Historical Crop Consumptive Use Analysis

San Juan/Dolores River Basin

Final Report

2016

Acknowledgments

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1.0 Executive Summary

The San Juan River Basin historical crop consumptive use analysis was performed on a monthly basis for the period from 1950 through 2013 to support the Colorado Decision Support System (CDSS). The CDSS project was developed jointly by the State of Colorado Water Conservation Board and the Division of Water Resources. The objective of the historical crop consumptive use portion was to quantify 100 percent of the basin's historical crop consumptive use. This report documents the input and results of the historical crop consumptive use analysis completed in 2016.

Information used in this model dataset is based on available data collected and developed through the CDSS, including information recorded by the State Engineer's Office. The model dataset and results are intended for basin-wide planning purposes. Individuals seeking to use the model dataset or results in any legal proceeding are responsible for verifying the accuracy of information included in the model.

1.1 Background

The San Juan/Dolores Basin is located in southwestern Colorado and encompasses approximately 10,172 square miles. The San Juan/Dolores River main stem headwaters rise in the Rocky Mountains at the continental divide near Rico, Colorado at an elevation of 13,007 feet and flows westerly to about 4,500 feet near the city of Bluff, Utah. Most streamflow originates from snowmelt in the surrounding mountains. Average annual precipitation in the basin ranges from 7 inches in the southwest corner of Colorado to 45 inches just east of Silverton. Crop irrigation accounts for the largest water use in the basin.

1.2 Approach

The San Juan/Dolores River historical crop consumptive use analysis was performed using StateCU, a generic, data driven consumptive use model and graphical user interface. The objective of the model is to develop monthly consumptive use estimates for the assessment of historical and future water management policies. Key information used by the model to assess historical consumptive use include irrigated acreage, crop types, monthly climate data, diversion records, and well information.

The historical crop consumptive use analysis also provides information and consumptive use estimates for the basin surface water model (StateMod) analysis of the San Juan/Dolores River Basin.

1.3 Results

Table 1 presents the average annual acreage and historical crop consumptive use analyses results for the 1950 to 2013 study period. As shown, the irrigation water requirement (IWR) averages 495,561 acre-feet per year while water supply-limited consumptive use averages 337,366 acre-feet per year. The average annual shortage in the basin is 32 percent. Higher shortages occur in the Florida River basin tributary to the Animas Basin (District 30), La Plata River basin (District 33), San Miguel River basin (District 60), the Disappointment Creek Basin (District 69), and the West Dolores Creek basin (District 71).

Table 1: Average Annual Acreage and Consumptive Use Results 1950 through 2013

Water District – Basin	Average Acres	IWR (acre-feet)	Supply-Limited CU (acre-feet)	Percent Short
29 – San Juan River	12,407	26,596	18,758	29%
30 – Animas River	29,804	66,734	39,682	41%
31 – Los Pinos River	45,615	109,322	98,956	9%
32 – McElmo Creek	49,169	93,843	78,434	16%
33 – La Plata River	20,106	40,140	13,417	67%
34 – Mancos River	11,121	28,918	17,367	40%
60 – San Miguel River	31,722	67,624	30,749	55%
61 – Paradox Creek	3,039	6,273	4,954	21%
63 – Dolores River	2,387	7,001	6,237	11%
69 – Disappointment Creek	2,079	3,981	1,578	60%
71 – West Dolores Creek	6,876	16,806	7,259	57%
73 – Little Dolores River	2,516	6,530	4,151	36%
77 – Navajo River	3,087	6,665	5,458	18%
78 – Piedra River	7,225	15,129	10,366	31%
San Juan/Dolores Basin Total	227,151	495,561	337,366	32%

Figure 1 presents historical acreage by crop type for 2010. The irrigated land coverages for 1993, 2005, and 2010 were considered in the analysis. Vegetable crops represent less than one tenth of a percent of the total irrigated acreage in the basin, therefore this crop has been omitted from the figure below. As shown, grass pasture is grown on the majority of irrigated land in the basin to support cattle ranching.

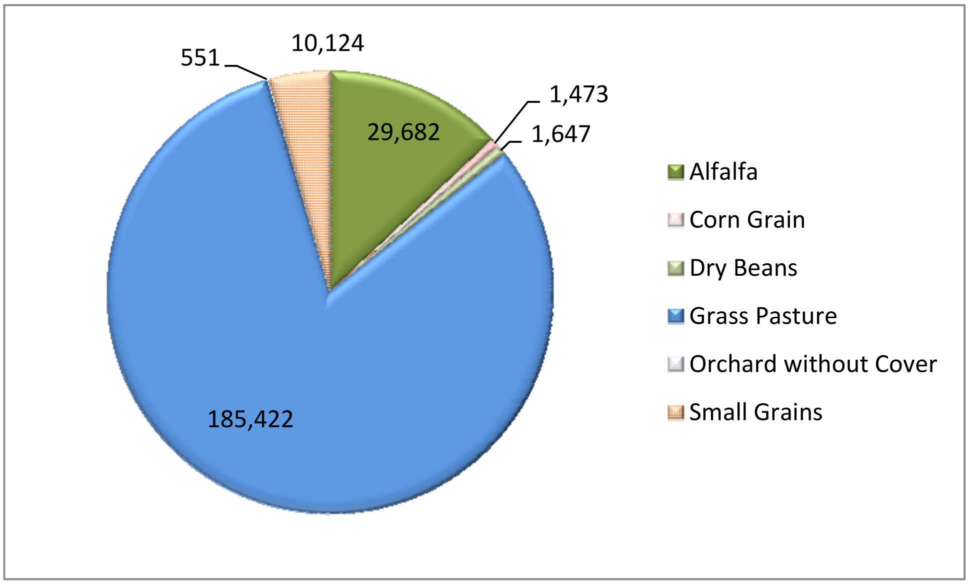

Figure 1: 2010 Irrigated Acreage by Crop Type

Figure 2 presents the annual historical acreage; irrigation water requirement and supply limited consumptive use for the study period. Note that the Dolores Project and associated irrigated acreage came online during the study period; Dove Creek Canal began irrigating crops in 1988 and Towaoc Canal in 1994. Acreage decreased in several areas due to prolonged supply limitations in the 2000s. **Figure 2** illustrates the irrigated acreage variation alongside the irrigation water requirement and supply limited consumptive use. Because the irrigated acreage and crop type vary over the study period, the most recent (2010) historical irrigated acreage was used to develop the statistics throughout the memorandum.

The pronounced yearly variations in irrigation water requirement are attributed to climate variability in the analysis (temperature and precipitation). The percent of irrigation water requirement not satisfied averaged 32 percent over the study period. Shortages averaging 28 percent from 1995 through 1999 are consistent with normal to above average stream flows. Shortages from 2001 to 2004, averaging 43 percent, represent below average stream flows. Shortages reached a maximum of 61 percent in 2002 due to extreme drought conditions.

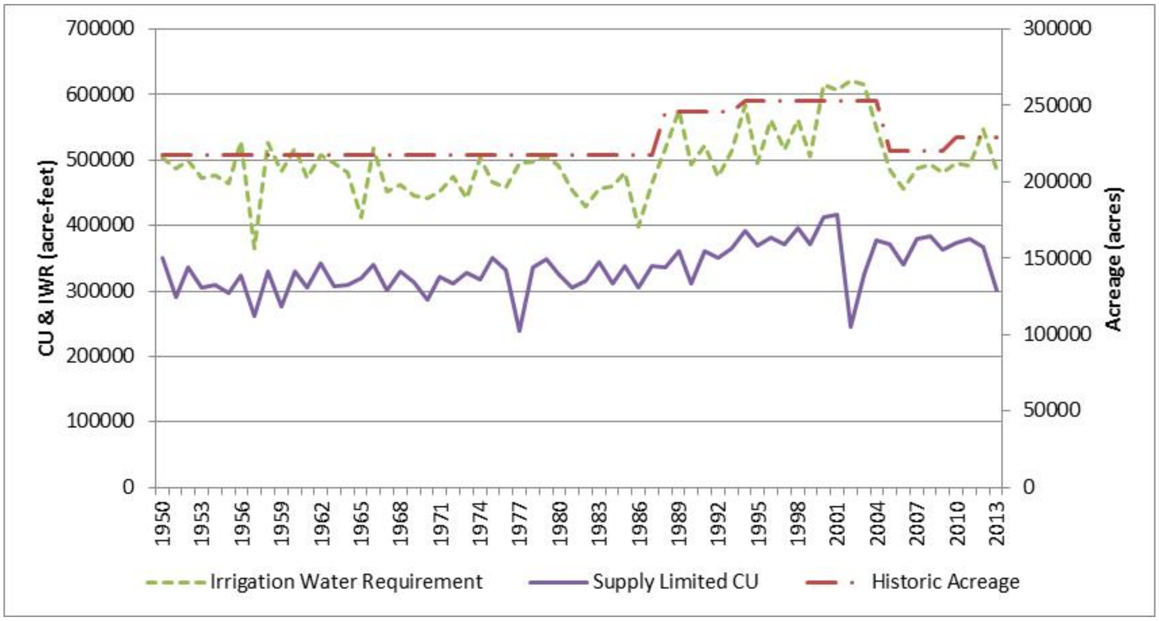

Figure 2: Historical Acreage, Irrigation Water Requirement, and Supply Limited CU 1950 through 2013

Figure 3 shows the annual estimated diversions from surface water to meet crop irrigation requirement and the average annual calculated system efficiency. The average annual surface water diversions from 1950 through 2013 were 865,287 acre-feet.

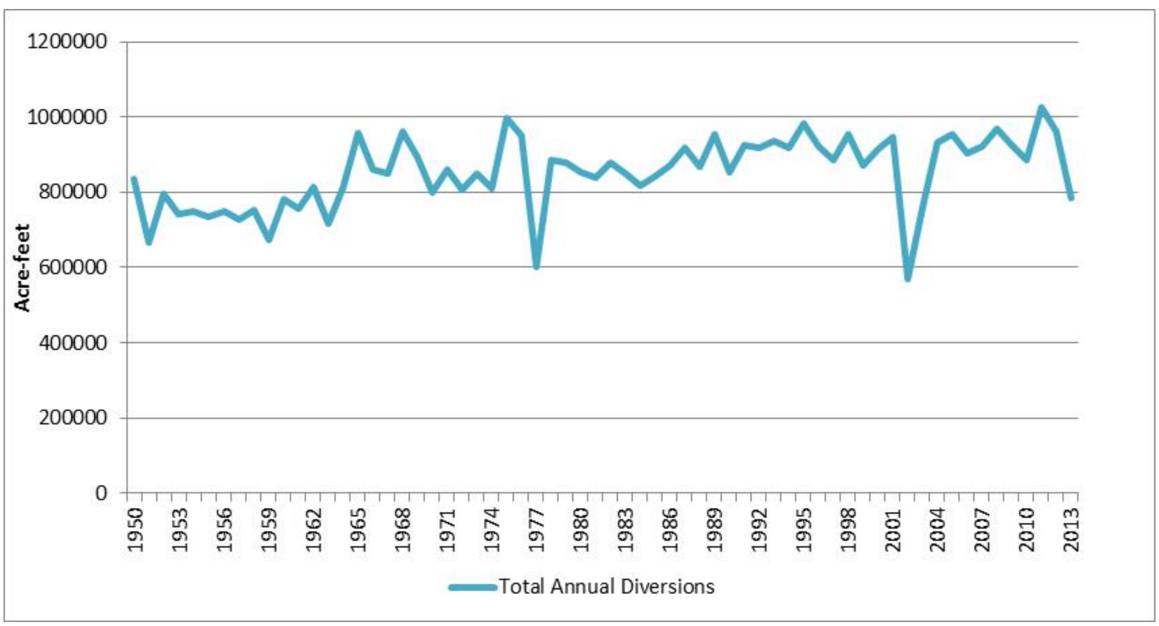

Figure 3: Annual Surface Water Diversions 1950 through 2013

2.0 Introduction

The estimation of historical crop consumptive use in the San Juan/Dolores River Basin and the tool used to perform the analysis are documented in three major reports as follows:

1. This report describes climate and crop data from HydroBase used in the historical consumptive use analysis, and the parameters used in analysis, including Blaney-Criddle crop coefficients and characteristics. The document all summarizes the results of the analysis; total irrigation water requirement and the supply-limited total consumptive use for the San Juan River basin.

2. San Juan River Basin Water Resources Planning Model User's Manual describes the development of the San Juan River Basin StateMod surface water model, including the consumptive use analysis used to determine the irrigation demands for the model. This document summarizes the process and results of developing the historical diversions and the structures list for the historical consumptive use analysis.

3. The StateCU Documentation describes the consumptive use model and graphical user interface used to perform the crop consumptive use analyses conducted as part of the Colorado River Decision Support System.

This Historical Crop Consumptive Use Analysis Report has not attempted to reiterate the detailed analyses and results of the previous efforts performed in support of the final historical crop consumptive use analysis. Instead, it summarizes the major results of each technical memorandum. Supporting memorandum and reports are available on the CDSS website.

2.1 Basin Description

The San Juan River basin extends into portions of New Mexico on the south and Utah to the west, contributing approximately 23,000 square miles of drainage area to the San Juan River at the gage in Bluff, Utah. About one third of this area, or 7,200 square miles, lies within Colorado. Elevations within the basin range from over 13,000 feet in the headwaters at the continental divide, to about 4,050 feet near the city of Bluff, Utah. The lowest point in the basin within Colorado is in the Four Corners area, with an elevation at about 4,800 feet. The major tributaries to the San Juan River include the Navajo River, Piedra River, Los Pinos River, Animas River, Florida River, La Plata River, Mancos River, and McElmo Creek. Average annual streamflow for years 1971 to 2013 in the San Juan River above Navajo Reservoir is about 425,000 acre-feet. Prior to completion in 1971 of the San Juan-Chama project, which diverts water from the San Juan River basin to the Rio Grande basin in New Mexico, the annual average streamflow above Navajo Reservoir was 457,900 acre-feet. At the Bluff, Utah gage, the annual average streamflow is 1,558,000 acre-feet.

The Dolores River rises in the San Juan National Forest near Bolam Pass, just north of the San Juan River basin. Some elevations around the headwater areas lie above 13,700 feet. The river flows southwest to McPhee Reservoir where it turns to flow to the northwest until it leaves Colorado and eventually joins the Colorado River near Cisco, Utah. The drainage area upstream of the gage at Cisco is approximately 4,580 square miles. The drainage area upstream of the most downstream Colorado gage on the Dolores River, at Gateway, Colorado is about 4,350 square miles. Major tributaries to the Dolores River include the West Fork of the Dolores, Lost Canyon Creek, Disappointment Creek, West Paradox Creek, and the San Miguel River. The mean annual flow at Cisco, Utah for the 32 years prior to the construction of McPhee Reservoir, and associated Dolores Project in 1986 was 612,200 acre-feet. After construction the mean annual flow was 435,500 acre-feet between 1986 and 2013. Part of the decrease in flow can be attributed to drought conditions in the 2000s.

Figure 4 shows the Water Districts represented in the San Juan/Dolores River StateCU model.

