities and/or Constraints)
2	
3	Progress on the ERMOU Project has been continuous since 1998, with development and use of the Eagle Park Reservoir as a phase component of the Project, investigation of specific project configurations described in the ERMOU, investigation of alternative project configurations, and acquisition and adjudication of water rights to be used for the ERMOU Project. Currently, the Project Sponsors are continuing investigations to evaluate the "Whitney Creek" alternative, consisting of a surface diversion from the Eagle River in the area of Camp Hale with a dual purpose storage reservoir / pumping forebay on Homestake Creek to store West Slope yield, and regulate and feed East Slope yield up to Homestake Reservoir. The Project Sponsors hope to conduct field reservoir siting studies for this possible Project component during the summer of 2014. They will continue to examine additional project variations and components that will be needed to develop the full yield contemplated for the ERMOU Project.
4	
5	

	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	I.A - Increase Raw Water Storage	I.B - Improve water court process	I.C - Develop land use policy improvements	I.D - Protect mainstem water rights	I.E - Define potential natural impacts to water suppl	I.F - Raise awareness of obstacles facing water providers	I.G - Ensure adequate safe drinking water	II.A - Reduce agricultural water shortages	II.B - Develop land use policy to reduce agricultural water to municipal (ATM) transfers	II.C - Identify agricultural production incentives	II.D - Reduce the potential for transmountain diversions (TMDs)	II.E - Increase agriculture community education on water issues	II.F - Improve agricultural efficiency, preservation, and conservation	III.A - Identify reaches that are at risk or will be in t future	III.B - Protect rivers, streams, lakes and riparian ar	III.C - Protect and improve water quality	III.D - Preserve recreational flows
2																	
3	x						x										
4	x							x									
5	x																

Figure A2 continued.

Gunnison Basin Implementation Plan - Proposed Project List (4/17/15)

Note: Relative rank within each tier does not indicate a higher priority. Legend provided below table

Ref #	Tier	Project	Project Sponsor	Water District	Sponsor Type	Use Type	Project Type	Geographic Extent	Basin Goals	Included in SWSI 2010?
1	1	Gunnison Basin Roundtable 2015 Education Action Plan Activities	Gunnison Basin Roundtable	All	SE	AG, M&I, NC	NS	MD	1, 2, 7, 9	N
2	1	Regional Conservation Partnership Program (RCPP)	CRWCD, TU, TNC, UVWUA, NFWCD, CWCD, BPWCD	40, 41	P	AG, NC	S, NS	MD	1, 2, 3, 5, 6, 7, 8	N
3	1	Inventory of Irrigation Infrastructure Improvement Needs - District 28	Upper Gunnison River Water Conservancy District	28	SE	AG, NC	NS	SD	1, 3, 5, 7, 8	N
4	1	Cole Reservoirs #4 and #5	Bill Martin	40	SE	AG	S	SD	1, 3, 8	N

Project Readiness (Feasible by 2025?)	Point of Contact: Name	Point of Contact: Email	Point of Contact: Phone Number	Purpose	Water Gained or Saved (AF)	Estimated Completion Date	Estimated Budget
Yes	George Sibley	george@gard-sibley.org		Creation and implementation of the 2015 GBRT Education Action Plan (EAP) to include such items as: active education or stewardship programs for high school students, a Basin Water Leaders program at universities in the Basin for college students to develop and deliver education programs for public K-12 schools, printed materials about "comfortable and intelligent desert living", sub-basin-specific half-day programs and printed materials for decision makers, etc.	NA	Ongoing	TBD
Yes	Cary Denison			Modernize and improve off and on farm water transmission and application infrastructure in Lower Gunnison to accurately meet ag water demands while improving flow and water quality.	TBD	Ongoing	50,000,000
Yes	Frank Kugel	fkugel@ugrwcd.org	970-641-6065	Systematically examine and prioritize projects to restore, maintain, or modernize significant agricultural water supply infrastructure. Inventory will target proposed projects to maximize impact on meeting agricultural shortages, preserving existing uses, and in some cases meeting other purposes such as stream connectivity and flow.	NA	2018	100,000
Yes	Bill Martin	NA	970-255-7406	This project involves the repair or replacement of the main headgate diversion from Surface Creek and cleaning of the associated inlet ditch. It would preserve and restore the use of an important pre-Compact water	146	2015	50,000

Figure A3. Screenshots of Gunnison Basin IPP dataset (GBIP_Simplified_Project_List_4-17-15.xlsx, "Planned Projects", "NC Protections & Monitoring" and "Completed_Ongoing" worksheets).

