Water-Related
Land Use
Inventories

UTAH

West Desert Basin
Columbia River Basin
2012 Inventory

UTAH DNR WATER RESOURCES

A Water-Related Land Use Inventory Report of the West Desert and Columbia River Basins

Utah Department of Natural Resources
Division of Water Resources

Report Compiled:
February 2013

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, Assistant Director, and supervised by Eric Edgley, 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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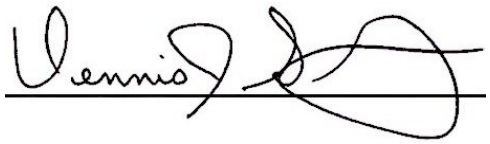


Dennis J. Strong, Director

TABLE OF CONTENTS

WEST DESERT & COLUMBIA RIVER BASIN
WATER-RELATED LAND USE INVENTORY

INTRODUCTION

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[I], wet/open water areas, dry land agriculture and residential/industrial 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 utilized 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[II] 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[III] 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 2.6 million acres of dry and irrigated agricultural land. This represents about 5 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.

WEST DESERT & COLUMBIA RIVER BASIN WATER-RELATED LAND USE DATA

Basin Description

The Columbia River Basin stretches across most of Washington, Oregon, Idaho, Montana, and parts of Nevada, Wyoming and Canada. Utah claims only a small portion of the basin that is bounded on the west by the Utah/Nevada state line, and on the north by the Utah/Idaho state line. Kelton Pass generally defines the eastern boundary of Utah's portion of the basin, while the crest (elevation 9960 ft.) of the Raft River Mountains forms the southern boundary. Utah's portion of the Columbia Basin falls entirely within Box Elder County.(1)

The West Desert Basin covers a large area of the western portion of Utah. Roughly three-fourths of the Utah/Nevada state line forms the western boundary of the basin. The crest of the Raft River Mountains coupled with the Utah/Idaho state line form the basin's northern boundary. Features such as the Promontory Mountains, Great Salt Lake, Oquirrh Mountains, Wah Wah Mountains, and several other smaller mountain ranges comprise the southeastern boundary.(1)

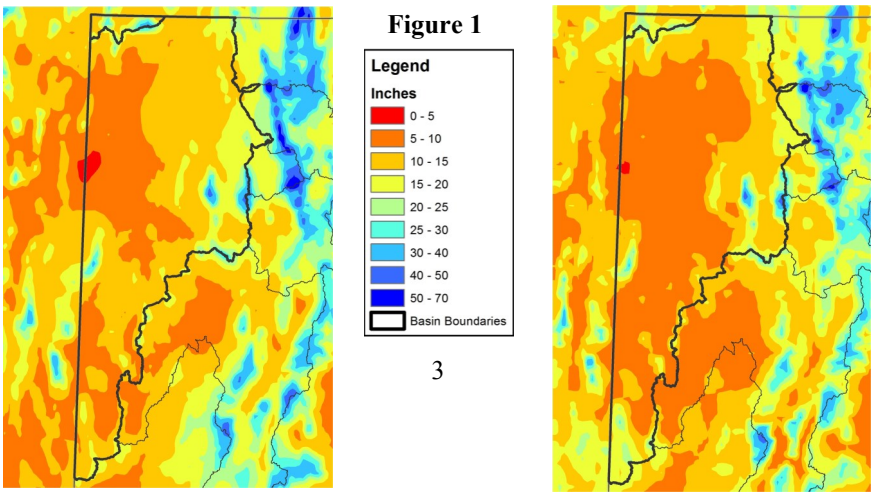
Figure 1 compares precipitation in 2011 to the average from 1971 to 2000. Precipitation across the entire basin averaged 12.3 inches in 2011 compared to 10.9 inches from 1971 to 2000(2)

Average annual precipitation ranges from approximately 4 inches in low lying areas to nearly 44 inches in the mountains. (2)

In 2011, annual precipitation values for the West Desert and Columbia River Basins ranged from approximately 3.8 inches in