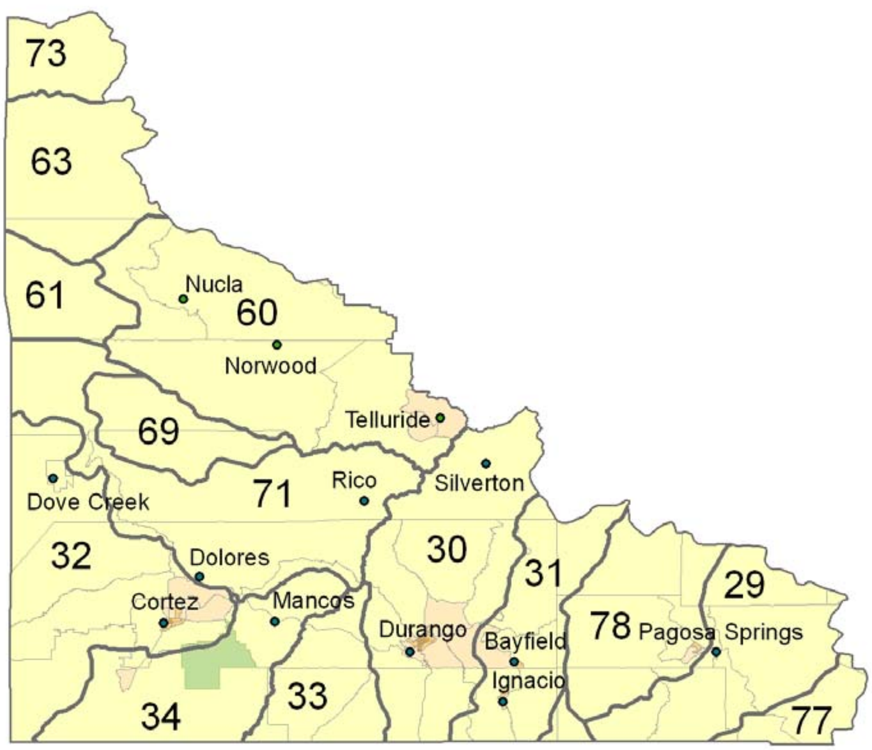

Figure 4: San Juan/Dolores River Basin

2.2 Definitions

Several terms used in this report have been broadly used in other studies. The following definitions are consistent with the American Society of Civil Engineers Manuals and Reports on Engineering Practice No. 70 - Evapotranspiration and Irrigation Water Requirement.

Potential Evapotranspiration (ET) The total amount of water that would be used for crop growth if provided with an ample water supply, also called potential consumptive use.

Effective Precipitation The portion of precipitation falling during the crop-growing season that is available to meet the evapotranspiration requirement of the crop.

Winter Effective Precipitation The portion of precipitation falling during the non-growing season that is available for storage in the soil reservoir, and subsequently available to crops during the next growing season.

Irrigation Water Requirement The amount of water required from surface or ground water diversions to meet crop consumptive needs. Calculated as potential evapotranspiration less effective precipitation and stored winter precipitation.

Water Supply-Limited Consumptive Use The amount of water actually used by the crop, limited by water availability; also called actual consumptive use.

The following terms are commonly used in the CDSS efforts:

Irrigated Parcel An irrigated "field" having the same crop type, irrigation method (sprinkler or flood), and water source - not divided by a large feature, such as river or highway.

Ditch Service Area The area of land that a ditch system has either the physical ability or the legal right to irrigate. Note that a ditch service area often includes farmhouses, roads, ditches, fallow fields and undeveloped lands. Therefore a ditch service area is typically greater than the land irrigated under that ditch.

Key Diversion Structure A ditch system that is modeled explicitly in both the StateCU historical consumptive use model efforts and the StateMod water resources planning model. Ditch systems are generally defined as key if they have relatively large diversions, have senior water rights, or are important for administration.

Diversion System Structure A group of diversion structures on the same tributary that operate in a similar fashion to satisfy a common demand.

Aggregated Diversion Structure A group of non-key structures. Aggregated diversions are typically aggregated based on location; e.g. diverting from the same river reach or tributary.

HydroBase The State of Colorado's relational database used in the CDSS efforts. HydroBase contains historical, real-time, and administrative water resources data.

Data Management Interface (DMI) A CDSS program that allows data to flow from HydroBase to the CDSS models using an automated data-centered approach.

StateMod The CDSS water allocation model used to analyze historical and future water management policies.

3.0 Model Development

The San Juan/Dolores River historical crop consumptive use analysis was performed using StateCU, a generic data driven consumptive use model and graphical user interface. The objective of the model is to develop monthly consumptive use estimates for the assessment of historical and future water management policies.

The model originated at the USBR and has undergone substantial enhancements while being applied to the Colorado River Decision Support System, the Rio Grande Decision Support System, and the South Platte Decision Support System. The *StateCU Documentation* provides a complete description of the model and its capabilities.

3.1 Modeling Approach

The general methodology used to estimate historical consumptive use for the San Juan/Dolores River Basin is as follows (See the *StateCU Documentation* for a more complete description of the calculation methods):

1. A San Juan/Dolores River Basin structure scenario was developed that includes 100 percent of the current irrigated acreage in the San Juan/Dolores River using the key and aggregated structures and their associated acreage and crop patterns. (See **Section 4.3**)
2. Climate stations were assigned to each structure based on spatial determination of climate station weights by hydrologic unit code (HUC).

3. Potential ET was determined using the SCS Modified Blaney-Criddle consumptive use methodology with TR-21 crop characteristics for acreage below 6500 feet and the Original Blaney-Criddle consumptive use methodology with high-altitude crop coefficients developed for Denver Water for acreage above 6500 feet. As recommended in the ASCE Manuals and Reports on Engineering Practice No. 70, Evapotranspiration and Irrigation Water Requirements (1990), an elevation adjustment of 10 percent adjustment upward for each 1,000 meters increase in elevation above sea level was applied to the Modified Blaney-Criddle method, i.e. for crops below 6500 feet. The SCS effective rainfall method outlined in the SCS publication Irrigation Water Requirement Technical Release No. 21 (TR-21) was used to determine the amount of water available from precipitation, resulting in irrigation water requirement.
4. Water supply-limited consumptive use was determined by including diversion records, conveyance efficiencies, application efficiencies, and soil moisture interactions. The model determined water supply-limited consumptive use by first applying surface water to meet irrigation water requirement for land under the ditch system. If excess surface water still remained, it was stored in the soil moisture reservoir. Then if the irrigation water requirement was not satisfied, surface water stored in the soil moisture reservoir was used to meet remaining irrigation water requirement.

3.2 File Directory Convention

To assist in the file organization and maintenance of official State data, the files associated with a historical consumptive use analysis will install to the default subdirectory \cdss\data\ *Analysis_description*\stateCU. *Analysis_description* is **sj2015** for the San Juan River crop consumptive use analysis, updated n 2015. Note that these directory conventions are not a requirement of the model, simply a data management convention for official State data.

3.3 File Naming Convention

Specific file names or extensions are not a requirement of the model except for the StateCU response file (*.rcu). Standard extensions have been adopted by the State for data management purposes, and are outlined in **Section 4.0 Data Development**.

3.4 Data Centered Model Development

Nearly all CRDSS StateCU input files have been generated from HydroBase using the data management interfaces StateDMI (Version 3.23.02, 04/17/2013) and TSTool (Version 10.26.00, 12/24/2013). A description of these tools as applied to StateCU is included in **Section 4 Data Description,** where applicable.

3.5 Product Distribution

The StateCU model and CRDSS input files can be downloaded from the State of Colorado's CDSS web page at http://cdss.state.co.us.

4.0 Data Description

The following sections provide a description of each input file, the source of the data contained in the input file, and the procedure for generating the input file. More detailed information regarding the file contents and formats can be found in the *StateCU Documentation*.

1. Simulation information files
    - StateCU Response File ***Section 4.1***
    - StateCU Control File ***Section 4.2***
2. Structure specific files
    - StateCU Structure File ***Section 4.3***
    - Crop Distribution File ***Section 4.4***
    - Annual Irrigation Parameter File ***Section 4.5***
    - Historical Diversion File ***Section 4.6***
3. Climate data related files
    - Climate Station Information File ***Section 4.7***
    - Climate Data Files ***Section 4.8***
4. Blaney-Criddle specific files
    - Blaney-Criddle Crop Coefficient File ***Section 4.9***
    - Crop Characteristics File ***Section 4.10***

4.1 StateCU Response File (sj2015.rcu)

The StateCU response file contains the names of input files used for a StateCU analysis. The StateCU response file was created using a text editor for the San Juan/Dolores Basin. Input file names in the response file can be revised through the StateCU Interface.

4.2 StateCU Model Control File (sj2015.ccu)

The StateCU Model control file contains the following information used in the historical consumptive use analysis:

- Beginning and ending year for simulation – The simulation period for the analysis was 1950 through 2015.
- Consumptive use analysis method – Monthly SCS Modified Blaney-Criddle, described in TR-21, and the monthly Original Blaney-Criddle analysis were used.

- Effective precipitation method – The SCS Effective Precipitation method, defined in TR-21 was used.
- Scenario type – The analysis was defined as a "structure" scenario.
- Soil moisture consideration – The soil moisture switch was set to "1" indicating the analysis should include soil moisture accounting.
- Initial soil moisture information – The initial soil moisture was set to 50 percent of the capacity for each structure.
- Winter carry-over precipitation percent – The winter carry-over precipitation defines the amount of non-irrigation season precipitation that is available for storage in the soil moisture reservoir. Winter carry-over precipitation was not used for this scenario; set to zero.
- Output options – The output summary switch was set to "3" indicating a detailed water budget output should be generated.

The StateCU model control file was created using a text editor for the San Juan/Dolores River Basin. Options in the model control file can be revised through the StateCU Interface.

4.3 StateCU Structure File (sj2015.str)

A structure file defines the structures to be used in the analysis. The structure file contains physical information and structure-specific information that does not vary over time including location information; available soil capacity; and assignments of climate stations to use in the analysis. Location information includes the latitude and county for each structure. The latitude is used in the Blaney-Criddle method to determine the hours of daylight during the growing season.

Key and Aggregate Structures

The structure file used in the historical consumptive use analysis was created using StateDMI to extract diversion structure location information stored in HydroBase. Early in the CDSS process it was decided that, while all consumptive use should be represented in the models, it was not practical to model each and every water right or diversion structure individually. Seventy-five percent of use in the basin, however, should be represented at strictly correct river locations relative to other users in both the StateCU and StateMod models. With this objective in mind, key structures to be "explicitly" modeled were determined by:

- Identifying net absolute water rights for each structure and accumulating each structure's decreed amounts
- Ranking structures according to net total absolute water rights
- Identifying the decreed amount at 75 percent of the basin-wide total decreed amount in the ranked list

- Generating a structures/water rights list consisting of structures at or above the threshold decreed amount
- Field verifying structures/water rights, or confirming their significance with basin water commissioners, and making adjustments

Based on this procedure, 5 cubic feet per second (cfs) was selected as the cutoff value for the San Juan River basin and 6.5 cfs was selected as the cutoff for the Dolores River basin. Key diversion structures are generally those with total absolute water rights equal to or greater than these cutoffs. The San Juan/Dolores model includes approximately 248 key diversion structures in Colorado.

Note that several structures in Water District 60 divert both for irrigation and for off-channel reservoir storage. To be consistent with the surface water modeling effort, the irrigation portion of the demands is represented by structure WDID_I.

The use associated with irrigated diversions having total absolute rights less than the cutoff value were included as “aggregate structures”. These nodes represent the combined historical diversions, demand, and water rights of many small structures within a prescribed sub-basin. The aggregation boundaries were based generally on tributary boundaries, gage location, critical administrative reaches, and instream flow reaches. To the extent possible, aggregations were devised so that they represented no more than 2,000 irrigated acres. In the San Juan/Dolores model, 48 aggregated nodes were identified, representing over 31,000 acres of irrigated crops. The diversion system structures and aggregates are read by StateDMI from list files. StateDMI then develops the historical diversions by summing the historical diversions of the individual structures, and their irrigation water requirement is based on the total acreage associated with the aggregation.

As presented in **Table 2**, 86 percent of 2010 acreage with a surface water source was assigned to key structures. The approach and results for selecting key structures and aggregations are outlined in more detail **Appendix A**.

Table 2: Key and Aggregate Structure Summary

Structure Type	**2005 Acreage**	**Percent of Total Acreage**	**2010 Acreage**	**Percent of Total Acreage**	**Number of Structures**
Key/Diversion System	191,623	87%	197,511	86%	248
Aggregated	28,938	13%	31,416	14%	48(1) (739)
Total Structures	**220,561**	**100 %**	**228,927**	**100 %**	**296**

(1) There are a total of 48 aggregated structures representing 504 individual structures.

Available Soil Moisture Capacities

Available soil moisture capacities were estimated from Natural Resources Conservation Service (NRCS) digital mapping and assigned to individual structures in the structure file. Soil moisture capacities for each structure, in inches of holding capacity per inch of soil depth, were provided for key and aggregate structures from comma separated list files. Structure soil moisture capacity by structure ranges from 0.0319 to 0.1775 inches per inch. **Table 3** summarizes the average soil moisture capacities used in the consumptive use analysis by Water District.

Table 3: Average Soil Moisture Capacity (inches/inch)

District	Average AWC
29	0.1030
30	0.1075
31	0.1137
32	0.1127
33	0.1110
34	0.1398
46	0.1069
60	0.1109
61	0.0856
63	0.0910
69	0.1191
71	0.0761
73	0.0894
77	0.1142
78	0.1041
Basin Average	**0.1057**

Climate Station Assignment

Climate stations were selected for use in the consumptive use calculation based on their period of records and location with respect to irrigated land (see **Section 4.7** for more information on climate stations). Climate stations and respective weights were assigned to county/hydrologic unit code (HUC) combinations, originally based on USBR assignments. Climate station weights were then assigned to structures based on this county/HUC area combination method.

4.4 Crop Distribution File (sj2015.cds)

The crop distribution file contains acreage and associated crop types for each key and aggregate surface water structures for every year in the analysis period (1950 through 2013). The irrigated acreage assessment for 1993 was originally developed by the State Engineer's Office and the USBR. Each irrigated parcel was assigned a crop type and provided a structure identifier (SWID) based on service area locations. The irrigated acreage, along with crop type identification, is available spatially through GIS shapefiles and is stored in HydroBase. **Table 4** summarizes the 2005 and 2010 acreage by crop type.

Table 4: Irrigated Acreage by Crop Type

Crop	2005 Acreage	2010 Acreage
Alfalfa	35,570	29,682
Corn Grain	549	1,473
Dry Beans	5,839	1,647
Grass Pasture	174,021	185,422
Orchard and Grapes	472	567
Spring Grains	4,106	10,124
Vegetables	4	12
Total Acreage	**220,561**	**228,927**

With the exception of the Dolores Project irrigated acreage, 1993 acreage and crop types were assigned to years 1950 through 2004 reflecting the limited change in irrigated acreage in the San Juan basin. The year 2005 acreage and crop types were assigned to 2005 through 2009, and the year 2010 acreage and crop types were assigned to 2010 through 2013.

The Dolores Project and associated irrigated acreage came online during the study period; Dove Creek Canal (322006) began irrigating crops in 1988 and Towaoc Canal (320884) in 1994. The Dolores Project, a USBR project, utilizes Dolores River water and storage in McPhee Reservoir to irrigate over 35,000 acres under the Dove Creek and Towaoc Canals. For these structures, irrigated acreage was set to zero in the StateCU analysis prior to the years they began irrigating. The acreages and start years were set in the crop distribution file using **StateDMI** set commands.

The crop distribution file used in the historical consumptive use analysis was created using **StateDMI. StateDMI** was used to extract the acreage and crop type information from HydroBase and develop the crop distribution file.

4.5 Annual Irrigation Parameter File (sj2015.ipy)

The annual irrigation parameter file contains yearly (time series) structure information required to run consumptive use simulations, including the following:

- conveyance efficiencies
- maximum flood irrigation efficiencies
- maximum sprinkler irrigation efficiencies

- acreage flood irrigated with surface water only
- acreage sprinkler irrigated with surface water only
- acreage flood irrigated with ground water only or supplemental to surface water
- acreage sprinkler irrigated with ground water only or supplemental to surface water
- maximum permitted or decreed monthly pumping capacity
- ground water use mode (ground water primary or secondary source)

The conveyance efficiency accounts for losses between the river headgate and the farm headgate, including losses through canals, ditches and laterals. The maximum flood irrigation and sprinkler efficiencies account for application losses between the farm headgate and the crops. Note that conveyance and maximum application efficiency data input data were not adjusted by year. However, a structure's overall, system efficiency may change by year due to changes in the percent of land served by sprinkler or flood application methods, or due to surface water supply in excess of crop requirement.

Ditch and lateral coverages for the San Juan and Dolores basins are not available to use in estimating structure ditch loss; therefore conveyance efficiency for all structures in the San Juan River Basin is set at 100 percent. Maximum flood irrigation and sprinkler irrigation efficiencies, that represent maximum overall system efficiencies, were estimated to be 54 percent and 72 percent respectively. The maximum flood and sprinkler irrigation system efficiency was derived based on a maximum application efficiency of 60 and 80 percent, respectively, and 90 percent conveyance efficiency. Efficiency numbers are derived and are not stored in HydroBase. Irrigation methods (flood vs sprinkler), however, are stored in HydroBase. **StateDMI** was used to extract the time series information from HydroBase, set the derived efficiency values, and create the annual irrigation parameter file. Efficiencies for the Dolores Project canals were set in the **StateDMI** commands to reflect the current level of sprinkler use under the project based on water user comments and GIS visual inspection of the irrigated acreage parcels under the canals.

