# Comparison of the Irrigated Lands in Logan Between Past and Current

**Final Report Prepared for**
Civil and Environmental Engineering
GIS in Water Resources
CEE 6440, Dr. Tarboton
Utah State University
Fall, 2018

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12/07/2018

## Introduction

Drought is already a substantial issue all around the World, and it is getting more serious every day (Figure 1) as the global warming increases its effects. Figure 1 illustrates that the intensity of drought in Utah, USA over time, there are slight and considerable changes in the intensity of drought in every time steps [1]. It is an immediate urgency to take actions to reduce its effects, and one of the important precautions will be the water use efficiency. However, the water use is quite a lot in the USA like everywhere else. Most of water is used especially in the agricultural lands for irrigation. As it can be seen on the figure 2 that shows total water use in the USA in 2015, the percentage of two largest categories are thermoelectric power and irrigation, 41.35% and 36.69% respectively [2]. Also, figure 3 shows the water use for irrigation (72.1%) in Utah which is more than the average in USA[3].

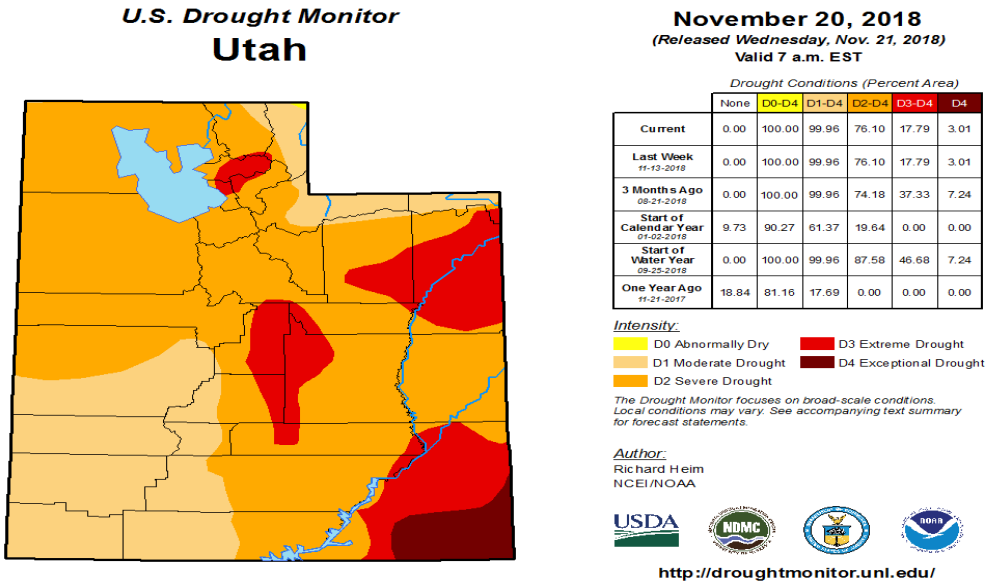


**Figure** 1:U.S. Drought Monitoring Over Time.

The problem associated with water usage in Utah is that some people pointed out that the amount of water use in Utah still has a high percentage and it needs to be reduced according to the water rights [4]. According to Utah Division of Water Right, “All waters in Utah are public property. A “water right” is a right to divert (remove from its natural source) and beneficially use water “. In addition to this, the lack of data which makes people assume that the amount of water used haven’t changed from past to date while agricultural lands in Utah are decreasing.

