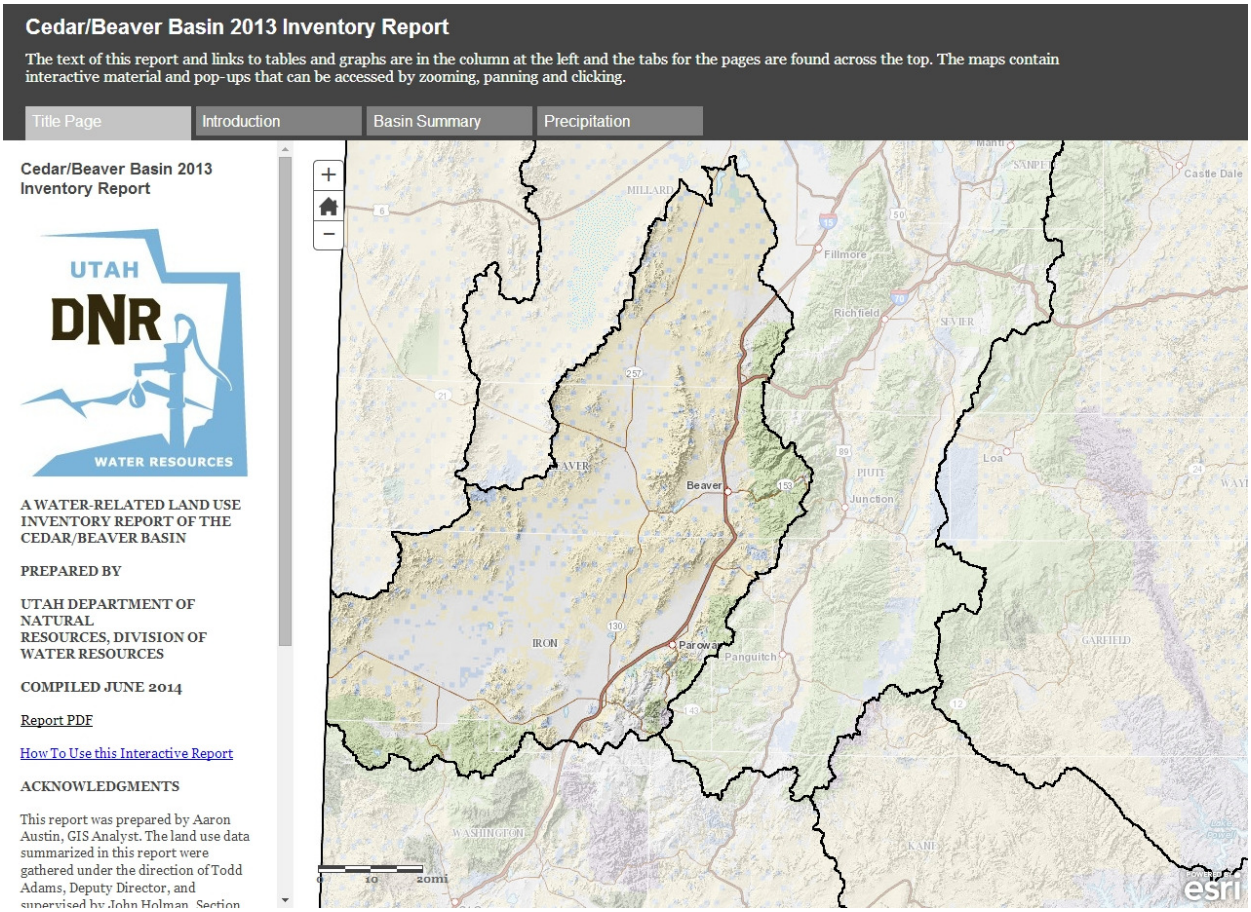
A WATER-RELATED LAND USE INVENTORY REPORT OF THE CEDAR/BEAVER BASIN

PREPARED BY

UTAH DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER RESOURCES

COMPILED JUNE 2014



ACKNOWLEDGMENTS

This report was prepared by Aaron Austin, GIS Analyst. The land use data summarized in this report were gathered under the direction of Todd Adams, Deputy Director, and supervised by John Holman, Section Chief, Technical Services, Utah Division of Water Resources.

The Technical Services Staff was chiefly responsible for the collection, preparation and analyses of the data. The data were summarized by Adam Clark, GIS Analyst. Additionally, select members of the Planning and Development Staffs assisted with the collection of the data.