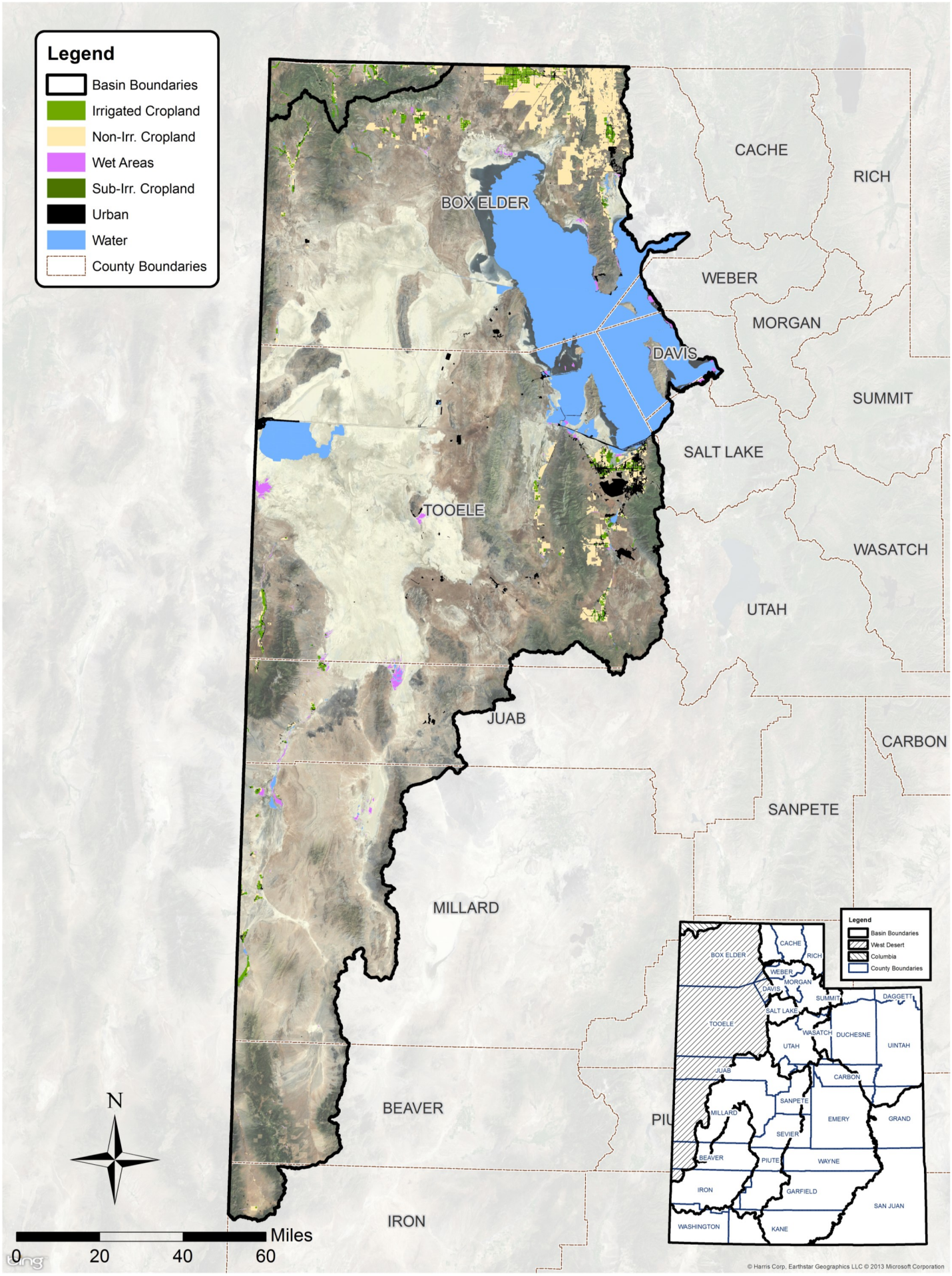
Figure 1

Annual Precipitation For 2011



Average Annual Precipitation 1971 to 2000

Figure 2 Mapped Water-Related Land Use in 2012 and Basin Location



low lying areas to 47 inches in the mountains.[2]

Normal January temperatures range from less than 10 degrees Fahrenheit to near 40 while normal July temperatures range from 44 to more than 96.[1]

The basin is characterized by small north/south trending mountain ranges separated by large areas of low-lying deserts. Much of these desert areas are the previous home of ancient Lake Bonneville. Today's Great Salt Lake is the desiccated remains of that lake. As Lake Bonneville receded it deposited coarser grained materials at the base of mountain ranges and finer-grained materials on the low-lying areas of the desert floor. The soils of the basin that are best suited for agriculture are typically deep and range in texture from moderately fine to moderately coarse. These areas are located primarily on the fans and terraces adjacent to the mountain ranges of the basin. The topography of these areas is gently sloping and generally ranges in elevation from 4,400 feet to 5,600 feet.[1]