4.6 Historical Irrigation Diversion File (sj2015.ddh)

The historical diversion file provides surface water supply information required to estimate supply-limited consumptive use. Irrigation diversions are provided for each modeled key and aggregate surface water diversion structure. **Figure 5** shows how surface water diversions for irrigation in the basin have changed over time. Surface water diversions for irrigation averaged approximately 853,183 acre-feet per year over the 1950 through 2013 study period. The variation seen in **Figure 5** is due to water supply limitations resulting from varying snowpack.

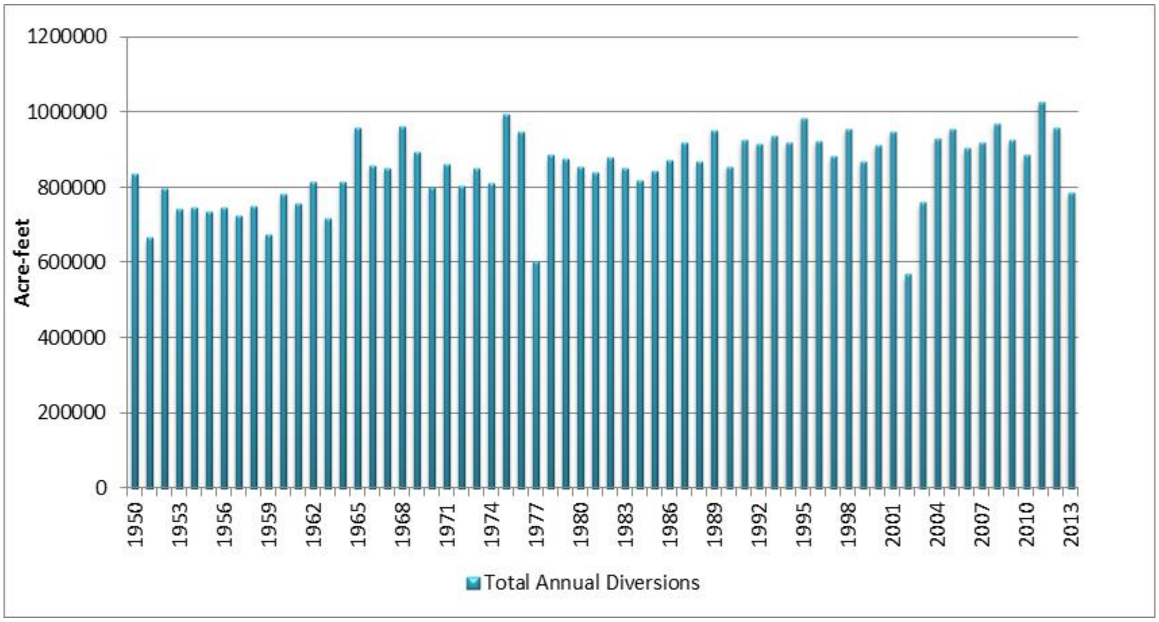

Figure 5: Total Annual Surface Water Irrigation Diversions

StateDMI was used to extract diversion records from HydroBase and fill missing data**.** Diversion data for structures included in a diversion system or aggregate structure are first extracted and filled, then combined with other structures' diversion data in the diversion system or aggregate structure. Note that diversion comments were considered when extracting data from HydroBase; for instance, if the diversion comment for a specific structure indicated the structure was not usable for a specific year, that year of data for that structure was set to zero.

Missing data were filled using a wet/dry/average pattern according to an 'indicator' gage. Each month of the streamflow at the indicator gage was categorized as a wet/dry/average month through a process referred to as 'streamflow characterization'. Months with gage flows at or below the 25^{th} percentile for that month are characterized as 'dry', while months at or above the 75^{th} percentile are characterized as 'wet', and remaining months are characterized as 'average'. Using this characterization, missing data points were filled based on the wet, dry, or average pattern. For example, a data point missing for a wet March was filled with the average of other wet Marches in the partial time series, rather than all Marches. The pattern streamflow gages used in the San Juan River basin are San Juan River at Pagosa Springs, CO (09342500), Animas River at Durango, CO (09361500), La Plata River at Hesperus, CO (09365500), San Miguel River near Placerville, CO (09172500), Dolores River at Dolores, CO (09166500). If missing data still existed after filling with a pattern file, historical monthly averages were used to fill the remaining data.

4.7 Climate Station Information File (COclim2015.cli)

The climate station information file provides climate station location information for climate stations used in the analysis, including latitude, elevation, county and HUC. A single climate station information file was developed for the entire western slope and therefore includes all key climate stations used in the Colorado River basin models (Gunnison, White, Yampa, Upper Colorado, and San Juan/Dolores). **Table 5** lists the subset of climate stations used in the San Juan/Dolores River analysis, their period of record, and their percent complete for temperature and precipitation data. The climate station information file was created using **StateDMI** to extract location information stored in HydroBase based on a list of climate stations to be used in the analyses.

Table 5: Key Climate Station Information

Station ID	Station Name	WD	Period of Record	Elevation (feet)	Percent Complete (1950 – 2013)	
					Temperature	Precipitation
USC00051886	Cortez	32	1929-2013	6153	95.69%	96.22%
USC00052326	Dolores	71	1957-2004	6940	-	84.90%
USC00052432	Durango*	30	1900-2013	6593	98.31%	95.70%
USC00053016	Fort Lewis	33	1940-2013	7600	96.48%	96.75%
USC00053146	Fruita 1 W*	72	1948-2013	4480	93.50%	93.49%
USC00053246	Gateway 1 SE	63	1956-2013	4550	82.16%	95.31%
USC00054254	Ignacio 8 E*	31	1948-2013	6621	81.24%	85.94%
USC00055970	Northdale	32	1948-2002	6680	81.41%	81.51%
USC00056012	Norwood*	60	1948-2013	7020	97.14%	95.70%
USC00056259	Pagosa Springs 4 NW*	78	1906-2013	7610	86.98%	88.80%
USC00056315	Paradox*	61	1948-2013	5282	80.34%	80.86%
USC00056520	Placerville*	60	1948-2013	7550	-	91.93%
USC00057017	Rico	71	1948-2001	8800	66.41%	79.43%
USC00057020	Ridgway	68	1982-2013	7200	47.92%	44.27%
USC00058204	Telluride 4 WNW	60	1900-2009	8672	92.06%	93.10%
USC00058560	Uravan	60	1960-2013	5010	81.38%	82.55%
USC00058582	Vallecito Dam	31	1948-2013	7650	99.22%	94.27%
USC00059275	Yellow Jacket 2 W*	32	1962-2013	6860	77.73%	75.78%

* Represents a combined climate station whereby the data from two or more stations has been combined to create a single key climate station.

4.8 Climate Data Files (COclim2015.tmp, COclim2015.prc, COclim2015.fd)

StateCU requires historical time series data, in calendar year, for temperature, frost dates, and precipitation. The CRDSS climate data files, developed using the **TSTool**, contain monthly data for fifty-four stations. Note that a single set of climate data files were developed for the entire western slope and therefore include data for all key climate stations used in the San Juan River basin models (Gunnison, White, Yampa, Upper Colorado, and San Juan/Dolores). **Table 6** summarizes the average annual temperature, frost dates and precipitation based on filled data for the subset of stations used in the San Juan/Dolores River analysis.

Table 6: Average Annual Filled Climate Values 1950 through 2013

Station Name	Station ID	Average Annual (1950 – 2013)		Frost Dates - Degrees F			
		Temperature (Degrees F)	Precipitation (Inches)	Spring 28 Deg	Spring 32 Deg	Fall 32 Deg	Fall 28 Deg
Cortez	USC00051886	49.1	12.57	7-May	24-May	30-Sep	14-Oct
Dolores	USC00052326	NA	18.36	-	-	-	-
Durango*	USC00052432	47.4	19.46	13-May	30-May	23-Sep	4-Oct
Fort Lewis	USC00053016	43.4	17.30	29-May	12-Jun	5-Sep	26-Sep
Fruita 1 W*	USC00053146	50.6	8.71	26-Apr	10-May	2-Oct	13-Oct
Gateway 1 SE	USC00053246	53.8	11.13	9-Apr	27-Apr	8-Oct	24-Oct
Ignacio 8 E*	USC00054254	46.0	13.73	17-May	4-Jun	20-Sep	4-Oct
Northdale	USC00055970	45.5	11.99	22-May	8-Jun	16-Sep	29-Sep
Norwood*	USC00056012	45.0	15.03	22-May	5-Jun	16-Sep	1-Oct
Pagosa Springs 4 NW*	USC00056259	42.9	19.88	29-May	12-Jun	31-Aug	21-Sep
Paradox*	USC00056315	50.2	12.62	1-May	13-May	28-Sep	10-Oct
Placerville*	USC00056520	45.4	16.37	18-May	27-May	14-Sep	29-Sep
Rico	USC00057017	38.6	25.87	13-Jun	21-Jun	31-Jul	5-Sep
Ridgway	USC00057020	42.7	17.09	31-May	15-Jun	27-Aug	17-Sep
Telluride 4 WNW	USC00058204	39.9	22.42	11-Jun	21-Jun	10-Aug	7-Sep
Uravan	USC00058560	53.1	12.44	11-Apr	29-Apr	9-Oct	24-Oct
Vallecito Dam	USC00058582	42.8	25.76	26-May	8-Jun	17-Sep	30-Sep
Yellow Jacket 2 W*	USC00059275	47.8	15.51	7-May	24-May	6-Oct	15-Oct

* Represents a combined climate station whereby the data from two or more stations has been combined to create a single key climate station.

Figures 6 and **7** show the 1950 through 2013 average monthly precipitation and temperature for the Cortez (USC00051886) climate station, located in the southwestern portion of the San Juan River Basin. Historical missing data for these climate stations were filled from 1950 through 2013 using **TSTool.** Historical month averages were used to fill missing precipitation data and linear regression techniques were used to fill missing temperature data**.**

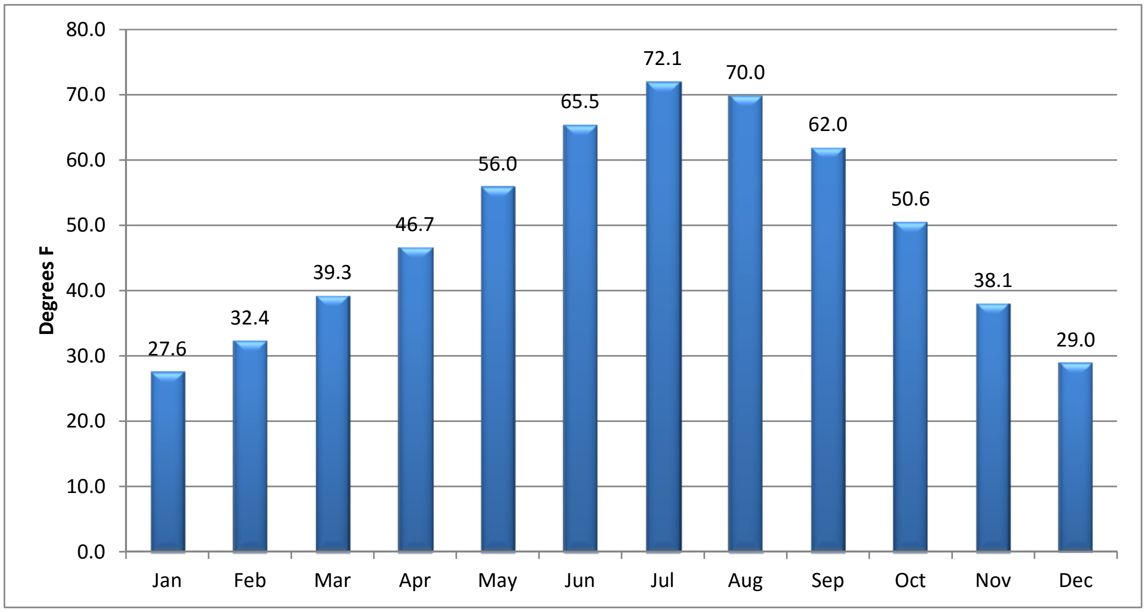

Figure 6: Average Mean Monthly Temperature Cortez Climate Station 1950 through 2013

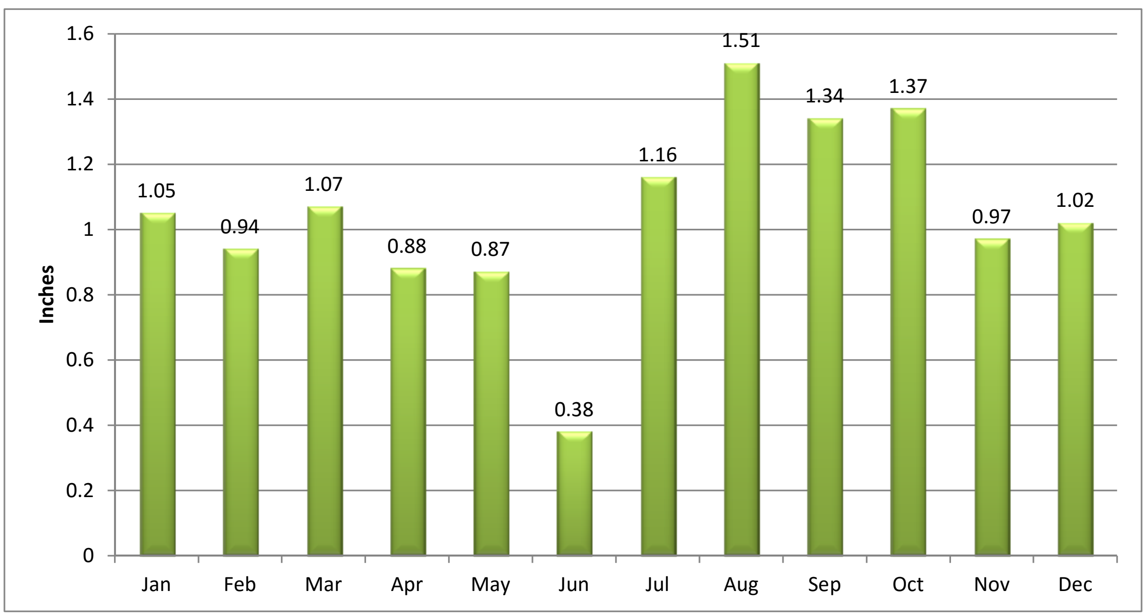

Figure 7: Average Mean Monthly Precipitation Cortez Climate Station 1950 through 2013

4.9 Blaney-Criddle Crop Coefficient File (CDSS.kbc)

The Blaney-Criddle crop coefficient file contains crop coefficient data used in the CRDSS historical consumptive use analysis. Standard TR-21 Blaney-Criddle crop coefficient curve data is available for the Modified Blaney-Criddle method. The crop coefficient file contains TR-21 curve data for several crops, however only seven TR-21 crops are modeled in the San Juan /Dolores River Basin; grass pasture, alfalfa, corn grain, dry beans, orchard without cover, vegetables and spring grains.

Structures with irrigated grass pasture acreage located above 6500 feet in elevation were assigned the Denver Water High Altitude crop coefficients, included in the CDSS.kbc file, for use with the Original Blaney-Criddle methodology. Additional details on high altitude crop coefficients can be found in the SPDSS Task 59.1 Technical Memorandum available on the CDSS website.

The flag to indicate an elevation adjustment to specific crops in the analysis is located in the crop coefficient file. It is recommended in the ASCE Manuals and Reports on Engineering Practice No. 70, Evapotranspiration and Irrigation Water Requirements (1990) that an elevation adjustment of 10 percent adjustment upward for each 1,000 meters increase in elevation above sea level be applied to the Modified Blaney-Criddle method when using TR-21 coefficients, i.e. for crops below 6500 feet. For this analysis, an elevation adjustment was applied for all Modified Blaney-Criddle crops. The elevation adjustment is applied based on the elevation of the structure, if provided in the structure file. However, in general, structure elevations are not available in HydroBase. If no structure elevation is provided, the elevation of the weighted climate station(s) is used for the elevation adjustment.