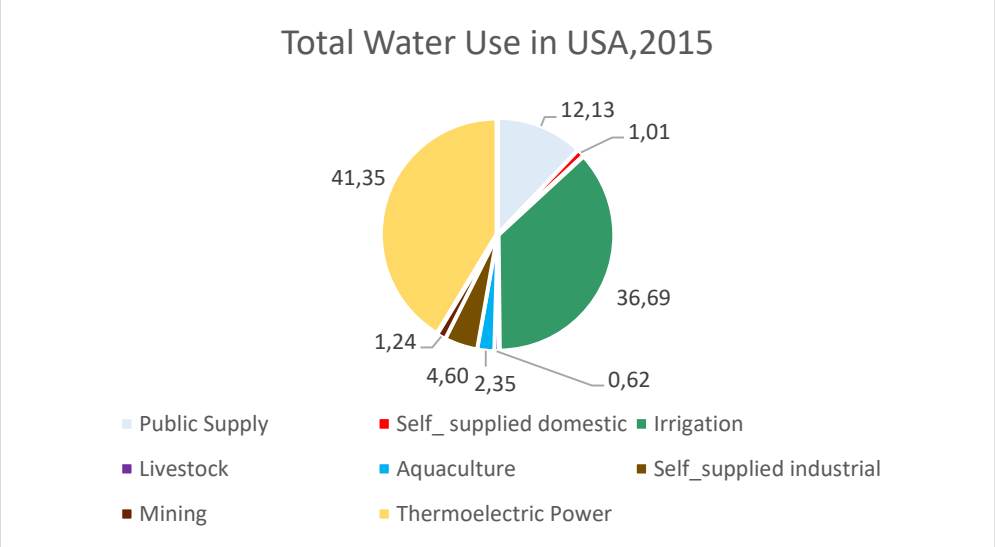


**Figure** 2:The percentage of water use in 2015,USA.

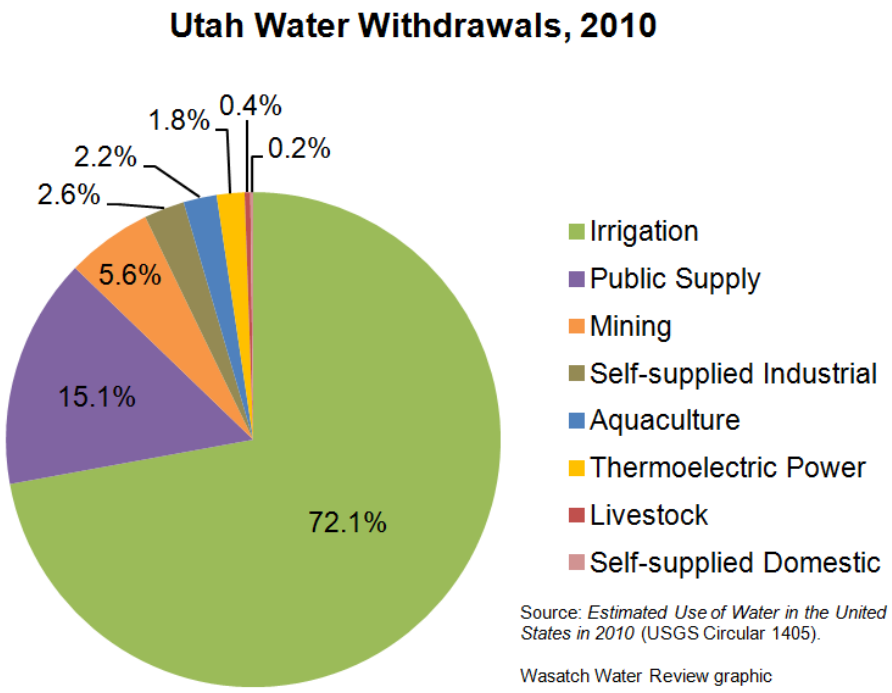


**Figure** 3:The percentage of water use in 2010, Utah,USA.

Although the lack of the data is challenging, the purpose of this study is to shade light on these issues, and for this aim, I tried to determine the amount of water-related land use in past and today while comparing the changes in residential areas.

## Methods

### 1.Study Area

Logan is situated in the north part of Utah, USA (Figure 3) with a population of 48174 based on 2010 census record [5]. The number of population is estimated double by 2050[5]. The total area for Logan is 48 square kilometers, which consist of 46.5 square kilometers of land and 1.5 square kilometers water [5]. Logan usually has dry summers and cold winters with moderate snowfall, and the precipitation is heaviest during the spring season. The location has pretty rough terrain, and the elevation is about 1382 m.