Ref #	Project	Project Sponsor	Water District	Sponsor Type	Use Type	Project Type	Geographic Extent	Basin Goal	Included in SWSI 2010?	Project Readiness (Feasible by 2020?)	Point of Contact : Name	Point of Contact : Email	Point of Contact : Phone Number	Purpose
1	HCCA Project		40		NC		SD		Y			Jeff, DK, Tom		
2	North Fork River Improvement Association - NFRIA		40		NC		MD	5	Y					
3	Fish Screen & Ladder at Redlands Power Canal	RWAPA (formerly USBR & FWS)	42	P	NC	S		5	N					Fish ladder and screen allow for endangered fish migration while preventing migration by nonnative fish.
4	Redlands Water and Power Canal	Redlands Power and Water Company	42	SE	NC	NS		5	N					
5	NPS WQ, Curecanti NRA (Aspinall Reservoirs) Sites		59		NC	NS			N					NPS effort to protect aquatic life and recreational Colorado WQ standards in Curecanti NRA and Black Canyon of the Gunnison NP.
6	ONRW Designation -- Streams Draining West Elks (heading in and flowing within Gunnison County only) to Curecanti NRA		59		NC	NS		5	N					NPS effort to protect quality and aquatic life of Curecanti NRA.
7	Roaring Judy	CPW	59	SE	NC	NS		5	N					Protect autumn minimum discharge needs for upstream migration of kokanee salmon.

Funding Year	Project	Description	Amount Funded	Funding Source
2007	Lake San Cristobal Controlled Outlet Structure (Part 1)	Hinsdale County and the Upper Gunnison River Water Conservancy District (UGRWCD) explored the feasibility of constructing a new permanent control structure at the outlet of Lake San Cristobal. The new structure allows for more controlled releases to regulate the lake level and prevent failure of the structure during flood events. The additional stored water resulting from the project will be used primarily as augmentation water within the Lake Fork of the Gunnison River. Other beneficial uses may include agriculture, recreation, and releases for instream flows.	40,000	WSRA
2007	Off-System Raw Water Storage Project 7 Water Authority/Uncompahgre Valley Water Users Association (Part 1)	The proposed new reservoir would be located on BLM and/or private land in the vicinity of Fairview Reservoir would have a capacity sufficient to supply P7 customers with domestic water for up to one full year. A detailed evaluation and comparative analysis of the potential sites was performed to identify the best reservoir location.	56,700	WSRA
2007	Orchard City Water Reservoir Project (Task 1-3)	This project involves the design of an approximately 500 acre foot off-channel reservoir to serve the municipal/domestic needs of	60,000	WSRA
2007	Orchard City Water Reservoir Project (Remaining Tasks)		480,000	WSRA
2007	Overland Reservoir Dam Expansion/Restoration (Part 1)		68,000	WSRA

Figure A3 continued.