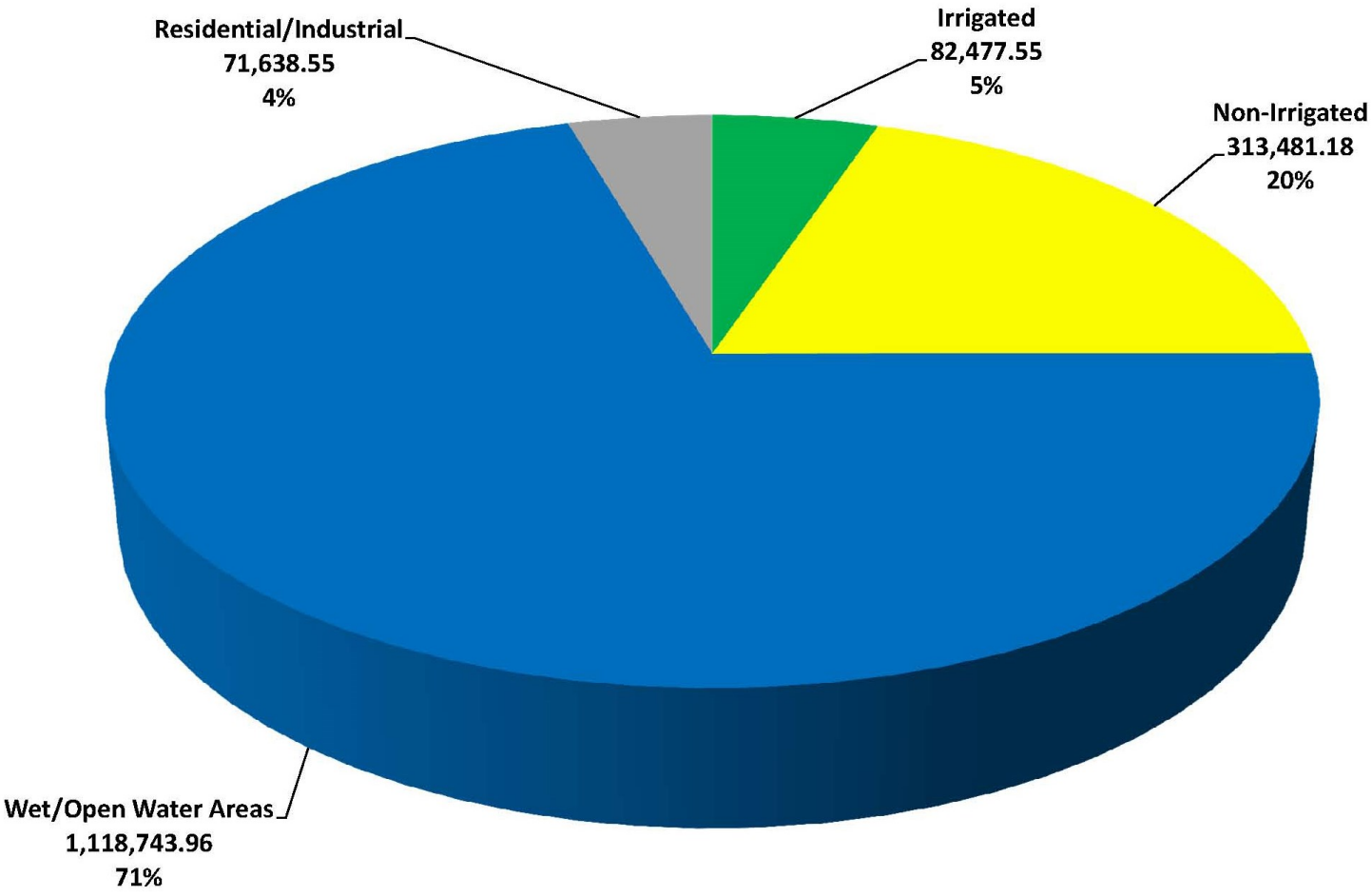
Figure 2 locates the West Desert/ Columbia Basin with respect to the Utah state and county borders and illustrates the water-related land use of the basin. The figure also depicts the county lines within the basin.