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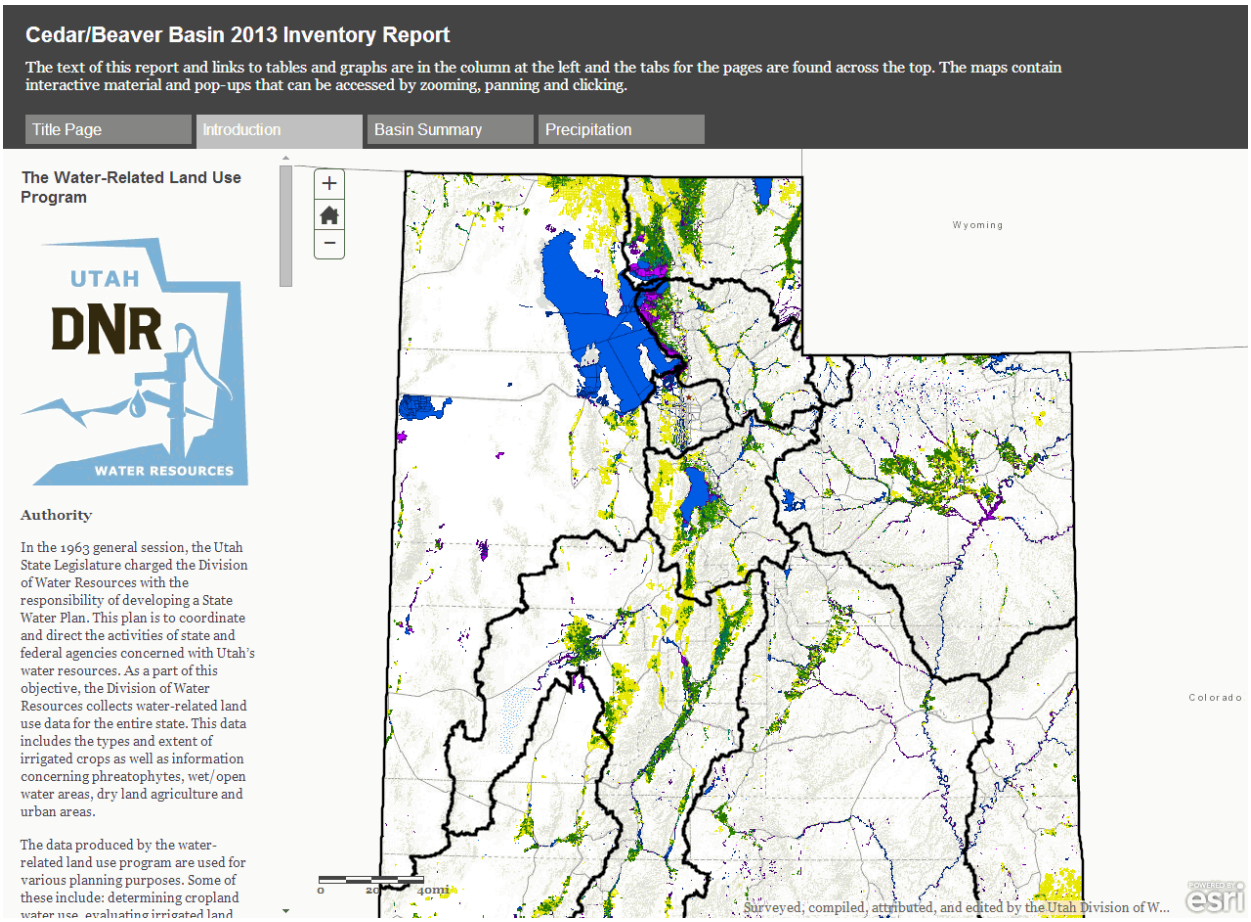


Authority

In the 1963 general session, the Utah State Legislature charged the Division of Water Resources with the responsibility of developing a State Water Plan. This plan is to coordinate and direct the activities of state and federal agencies concerned with Utah's water resources. As a part of this objective, the Division of Water Resources collects water-related land use data for the entire state. This data includes the types and extent of irrigated crops as well as information concerning phreatophytes, wet/open water areas, dry land agriculture and urban areas.

The data produced by the water-related land use program are used for various planning purposes. Some of these include: determining cropland water use, evaluating irrigated land losses and conversion to urban uses, planning for new water development, estimating irrigated acreages for any area, and developing water budgets. Additionally, the data are used by many other state and federal agencies.

Previous Methods

The land use inventory methods used by the division in conducting water-related land use studies have varied with regard to the procedures used and the precision obtained. During the 1960s and 70s,

inventories were prepared using large format vertical-aerial photographs supplemented with field surveys to label boundaries, vegetation types, and other water use information.

After identifying crops and labeling photographs, the information was transferred onto a base map and then planimetered or "dot-counted" to determine the acreage. Tables for individual townships and ranges were prepared showing the amount of land in each land use category within each section. Data were then available for use in preparing water budgets.

In the early 1980s, the division began updating its methodology for collecting water-related land use data to take advantage of the rapidly growing fields of Remote Sensing and computerized Geographic Information Systems (GIS).

For several years during the early 1980's, the division contracted with the University of Utah Research Institute, Center for Remote Sensing and Cartography (CRSC), to prepare water-related land use inventories. During this period, water-related land use data was obtained by using high altitude color infrared photography and laboratory interpretation, with field checking.

In March 1984, several division staff members visited the California Department of Water Resources to observe its methodology for collecting water-related land use data for state water planning purposes.

Based on its review of the California methodology and its own experience, the division developed a water-related land use inventory program. This program included the use of 35mm slides, United States Geological Survey (USGS) 7-1/2 minute quadrangle maps, field-mapping using base maps produced from the 35mm photography and a computerized GIS to process, store and retrieve land use data.