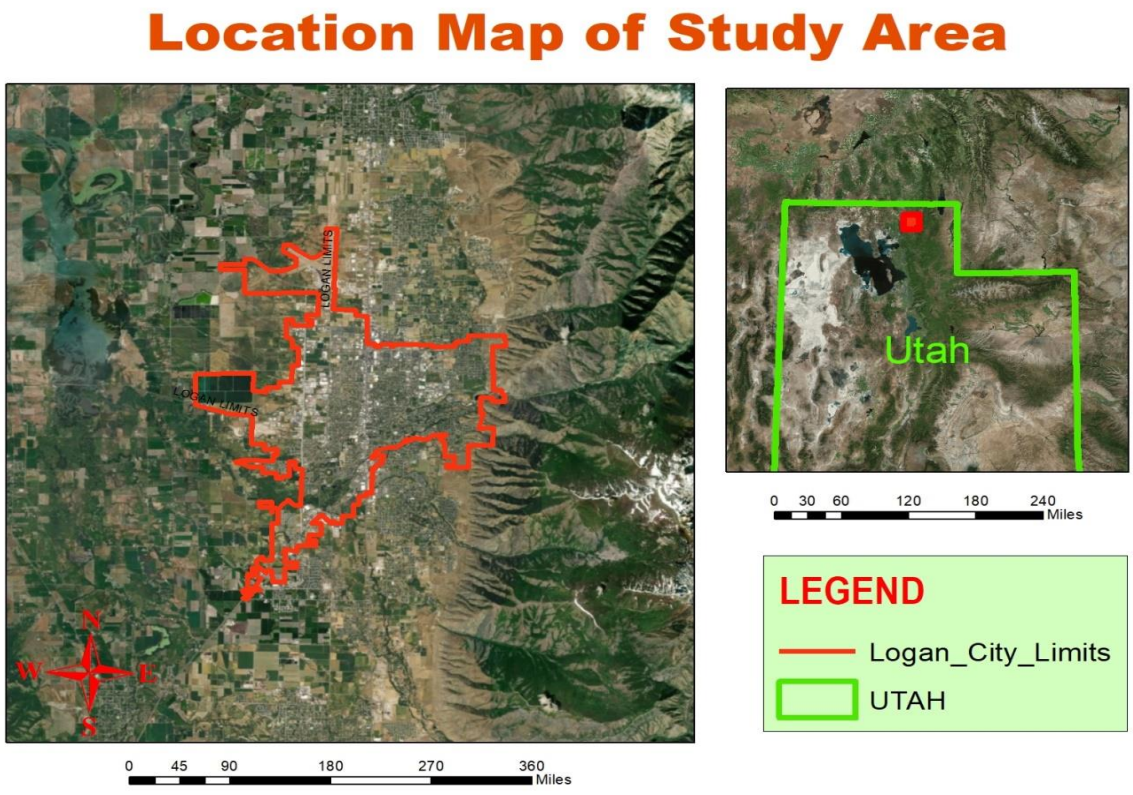


**Figure** 4:The location map of Logan, which is located in 41° 44’ 16’’ N - 111° 49’ 51’’ W.

### 2. Data and Data Analysis

Data tools used in this research are ArcGIS and Google Earth. ArcGIS is commonly used for many purposes and very popular among the scientists. For data comparison for past and today, historical imagery in google Earth was used. The

extracted data from google earth for 1990 and 2018 were prepared for image classification.

For extracting historical data for 1990 and 2018 from google earth, I followed the steps below;

On google earth;

- I converted lag/log to decimal degrees, navigate the study area and position the image for adding placemarks.
- I randomly chose 4 same placemarks for 1990 and 2018 as reference points (figure 4) and noted the coordinates for these points.
- Then I saved the images from both years with same reference points.