The basin spans all or part of nine counties: Beaver, Box Elder, Davis, Iron, Juab, Millard, Salt Lake, Tooele and Weber.

Data Collection

The Division inventoried water-related land use in the West Desert and Columbia River Basins during the summer of

Figure 3 Delineation of Water-Related Land Use Categories within the West Desert and Columbia Basins in 2012.



2012. Previous inventories were done in 1989, 1997 and 2005. In 2012, the division inventoried over 1,590,000 acres of land in the West Desert and Columbia Basins. This represents roughly 14 percent of the total land area in the entire basin. Data for the Great Salt Lake was collected for the first time in this basin representing roughly 1 million additional inventoried acres in the Wet/Open Water Areas category.

Data Summary

Of the over 1,590,000 acres inventoried in 2012, 82,478 were irrigated lands (including land that was sub-irrigated), 313,481 were non-irrigated (including land that was fallow and idle), 1,118,744 were wet/open water areas (including The Great Salt Lake, reservoirs, evaporation ponds and mountain lakes), and 71,639 were residential/industrial areas (including farmsteads and rural housing).

Figure 3 delineates the four categories of water-related land use listed above by percentage.

Figure 4 represents data from the surface irrigated and sub-irrigated cropland categories. The data are broken down into 16 different subcategories.

Table 1 presents the total basin acreage for irrigated lands, non-irrigated lands, wet/open water areas, and residential/industrial lands and Table 2 provides a comparison of acreage totals by survey year.

Figure 5 shows a comparison of surface irrigated lands through the subsequent land use inventories.

Figure 4 Breakdown of Irrigated Cropland within the West Desert and Columbia River Basins in 2012.