Areas for survey were first identified from previous land use studies and any other available information. The identified areas were then photographed using an aircraft carrying a high quality 35mm single lens reflex camera mounted to focus along a vertical axis to the earth. Photos were taken between 6,000 and 6,500 feet above the ground using a 24mm lens. This procedure allowed each slide to cover a little more than one square mile with approximately 30 percent overlap on the wide side of the slide and 5 percent on the slide's narrow side.

The slides were then indexed according to a flight-line number, slide number, latitude and longitude. All 35mm slides were stored in files at the division offices and cataloged according to township, range and section, and quadrangle map location.

Water-related land use areas were then transferred from the slide to USGS 7-1/2 minute quadrangle maps using a standard slide projector with a 100-200mm zoom lens. This step allowed the technician to project the slide onto the back of a quadrangle map. The image showing through the map was adjusted to the map scale with the zoom lens. Field boundaries and other water-use boundaries were then traced on the 7-1/2 minute quadrangle map.

Next, a team was sent to use the map in the field to check the boundaries and current year land use field data on the 7-1/2 minute quadrangles.

The final step was to digitize and process the field data using ARC/INFO software developed by Environmental Systems Research Institute (ESRI).

Starting in 2000 with the land use survey of the Uintah Basin, the division further improved its land use program by using digital data for the purposes of outlining agricultural and other land cover boundaries. The division used satellite data, USGS Digital Orthophoto Quadrangles (DOQs), National Agricultural

Imagery Program (NAIP), and other digital images in a heads-up digitizing mode for this process. This allowed the division to use multiple technicians for the digitizing process.

Digitizing was done as line and polygon files using ArcView 3.2 with a satellite image, DOQ or NAIP image as a background with other layers added for reference. Boundary files were created in logical groups so that the process of edge-matching along quad lines was eliminated and precision increased. Subsequent inventories were digitized in the ArcMap 9.x software versions.

Present Methodology

Using the latest statewide NAIP Imagery and ArcGIS 10, all boundaries of individual agricultural fields, urban areas, and significant riparian areas are precisely digitized.

Once the process of boundary digitizing is done, the polygons are loaded onto tablet PCs. Field crews are then sent to field check the crop and irrigation type for each agricultural polygon and label the shapefiles accordingly. Each tablet PC is attached to a GPS unit for real-time tracking to continuously update the field crew's location during the field labeling process. This improved process has saved the division much time and money and even greater savings will be realized as the new statewide field boundaries are completed.

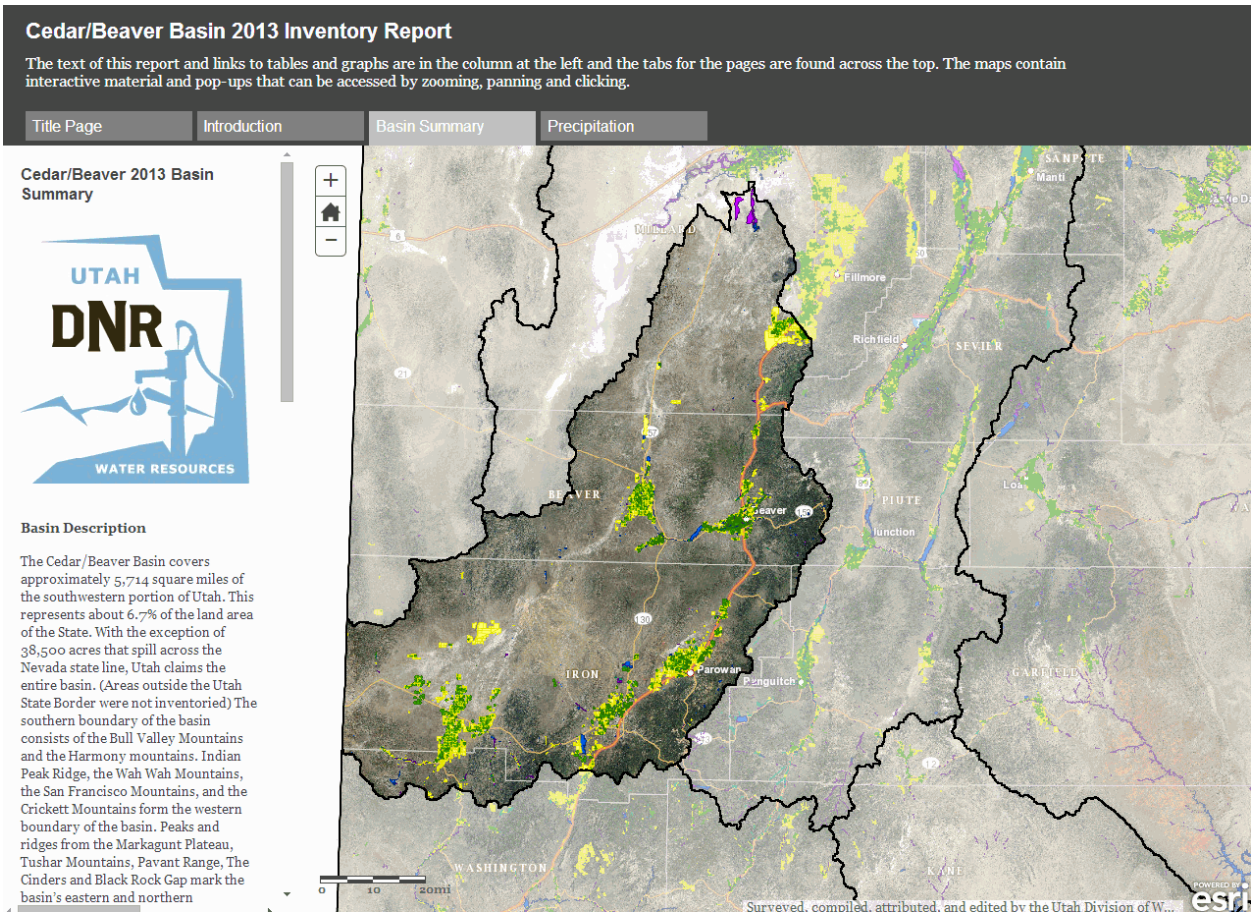
Once processed and quality checked, the data is filed in the State Geographic Information Database (SGID) maintained by the State Automated Geographic Reference Center (AGRC). Once in the SGID, the data becomes available to the public. At this point, the data is also ready for use in preparing various planning studies.