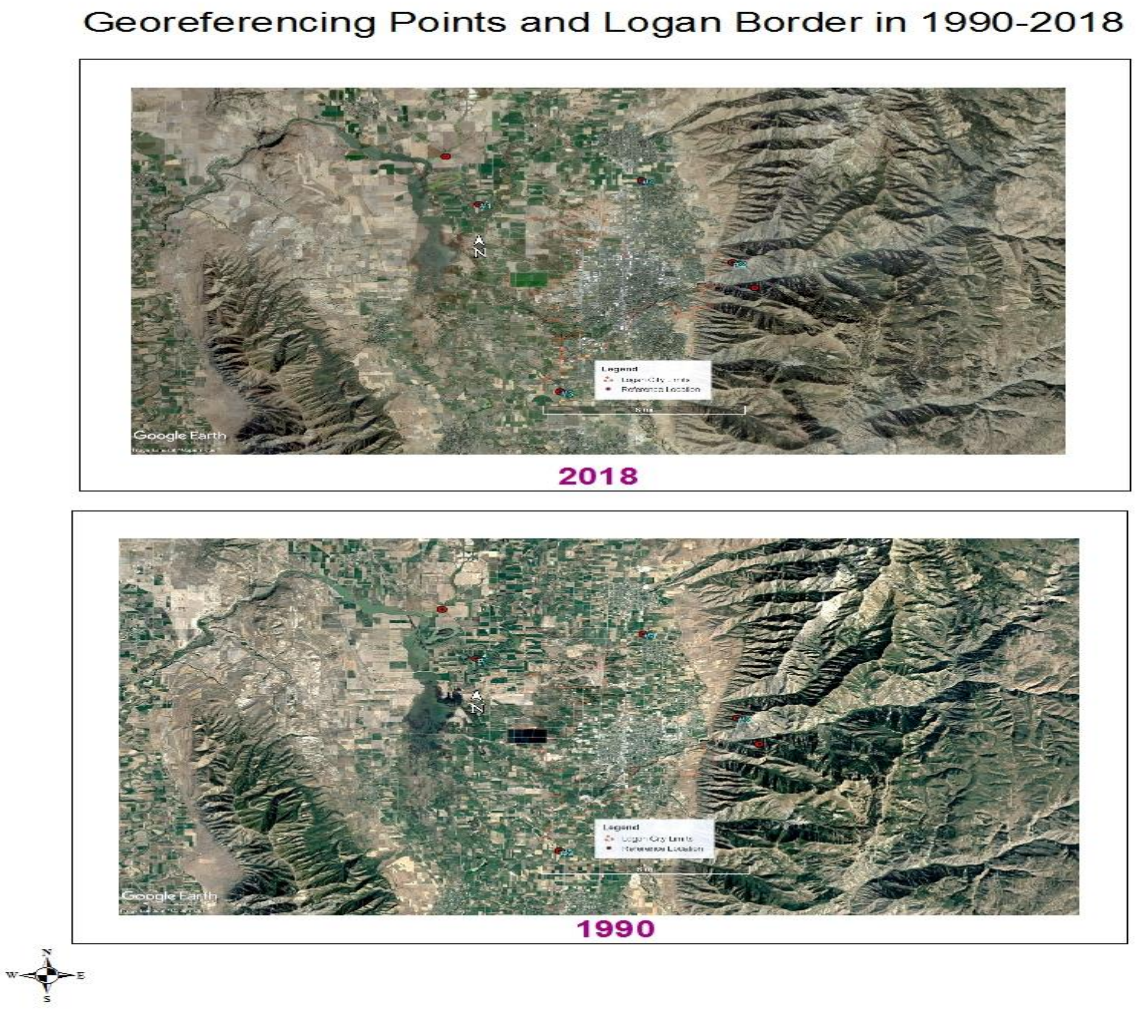


Figure 5:Four reference points for historical images and Logan city limit.

On ArcGIS;

- I first set the geographic coordinate system as NAD 1983 N 12.
- From toolbars, I chose the georeferencing to place the images (1990 and 2018) to the exact location.
- From georeferencing toolbar, I clicked “add control points” and then “input X and Y” and added the coordinates I noted before (figure 5).

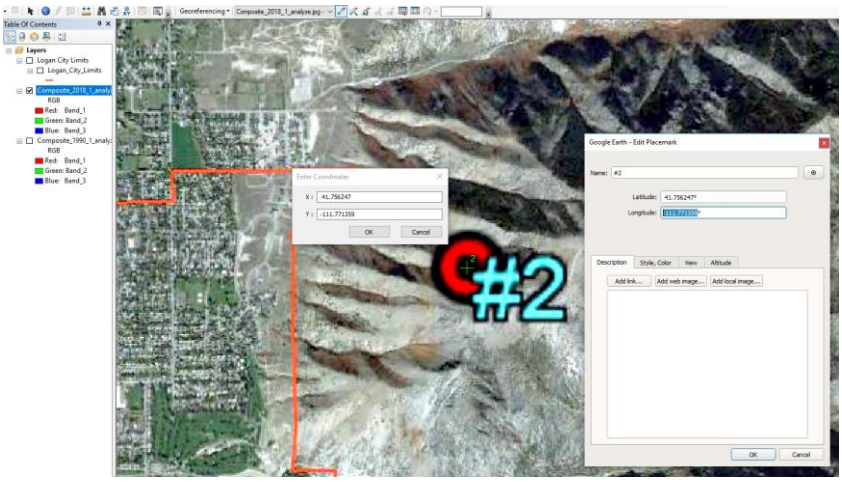


Figure 6:Adding the XY values to place the image to the exact location.