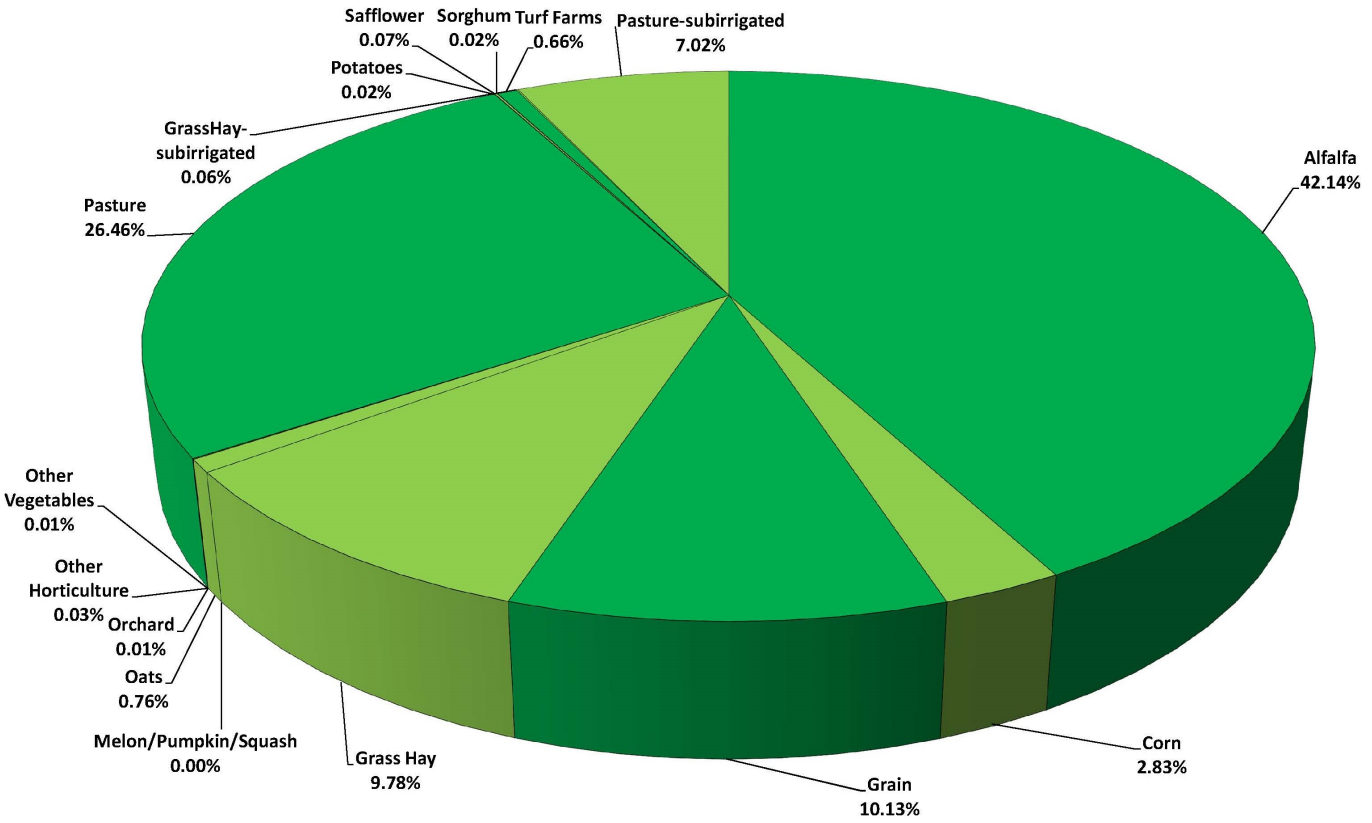


Table 1 West Desert and Columbia River Basins Land Use Summary of Land Cover by County for 2012