In conducting water-related land use inventories, the division attempts to inventory all lands or areas that consume or evaporate water other than natural precipitation. Areas not inventoried are mainly desert, rangeland and forested areas.

Wet/open water areas and dry land agriculture areas are mapped if they are within or border irrigated lands. As a result, the numbers of acres of wet/open water areas and dry land agriculture reported by the division may not represent all such areas in a basin or county.

During land use inventories, the division uses 11 hydrologic basins as the basic collection units. County data is obtained from the basin data. The water-related land use data collected statewide covers more than 4.3 million acres of dry and irrigated agricultural land. This represents about 8 percent of the total land area in the state.

Due to changes in methodology, improvements in imagery, and upgrades in software and hardware, increasingly more refined inventories have been made in each succeeding year of the Water-Related Land Use Inventory. While this improves the data we report, it also makes comparisons to past years difficult. Making comparisons between datasets is still useful; however, increases or decreases in acres reported should not be construed to represent definite trends or total amounts of change up or down. To estimate such trends or change, more analysis is required.



Basin Description

The Cedar/Beaver Basin covers approximately 5,714 square miles of the southwestern portion of Utah. This represents about 6.7% of the land area of the State. With the exception of 38,500 acres that spill across the Nevada state line, Utah claims the entire basin. (Areas outside the Utah State Border were not inventoried) The southern boundary of the basin consists of the Bull Valley Mountains and the Harmony mountains. Indian Peak Ridge, the Wah Wah Mountains, the San Francisco Mountains, and the Crickett Mountains form the western boundary of the basin. Peaks and ridges from the Markagunt Plateau, Tushar Mountains, Pavant Range, The Cinders and Black Rock Gap mark the basin's eastern and northern boundaries. The basin spans portions of Beaver, Garfield, Iron, Millard and Washington counties.

Elevations in the basin range from 12,169 feet at Delano Peak in the Tushar Mountains on the east and 9,660 feet at Frisco Peak in the San Francisco Mountains on the west to 5,600 feet in Cedar Valley, 5,200 feet in Escalante Valley, and 4,600 near Clear Lake. A notable feature of the basin is Cedar Breaks National Monument.

Data Collection

The Division inventoried water-related land use in the Cedar/Beaver Basin during the summer of 2013. Previous inventories were done in 1989, 2001 and 2007. In 2013, the division inventoried roughly 240,634 acres of land in the Basin. This represents about 7% of the total land area in the basin.

Data Summary

Of the roughly 240,634 acres inventoried in 2013, 97,350 were irrigated lands (including land that was sub-irrigated), 71,480 were non-irrigated (including land that was fallow and idle), 15,438 were wet/open water areas (including reservoirs and mountain lakes), 41,338 were residential/industrial areas (including farmsteads and rural housing) and 15,100 were other non-irrigated lands.

Summary Table -total basin acreage for irrigated lands, non-irrigated lands, wet/open water areas, and residential/industrial are presented by county. Note: County numbers are only the basin portion of the county.

Summary Tables - Excel or Google Spreadsheet download link of Basin Tables 1989 to 2013