- After adding 4 coordinates, I tested the images to see if there is a mistake by adding a basemap (figure 6).


Figure 7:One of the images from google Earth with a basemap, and the image fits very well.

For image classification for both pictures, the same steps were followed after image classification was activated from toolbar. I used an unsupervised classification method because I didn't have an example data. I classified the same location of the pictures into land and urban areas. For this method I followed these steps:

- After setting one of the pictures, I clicked "draw polygon" and I drew many polygons on the images and combined all of them as one for land and urban areas separately (figure 7).
- After finishing this step, I created a signature to use for classification.
- The method for classification I used was maximum likelihood classification with the signature I created.
- After ending classification, land and urban areas for both years are calculated and the difference is determined.

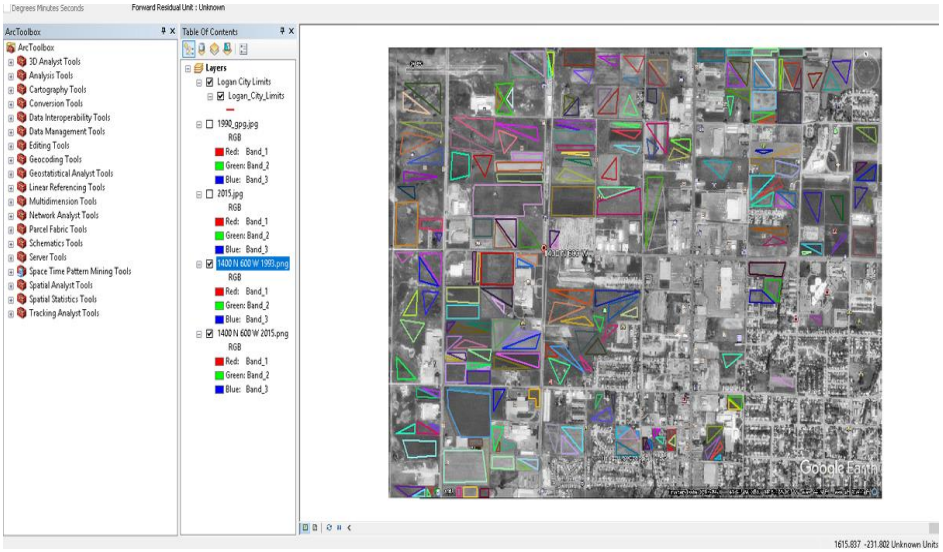


Figure 8:Drawing the polygon for classification method.

Water-related landuse data were available for 1990 and 2015 for whole Utah in ArcGIS online [6]. I created a polygon and determined the Logan city limits to use this later for clipping these datasets for only Logan, Utah. After adding water-related landuse data and creating the polygon, clip tool in geoprocessing was used to clip landuse data for these two years based on the polygon borders (figure 7).