No.	Project	Project Description	GIS Shapefile
1	MacFarlane Reservoir **	Outlet work and toe drain improvements to existing reservoir (WDID 4703614)	CUProjects_Point
2	Evapotranspiration Project	Continued support of climate station operation and lysimeter data collection to develop high altitude ET	N/A
3	Walden Reservoir	Dredge reservoir bottom to increase capacity for new use (WDID 4703627)	CUProjects_Point
4	Basinwide Augmentation Plan	Develop basinwide plan to augment various uses, potentially including augmenting depletions from livestock, industrial or municipal development in the basin	N/A
5	Hanson and Wattenberg Ditch Acreage	Irrigable acreage (1,612 acres) potentially served by rehabilitated Hanson and Wattenberg Ditch or new North	CUProjects_Poly
6	Proposed Streamgage Installation	Identify and potentially install new streamflow gages at key locations	N/A
7	Storage Protocol	Protocol for storage under the Equitable Apport. Decree	N/A
8	Irrigation Season Protocol	Protocol to define irrigation season in the basin	N/A
9	Irrigated Acreage Assessment Protocol	Protocol for delineating irrigation acreage under the Equitable Apport. Decree	N/A
10	Proposed Willow Creek Reservoir	New reservoir near Willow Creek crossing of Highway 125, potentially filled from Willow Creek or Illinois River	CUProjects_Point
11	Dam Ditch Headgate Improvement **	Redesign/replace existing headgate to increase capacity, ease maintenance issues and improve fish connectivity (WDID 4700582)	N/A

No.	Project or Segment	Project or method	Primary focus	To benefit:	Contact	GIS Shapefile
1	Bear Draw	Relocate trail out of wetland	Wetlands	Fishery, wetlands, amphibians	USFS	ERProjects_Point
2	BLM Water quality/quantity: Various reaches in North Platte Basin	Monitor water quality/quantity	Water quality/quantity	Fishery, wildlife, livestock, water quality	BLM	N/A
3	Boettcher Lake Rehabilitation	Rehabilitate/replace irrigation infrastructure	Improve/increase irrigated meadows	Waterfowl habitat	DU, Private Owner	ERProjects_Point
4	Boreal Toad Studies - Twisty Park/County Wide	Boreal Toad Studies	Species of concern	Amphibians	CPW	N/A
5	Brown Creek Fence	Improve water quality and riparian habitat from improved grazing management through fencing	Water quality, riparian habitat	Fishery, wetlands, amphibians	USFS	ERProjects_Point
6	Brownlee SWA- North Platte River	Brownlee SWA river channel/riparian corridor habitat/water quality improvements	Improve fishery habitat, water quality, erosion control	Fishery, riparian plant community	CPW	ERProjects_Point
7	Camp Creek	Remove fill & culverts from wetland	Wetlands, water quality, aquatic passage, stream function	Fishery, wetlands, amphibians	USFS	ERProjects_Poly
8	Camp Creek	Replace double culverts	Stream function, aquatic passage	Fishery	USFS	ERProjects_Poly

Figure A4. Screenshots of North Platte Basin IPP dataset (NPBIP_IPPLists.xlsx, "CU Projects" and "NCNA_ER Projects" worksheets).

ID	Project	Sponsor	Cost				
			Total	2014	2015	2016	2017
1	Boatable Days Flow Evaluation	Trout Unlimited	$19,500		$11,167	$4,167	$4,167
2	Conejos River System Confluence Management	Conejos Water Conservancy District	$582,000	$193,000	$355,000	$34,000	
3	Consolidated Ditch Diversion and Headgate Rehabilitation Project	Colorado Rio Grande Restoration Foundation, NRCS, Private	$1,500,000	$43,450	$173,850	$1,258,850	$23,850
4	Doppler Radar Weather Forecasting Project	RWEACT, CWCB, USFS, NWS	$393,750	$78,750	$78,750	$78,750	$78,750
5	Economic Impact Statement Analysis of the Effects of Reduced Groundwater Irrigation on the Ro Grande Basin	San Luis Valley Council of Governments	$80,364		$38,932	$41,432	
6	Groundwater Management Subdistricts	Rio Grande Water Conservation District	$66,000,000		$4,125,000	$4,125,000	$4,125,000
7	Hydrologic Recharge Feasibility Study for Rio Grande Basin Augmentation	San Luis Valley Irrigation Well Owners, Inc.	$180,000	$80,000	$100,000		
8	Increasing Water Holding Capacity of Soil for Agricultural Sustainability	Rio Grande Watershed Conservation and Education Initiative	$5,403,164	$905,861	$1,801,055	$1,801,055	$895,194