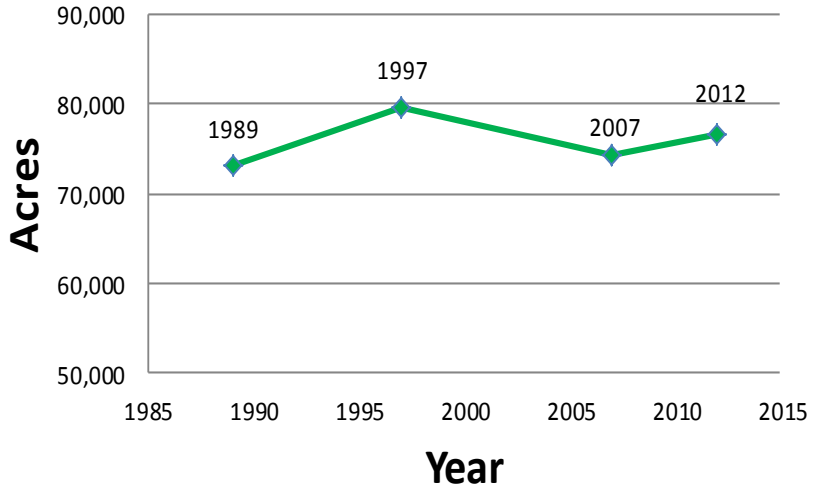
West Desert/Columbia River Basin Land Use 2012 (Acres)														
		COLUMBIA RIVER	WEST DESERT											
Category	Cover	BOX ELDER	BEAVER	BOX ELDER	DAVIS	IRON	JUAB	MILLARD	SALT LAKE	TOOELE	UTAH	WEBER	WEST DESERT Total	Grand Total
Surface-Irrigated														
	Alfalfa	752	0	20,869	0	0	1,089	3,412	0	8,637	0	0	34,007	**34,759**
	Corn	0	0	790	0	0	63	579	0	899	0	0	2,331	**2,331**
	Grain	179	0	6,227	0	0	113	709	0	1,128	0	0	8,177	**8,356**
	Grass Hay	2,513	0	3,793	0	0	112	105	0	1,543	0	0	5,553	**8,065**
	Melon/Pumpkin/Squash	4	0	0	0	0	0	0	0	0	0	0	0	**4**
	Oats	0	0	489	0	0	0	0	0	137	0	0	625	**625**
	Orchard	0	0	0	0	0	3	4	0	1	0	0	8	**8**
	Other Horticulture	5	0	8	0	0	0	0	0	11	0	0	19	**24**
	Other Vegetables	0	0	0	0	0	0	0	0	11	0	0	11	**11**
	Pasture	4,404	0	3,828	0	127	982	3,328	0	9,153	0	0	17,417	**21,821**
	Potatoes	0	0	16	0	0	0	0	0	0	0	0	16	**16**
	Safflower	0	0	62	0	0	0	0	0	0	0	0	62	**62**
	Sorghum	0	0	0	0	0	0	0	0	16	0	0	16	**16**
	Turf Farms	0	0	0	0	0	0	0	0	543	0	0	543	**543**
	Irrigation Method													
	Flood	4,837	0	7,328	0	127	362	2,747	0	8,617	0	0	19,180	**24,017**
	Sprinkle	3,019	0	28,752	0	0	2,001	5,391	0	13,462	0	0	49,605	**52,624**
	Subtotal	7,856	0	36,080	0	127	2,362	8,137	0	22,080	0	0	68,786	**76,642**
Sub-Irrigated														
	GrassHay-subirrigated	8	0	0	0	0	0	0	0	40	0	0	40	**48**
	Pasture-subirrigated	0	0	1,576	0	0	61	56	0	4,096	0	0	5,788	**5,788**
	Subtotal	8	0	1,576	0	0	61	56	0	4,136	0	0	5,828	**5,836**
Non-Irrigated														
	Dry Alfalfa	0	0	499	0	0	18	0	0	362	0	0	878	**878**
	Dry Fallow	0	0	13,855	0	59	0	0	0	86	0	0	14,000	**14,000**
	Dry Grain/Seeds	0	0	34,324	0	0	0	0	0	257	0	0	34,581	**34,581**
	Dry Idle	853	48	44,120	0	284	74	0	0	2,438	0	0	46,965	**47,818**
	Dry Oats	0	0	1,782	0	0	0	0	0	0	0	0	1,782	**1,782**
	Dry Pasture	2,011	0	18,068	0	0	361	526	0	30,977	0	0	49,932	**51,943**
	Dry Safflower	0	0	6,707	0	0	0	0	0	4	0	0	6,711	**6,711**
	Fallow-Irrigated Land	20	0	5,446	0	0	47	0	0	598	0	0	6,091	**6,111**
	Idle-Irrigated Land	3,410	0	18,578	7	556	993	1,777	0	14,530	0	0	36,441	**39,852**
	Subtotal	6,294	48	143,379	7	899	1,493	2,303	0	49,254	0	0	197,382	**203,676**
Other Non-Irrigated														
	Range Pasture	31	0	87,176	0	0	135	387	0	22,076	0	0	109,774	**109,805**
Wet/Open Water Areas														
	Evaporation Pond	0	0	11,875	0	0	1	0	0	113,439	0	2,655	127,970	**127,970**
	Lakes & Ponds	0	0	518,899	186,159	0	122	3,144	14,462	142,122	0	41,039	905,946	**905,946**
	Reservoirs	99	13	2,274	1,501	9	1,560	381	646	38,395	0	0	44,777	**44,876**
	Riparian	201	224	5,777	4,164	69	7,642	4,583	1,563	13,733	0	1,230	38,985	**39,186**
	Sewage Lagoon	0	0	0	0	0	0	0	0	175	0	0	175	**175**
	Streams	0	0	359	0	0	7	0	0	200	0	24	590	**590**
	Subtotal	300	237	539,184	191,823	78	9,331	8,109	16,671	308,064	0	44,948	1,118,444	**1,118,744**
Residential/Industrial														
	Urban	439	22	12,073	14	34	1,748	761	0	55,410	3	0	70,065	**70,504**
	Urban Grass/Parks	1	0	24	0	0	3	0	0	1,106	0	0	1,133	**1,134**
	Subtotal	440	22	12,097	14	34	1,751	761	0	56,516	3	0	71,198	**71,639**
Total Land Use/Land Cover		**14,929**	**307**	**819,492**	**191,843**	**1,137**	**15,134**	**19,752**	**16,671**	**462,125**	**3**	**44,948**	**1,571,412**	**1,586,341**