CEDAR/BEAVER BASIN LAND USE 2013 (Acres)							
Category	**Cover**	**BEAVER**	**GARFIELD**	**IRON**	**MILLARD**	**WASHINGTON**	**Total**
Surface-Irrigated							
	Alfalfa	18553.92	0.00	42848.20	3415.77	1300.44	**66,118.33**
	Corn	2031.04	0.00	5237.39	490.27	153.64	**7,912.34**
	Grain	1383.73	0.00	1996.37	1643.07	23.59	**5,046.76**
	Grass Hay	2009.66	0.00	882.97	142.13	119.84	**3,154.60**
	Oats	764.91	0.00	1654.72	30.67	0.00	**2,450.31**
	Orchard	0.00	0.00	23.84	0.00	0.73	**24.57**
	Other Vegetables	0.00	0.00	4.92	0.00	9.25	**14.17**
	Pasture	6886.40	0.00	3015.60	110.10	398.60	**10,410.70**
	Potatoes	0.00	0.00	130.12	0.00	0.00	**130.12**
	Sorghum	200.62	0.00	0.00	17.28	0.00	**217.90**
	Turf Farms	0.00	0.00	311.00	0.00	0.00	**311.00**
	Vineyard	0.00	0.00	0.00	0.00	3.69	**3.69**
	Irrigation Method						
	Flood	7686.65	0.00	1770.38	1117.75	340.48	**10,915.26**
	Sprinkle	24143.63	0.00	54334.75	4731.54	1669.29	**84,879.22**
	Subtotal	31830.28	0.00	56105.14	5849.30	2009.77	**95,794.48**
Sub-Irrigated							
	GrassHay-subirrigated	3.45	0.00	5.51	0.00	0.00	**8.96**
	Pasture-subirrigated	516.37	0.00	725.88	0.00	304.48	**1,546.73**
	Subtotal	519.81	0.00	731.40	0.00	304.48	**1,555.69**
Non-Irrigated							
	Dry Alfalfa	63.95	0.00	163.47	0.00	42.26	**269.68**
	Dry Fallow	0.00	0.00	106.31	0.00	0.00	**106.31**
	Dry Grain/Seeds	8.02	0.00	1143.00	2621.01	9.29	**3,781.33**
	Dry Idle	352.87	0.00	13676.83	176.31	382.77	**14,588.77**
	Dry Oats	0.00	0.00	7.39	0.00	0.00	**7.39**
	Dry Pasture	2972.90	0.00	7525.40	5348.78	2301.26	**18,148.34**
	Fallow-Irrigated Land	261.78	0.00	1680.57	19.83	145.11	**2,107.29**
	Idle-Irrigated Land	11241.59	0.00	17215.34	3121.22	821.00	**32,399.15**
	Subtotal	14901.12	0.00	41518.30	11287.15	3701.68	**71,408.26**
Other Non-Irrigated							
	Range Pasture	1853.90	0.00	7020.99	4764.23	1460.52	**15,099.64**
Wet/Open Water Areas							
	Evaporation Pond	0.00	0.00	6.94	0.37	27.05	**34.35**
	Lakes & Ponds	171.60	0.00	1910.36	0.00	10.16	**2,092.11**
	Reservoirs	2283.80	17.15	1486.36	607.70	463.44	**4,858.46**
	Riparian	426.61	0.00	1177.90	4928.70	489.77	**7,022.98**
	Sewage Lagoon	597.90	0.00	304.18	0.00	0.00	**902.08**
	Streams	486.12	0.00	19.57	0.00	22.13	**527.81**
	Subtotal	3966.03	17.15	4905.31	5536.76	1012.54	**15,437.80**
Residential/Industrial							
	Urban	9524.14	0.00	27961.39	1489.91	1733.03	**40,708.47**
	Urban Grass/Parks	164.05	0.00	419.68	6.57	38.90	**629.21**
	Subtotal	9688.19	0.00	28381.08	1496.48	1771.94	**41,337.68**
Total Land Use/Land Cover		**62,759.33**	**17.15**	**138,662.22**	**28,933.92**	**10,260.93**	**240,633.55**