The crop coefficient file used in the historical consumptive use analysis was created using **StateDMI** to extract the representative crop coefficients from HydroBase.

4.10 Crop Characteristic File (CDSS.cch)

The crop characteristic file contains information on planting, harvesting, and root depth. Standard TR-21 Blaney-Criddle crop characteristics were adaptedin the analysis. Crop characteristics from the Denver Water study were used for grass pasture above 6,500 feet in elevation. **Table 7** illustrates the crop characteristics for the crops grown in the San Juan/Dolores River basin, including high altitude grass pasture.

The crop characteristic file used in the historical consumptive use analysis was created using **StateDMI** by extracting the representative crop characteristics from HydroBase and develop the crop characteristics input file.

Table 7: Characteristics of Crops in the San Juan/Dolores Basin

Crop Type	Source	Length of Season	Beginning Temperature	End Temperature
Alfalfa	TR-21	365	50	28
Corn Grain	TR-21	140	55	32
Dry Beans	TR-21	112	60	32
Grass Pasture	TR-21	365	45	45
Orchard w/out Cover	TR-21	365	50	45
Spring Grains	TR-21	137	45	32
Vegetables	TR-21	146	55	45
High Alt. Grass Pasture	Denver Water Study	365	42	42

5.0 Results

5.1 StateCU Model Result Presentation

The San Juan River Basin historical crop consumptive use results are a product of the input files described in **Section 4**. This section provides a summary of historical crop consumptive use and system efficiencies. Results for individual key and aggregated structures can be easily viewed and printed by obtaining the StateCU input files and StateCU model from the CDSS web site (see **Section 3.5**).

Table 8 shows the average annual basin consumptive use water budget accounting for the period 1950 through 2006. The individual component results are discussed in detail in the following sections.

Table 8: Basin Average Annual Results 1950 through 2006 (acre-feet)

		Surface Water Diversion Accounting					Estimated Crop CU		
			Surface Water Diversion To:						
Water District	Irrigation Water Required	River Headgate Diversion	CU	Soil	Non-Consumed	Annual System Efficiency	From SW	From Soil	Total
29	26,596	60,427	17,026	1,724	41,678	27%	17,026	1,733	18,758
30	66,734	129,738	37,919	1,712	90,108	21%	37,919	1,746	39,665
31	109,322	211,480	88,656	8,413	114,412	28%	88,656	8,359	97,015
32	93,843	193,898	70,781	7,658	115,458	33%	70,781	7,653	78,434
33	40,140	26,883	10,558	2,814	13,511	43%	10,558	2,859	13,417
34	28,918	33,218	15,297	2,041	15,880	51%	15,297	2,070	17,367
60	67,624	82,289	26,950	3,492	51,847	35%	26,950	3,554	30,504
61	6,273	14,564	4,565	389	9,610	27%	4,565	389	4,954
63	7,001	21,081	5,770	469	14,842	27%	5,770	467	6,237
69	3,981	3,366	1,242	330	1,795	32%	1,242	337	1,578
71	16,806	17,292	6,600	649	10,043	32%	6,600	659	7,259
73	6,530	8,275	3,463	680	4,131	53%	3,463	688	4,151
77	6,665	20,337	4,865	588	14,883	22%	4,865	592	5,458
78	15,129	30,336	9,507	852	19,978	25%	9,507	860	10,366
Basin Total	495,561	853,183	303,199	31,810	518,174	29%	303,199	31,963	335,162

Irrigation Water Required is potential consumptive use less the amount of precipitation effective in meeting crop demands directly during the irrigation season. Note that a conveyance loss of 10 percent is factored directly into the maximum system application efficiencies, as presented in **Section 4.5**. Therefore the *River Headgate Diversion* is adjusted for conveyance and application efficiency through the maximum application efficiency value. The *Non-Consumed* represents the total water not consumed by the crops; loss through canal conveyance or during application of the irrigation water. The non-consumed portion of diversions returns to the river and is available for re-diversion downstream.

5.2 Historical Crop Consumptive Use

Table 9 presents the historical crop consumptive use analysis results for the 1950 to 2006 study period. Irrigation water requirement in the San Juan/Dolores River basin is satisfied primarily from surface water diversions, resulting in an estimate of water supply limited consumptive use. The San Juan/Dolores River basin averages 335,119 acre-feet of water supply limited consumptive use annually. The average annual shortage in the basin is 32 percent. Note the consumptive use from surface water includes excess surface water stored in the soil moisture and then subsequently used by crops.

Table 9: Average Annual Consumptive Use Results 1950 through 2006

Water District – Basin	Average Acres	IWR (acre-feet)	Supply-Limited CU (acre-feet)	Percent Short
29 – San Juan River	12,407	26,596	18,758	29%
30 – Animas River	29,804	66,734	39,682	41%
31 – Los Pinos River	45,615	109,322	98,956	9%
32 – McElmo Creek	49,169	93,843	78,434	16%
33 – La Plata River	20,106	40,140	13,417	67%
34 – Mancos River	11,121	28,918	17,367	40%
60 – San Miguel River	31,722	67,624	30,749	55%
61 – Paradox Creek	3,039	6,273	4,954	21%
63 – Dolores River	2,387	7,001	6,237	11%
69 – Disappointment Creek	2,079	3,981	1,578	60%
71 – West Dolores Creek	6,876	16,806	7,259	57%
73 – Little Dolores River	2,516	6,530	4,151	36%
77 – Navajo River	3,087	6,665	5,458	18%
78 – Piedra River	7,225	15,129	10,366	31%
San Juan/DoloresBasin Total	227,151	495,561	337,366	32%

Figure 8 presents basin crop consumptive use results by year. As shown, the percent of irrigation water requirement not satisfied, averaging 32 percent, is directly related to water supply. Note that the increase in irrigation water requirement post 1988 is due to the additional acreage irrigated by the Dolores Project. Shortages averaging 28 percent from 1995 through 1999 are consistent with normal to above average stream

flows. Shortages from 2001 to 2004, averaging 43 percent, represent below average stream flows peaking at 61 percent in 2002 due to drought conditions.

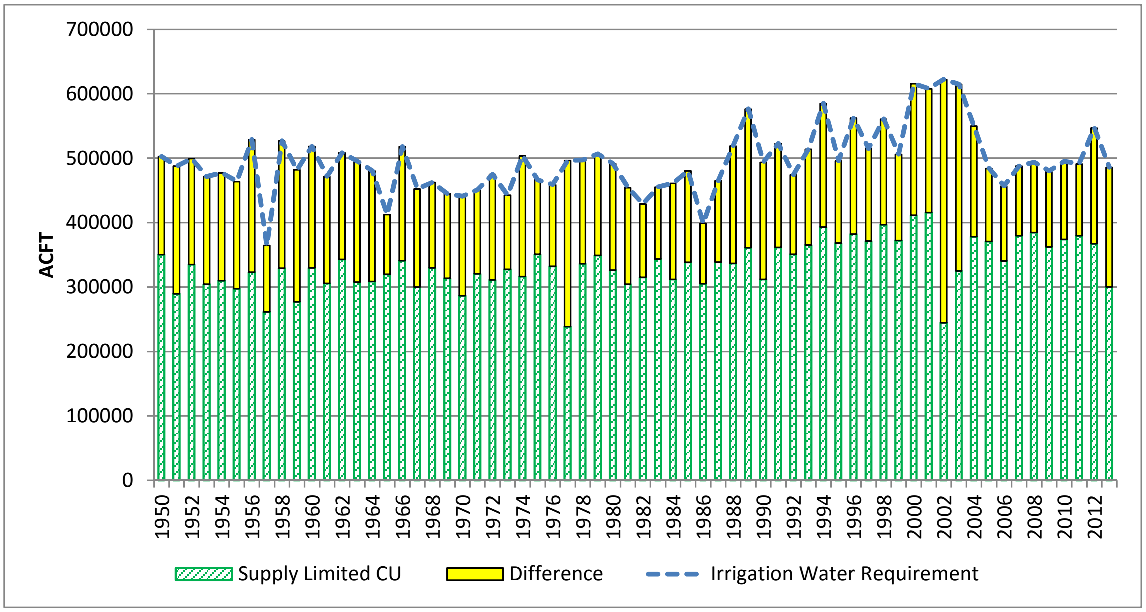

Figure 8: Irrigation Water Requirement and Supply Limited CU

Average monthly shortages for the study period vary from a low of 17 percent in April to 39 percent in September and October, as shown in **Table 10**. In general, the shortages in the basin are moderately high. Late season shortages may be due to physical supply limitations or indicative of irrigation practices whereby a land owner will choose to stop irrigating prior to the end of the full growing season as estimated based on temperature triggers.

Table 11: Average Monthly Shortages 1950 through 2013

Apr	May	Jun	Jul	Aug	Sep	Oct
17%	21%	29%	38%	37%	39%	39%

Figure 9 present shortages by year. Shortages increased dramatically in the drought years in the early 2000s.

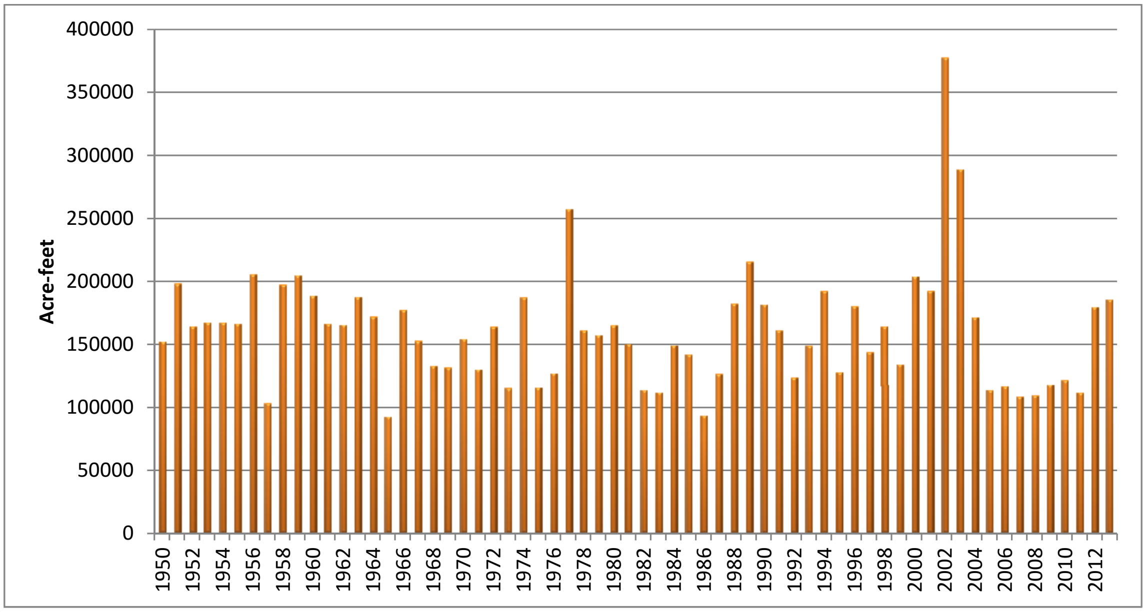

Figure 9: Annual Shortages

5.3 Estimated Actual Efficiencies

As described in the *StateCU Documentation*, the amount of surface water available to meet the crop demand is the river headgate diversion less conveyance losses and application losses. If the surface water supply exceeds the irrigation water requirement, water can be stored in the soil moisture up to its water holding capacity.

Maximum system efficiencies for surface water diversions are provided as input to StateCU, as described in **Section 4.5**. Actual system efficiencies are calculated based on the amount of water available to meet crop demands and the application method (e.g. flood or sprinkler). Based on the 1993 irrigated acreage assessment, about 18,250 acres, or 8 percent of the total irrigated acreage in the basin, is served by sprinklers. It increased to over 36,000 (16 percent) by 2010. The increase largely occurred when the Dolores Project came on-line. The remaining acreage is irrigated with flood irrigation practices.

Table 12 provides the average monthly calculated system efficiencies for surface water supplies. Surface water system efficiencies have remained relatively constant throughout the study period, with the slight variations due to water availability.

Table 12: Average Monthly Calculate System Efficiencies

Apr	May	Jun	Jul	Aug	Sep	Oct
34%	44%	48%	48%	38%	36%	29%

6.0 Comments and Concerns

The historical crop consumptive use estimates are based on measured and recorded data; information from other studies; information provided by local water commissioners and users; and engineering judgment. The results developed for this project are considered appropriate to use for CRDSS planning efforts. Areas of potential improvement or concern include:

- Historical Acreage. The irrigated acreage assessed for year 1993 serves as the basis for estimating historical acreage from 1950 to 2004 and is considered relatively accurate, as are irrigated acreage estimates for years 2005 and 2010. Diversion structures with irrigated acreage in either 2005 or 2010 were represented in the model.
- System Efficiencies. Maximum system efficiency estimates were set for the basin as a whole, in general based on user-supplied information. Limited conveyance efficiency information exists for ditches in the basin. Canal loss studies, specifically for the larger systems, could improve the estimate of maximum system efficiencies used in the historical consumptive use estimate. Additionally, conveyance efficiency estimates based on soil type and ditch length, determined by the GIS soil type and canal coverages, could be used to also increase the accuracy of the maximum system efficiency estimates.
- Water Use. The results presented are based on an approach that attempts to represent how water is actually applied to crops in the basin. The approach used is based on engineering judgment and informal discussions with water users. The effort did not include determining surface water shares for each owner under a ditch or determining different application rates based on crop types. Instead historically diverted water was shared equally based on acreage under each ditch system. This basin-wide historical crop consumptive use analysis is appropriate for CDSS planning purposes; however, it should be used as a starting point only for a more detailed ditch level analysis.

Appendix A: Aggregation of Irrigation Diversion Structures

A-1: San Juan/Dolores River Basin Aggregated Irrigation structures
A-2: Identification of Associated Structures (Diversion System and Multi-structures)

A-1: San Juan/Dolores River Basin Aggregated Irrigation structures

Introduction

The original CDSS StateMod and StateCU modeling efforts were based on the 1993 irrigated acreage coverage developed during initial CRDSS efforts. Irrigated acreage assessments representing 2005 and 2010 have now been completed for the western slope basins. A portion of the 2005 and 2010 acreage was tied to structures that did not have identified acreage in the 1993 coverage, and, consequently, are not currently represented in the CDSS models. As part of this task, aggregate and diversion system structure lists for the western slope basins were revised to include 100 percent of the irrigated acreage based on both the 2005 and 2010 assessments. The update also included identification of associated structures and the development of “no diversion” aggregates—groups of structures that have been assigned acreage but do not have current diversion records.

The methodology for identifying associated structures is described more in-depth in **Section A-2** of this appendix. In general, associated structures—which divert to irrigate a common parcel of land—were updated to more accurately model combined acreage, diversions, and demands. These updates include the integration of the 2005 irrigated acreage, the 2010 irrigated acreage, as well as verification based on diversion comments and water right transaction comments. In StateCU, the modeling focus is on the irrigated parcels of land. Therefore, all associated structures are handled in the same way. The acreage is assigned to a single primary node, which can be supplied by diversions from any of the associated structures. In StateMod, there are two types of associated structures. Diversion systems represent structures located on the same tributary that irrigate common land. Diversions systems combine acreage, headgate demands, and water rights; StateMod treats them as a single structure. In contrast, multi-structure systems represent structures located on different tributaries that irrigate common land. Multi-structure systems have the combined acreage and demand assigned to a primary structure; however, the water rights are represented at each individual structure, and the model meets the demand from each structure when their water right is in priority.

“No diversion” aggregates are included in StateCU in order to capture 100 percent of irrigated acreage. However, they were not included in the StateMod modeling effort. Because the individual structures included in these aggregates do not have current diversion records, their effect on the stream cannot be accounted for in the development of natural flows. Therefore, it is appropriate that their diversions also not be included in simulation. The individual structures in the “no diversion” aggregates generally irrigate minimal acreage, often with spring water as a source. There is an assumption that the use will not change in future “what-if” modeling scenarios.