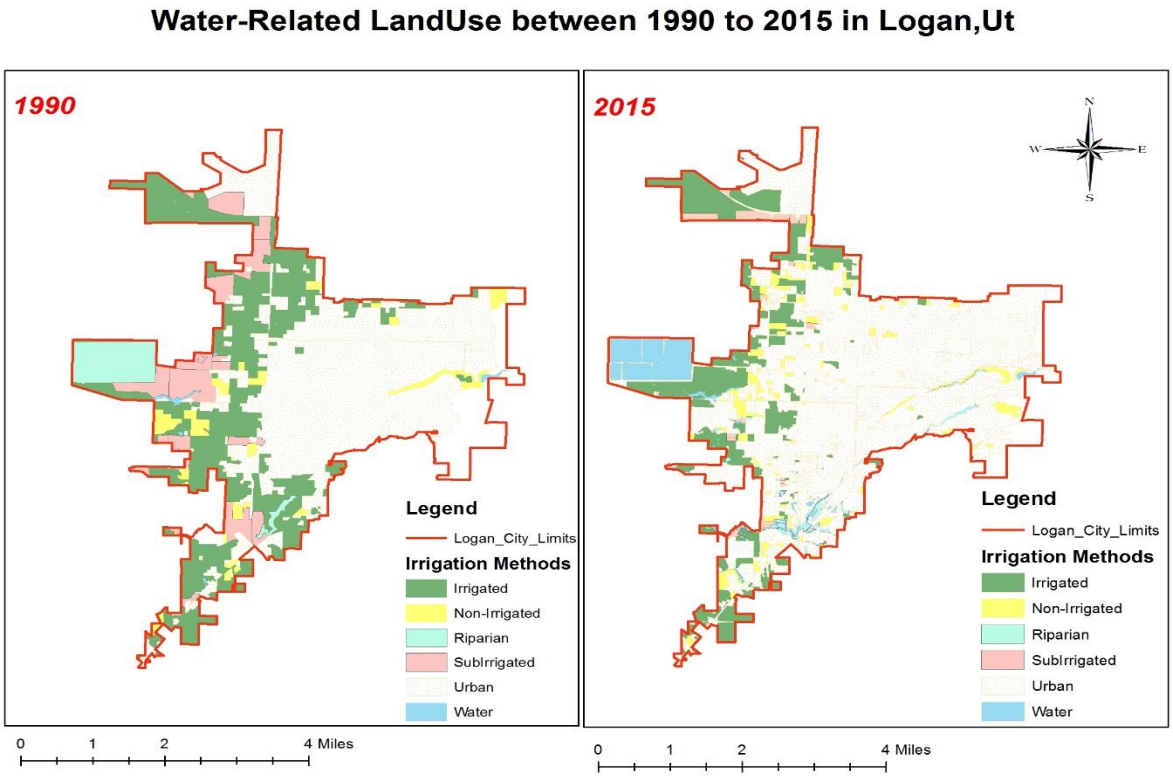


Figure 9:Water-Related Landuse for 1990 and 2015 in Logan,Ut.

From the attribute tables of the datasets, I determined the amount of each component of water-related landuse from “select by attribute”.

| Water-related LandUse | 1990 (Acres) | 2015 (Acres) |
|---|---|---|
| Irrigated | 5158.445705 | 2652.422535 |
| Non-Irrigated | 517.134278 | 582.344862 |
| Sub-Irrigated | 527.722195 | 258.195526 |
| Riperian | 2357.654526 | 663.710082 |
| Urban | 6607.626135 | 28058.151766 |
| Water | 43.556343 | 577.224839 |

Table 1: Water related Land use for 1990 and 2015.

## Discussion

The amount of the water used in 1990 wasn't obvious because of the lack of information but it is thought the same amount as today by some people. Based on our image analysis agricultural areas was 515 970 000-meter square in 1990 and 548 317 800-meter square in 2018 and difference between these years was 32 347 800-meter square.

When I checked table 1, there was huge differences between water related landuse in 1990 and 2015. When irrigated areas declined to the half from 5158.445705 acres, there was a big increase in urban areas from 6607.626135 acres to 28058.151766 acres. The changes in urban and land areas from 1990 and 2015 were obvious without an analysis (figure 9).


*Figure 10:The change in the urban and land areas in 1990 and 2015.*

Our results demonstrated that there were remarkable decreases in water-related land use except for increasing urban lands and water. This shows that if the amount of water use is not changing over time, this might be because of the following reasons:

- With increasing the effects of drought, the farmers in the areas increased the frequency of irrigation for plants.
- Old irrigation methods requiring more water use.
- Changing vegetation type requiring more water.

## Conclusion

Drought is an important issue all over the World, and it is limiting water supplies. In order to avoid the unexpected results about the water shortage, there should be taken some precautions for water usage. For example, new technological irrigation methods could be applied to reduce the amount of the water used with the same efficiency. Also, farmers can be informed about crop rotations and irrigation systems to save more water in the field.

**References**


[1] Bathke,D.(2018,November 20). United States drought monitor Utah. Retrieved November 20, 2018 from https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?UT.

[2] Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L., and Linsey, K.S., 2018, Estimated use of water in the United States in 2015: U.S. Geological Survey Circular 1441, 65 p., https://doi.org/10.3133/cir1441.

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