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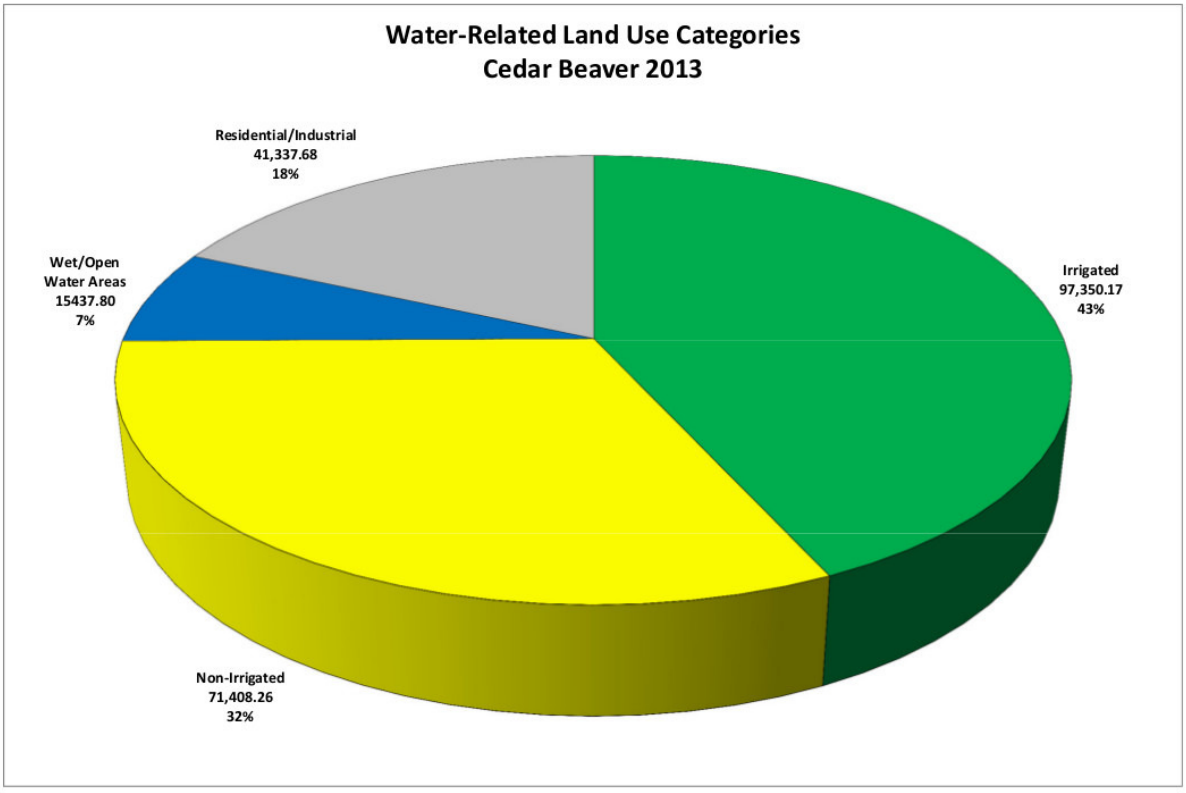
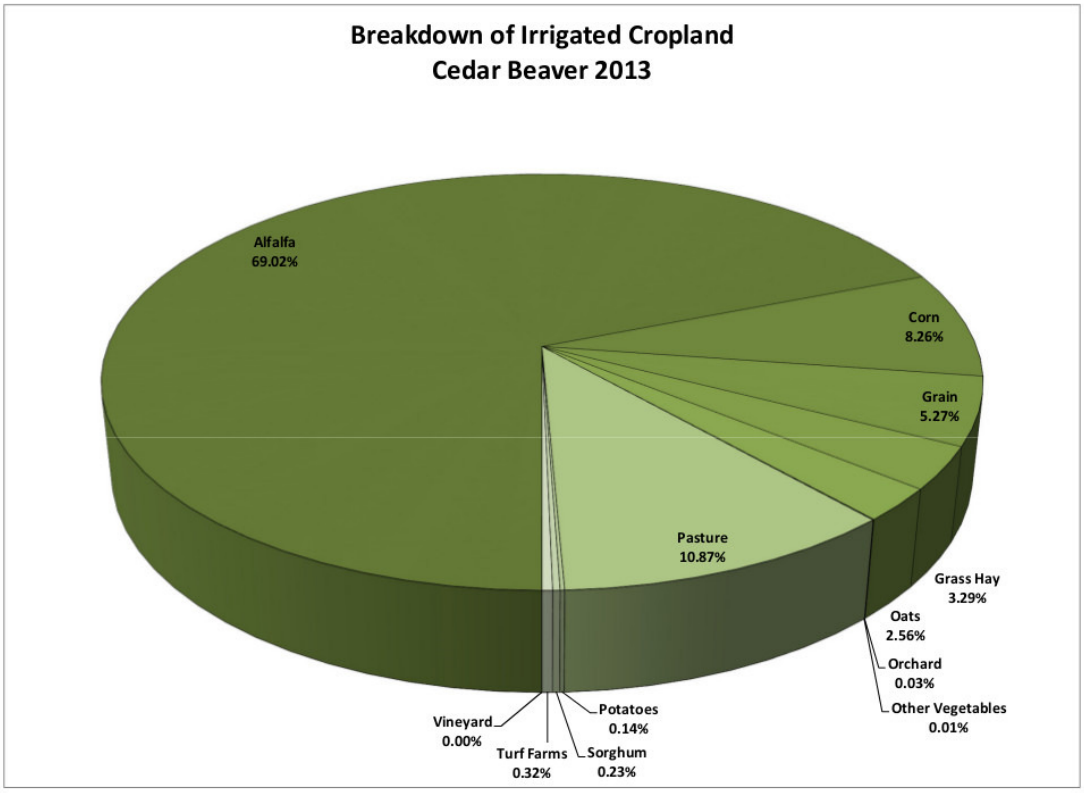
https://docs.google.com/spreadsheet/ccc?key=0AsagagPrSa5xdFV3dkdQdUg1dnpVbFE2WTVlbW5RNXc&usp=sharing

Land Use Category Pie Chart - delineates four categories of water-related land use by percentage and acreage.