Approach

The following approach was used to update the aggregated structures in the San Juan/Dolores River Basin.

1. Identify structures assigned irrigated acreage in either the 2005 or 2010 CDSS acreage coverages.
2. Identify Key structures represented explicitly in the model. The process for determining key structures is outlined in **Section 4** of the report.
3. Identify Key structures that should be represented as diversion systems or multi-structures, based on their association with other structures as outlined in **Section A-2** of this appendix.
4. Aggregate remaining irrigation structures identified in either the 2005 or 2010 irrigated acreage coverages based on the aggregate spatial boundaries shown in Figure A-1. The boundaries were developed during previous San Juan/Dolores River Basin modeling effort to general group structures by tributaries with combined acreage less than 2,200.
5. Further split the aggregations based on structures with and without current diversions during the period 2000 through 2012.

Results

Table A-1 indicates the number of structures in the aggregation and the total the 2005 and 2010 aggregated acreage. All of the individual structures in the aggregates have recent diversion records.

Table A-1: San Juan/Dolores River Basin Aggregation Summary

Aggregation ID	Aggregation Name	Number of Structures	2005 Acres	2010 Acres
29_ADS002	San Juan at Pagosa Springs	32	1,129	1,262
29_ADS003	San Juan at Carracas	47	1,621	1,662
30_ADS007	Animas River at Durango	18	581	579
30_ADS008	Florida R abv Salt Creek	39	1,130	1,408
30_ADS009	Florida River at Bondad	28	759	817
30_ADS010	Animas River at State Line	14	254	236
31_ADS005	Los Pinos River at Dry Creek	13	612	697
31_ADS006	Los Pinos River at State Line	39	1,365	1,454
32_ADS015	McElmo Creek abv Alkali	46	1,123	1,233
32_ADS016	McElmo Creek nr State line	49	1,186	1,232
33_ADS011	La Plata River	22	863	1,089
34_ADS012	Mancos River abv W Mancos	8	576	590
34_ADS013	Mancos River abv Chicken Creek	4	149	138
34_ADS014	Mancos River nr State Line	15	639	983
60_ADS020	San Miguel River nr Placerville	11	551	674
60_ADS021	San Miguel River abv W Nat Crk	6	608	798
60_ADS022	San Miguel River at Naturita	19	1,908	2,952
61_ADS019	Paradox Creek	15	963	962
63_ADS023	Dolores River at Gateway	20	949	1,007
63_ADS024	West Creek	35	1,281	1,213

69_ADS018	Disappointment Creek	10	407	379
71_ADS017	Dolores River abv McPhee River	16	390	412
71_ADS019	Dolores River abv Big Gypsum	2	163	146
73_ADS025	Little Dolores River	30	1,764	1,714
77_ADS001	Navajo River	20	1,131	1,131
78_ADS004	Piedra River	34	2,486	1,977
Total		**592**	**24,588**	**26,744**

Table A-2 shows the number of structures in the "no diversions" (AND) aggregates and the total 2005 and 2010 acreage. None of the individual structures in the aggregates have recent diversion records.

Table A-2: No Diversion Aggregation Summary

Aggregation ID	Aggregation Name	Number of Structures	2005 Acres	2010 Acres
29_AND002	San Juan at Pagosa Springs	14	331	371
29_AND003	San Juan at Carracas	11	663	499
30_AND007	Animas River at Durango	24	578	642
30_AND008	Florida R abv Salt Creek	8	146	155
30_AND009	Florida River at Bondad	3	51	51
30_AND010	Animas River at State Line	8	40	54
31_AND005	Los Pinos River at Dry Creek	15	139	425
31_AND006	Los Pinos River at State Line	12	339	389
32_AND015	McElmo Creek abv Alkali	2	5	10
32_AND016	McElmo Creek nr State line	2	32	32
33_AND011	La Plata River	14	297	256
34_AND013	Mancos River abv Chicken Creek	1	30	30
60_AND020	San Miguel River nr Placerville	1	145	145
60_AND021	San Miguel River abv W Nat Crk	2	135	135
61_AND019	Paradox Creek	1	0	42
63_AND023	Dolores River at Gateway	3	9	82
63_AND024	West Creek	3	211	211
71_AND017	Dolores River abv McPhee River	5	120	120
71_AND019	Dolores River abv Big Gypsum	3	38	77
73_AND025	Little Dolores River	4	66	93
77_AND001	Navajo River	3	220	94
78_AND004	Piedra River	8	758	762
Total		**147**	**4,350**	**4,672**

Table A-3 indicates the structures in the diversion systems and multi-structures.

Table A-3: Diversion System and Multi-Structure Summary

Diversion System	Diversion System Name	WDID
3204675 Dolores_Tunnel	DOLORES TUNNEL	3204675
	DOLORES TUNNEL	7104675
3200772 MVI_U_Lateral	MVI U LATERAL	3200772
	GREAT CUT DIKE	7104676
	GREAT CUT DIKE	3204676
2900519 BEIGHLEY NO 1_DIVSYS	BEIGHLEY NO 1 DITCH	2900519
	BEIGHLEY NO 2 DITCH	2900520
2900601 FOUR-MILE_DIVSYS	FOUR-MILE DITCH	2900601
	MESA DITCH	2900669
	HYDEAWAY RANCH DITCH	2900625
	MCGIRR-SNOWBALL DITCH	2900911
2900613 HALLETT DITCH_DIVSYS	HALLETT DITCH	2900613
	COLTON AND MONTROY DITCH	2900566
2900588 ECHO DITCH_DIVSYS	ECHO DITCH	2900588
	RAY SPRING	2900834
2900653 LONG HORN_MEE_DIVSYS	LONG HORN AND MEE DITCH	2900653
	HARE DRAINAGE D NO 1 & 2	2900616
2900560 CHAPSON HOWE_DIVSYS	CHAPSON AND HOWE DITCH	2900560
	CORRAL DITCH	2900568
	ELK CREEK DITCH	2900593
3001011 FLORIDA_FARMERS_CANAL	FLORIDA FARMERS DITCH	3001011
	FLORIDA CANAL	3001013
	BLOHM WASTE WATER SYSTEM	3001465
3001219 SITES-KERN_DIVSYS	SITES-KERN DITCH	3001219
	APPERSON-SITES DITCH	3001026
3100505 DR MORRISON_DIVSYS	DR MORRISON DITCH	3100505
	DR MORRISON DITCH	3100664
3100511 THOMPSON-EPPERSON DITCH	THOMPSON-EPPERSON DITCH	3100511
	COUCH D NO 1 & PUMP PLT	3100602
	COUCH D NO 2 & PUMP PLT	3100603
3100519 DUNCAN DIVSYS	KING DITCH	3100519
	HUNTER WASTE WATER DITCH	3100823
	WAGNER DITCH	3100828
3100523 SCHRODER IRG_DIVSYS	SCHRODER IRRIGATION DITC	3100523
	CITIZENS IRR DITCH	3100515
	DUNHAM IRRIGATION DITCH	3100550
	HARPER POND & DIV #1	3100811
3100547 ROBERT MORISON DIVSYS	ROBERT MORRISON DITCH	3100547
	FASSETT DITCH	3100596
3100575	SEMLER DITCH	3100575

SEMLER DITCH_DIVSYS	SEMLER DITCH E AND E	3100593
3100583 GOOSEBERRY_DIVSYS	PORTER DITCH	3100583
	INDIAN CREEK DITCH	3100588
3100665 SPRING CREEK_DIVSYS	SPRING CREEK DITCH	3100665
	WEIGANDT DITCH	3100568
	GENTRY DITCH	4600514
	BABCOCK DITCH 26	4600519
	SCHALLES DITCH NO 1	3100586
	DANNELS-SPG CR WW DIVR	3100614
	HORNER-HEATH DITCH	4600500
	AUSTIN NO 2 DITCH	4600509
	SWANEMYR DITCH NO 1	4600525
	GUFFEY DITCH NO 1	4600532
	MARQUEZ DITCH	4600537
	YOUNGS ALLISON DITCH	4600542
	WASTE WATER SET DITCH	4600547
	ALLISON LATERAL WW DITCH	4600548
	ODESSA DITCH	7800695
	JOHN DARLINGTON DITCH	4600520
	OCHSNER DITCH	3100582
	TIFFANY DITCH	3100577
	GREEN POND (WELL)	4605000
3400560 RUSH RESERVOIR DIVSYS	RUSH RESERVOIR DITCH	3400560
	BAUER RESERVOIR NO 1	3403585
	L A BAR RESERVOIR	3403590
3400582 WILLIAMS DITCH_DIVSYS	WILLIAMS DITCH	3400582
	A T ROBB NORTH DITCH	3400501
7100531 WEST DOLORES	EAST EDER DITCH	7100531
	EAST EDER DITCH AP	7100701
7102002 SUMMIT_IRRIG	SUMMIT RES OUTLET	7102002
	SUMMIT IRRIG SYSTEM	7102004
	BIG PINE RES OUTLET	3402000
	A M PUETT RES OUTLET	3200704
	SUMMIT OUTLET	3202002
	SELLERS & MCCLANE RES	3403592
7100586 RIEVA DITCH_DIVSYS	RIEVA DITCH	7100586
	RIEVA DITCH AP2	7100690
7700531 ENTERPRISE_DIVSYS	ENTERPRISE DITCH	7700531
	ENTERPRISE DITCH (BEAL)	7700513
7800507	BARNES-MEUSER AND SHAW D	7800507

BARNES-MEUSER_DIVSYS	PATTERSON IRRIGATION D	7800597
	C R MARTIN DITCH	7800519
6100512 AMENDED LAURA_DIVSYS	AMENDED LAURA DITCH	6100512
	ROBERTS PLACE WELL 1	6105010
7800562 HOPE SPRINGS_DIVSYS	HOSSACK CREEK DITCH	7800562
	LINDNER SPRING NO 3	7800577
	HOSSACK CREEK DIT ALT PT	7800699
3400577 WEBER RESERVOIR INLET D	WEBER RESERVOIR INLET D	3400577
	WEBER RESERVOIR	3403594
2900686 PARK MULTISYS	PARK DITCH	2900686
	HALLETT DITCH DIVSYS	2900613
	COLTON AND MONTROY DITCH	2900566
2900718 TURKEY MULTISYS	SNOWBALL DITCH	2900718
	FOUR-MILE DIVSYS	2900601
	MESA DITCH	2900669
	HYDEAWAY RANCH DITCH	2900625
	MCGIRR-SNOWBALL DITCH	2900911
3000506 ANIMAS CONS. MULTISYS	ANIMAS CONSOLIDATED D	3000506
	J P LAMB DITCH	3000581
3100665 SPRING CREEK MULTISYS	SPRING CREEK DIVSYS	3100665
	BRIGGS DITCH	4600503
	CAMPBELL DITCH	3100567
3300533 PINE RIDGE MULTISYS	PINE RIDGE DITCH	3300533
	BODO PINE RIDGE DITCH	3001056
6100502 GALLOWAY MULTISYS	GALLOWAY DITCH	6100502
	A E L R P & PL	6100602
7800507 BARNES-MEUSER-SHAW MULTISYS	BARNES-MEUSER AND SHAW DIVSYS	7800507
	BARNES DITCH	7800506
7800544 F S MOCKLER MULTISYS	F S MOCKLER IRR DITCH	7800544
	CIMARRON DITCH	7800524
7800590 PAGOSA MULTISYS	NICKLES BROTHERS DITCH	7800590
	STEVENS AND CLAYTON D	7800617
	CLAYTON-REED DITCH	7800525
7800604 PIEDRA FALLS MULTISYS	PIEDRA FALLS DITCH	7800604
	LITTLE PAGOSA CREEK DIVR	7800659
	CARL AND WEBB DITCH	7800523
	PAGOSA DITCH	7800594

1) Acreage is assigned to both structures and combined for consumptive use analysis
2) Historical diversions are calculated based on diversion to irrigation and reservoir releases to irrigation
3) Diversion system also a Multisystem component

Figure A-1 shows the spatial boundaries of each aggregation. **Exhibit A**, attached, lists the diversion structures represented in each aggregate. **Exhibit B** lists the diversion structures represented in each no diversion aggregate. Both **Exhibit A** and **Exhibit B** provide a comparison of the 2005 and 2010 irrigated acreage assigned to each structure.

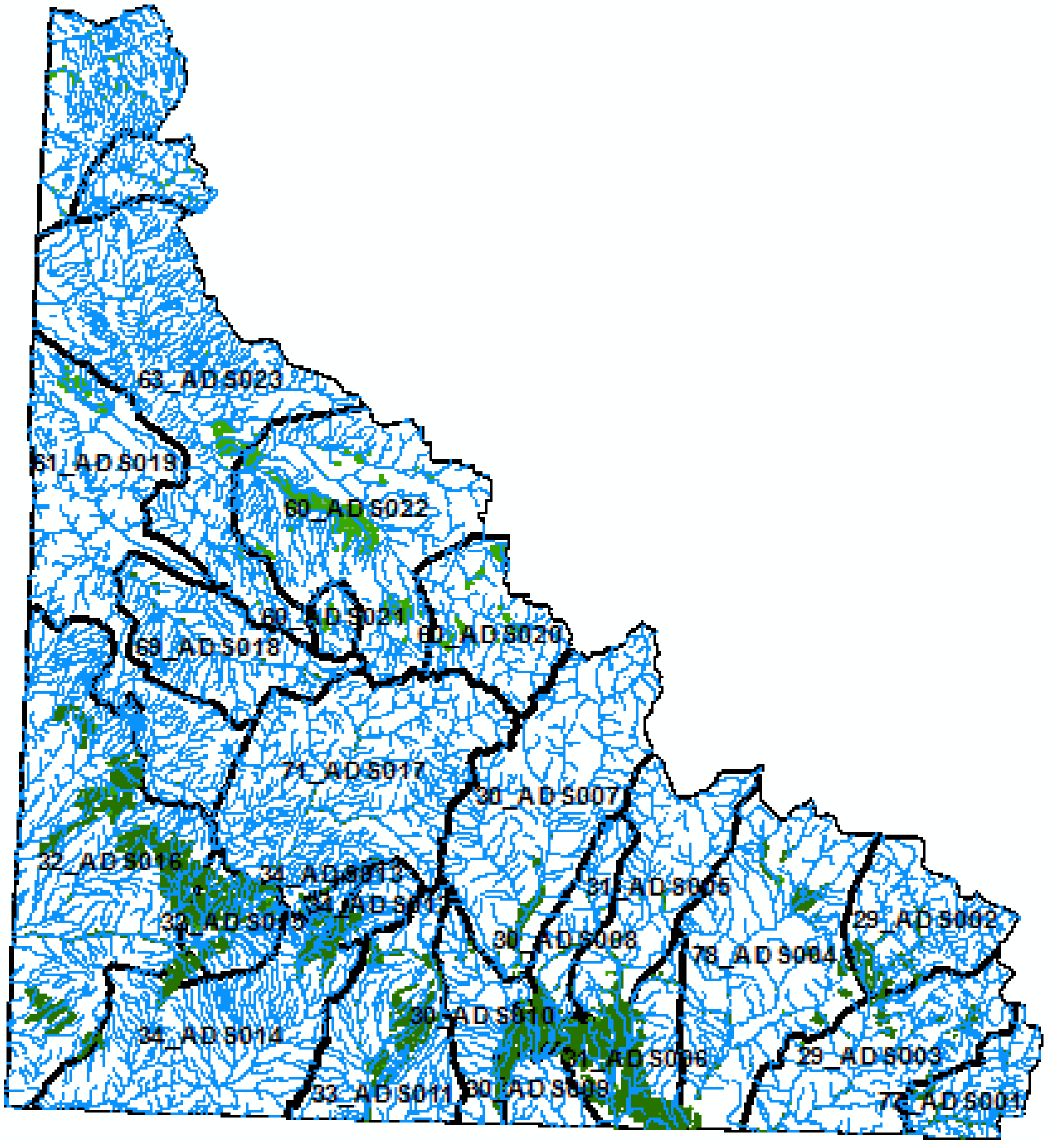

Figure A-1: Aggregate Structure Boundaries

Recommendations

As part of this modeling update, various lists have been developed for review and reconciliation by the Water Commissioner. The lists include:

- Structures tied to irrigated acreage that do not have current diversion records
- Structures tied to irrigated acreage that do not have water rights for irrigation
- Structures that have current diversion records coded as irrigation use, but do not have irrigated acreage in either 2005 or 2010
- Structures that have irrigation water rights, but do not have irrigated acreage in either 2005 or 2010
- More than one structure is assigned to the same irrigated parcel, however there was no indication that the structures serve the same acreage in either diversion comments or water rights transaction comments.