Table 2 Comparison of Land Cover Totals by Inventory Year*

WEST DESERT/COLUMBIA LAND USE (Acres)											
	Beaver	Box Elder	Davis	Iron	Juab	Millard	Salt Lake	Tooele	Utah	Weber	Basin
1989 Land Use Summary											
Surface-Irrigated	0	36,525	0	0	2,494	6,174	0	27,902	0	0	**73,096**
Sub-Irrigated	0	76	0	0	317	0	0	574	0	0	**967**
Non-Irrigated	0	117,668	0	0	1,460	1,004	0	13,743	0	0	**133,875**
Other Non-Irrigated	0	0	0	0	0	0	0	0	0	0	**0**
Wet/Open Water Areas	0	50,936	0	0	8,015	360	0	18,573	0	0	**77,883**
Residential/Industrial	0	4,314	0	0	153	306	0	8,198	0	0	**12,972**
Total Land Use/Land Cover	**0**	**209,520**	**0**	**0**	**12,439**	**7,844**	**0**	**68,990**	**0**	**0**	**298,793**
1997 Land Use Summary											
Surface-Irrigated	0	37,874	0	0	2,528	6,506	0	32,760	0	0	**79,669**
Sub-Irrigated	0	154	0	0	0	0	0	9,344	0	0	**9,499**
Non-Irrigated	0	119,703	0	0	529	1,651	0	20,548	0	0	**142,432**
Other Non-Irrigated	0	0	0	0	0	0	0	0	0	0	**0**
Wet/Open Water Areas	0	3,598	0	0	7,786	5,565	0	92,166	0	0	**109,114**
Residential/Industrial	0	3,700	0	0	186	281	0	18,051	0	0	**22,218**
Total Land Use/Land Cover	**0**	**165,029**	**0**	**0**	**11,029**	**14,004**	**0**	**172,870**	**0**	**0**	**362,932**
2007 Land Use Summary											
Surface-Irrigated	0	43,227	0	0	2,512	6,653	0	21,954	0	0	**74,345**
Sub-Irrigated	0	1,601	1	0	567	79	0	5,371	0	0	**7,620**
Non-Irrigated	26	180,695	1	0	1,241	4,126	0	54,462	0	0	**240,553**
Other Non-Irrigated	0	40,840	0	0	0	224	0	23,251	0	0	**64,315**
Wet/Open Water Areas	0	10,385	3,617	0	8,204	5,221	989	39,679	0	789	**68,884**
Residential/Industrial	2	10,374	0	0	275	253	0	86,488	3	0	**97,395**
Total Land Use/Land Cover	**29**	**287,122**	**3,620**	**0**	**12,799**	**16,555**	**989**	**231,205**	**3**	**789**	**553,111**
2012 Land Use Summary											
Surface-Irrigated	0	43,936	0	127	2,362	8,137	0	22,080	0	0	**76,642**
Sub-Irrigated	0	1,583	0	0	61	56	0	4,136	0	0	**5,836**
Non-Irrigated	48	149,673	7	899	1,493	2,303	0	49,254	0	0	**203,676**
Other Non-Irrigated	0	87,207	0	0	135	387	0	22,076	0	0	**109,805**
Wet/Open Water Areas	237	539,484	191,823	78	9,331	8,109	16,671	308,064	0	44,948	**1,118,744**
Residential/Industrial	22	12,537	14	34	1,751	761	0	56,516	3	0	**71,639**
Total Land Use/Land Cover	**307**	**834,420**	**191,843**	**1,137**	**15,134**	**19,752**	**16,671**	**462,125**	**3**	**44,948**	**1,586,341**

*Data for the Great Salt Lake was collected for the first time in this basin representing roughly 1 million additional inventoried acres in the Wet/Open Water Areas category. Also, Please refer to the word of caution on page 3 regarding comparisons between datasets.

Figure 5 Surface Irrigated Land Use Comparison Graph



Data Access

GIS data used in this summary may be downloaded from the Utah AGRC. Current land use datasets are available as a statewide layer or by county and are offered in shapefile and geodatabase formats. To download the most recent dataset, Go to:

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

For past GIS datasets, Please contact Technical Services at the Division of Water Resources

www.water.utah.gov/planning/landuse/index.htm

Past Land Use Reports for this area and a PDF of this report can be found at

www.water.utah.gov/planning/landuse/publ.htm

Metadata is available at

www.water.utah.gov/planning/landuse/gisdata.htm

Additional Uintah Basin reports as well as many other reports can be found at

www.water.utah.gov/planning

REFERENCES

1. Water-Related Land Use Inventories, UTAH, State Summary
Utah Division of Water Resources, March 1999.

2. Prism Group, Oregon State University, prism.oregonstate.edu/
Maximum, Minimum and Mean precipitation calculated using Zonal Statistics tool with ESRI ArcInfo license

GLOSSARY

I. Phreatophyte - A deep-rooted plant that obtains water from a permanent ground supply or from the water table.

II. Planimetered or dot-counted - process to determine acreage by assigning an acreage value to a "dot" based on map scale and then counting the number of "dots" within a specific boundary.

III. Heads-up digitizing - Manual digitization by tracing a mouse over features displayed on a computer monitor, used as a method of vectorizing raster data.