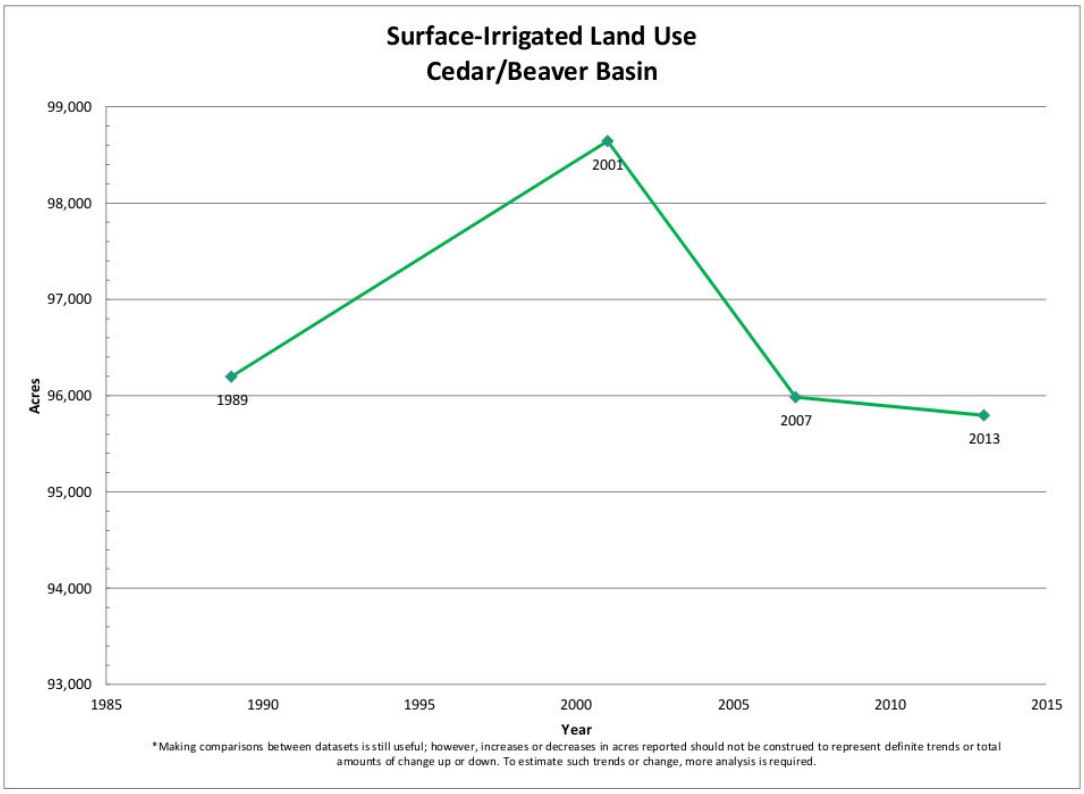
Irrigated Cropland Pie Chart - represents data from the surface irrigated and sub-irrigated cropland categories. The data are broken down into 10 different subcategories.



Surface-Irrigated Comparison Chart - compares surface-irrigated acreage totals from all inventories.

CEDAR/BEAVER BASIN LAND USE (Acres)						
	BEAVER	GARFIELD	IRON	MILLARD	WASHINGTON	TOTAL
1989 Land Use Summary						
Surface-Irrigated	35,152	0	58,431	229	2,386	**96,197**
Sub-Irrigated	141	0	7	0	0	**148**
Non-Irrigated	6,397	0	16,707	232	1,998	**25,335**
Other Non-Irrigated	0	0	0	0	0	**0**
Wet/Open Water Areas	1,820	0	4,085	12,854	195	**18,954**
Residential/Industrial	3,679	0	8,565	26	549	**12,819**
Total Land Use	**47,190**	**0**	**87,795**	**13,340**	**5,128**	**153,453**
2001 Land Use Summary						
Surface-Irrigated	35,380	0	60,640	106	2,516	**98,642**
Sub-Irrigated	0	0	16	0	0	**16**
Non-Irrigated	6,196	0	41,255	1,629	3,233	**52,312**
Other Non-Irrigated	0	0	0	0	0	**0**
Wet/Open Water Areas	2,402	3	7,643	4,984	641	**15,672**
Residential/Industrial	3,703	0	12,950	56	746	**17,455**
Total Land Use	**47,680**	**3**	**122,504**	**6,774**	**7,135**	**184,096**
2007 Land Use Summary						
Surface-Irrigated	31,425	0	57,591	4,914	2,057	**95,986**
Sub-Irrigated	523	0	909	0	429	**1,861**
Non-Irrigated	11,190	0	44,114	8,735	3,461	**67,499**
Other Non-Irrigated	579	0	1,549	7,351	1,665	**11,144**
Wet/Open Water Areas	3,313	2	5,401	5,382	939	**15,038**
Residential/Industrial	9,012	0	24,975	1,896	1,090	**36,973**
Total Land Use	**56,041**	**2**	**134,539**	**28,278**	**9,640**	**228,500**
2013 Land Use Summary						
Surface-Irrigated	**31,830**	**0**	56,105	5,849	2,010	**95,794**
Sub-Irrigated	**520**	**0**	731	0	304	**1,556**
Non-Irrigated	**14,901**	**0**	41,518	11,287	3,702	**71,408**
Other Non-Irrigated	**1,854**	**0**	7,021	4,764	1,461	**15,100**
Wet/Open Water Areas	**3,966**	**17**	4,905	5,537	1,013	**15,438**
Residential/Industrial	**9,688**	**0**	28,381	1,496	1,772	**41,338**
Total Land Use	**62,759**	**17**	**138,662**	**28,934**	**10,261**	**240,634**

Inventory Comparison Table - provides a comparison of acreage totals by survey year.