Exhibit A: Diversion Structures in each Aggregate

Aggregation ID	Diversion Structure Name	WDID	2005 Acres	2010 Acres
29_ADS002 San Juan at Pagosa Springs	Allen Ditch	2900502	48	48
	Bruce Spruce Ditch	2900610	2	2
	Canon Creek Ditch	2900644	0	44
	Cockrell Ditch	2900680	67	67
	Deer Creek Ditch	2900702	30	30
	Diamond Ditch	2900737	9	9
	Falls Creek Ditch	2900755	38	38
	Flaugh Ditch	2900781	120	120
	Girardin Ditch	2900548	24	24
	Gomez Ditch No 1	2900574	8	8
	Goodman-Gomez Ditch	2900575	23	23
	Johnny Creek Ditch	2900607	36	36
	K O Harman Ditch No 1	2900672	17	17
	Lake Fork Ditch	2900674	5	5
	Lane Creek Ditch	2900728	66	66
	Lost Ditch	2900758	24	24
	Masco-Masco Ditch	2900794	63	63
	Murphy Ditch	2900926	37	37
	New Ditch	2900997	38	38
	Old Strong Ditch	2900594	19	19
	Pangborn Ditch	2900608	0	44
	Power Line Ditch	2900639	0	44
	Roesler Ditch	2900565	178	178
	Strawn Ditch	2900598	5	5
	Sunset Cottages D No 1	2900636	8	8
	Turkey Creek No 2 Ditch	2900643	2	2
	Will Macht Ditch	2900656	24	24
	Young Ditch	2900666	38	38
	Garden Ditch	2900730	8	8
	Bruce Spruce Ditch Alt	2900553	14	14
	Horse Gulch Ditch	2900696	173	173
	Joe Hersch Ditch No 1Ap #2	2900685	6	6
29_ADS003 San Juan at Carracas	Arroyo Ditch	2900529	0	7
	Berryhill Ditch No 1	2900546	91	91
	Berryhill Ditch No 2	2900558	16	16
	Brown Ditch	2900561	10	10
	Cabe Ditch	2900577	14	15
	Carls Ditch	2900658	39	39
	Carrico Ditch	2900694	3	3

	Catchpole Meadow Ditch	2900723	66	66
	Catchpole Mill-Creek D	2900754	48	48
	Chavez Ditch	2900761	18	0
	Chavez No 2 Ditch-1968	2900783	27	27
	Chavez No 2 Ditch	2900925	9	9
	Dillinger Blanco Ditch	2900528	13	13
	Dillinger Fish Creek D	2900551	81	89
	Dillinger Spring Ditch	2900554	10	10
	Echo Waste Water Ditch	2900563	12	12
	John M Rippy Ditch	2900576	50	50
	John T Tiernan No 1 D	2900578	58	58
	John T Tiernan No 2 D	2900591	24	24
	Latham Ditch	2900646	65	65
	Lippert No 2 Ditch	2900652	27	27
	Little Blanco Highline D	2900663	63	63
	M O Brown Ditch	2900753	7	7
	Martinez Pipeline And D	2900762	36	36
	O-Waste Water Ditch	2900802	40	40
	Oppenheimer Waste Wtr D	2900920	22	22
	Porcupine Ditch	2900556	87	87
	R N Snow Ditch No 1	2900557	15	15
	Sam Teeson Ditch	2900634	29	29
	Sheep Cabin	2900635	85	85
	Sig Brown Ditch	2900679	38	38
	Spring Run Ditch	2900705	82	82
	Square Top Ditch	2900722	72	72
	Sweede Ditch	2900759	39	39
	Villarreal Ditch And Pl	2900822	31	31
	White Creek No 1 Ditch	2900846	40	40
	White Creek No 2 Ditch	2900959	17	17
	Zabriskie Ditch	2900564	15	14
	Harman Ditch No 1	2900633	17	17
	Harman Ditch No 2	2900651	13	13
	Campbell Ditch No 1	2900681	39	39
	Little Blanco Highline D	2900699	64	64
	Mees Ditch	2900711	8	8
	Wunderlich Pump Site	2900713	36	36
	3R Ranch Diversion	2900731	3	3
	Cattey Pump No 1	2900742	2	2
	Espinosa No 1 Ditch	2900505	41	85
30_ADS007 Animas River at	Ambold Ditch (Jeckel)	3000521	78	78
	Ambold Ditch No 2	3000536	34	34

Durango	Animas City Ditch	3000551	13	11
	Canon No 2 Ditch	3000614	33	33
	Conley Ditch	3000667	11	24
	Elbert No 1 Ditch (J)	3000925	15	15
	F Steinegger Irg Ditch	3000503	159	159
	Gaines-Buchanan Ditch	3000543	22	22
	Kroulik Ditch	3000642	22	16
	Pomona Ditch	3000649	8	8
	Quinn-Naegelin Ditch	3000505	19	19
	Ragsdale Ditch	3000525	10	10
	Shaffer Ditch	3000611	2	4
	Talley Ditch	3000615	7	7
	Falls Creek Div Pts Pt 1	3000502	21	21
	Walter Ditch	3000584	9	0
	Three Sisters Ditch	3000632	105	105
	Falls Creek Div Pts Ap Pt 2	3000752	11	11
30_ADS008 Florida River above Salt Creek	Abling And Cash Ditch	3001004	24	24
	Conway Ditch	3001012	26	26
	Aberson Ditch	3001014	75	75
	Campion Ditch	3001015	4	4
	Pennington-Conway Ditch	3001109	79	79
	Stewart Ditch	3001171	25	34
	Prescott North Side D	3001176	49	49
	Prescott South Side D	3001191	46	46
	Waring Irrigating Ditch	3001196	43	43
	Banks Ditch	3001210	1	1
	Cash 1888 Ditch	3001463	0	126
	Crandall Ditch	3001001	3	0
	Freienmuth-Mccoy Ditch	3001002	71	71
	Hedges-Clark Ditch	3001120	75	75
	Highline Ditch	3001136	31	31
	Jones No 1 Ditch	3001144	6	6
	Lyman Ditch	3001224	6	6
	Mccaw Ditch	3001230	35	42
	Miller Ditch	3001244	0	54
	Moons Return Flow Ditch	3001263	3	3
	Nathan Bird Ditch	3001267	38	45
	Palmer Horse Gulch Ditch	3001604	21	21
	Parker Ditch	3001005	33	33
	Payne Canyon Ditch	3001008	17	17
	Reynolds-Brasher Ditch	3001017	5	5
	Rosa Waldner Ditch	3001080	99	99

	Schalles Seepage Ditch	3001121	19	19
	Sherer Ditch	3001150	2	2
	Spring Ditch	3001165	83	99
	Stratman Ditch	3001169	21	21
	Thornton-Smith Ditch	3001406	0	46
	Tyner West Side Ditch	3001032	92	92
	Wawona Ditch	3001161	8	8
	Williamson Ditch	3001200	20	28
	Robertson Spring	3001457	0	7
	Dashner #2 Ditch	3001238	21	21
	Darin And Jeff Ditch	3001158	22	22
	Harshfield Ditch	3001067	18	18
	Stratman Combined Ditch	3001385	10	10
30_ADS009 Florida River at Bondad	Barnes No 1 Ditch	3001060	33	33
	Big Cottonwood D No 1	3001110	12	12
	Big Cottonwood No 2 D	3001188	85	85
	Brown Ditch	3001201	8	8
	Brown Ditch	3001330	27	23
	Gaines Ditch	3001348	7	7
	George P White Ditch	3001553	25	25
	Home Ditch	3001044	26	27
	Park Ditch	3001123	7	7
	Paxton Ditch	3001170	8	38
	Rea Ditch	3001349	16	9
	Seale Waste Water Ditch	3001369	50	70
	Sisley Ditch	3001445	37	37
	Teti Canyon Ditch	3001569	10	10
	Sease Canon Ditch No 2	3001575	41	41
	Harper Irr System No 1	3001113	8	8
	Harper Irr System No 2	3001218	26	26
	Ball Ditch Pump Station	3001236	26	45
	Kennedy Waste Ditch No 2	3001294	40	40
	Kennedy Waste Ditch No 3	3001350	40	40
	Kennedy Waste Ditch No 4	3001515	40	40
	Clark Irrigation Ditch	3001035	18	18
	Watson Pump	3001045	65	65
	Seibert Ditch No 2	3001059	6	6
	John Barnes Ditch	3001175	45	45
	Big Canyon Ditch & Pump	3001331	37	37
	L Short Wastewater Pl	3001344	9	9
	Leroys Ditch	3001362	8	8
30_ADS010	Cason Ditch	3001068	18	23

Animas River at State Line	Covert Ditch	3001135	28	29
	Harbaugh Ditch	3001119	28	0
	Johnson Ditch	3001225	16	16
	Jones Ditch	3001132	38	38
	Lemon Ditch	3001139	45	45
	Shields No 1 Ditch	3001212	0	6
	Shields No 2 Ditch	3001427	5	5
	Spring Ditch & Pipeline	3001074	4	4
	Steward Irrigating Ditch	3001227	60	47
	Taggart Ditch	3001234	9	9
	Mckee Diversion #1	3001211	0	4
	Mckee Diversion #2	3001415	0	6
	Harbison Ditch	3001416	5	5
31_ADS005 Los Pinos River at Dry Creek	Dale Ditch	3100504	26	26
	Palmer Ditch	3100530	39	39
	Ludewig Ditch	3100533	12	53
	Buhman Ditch	3100564	5	5
	Graham Creek No 1 Ditch	3100659	15	25
	Graham Creek No 2 Ditch	3100531	11	21
	Patrick Ditch	3100534	22	25
	Mitchell Ditch	3100601	34	44
	Gipson Ditch	3100677	34	44
	Potter-Pierce W Return D	3100691	103	103
	Nannice Ditch	3100522	298	298
	Coronado Divr And Pump	3100536	7	7
	Spring Gulch Ditch	3100562	6	6
31_ADS006 Los Pinos River at State Line	Dennie Ditch	3100506	48	33
	Goodnight Ditch	3100560	168	226
	Joe S & Char B Mack Irg	3100654	123	123
	John M King East Ditch	4600512	114	114
	John M King West Ditch	4600533	58	58
	Citizens Irr Canal	3100532	39	39
	Clara Wolf Ditch	3100578	0	22
	Ignacio Draw Ditch	3100645	33	33
	Carlson Ditch No 1	3100655	26	26
	Robt Morrison D Heair Ex	3100771	56	56
	Luter Ditch No 1	3100815	7	7
	Ainsworth Waste Water D	3100950	8	11
	Heair Ditch No 1	4600516	84	84
	Joe S & Char B Mack Irg Ap	4600518	0	8
	Larsen No 1 Ditch	3001312	12	12
	Linebarger Ditch	3100569	12	12

	Hecht Ditch No 1	3100653	14	14
	Denton Ditch	3100755	131	131
	Knight Ditch	3100920	27	27
	Clark-Campbell Diversion	4600501	83	83
	Flagg Ditch No 1	4600510	26	26
	Perino Ditch	4600511	8	8
	Buck Ditch	4600513	12	24
	Bryant Ditch	4600515	19	19
	Mills Ditch	4600530	15	15
	Austin No 1 Ditch	4600566	16	16
	Brown Ditch	3100561	26	26
	Briggs-Scofield Ditch	3100572	28	28
	Lonne Ditch	3100754	15	15
	Karl Ditch	3100767	23	23
	Shock Ditch No 1	4600505	14	14
	Shock Ditch No 2	4600506	14	14
	Babcock Ditch 25	4600507	9	9
	Young Ditch	4600508	54	54
	Knutson Ditch No 2	4600521	3	3
	Engler Ditch	4600527	0	14
	Frahm Ditch	3100570	13	0
	Girardin Irrigation Sys	3100681	9	9
	Kerrigan Ditch #2	4600529	18	18
32_ADS015 McElmo Creek above Alkali	Ausburn Ditch	3200506	29	29
	Blum Ditch	3200530	35	35
	Bord Ditch	3200532	21	21
	Cox Ditch	3200556	25	25
	Crow Canyon Ditch No 1	3200613	19	17
	Crow Canyon Ditch No 3	3200675	20	20
	Dunham Ditch	3200707	4	4
	Earl Hart Ditch	3200758	111	213
	Godfrey Ditch	3200821	12	12
	Green Ditch	3200898	55	55
	Hetherington Ditch	3200944	0	9
	Higman Pickup Ditch	3200945	42	42
	Holaday No 2 Ditch	3200512	49	60
	Jim Mann Ditch	3200548	34	34
	King Ditch	3200583	16	16
	Kirkeeng Ditch	3200587	8	3
	M And H Ditch	3200595	18	18
	Mac Porter Ditch	3200614	16	16
	Martin Ditch	3200646	9	9

	N E Carpenter Seepage D	3200658	57	57
	Powell And Cody Ditch	3200757	71	71
	Rauh Ditch	3200763	13	13
	Roelfs Ditch	3200834	34	11
	Runck Ditch	3200835	25	25
	Steve No 1 Ditch	3200880	15	34
	Stone Ditch	3200941	12	12
	West Carlisle Ditch	3200967	10	10
	Wilkerson Ditch	3201007	18	18
	Thomas Ditch No 1	3200569	7	5
	Mcdonald Ditch No 4	3200572	4	4
	Randol Ditch	3200601	10	10
	Frye Ditch #1	3200616	12	12
	Frye Ditch #2	3200644	53	53
	Carls Pump	3200685	7	6
	Poppy Patch Ditch	3200714	4	4
	Goode Ditch	3200878	24	24
	Antholz Ditch	3200511	19	19
	Mcnutt Ditch	3200534	18	17
	Hover Ditch	3200600	8	8
	Ancell Ditch	3200635	6	6
	Fox Ditch	3200653	25	25
	Leighton No. 1 Ditch	3200672	39	39
	Leighton No. 2 Ditch	3200689	56	56
	Tipton Ditch	3200706	39	39
	Mckinney Ditch	3200988	2	2
	Ertel Drainage Pipe	3200580	15	15
32_ADS016 McElmo Creek near State Line	Brixey-Comisky Ditch	3200514	65	65
	Brumley Draw Irr Ditch	3200520	46	46
	Charles Mattson Ditch	3200527	25	25
	Comisky Ditch No 3	3200552	2	2
	Comisky Ditch No 4	3200573	10	10
	Duran Ditch	3200588	9	9
	Duran Ditch No 1	3200599	3	3
	Fawell Ditch	3200612	31	31
	Gafford Ditch	3200629	57	57
	Gafford Ditch No 2	3200632	56	56
	Greenlee Ditch	3200664	47	47
	Higgins Ditch	3201023	10	15
	Hopper Ditch	3200513	21	21
	J A Leonard Ditch	3200526	60	60
	Jewell Ditch	3200594	100	100

	Juan Ditch No 1	3200626	10	10
	Keeler Ditch	3200628	0	4
	Keith Pump And Pipeline	3200660	1	1
	Koppenhaffer Ditch	3200661	31	0
	Larmore Collection Ditch	3200665	46	46
	Lynch Ditch	3200681	122	132
	Margwain Pump Sta No 1	3200841	2	26
	Mccall Ditch	3200893	25	25
	Messinger-Hampton D No 1	3200897	29	47
	Milligan No 1 Ditch	3201004	14	14
	Milligan No 2 Ditch	3200560	6	6
	Morgan Waste Water Ditch	3200564	9	9
	R G Whyman Ditch	3200592	19	19
	Sattley Ditch No 1	3200602	3	3
	Sattley Ditch No 2	3200617	11	1
	Sattley Ditch No 3	3200619	5	15
	Short Ditch	3200659	22	22
	Shumway Perkins Pmpg Sta	3200674	44	48
	Stevens No 1 Ditch	3200686	19	19
	Stevens No 2 Ditch	3200798	19	19
	Trail Canyon Ditch	3200928	73	78
	Westfall Ditch	3201059	26	0
	Anderson Ditch	3200551	6	6
	Stocks Ditch	3200563	11	11
	Wofford Ditch	3200581	6	6
	Leo S Pump	3200596	14	14
	Mcafee Ditch	3200605	27	27
	Devins Ditch And Pump	3200645	2	2
	Hindall Pump	3200673	5	5
	Coulon Ditch	3200777	7	28
	No 14 Pickup Ditch	3200951	11	19
	Cattail Spring	3200990	5	5
	Larmore Collection Dit Ap1	3201038	12	12
	Goodall Ditch	3200597	4	4
33_ADS011 La Plata River	Mccaleb Ditch	3300502	15	45
	Caviness Ditch	3300519	14	14
	Dick Ditch	3300522	40	97
	Keller Ditch	3300523	49	49
	Chidal Ditch	3300530	78	66
	Holder Ditch	3300541	20	20
	Lory Spring Ditch	3300546	24	24
	H C Strobel Ditch	3300557	46	120