	Project or Method	Needs Met				Basin Goals Met													
		Ag	M&I	Env & Rec	Water Admin	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Boatable Days Flow Evaluation			x	x	✓	✓				✓	✓			✓	✓	✓	✓	✓
2	Conejos River System Confluence Management Project	x		x		✓	✓		✓	✓	✓				✓	✓	✓		✓
3	Consolidated Ditch Diversion and Headgate Rehabilitation Project	x		x	x	✓	✓		✓	✓	✓			✓	✓	✓	✓		✓
4	Closed Basin River / Creek and Wetland Water Table Study	x		x	x	✓	✓	✓	✓		✓				✓	✓	✓	✓	✓
5	Doppler Radar Weather Forecasting Project	x	x	x	x	✓	✓				✓	✓			✓	✓	✓	✓	✓

	Project or Method Types	Needs Met				Basin Goals Met													
		Ag	M&I	Env/Rec	Water Admin	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Acquisition of Replacement Supplies for M&I Pumping Depletions	x	x	x	x		✓	✓	✓	✓	✓	✓			✓		✓		
2	Adaptive Management to Mitigate Climate Change Impacts	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Alternative Agriculture Methods and Improved Irrigation Efficiency to Reduce Consumptive Use	x		x	x	✓	✓	✓	✓	✓		✓	✓		✓				
4	Alternative Cropping Education and Promotion Program	x		x			✓	✓	✓	✓		✓	✓						
5	Basin-wide Water Public Education Program	x	x	x	x	✓	✓	✓			✓		✓		✓	✓	✓	✓	✓

Figure A5. Screenshots of Rio Grande Basin IPP dataset (Updated Tables 8-10_Project Sheet Summaries_09-11-2017.xlsx, "Budget", "Specific Project Needs Met" and "General Projects" worksheets).

	A	B	C	D
8	**BNDSS IPP ID**	**BNDSS IPP Category**	**Basin**	**Project**
9	Morgan_UIPP_FIB	UIPP	South Platte	Morgan County Unspecified IPP Firming In-Basin
10	Morgan_UIPP_GIES	UIPP	South Platte	Morgan County Unspecified IPP Grow Into Existing Supply
11	ClearCreek_UIPP_FIB	UIPP	South Platte	Clear Creek County Unspecified IPP Firming In-Basin
12	ClearCreek_UIPP_GIES	UIPP	South Platte	Clear Creek County Unspecified IPP Grow Into Existing
13	FtMorganCBT&AugPlan	IPP	South Platte	Fort Morgan CBT & Augmentaion Plan
14	WindyGap	IPP	South Platte	Windy Gap Firming

	E	F	G	H	I
8	**SWSI 2010 Type**	**BNDSS IPP Type**	**BNDSS Yield [Ac Ft]**	**BNDSS Sponsor ID**	**Providers**
9	FIB	MDIB	2081		
10	GIES	GIES	2081		
11	FIB	MDIB	899		
12	GIES	GIES	899		
13	FIB	MDIB		FtMorgan	Fort Morgan, City of
14	FTB	TS	30000	NCWCD	Northern Colorado Water Conservancy District, Erie, Lafayette, Longmont, Louisville, Broomfield, Loveland, Greeley, Fort Lupton, Superior, Central Weld County Water District, Evans, Little Thompson Water District

	J	K	L	M	N	O	P	Q
8	**Estimated Cost**	**Estimated Completion Date**	**Storage**			**Data Sheet Priorities - by Yield-BNDSS & Proportion of Basin Yield**	**Point of Contact**	**Email Address**
9						3	Allyn Wind	wind@kci.net
10						3	Allyn Wind	wind@kci.net
11						3	Bert Weaver	bweaver@co.clear-creek.co.us
12						3	Bert Weaver	bweaver@co.clear-creek.co.us
13							Brad Curtis	bcurtis@cityoffortmorgan.com
14	261000000		90000			1	Brian Werner	bwerner@ncwcd.org

	R	S	T	U	V	W	X	Y	Z	AA
8	**Comments**	**Date IPP Data Sheet Sent via Email**	**Alternate Contact Data Sheet Sent via Email**		**IPP Data Sheet Complete?**	**Condensed IPP data sheet sent via email**	**Condensed IPP Survey Received**	**Change in Yield (AFY)**	**Change in Estimated Year of Completion**	**Comment on Returned Survey**
9		x		0		x				
10		x		0		x				
11		x		0		x				
12		x		0		x				
13		x		0		x				
14		x		1	x				2020	

Figure A6. Screenshots of South Platte / Metro Basin IPP dataset Gap Analysis (SPMetro HDR Phase 2.xlsx, "BNDSS IPP List" worksheet).