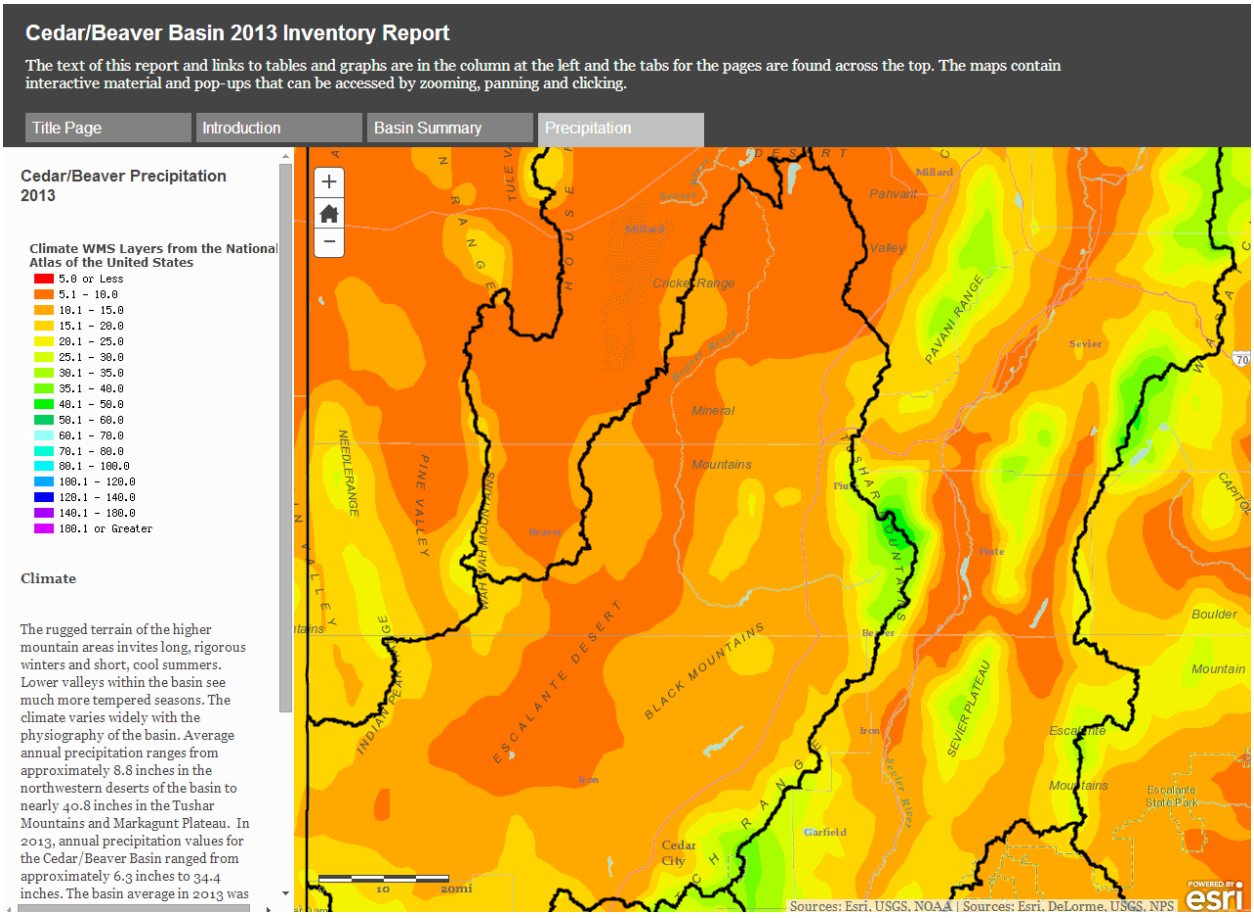
Data Access

ArcGIS Rest Service

http://maps.dnr.utah.gov/arcgis/rest/services/WRE/UtahCurrentLanduse/MapServer

Shapefile Downloads

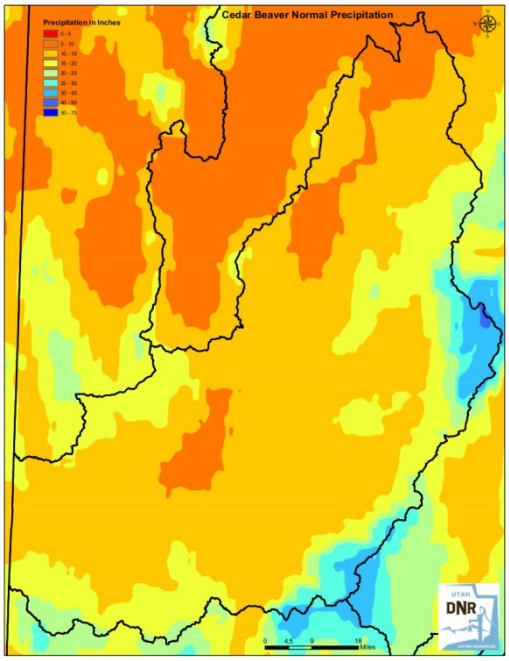
http://gis.utah.gov/data/planning/water-related-land/



Climate

The rugged terrain of the higher mountain areas invites long, rigorous winters and short, cool summers. Lower valleys within the basin see much more tempered seasons. The climate varies widely with the physiography of the basin. Average annual precipitation ranges from approximately 8.8 inches in the northwestern deserts of the basin to nearly 40.8 inches in the Tushar Mountains and Markagunt Plateau. In 2013, annual precipitation values for the Cedar/Beaver Basin ranged from approximately 6.3 inches to 34.4 inches. The basin average in 2013 was about 11.3 inches, which is about 80% of the 30 year average from 1981 to 2010 which was approximately 14.3 inches.

Cedar/Beaver Normal Precipitation



Cedar/Beaver 2013 Precipitation