	Spring Ditch (Hotter)	3300669	56	56
	John Sponsel Ditch	3300513	4	4
	Old Indian Ditch	3300516	99	99
	White-Roux And Owens D	3300527	81	74
	Upper Davis Ditch	3300539	128	128
	Morgan And Stambaugh D	3300592	26	73
	Schaefer Ditch	3300555	8	8
	M K And T Ditch	3300567	36	72
	Williams Ditch No 1	3300568	36	36
	Williams Ditch No 2	3300685	19	19
	Stinson-Spring Hollow D	3300505	32	32
	Real Erickson Ditch	3300515	40	40
	Gh Ditch	3300517	6	6
	Kowalski Pump	3300565	5	5
34_ADS012 Mancos River above West Mancos River	Cavu Ditch No 1	3400532	49	49
	Davenport Ditch	3400517	59	59
	Field Ditch	3400509	5	5
	Graybeal Ditch	3400525	9	9
	Samson Ditch	3400569	104	104
	Smith Ditch	3400681	91	104
	Spencer Ditch	3400562	257	257
	Jones Waste Water Ditch	3400566	2	2
34_ADS013 Mancos River above Chicken Creek	E C Smith Ditch	3400537	9	9
	Jim Beam Ditch	3400563	1	1
	John Carter Ditch	3400521	120	128
	Sellers Waste Water D	3400538	19	0
34_ADS014 Mancos River near State Line	Charles Ellis Sep & Ww D	3400519	39	43
	Decker Seepage Ditch	3400549	4	4
	Doerfer Ditch	3400581	16	16
	Exon Ditch	3400599	26	0
	John Seepage Ditch	3400511	8	0
	Mancos Canyon Ditch	3400539	22	61
	Mathews Ditch	3400575	0	185
	Michaels Seepage Ditch	3400611	3	3
	Weaver Seepage Ditch	3403586	12	12
	Willden & Brinkerhoff D	3400518	17	17
	Graf Ditch	3400524	14	14
	Garrett Ditch	3400545	36	36
	Jordan Ditch	3400586	11	11
	Janz No. 1 Ditch	3400694	9	0
	Bauer Reservoir No 2	3400546	423	582
60_ADS020	Agricultural Ditch	6000505	108	108

San Miguel River near Placerville	Bank Of Delta Ditch	6000517	15	15
	Benson Ditch	6000524	27	27
	Champlin Ditch	6000553	72	72
	Eder Creek Ditch	6000586	28	28
	House Flood Waste	6000642	5	5
	Mill Creek Ditch No 1	6000693	75	75
	Muddy Creek Ditch	6000706	94	216
	Ohio Kokomo Flood & Wd	6000725	91	91
	Tabor Ditch	6000774	15	15
	Ptarmigan Ditch	6001554	20	21
60_ADS021 San Miguel River above W. Naturita Creek	Cone Grove Camp Ditch	6000563	38	38
	Curtis Stockdale No 1&2	6000570	11	11
	Jay Bar	6000653	30	18
	Stockdale Bennett Ditch	6000768	57	45
	Spectacle Ditch	6001164	0	157
	Redd Harmon Collector D	6000814	471	530
60_ADS022 San Miguel River at Naturita	Barry No1 Ditch	6000518	19	19
	Black Springs Ditch	6000526	6	6
	Carpenter Ditch	6000548	56	56
	Cole Seepage & Fld Wtr D	6000560	32	34
	Doing Ditch	6000582	57	111
	Dry Park Ditch	6000587	224	227
	Eggleston Ditch	6000624	39	57
	Flying H Ditch	6000634	0	326
	Hanks Valley Ditch No 1	6000648	62	362
	Highline Ditch	6000655	56	56
	Iowanna Ditch	6000701	86	86
	Jensen Seep Ditch (Nor)	6000702	57	57
	Morgan No 1 Ditch	6000738	114	114
	Morgan No 2 Ditch	6000792	671	671
	Priestly Ditch No 1	6000802	16	16
	W A Ross Ditch No 1	6001171	364	364
	Williams Ditch No 1	6000577	29	29
	Love Ditch No 3	6000598	17	17
	Swyhart Ditch No 1	6001627	0	342
61_ADS019 Paradox Creek	Tamarisk Ditch	6100505	40	57
	Goshorn Ditch No 1	6100506	563	601
	Ice Lake Ditch	6100509	21	17
	Jenny Ditch	6100510	21	17
	Lammert Ditch & Enlg	6100511	15	15
	Manning Ditch	6100514	12	12
	Robinson Ditch	6100530	20	26

	Spring Creek Ditch	6100533	9	8
	Sumner Ditch	6100534	17	17
	Swain Ditch Extension	6100536	39	39
	Talbert Ditch	6100539	26	30
	Waggoner Ditch	6100543	89	28
	Mary E Young Ditch	6100547	31	31
	Arrowhead Ditch	6100551	32	33
	Boiling Spring	6100663	26	30
63_ADS023 Dolores River at Gateway	Dry Creek Ditch No 1	6000581	33	33
	Elmer Ditch	6000590	48	51
	North Mt Ditch	6000721	365	365
	Merrifield Ditch	6000812	15	17
	Mike Young Ditch No 1	6000816	0	34
	Mike Young Ditch No 2	6000867	33	33
	Burbridge Ditch	6001692	79	79
	Spring Creek Ditch No 2	6300502	51	51
	Ben Ames Ditch	6300505	3	0
	Blue Creek Ditch	6300514	57	57
	Calamity Ditch	6300542	22	7
	Cottonwood Ditch	6300550	0	32
	Mesa Creek Ditch	6300555	44	44
	Patterson Ditch	6300563	36	37
	Rock Creek Ditch	6300571	29	29
	Tom Watkins Ditch	6300574	38	38
	West Ditch	6300578	22	22
	Willow Ditch	6000815	35	37
	Casto Pumping Plant	6300519	36	36
	Red Cross Ditch Pt A	6300734	0	3
63_ADS024 West Creek	Bennett Ditch	6300504	26	18
	Booth Ditch No 1	6300506	42	43
	Booth Ditch No 2	6300507	29	29
	Casement Ditch	6300515	93	79
	Cox Ditch	6300520	69	69
	Fields Ditch	6300523	3	3
	Foy & Tomlinson Ditch	6300525	17	17
	Gill Ditch	6300527	56	56
	Harms Ditch	6300528	4	4
	Highline Ditch	6300530	74	57
	Idlewild Highline D No 2	6300531	9	9
	J R Hatch Ditch	6300532	5	6
	L L Hall Ditch	6300533	15	15
	Loba Ditch No 4	6300537	6	7

	Loba Ditch No 5	6300538	42	42
	Lone Oak Ditch	6300539	14	14
	Lone Oak Ditch No 2	6300540	34	34
	Pansy Highline Ditch	6300549	44	48
	Pine Mesa Ditch Headgate No. 1	6300552	168	168
	Ren Hatch Ditch	6300554	4	4
	Silzell Ditch	6300558	76	75
	Smith D No 1 Ext	6300559	28	24
	Smith Ditch No 1	6300560	4	4
	Smith Ditch No 2	6300561	4	4
	South Loba Ditch	6300562	27	0
	Triangle Bar Ditch	6300564	131	131
	Unaweep Cattle Range D 2	6300565	39	40
	Unaweep Cattle Range D 3	6300566	47	47
	Unaweep Cattle Range D 4	6300567	30	30
	W S Lafair Ditch	6300569	14	14
	West Creek Ditch No 1	6300572	54	52
	Wild Rose Ditch	6300573	9	10
	Rachel Graham	6300577	3	3
	Columbine Ditch	6300682	5	5
	Turner Creek Ditch	6300735	55	55
69_ADS018 Disappointment Creek	Clark Ditch	6903531	67	75
	Evans Ditch	6900504	38	38
	Johnson And Davis Ditch	6900513	41	5
	Melvin A Irr Ditch	6900525	14	14
	Melvin A Waste-Water D	6900514	14	14
	Morrison Ditch	6900515	32	32
	Thomas Ditch	6900527	23	23
	Young Ditch	6900529	37	37
	Dunham Ditch	6900501	61	61
	Garner Reservoir	6900511	82	82
71_ADS017 Dolores River above McPhee Reservoir	Unnamed Ditch Or P-L	7100510	6	6
	Carter Ditch	7100562	7	7
	Frank Robinson Ditch	7100608	17	17
	Home Ditch	7100623	13	35
	Knoblock Ditch	7100558	15	15
	Leavensworth Ditch	7100589	20	20
	Lyons Ditch	7100593	36	36
	Ortiz Ditch	7100603	21	21
	Riverside Ditch	7100705	69	69
	Rogers Ditch	7100565	54	54
	Royce And Risley Ditch	7100588	13	13

	Starrett Ditch	7100601	35	35
	Stoner Creek Ditch	7100517	26	26
	Sulphur Gulch Ditch	7100534	12	12
	Wattles And Freeman D	7100547	40	40
	Kipper Ditch No 1	7100576	5	5
71_ADS019 Dolores River ab Big Gypsum	Geo P Moore Ditch	7100539	34	34
	Lone Dome Ditch	7100564	129	112
73_ADS025 Little Dolores River	Gateway West Side Ditch	6300526	10	10
	Wines Ditch No 1	6300575	52	55
	Wines Ditch No 2	6300576	13	11
	Bieser Ditch	7300501	32	29
	Brouse Ditch	7300502	13	7
	Chiquito Dolores Ditch	7300504	121	113
	Chiquito Dolores No 2	7300505	127	124
	Dierich Ditch	7300506	74	86
	Fruita Water Works Pl	7300507	19	0
	Hafey South Side Ditch	7300511	0	7
	Mcginley Ditch	7300512	21	20
	Murphy I S D Ex Ditch	7300513	187	33
	Nellie S Ditch	7300515	19	58
	Reed Ditch	7300516	81	86
	Robbins Ditch	7300517	105	105
	Roehm Ditch	7300519	19	23
	Upper Saxbury Ditch	7300530	169	174
	A R Hall Ditch	7300533	35	20
	H H Russel D	7300534	180	180
	Hill Ditch	7300537	42	42
	Moorland Ditch	7300538	174	254
	Selby Irrigating Ditch	7300541	134	154
	Kell Ditch No 1	7300542	19	16
	Kell Ditch No 2	7300543	6	6
	Eaches Ditch	7300561	12	18
	Lane Ditch	7300566	1	1
	Madden Ditch No 3	7300622	10	10
	Madden Ditch Extended	7300634	35	39
	Skinner Ditch	7300641	19	0
	Cook Irrigating D Pt A	7300508	34	34
77_ADS001 Navajo River	Bigbee Ditch No 1	7700504	428	428
	Bramwell Irr Ditch	7700509	55	55
	Brooks Ditch	7700511	37	37
	Buckhammer Ditch	7700552	24	24

	Confar And Russell Ditch	7700555	38	38
	Elmer Ditch No 2	7700572	64	64
	Gardner Lake Ditch	7700512	4	4
	Highfills Price Cr D No1	7700516	65	65
	Klondike Ditch	7700538	20	20
	L A Sappington Ditch	7700530	57	57
	Little Navajo Ditch	7700563	31	31
	Navajo Mill & Irg Ditch	7700575	97	97
	Paxman Ditch	7700582	2	2
	Peterson Creek Ditch	7700550	26	26
	Russell Ditch	7700573	9	9
	Spring Creek Ditch	7700581	78	78
	Spring Gulch Ditch	7700546	51	51
	Talamante Ditch No 1	7700580	7	7
	Weisel Creek Ditch	7700591	24	24
	New Bond House D(Iron)	7700636	14	14
78_ADS004 Piedra River	Lopez Ditch	4600523	44	44
	Lopez-Gallegos Ditch	4600522	26	26
	Hays Ditch	7800500	29	29
	Abeyta Ditch	7800510	22	22
	B O Thayer No 1 Ditch	7800515	49	49
	B O Thayer No 2 Ditch	7800526	49	49
	Big Pagosa Ditch	7800528	29	29
	Burkhard Ditch	7800610	77	77
	Coal Hill Ditch	7800611	20	20
	Cottonwood Ditch	7803624	77	77
	Dunnagan Ditch	7800505	284	0
	Dyke No 1 Ditch	7800575	41	41
	Ford Ditch	7800607	40	40
	Grimes Ditch	7800612	133	132
	H E Freeman No 1 Ditch	7800652	134	134
	J R Scott Ditch	4600524	46	46
	John R Stevens Ditch	7800504	49	49
	Jule Macht Spring And D	7800557	529	556
	Kerr Ditch	7800558	9	9
	Kleckner Ditch	7800566	110	110
	Lower Davis Ditch	7800572	28	28
	Pargin Ditch	7800579	0	26
	Plumteau Creek Ditch	7800616	89	89
	Ralph L Reno Ditch	7800648	29	29
	Riverview Ditch	7800722	50	54
	Ross Ditch	7800538	3	3

	Snow Ditch	7800539	10	14
	Vye Ditch No 1	7800546	12	12
	Wildwater Ditch	7800568	30	30
	Clara Fredricks Ditch	7800576	13	13
	Minor Ditch	7800642	3	3
	Lynd-Plumteau Ck Ditch	7800676	94	94
	Dunagan Reservoir	7803638	284	0
	Spring Creek Reservoir	7800595	43	43
Total			**24,588**	**26,744**

Exhibit B: Diversion Structures in each “No Diversion Records” Aggregate

Aggregation ID	Diversion Structure Name	WDID	2005 Acres	2010 Acres
29_AND002 San Juan at Pagosa Springs	At Last Spring No 1 W Side	2900506	2	2
	Brown Spring & Pipeline	2900547		44
	Cummings Ditch	2900570	33	28
	Cummings-Bear Cannon Ditch	2900571	27	27
	Davis Ranch Springs	2900573	7	7
	K O Harman Ditch No 2	2900640	18	18
	R B Cowden Irr D No 2	2900698	18	18
	W B Turner Irr System	2900746		
	Dermody Pump	2900789		
	Cummings-Bear Cannon Alt Pt	2900793		
	Coal Mine Draw	2900932		
	Hinds Pumpsite Alt Pt	2900991		
	Water Fall CR Min Flow	2901909		
	Wolf CR Village Well #1	2905045		
29_AND003 San Juan at Carracas	Baker Sprinker Pump Station	2900515	16	20
	Blake No 1 Pumping Sta	2900533	111	
	Bonds San Juan R P Plt	2900539	14	14
	Dirnberger Spg & Pl No 2	2900580	40	
	McGirr-Gomez Ditch	2900667	41	41
	Murray Ditch	2900673	26	
	Virginia Ditch Alt Pt	2900805	114	114
	Felix Gomez Irr System	2900810		
	Sophia’s Pump	2900818		
	Adams Spring	2900838		
	Big Branch Ditch	2902003	137	137
30_AND007 Animas River at Durango	Bowman Pump No 1 w/ A-H	3000515	13	13
	Boyd Ditch	3000516		7
	Elbert No 1 Ditch (W)	3000537	9	9
	Gilmour Pipeline No 1	3000552	2	2
	Haynie Pump	3000564	18	18
	L Carson Ditch	3000585		3
	Macy Spring and PL Sys	3000595		3
	Spring Ditch	3000637		12
	Tamarron WW Effluent PL	3000643	4	4
	Tank Creek Ditch	3000644		7
	Wilderness Pipeline	3000684	4	4
	Tall Timber Ditch	3000694	52	52
	Dyar Pump Station	3000724		11
	Dyar-McCoy Diversion Sta	3000747	1	1