	A	B	C	D	E	F	G	H
3		**PROPOSED IPPs**						
4	**ID**	**Date**	**Sub Basin**	**NC/C/B**	**Description**	**County**	**Status**	**Remaining Steps**
5	1-A	Jul-13	Animas	C	Animas-LA Plata Project. Utilization of Animas-LA Plata Project water supplies for multiple purposes by Southern Ute Indian Tribe, Ute Mountain Ute Indian Tribe, Animas-LA Plata Water Conservancy District, City of Durango, LA Plata West Water Authority, Lake Durango Water Authority, Colorado Water Conservation Board, LA Plata Archuleta Water District, and others that may be entitled to ALP water. The utilization could include treatment and conveyance (pumps and pipelines) of raw or treated water.	La Plata, Archuleta, Montezuma	Not Complete	
6	2-A	Jul-13	Animas	NC	Lake Nighthorse Recreation. Provide boating, fishing, and swimming opportunities.	La Plata	Not Complete	
7	3-A	Oct-13	Animas	C	La Plata Archuleta Water District. Design and construction of a treatment plant for ALP water possibly in coordination with City of Durango. Transmission and distribution pipelines to convey treated water from the treatment plant to customers.	La Plata	Not Complete	Investigate potential partnerships, acquire land, design and construct
8	4-A	SWSI 2010	Animas (Florida)	C	Florida Water Conservancy District. Need for industrial, municipal, domestic, commercial, wildlife, wetlands, exchange, augmentation, hydropower, irrigation, and fire protection water within the Florida River basin. The District has initiated institutional changes by entering into a water service contract with the BOR to use decreed 114 AF water right for augmentation purposes and has obtained a 2,500 AF water right to address the aforementioned uses. Utilization of the 2,500 AF will require another water service contract with the BOR, voluntary water turn in by users, and irrigation system efficiency improvements by the Florida Mesa Ditch Companies that would firm up agricultural delivery and provide additional water supply for those other uses in Lemon Reservoir through the reduction of losses in the delivery system.	La Plata	Not Complete	Finalize water service contract with BOR and Complete additional irrigation system improvements

	I	J	K	L	M	N	O
		IPP Contact Information					
	Need Addressed	**Sponsors**	**Lead contact & Source of Info.**	**Project vs. Process**	**Project ready for implementation NOW?**	**Does the need exist today?**	**Already received some WSRA funding?**
	Municipal water supply	Southern Ute Indian Tribe, Ute Mountain Ute Indian Tribe, Animas-LA Plata Water Conservancy District, City of Durango, LA Plata West Water Authority, Lake Durango Water Authority, Colorado Water Conservation Board, LA Plata Archuleta Water District, and others that may be entitled to ALP water		Both	Yes	Yes	Yes
	Recreation	Animas La Plata Water Conservancy District, Bureau of Reclamation, La Plata county, City of Durango		Project	Yes	Yes	Yes
	Municipal water supply	La Plata Archuleta Water District	Lead and Source: Ed Tolen	Project	No	Yes	Yes
	Municipal, Industrial & Agricultural water supplies	Florida Water Conservancy District	Lead & Source: Florida Water Conservancy District	Project	Yes	Yes	Yes

Figure A7. Screenshot of Southwest Basin IPP dataset (SWBRT Draft IPP List Clean copy.xlsx, "Animas" worksheet).