	Allen Pump #1	3000751	149	149
	Bridges Pump	3000785	4	4
	Redcliff Pump Station	3000811	27	27
	Darryl's Pump	3000843	15	15
	Val-air Pump	3000855	4	4
	Arnold Diversion	3000900	19	19
	Emmett Wastewater Divr	3000903		
	S Woods Diversion	3000951		
	Jenkins Ditch	3001128		
	Wielang Ditch	3001266	3	5
30_AND008 Florida River above Salt Creek	Upper Florida Ditch	3001010	26	26
	Gallaher Ditch	3001111	13	13
	Shreck Ditch	3001215	19	19
	West-Martin Ditch	3001368	37	29
	Black Ditch	3001374	10	10
	Willon Creek D 2ND Headgate	3001423		
	Rathjen Waste Water	3001594		
	K-K Bog Spring	3006023	36	36
30_AND009 Florida River at Bondad	Dore Pump	3001087	25	25
	Roundtree WW System	3001197	20	20
	Siebert Ditch	3001204	6	6
30_AND010 Animas River at State Line	Carleno Ditch	3001066	5	3
	Foy Cogburn Pipeline	3001107	6	5
	Sever Pipeline	3001205	9	9
	Van Endert Ditch	3001248	9	9
	Zinc Spring No 5	3001276	7	7
	Duane Cogburn Pipeline	3001345	4	3
	Wegs Pump	3001661		
	Peters Pump	3001669		13
31_AND005 Los Pinos River at Dry Creek	Robeson No 2 Ditch	3100542	25	25
	Montgomery Ditch	3100610	9	9
	Pixler Ditch	3100656		94
	Schroder Ditch Extension	3100662	27	27
	Wildorado Res East Ditch	3100705		46
	Colorado SW Ditch No 1	3100708	11	11
	Pine River Cemetary Pump	3100772		86
	Morgan Spring #2	3100840	13	13
	Morgan Diversion #A	3100842	7	7
	Moore Pond Diversion	3100909	10	10
	Benoit Irrigation Pump	3100933		2
	Cruson Pump	3100993	6	6
	Vallecito Reservoir	3103518		

	Gosney Storage System	3103711		21
	Duffy Diversion Pond	3103712	32	32
31_AND006 Los Pinos River at State Line	Agency Ditch	3100500	4	
	Baily Canon Ditch	3100548	121	121
	Beaver Valley Ditch	3100571	16	16
	Jaques Pond & Divr No 1	3100658	5	59
	McCoy Ditch	3100717	9	9
	Shelhamer Lower End D #1	3100834	15	15
	Pack Waste Water Ditch	3100873	3	3
	Hargreaves Ditch	3100880		
	Neil Waste Water Ditch	3100918		
	Black Draw Reservoir #1	3101069	30	30
	Phelps Diversion #1	4600550	130	130
	Phelps Diversion #2	4600563	3	3
32_AND015 McElmo Creek above Alkali	Bradford-Whilldin Div PL	3200710	1	7
	Bennys Pump	3200720		
32_AND016 McElmo nr State Line	Plemons Ditch	3200643		
	Sprickert No 1 Ditch	3200671		
33_AND011 La Plata River	P M Davis Ditch	3300503	16	
	Moss Ditch	3300509	39	39
	Sena Ditch	3300556	19	19
	John F Reit Ditch	3300558	68	68
	Eno Seepage Dit ch	3300570	4	4
	Hubbs Ditch No 1	3300579	12	12
	Hubbs Ditch No 2	3300580	11	11
	Paulek No 1 Ditch	3300583	6	6
	Lapp North Spring System	3300594		
	Townsend Spring No 1	3300596		
	Wheeler 2 Ditch	3300604		
	Isgar Irrigation System	3300616		
	Greer Ditch	3300626	9	29
	O.F.C. Ditch	3300673	11	
34_AND013 Mancos Riv ab Chicken Creek	Jackson Gulch Reservoir	3403589	30	30
60_AND020 Mancos River nr State Line	Prospect Cr Hole No 2/17	6001854	145	145
60_AND021 San Miguel R nr Placerville	Brewster Cr Ditch	6000537	90	90

	Homestead No2 Ditch	6000990		
61_AND019 Dolores River nr Bedrock	N Mid Met Draw Div Ditch	6100553		42
63_AND023 Dolores River at Gateway	Lonsway Ditch	6000674		
	Richards Pump St No 2	6001622		
	Cliff Dwellers Ditch	6300517		
63_AND024 West Creek	Burg Ditch No 1	6300509	168	168
	Craig Res No 2	6303640		
	Craig Res No 1	6303644	35	35
71_AND017 Dolores River above McPhee Reservoir	Jesse Love Ditch	7100553	7	7
	Silvey Ditch	7100599	16	16
	Ethel Belmear Reservoir	7103610	26	26
71_AND019 Dolores River ab McPhee Res	Lawrence E Rogers Ditch	7100561	15	15
	Suckla Pump Site	7100607	23	39
	Willis Rogers Ditch	7100636		22
73_AND025 Little Dolores River	Cook Irrigation Ditch	7300532	1	1
	Green Shaft Reservoir	7303602	1	1
	Madden Trout Pond No 2	7303603		
	Duvall Res. No. 1	7303612	19	58
77_AND001 Navajo River	Coyote-Boon Creek Ditch	7700519	141	15
	Krenz Ditch	7700551		
	Olen W Crowley Art Well	7705004		
78_AND004 Piedra River	Herrera Pump Site No 1	2900764	12	12
	Dutton Collection Ditch	2902007	11	11
	Don Thompson Pump No 1	7800535	19	19
	Don Thompson Pump No 2	7800536	300	300
	Bynum Pumpsite	7800669	14	14
	Town Center Pump	7800675		
	McWhirters Pond & Pump	7800677		
	Tishner Pumpsite	7800687	4	4
Total			**3,354**	**3,610**

A-2: Identification of Associated Structures (Diversion Systems and Multi-structures)

Background

The previous CDSS Western Slope models include associated structures which divert to irrigate common parcels of land. These associations were primarily based on information provided directly during meetings with Water Commissioners, and were not based on information from the original 1993 irrigated acreage assessment. The original CDSS 1993 irrigated acreage assessment was based on the USBR identification of irrigated land enhanced with a water source (ditch identifier) that served that land. Many of the irrigated acreage parcels covered more than one ditch service area and, in lieu of spending significant time splitting the parcels by ditch service area, more than one ditch was assigned. For CDSS modeling purposes, the acreage was simply "split" and partially assigned to each ditch.

Introduction

For the recent 2005 and 2010 acreage assessments, there was significant effort spent trying to refine irrigated parcels based on the legal and physical ditch boundaries so, where possible, there was only one ditch assigned to each irrigated parcel in Divisions 5, 6, and 7. Division 4 efforts concentrated on a few areas, but not the entire basin. To model these ditches as accurately as possible, it is important to understand if the acreage that is still assigned to more than one ditch is actually irrigated by all assigned ditches in a comingled fashion or, alternatively, if the acreage should be "split" and the structures should be modeled as having no association. Ditches combined for modeling because the supplies are believed to be comingled are termed "associated structures" for the CDSS modeling effort.

Some associated structures can be identified based on the HydroBase water rights transaction table because they are decreed alternate points or exchange points, while others can be identified based on Water Commissioner accounting procedures, generally documented in their comments accessible through Hydrobase. In the models, associated structures are represented as diversion systems if the structures are located on the same tributary or multi-structure systems if they are located on different tributaries. As part of Task 3, the associated structures were updated to more accurately model the combined acreage, diversions, and demands. These updates include the integration of the 2005 irrigated acreage, the 2010 irrigated acreage, as well as verification of associated structures based on diversion comments and water right transaction comments.

Approach

The following steps were used to identify associated structures in Divisions 5, 6, and 7. Because the Division 4 parcels have not yet been refined to the ditch service level, no effort was made to determine additional associated structures. Note, however, the parcels that require additional refinement have been identified and provided to Division 4. These updates should be included with the next acreage assessment.

Updating the associated structures was a multi-step process that involved 1) identifying potential associated structures by integrating the 2005 and 2010 CDSS irrigated acreage, 2) verifying the associated structures using the diversion and water right transaction comments, and 3) making recommendations on how to best represent the associated structures in the CDSS Western Slope models.

1) *Develop an Associated Structure List Based on Revised 2005and 2010 CDSS Irrigated Acreage*

An initial associated structure list was developed by combining the CDSS revised 2005 and 2010 irrigated acreage. During this process the overlapping similarities between the two irrigated acreage coverages were integrated, resulting in a list of associated structures containing unique IDs. An illustrative example is presented below. In this example, the 2005 irrigated acreage coverage contains parcel A assigned to structures 1, 2, and 3; while the 2010 irrigate acreage coverage contains parcel B assigned to structures 2 and 4. Parcel A and B are integrated, resulting in an association comprised of structures 1, 2, 3, and 4.

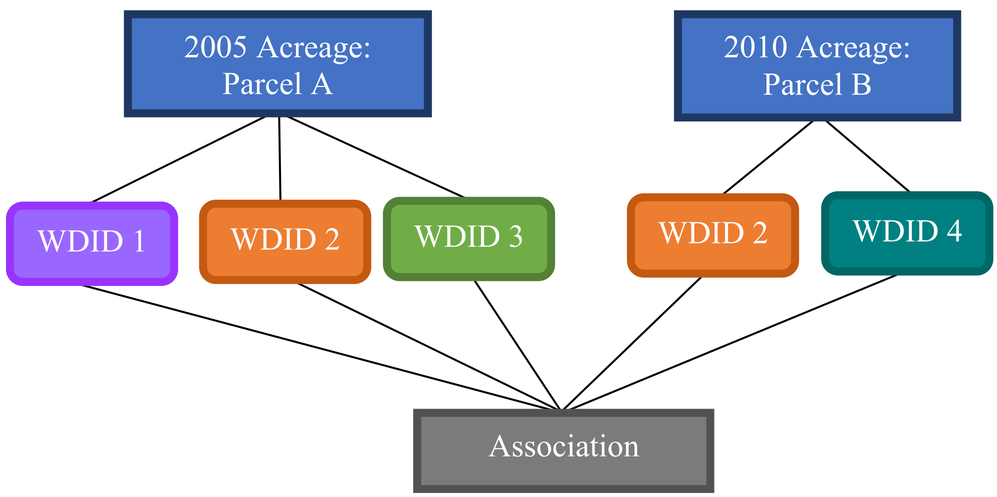

Figure A-2. Example of integrating the CDSS irrigated acreage coverage to identify associated structures.

2) *Verify the Associations Using Diversion and/or Water Right Transaction Comments*

Once a unique list of associated structures was developed, each association was verified using diversion comments and/or water right transaction comments. If the diversion comments and/or water right transaction comments could not verify structure associations, then unverified structures were removed from the list of associated structures (i.e., their diversions will not be treated as commingled). Types of verification included comments identifying structures as alternate points of diversion, points of exchange, acreage reported under alternative structure, same points of diversion, and water right transfers.

Below is an example of the verification methodology using the diversion and/or transaction comments for the association shown in step 1.

Table A-4. Example of Integrating the Diversion and Water Right Transaction Comments for Verification.

WDID	Verification Comment	Source	Verified?
1	Irrigates Y Ranch	Diversion Comment	N
2	Water right transferred to WDID 4	Transaction Comments	Y
3	Acreage is recorded under WDID 2	Diversion comments	Y
4	-	-	Y

Given this example, WDID 1 was not verified by the comments and, thus, not included in the final list of associated structures.

3) *Recommend a Modeling Approach for Representing Associated Structures in the CDSS Western Slope Models*

Using the refined associated structure list developed in step 2, recommendations on how to best represent the associated structures in the CDSS models were provided. These recommendations were based on the following criteria:

- If located on non-modeled tributaries, the associated structures were added to appropriate aggregates.
- Associated structures were explicitly modeled—either in diversion systems or multi-structure systems—if the net water rights for at least one structure in the association exceeded a specific threshold identified in previous modeling efforts. In general, the thresholds represent 75% of the net water rights and are listed in **Table A-5**.

Table A-5. Water Right Thresholds for Explicit Modeling

CDSS Model	Water Right Threshold (CFS)
Yampa	5
White	4.8
Upper Colorado	11
San Juan/Dolores	5/6.5

Structures located on the same tributary were modeled as diversion systems, while structures located on different tributaries were modeled as a multi-structure system. Note, diversions systems combine acreage, headgate demands, and water rights; and the model treats them as a single structure. Contrastingly, multi-structure systems have the combined acreage and demand assigned to a primary structure; however, the water rights are represented at each individual structure, and StateMod meets the demand from each structure when their water right is in priority. **Figure A-3** illustrates how a diversion system is modeled, while **Figure A-4** illustrates how a multi-structure system is modeled.

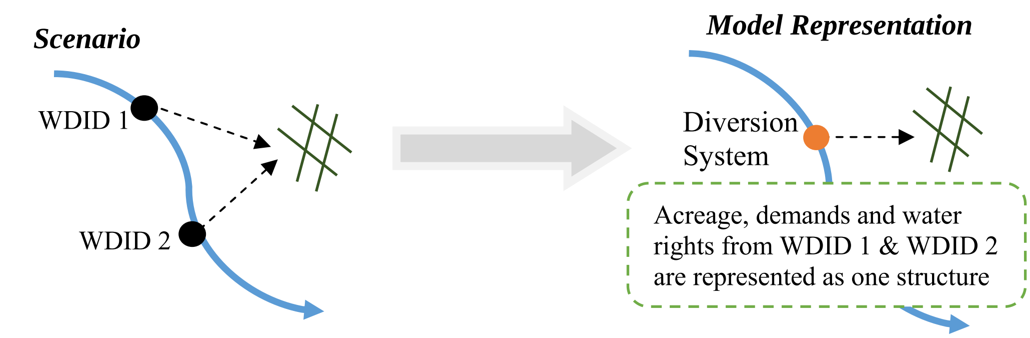

Figure A-3. Model Representation of a Diversion System.

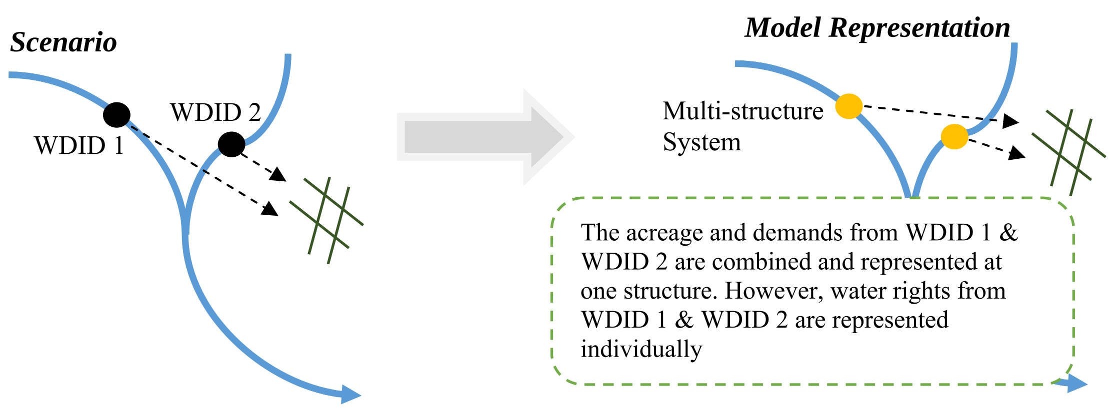

Figure A-4. Model Representation of a Multi-structure System.

- The structure with the most irrigated acreage—based on the 2005 and 2010 CDSS coverages—was selected as the modeled structure for each diversion system.
- The structure with the greatest net water rights was selected as the primary structure for multi-structure systems.

- If none of the structures in an association exceeded the water right threshold identified in Table 2 and have contemporary diversion records, the structures were modeled in an aggregate.
- If all structures in an associated did not have diversion records, the structures were placed in a “no diversion” aggregate.