	A	B	C	D	E	F
1	ID	Name	Location	Additional Details	Proponents	GIS File
2	1	Upper Yampa backwater modifications	Initial projects located within Chuck Lewis SWA and within Steamboat Springs on the south end of city limits. However, multiple sites throughout the Upper Yampa River corridor could benefit from alterations of backwater habitats. Benefits to the Upper Colorado Endangered Fish Recovery Program by implementing one element of the program's non-native fish control strategy. Also benefits other environmental attributes of the riverine ecosystem. All other elements of the nonnative fish control strategy are part of keeping the Yampa River Basin PBO in place below.	Stakeholders would develop multi-faceted projects implementing habitat modifications/restoration activities to alleviate unnatural backwater habitats to minimize non-native species recruitment and improve ecological functions of the riverine system. Multiple recreational benefits would be realized as well.		IPP_Point
3	2	Loudy Simpson access and recreational river enhancements	Yampa River at Loudy Simpson Park in Craig, Colorado.	Provide improved access to river and restoration/rebuild of riffle for non-consumptive needs specific to increasing recreational opportunities and float boating in the Yampa River at the park.	Possibly Moffat County Tourism Association	IPP_Point
4	3	Upper Elkhead Creek Stream Restoration	Stream restoration will occur on approximately 16 miles of Elkhead Creek and its tributaries from the southern end of California Park upstream to the headwaters.	Indirect benefits to consumptive uses include a reduction in sediment entering Elkhead Reservoir.	Forest Service	IPP_Reach

	A	B	C
1	Map ID	**Name of Project**	**Location**
2	1	Elkhead Reservoir Enlargement Project	Yampa: Elkhead Creek
3	2	Fish Creek Direct Flow and Storage	Yampa: Fish Creek in Buffalo Pass Area
4	3	Lake Avery Enlargement	White: Expansion to Big Beaver Reservoir (Lake Avery)
5	4	Little Bear 1 Reservoir	Yampa: Fortification Creek Basin
6	5	Milk Creek Reservoir	Yampa: Milk Creek

D	E	F	G
In BIP model?	**Propoents**	**GIS File**	**Description**
No	Colorado River Water Conservation District	IPP_Point	pg 113
No	Mt Werner Water / City of Steamboat Springs	IPP_Point	pg 113
Yes	Yellow Jacket Water Conservancy District	IPP_Point	pg 157
Yes		IPP_Point	pg 153
Yes	Juniper Creek WCD	IPP_Point	pg 155

Figure A8. Screenshots of Yampa / White Basin IPP dataset (BIP_IPPs.xlsx, "NonConsumptive" and "Consumptive" worksheets).

Appendix B: Identified Projects and Processes Maps

This appendix provides an explanation of data availability and how locations were determined for IPPs that lacked location data.

Contents

Introduction

The Statewide Water Supply Initiative (SWSI) projects have resulted in "Identified Projects and Processes" (IPP) datasets for each Basin Roundtable. IPP datasets for consumptive projects are typically lists of projects in Excel workbooks defined at varying levels of detail and may or may not include spatial data. These datasets have been updated and used at various times as input to SWSI, Basin Implementation Plans (BIPs), Colorado Water Plan (CWP) and other studies.

Due to the complexity of studies, variation by basin and number of entities involved, IPP data across basins are inconsistent in content and format. The SWSI Update is reviewing handling and formatting of IPP data to ensure that useful data products can be created and analyses can be performed consistently. In particular, it is desirable to establish consistency in data and stewardship of data, as well as to confirm the most current IPP datasets.

One of the most desirable products from this effort is one or more maps of IPPs filtered by different criteria. This document describes a first attempt to create a statewide map of IPPs that is focused on consumptive IPP projects, although environmental and recreational (E&R, or nonconsumptive) projects are included for some basins if data were readily available. In order to create a basic map, latitude and longitude coordinates are required. For several basin datasets, coordinate data were incomplete or missing entirely. The remainder of this memo describes the methods the Open Water Foundation used to obtain coordinate data for consumptive IPPs.

Data Availability

Availability of coordinate data for IPPs varied by basin. The following describes the level of coordinate data provided to OWF by basin:

- **Arkansas Basin** – latitude and longitude coordinates were provided in the Excel file of IPPs for many, but not all, IPPs. Coordinate data were available for both consumptive and E&R projects.
- **Colorado Basin** – no coordinate data were provided; IPPs were categorized by "region" within the basin.
- **Gunnison Basin** – shapefiles of point data for both consumptive and E&R projects were provided, but not all projects were included in the shapefiles.
- **North Platte Basin** – shapefiles of point and line data for both consumptive and E&R projects were provided for most, but not all, projects.

- **Rio Grande Basin** – a .kmz file of points representing IPPs for both consumptive and E&R projects was provided, but not all projects were included.
- **South Platte and Metro basins** – no coordinate data were provided; county designation was included in the Excel file.
- **Southwest Basin** – shapefiles of point and line data for both consumptive and E&R projects were provided, but not all projects were included in the shapefiles.
- **Yampa-White Basin** – shapefiles of point and line data for both consumptive and E&R projects were provided, and all consumptive projects were included in the shapefiles.

For basins such as the North Platte, Southwest and Yampa-White that contained both point and line data, points tended to be associated with consumptive projects, whereas lines tended to be associated with E&R projects. At this time, OWF has not attempted to convert line data into point data. If an E&R project contained a point location, then that project is included in the map. Therefore, while this map focuses on consumptive IPPs, it should be understood that some E&R IPPs are also included.

Latitude/Longitude Flag Descriptions

In order to document and keep track of the methods used to determine coordinate locations for IPPS, OWF created a "Lat_Long_Flag" column in the IPP dataset. The flag consists of a 1- or 2-character designation; the first character is a letter and the second character is a number. The designations are as follows:

- G = coordinates are good; provided by the consultant in either an Excel datasheet or GIS shapefiles
- g = coordinates are based on an estimation technique:
    - g1 = coordinates based on centroid of county boundary
    - g2 = coordinates based on centroid of municipal boundary
    - g3 = coordinates based on centroid of water district boundary
    - g4 = coordinates based on location of reservoir
    - g5 = other; based on a location described in the IPP name, such as a school or the Shoshone Plant
    - g6 = coordinates based on centroid of county boundary, then offset by 0.02 (or 0.04, 0.06, etc.) degrees longitude to allow for visibility on map
    - g7 = coordinates based on centroid of municipal boundary, then offset by 0.02 (or 0.04, 0.06, etc.) degrees longitude to allow for visibility on map
    - g8 = coordinates based on centroid of water district boundary, then offset by 0.02 (or 0.04, 0.06, etc.) degrees longitude to allow for visibility on map
    - g9 = coordinates based on general location on stream
    - g10 = coordinates based on address of water provider, ditch company, etc.
    - g11 = coordinates based on primary diversion structure of transbasin diversion project
    - g12 = coordinates based on ditch's diversion structure
    - g13 = coordinates based on ditch's diversion structure, then offset to allow for visibility on map
    - g14 = coordinates based on IPP-Projects layer from Colorado Mesa University's Colorado Headwaters Map (applies to Colorado Basin only)
- M = coordinates missing in original source and therefore values cannot be provided:

- M1 = coordinates not determined because general location cannot be determined from IPP name or description
- M2 = coordinates not determined because IPP is an E&R IPP

IPPs designated with a g6, g7, g8 or g13 flag were necessary in order to allow IPPs to be shown on the map that represented the same basic location. An effort was made to standardize how much the locations were offset, such as by 0.02 degrees longitude. An example is the numerous IPPs that were generally located within Grand County. However, IPPs associated with a reservoir did not use this offsetting technique and instead were manually located to make sure they were placed within the reservoir's boundary.

For most basins, coordinate data could not be determined for several IPPs because the name or description of the IPP was too generic, such as "Improvements to Ditch and Canal Diversion Structures". In these instances, the Lat_Long_Flag designation is M1 and the IPP could not be included in the map. Therefore, it should be understood that the IPP map does not contain the entire list of consumptive IPPs.

Appendix C: Statewide IPP Locations Estimates

This is an electronic appendix that include an exhaustive list of IPPs across the state. The appendix is organized by basin and includes flags related to the how the location (latitude/longitude) was determined. See Appendix B for additional detail.

File name: *AppendixC - Statewide-IPPs-locations.xlsx*