

# HYDROLOGIC IMPACT OF REPLACEMENT OF ASHE JUNIPER FORESTS BY RESIDENTIAL SUBDIVISIONS IN UPPER LEON CREEK WATERSHED

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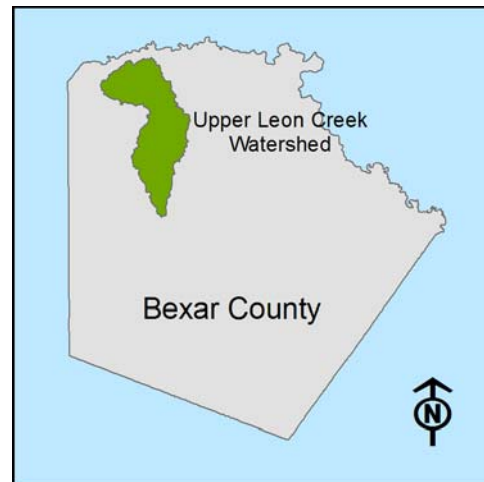
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## ABSTRACT

*Juniperus ashei* comprises much of the forestation of the Upper Leon Creek watershed in Bexar County, Texas. This watershed is primarily located within the Contributing and Recharge Zones of the Edwards Aquifer, a sensitive karst aquifer providing water for over 1.8 million people. This study analyzes the hydrological impacts of conversion of juniper forests to residential land use in this watershed. Stormwater runoff near the Leon Creek Grissom Road crossing would increase by 13%. Annually, an additional 605 million cubic feet of water would flow past the Grissom Road crossing.

ASHE JUNIPER (*Juniperus ashei*), commonly called cedar, is the predominant tree in the watershed of Upper Leon Creek in Bexar County, Texas. This watershed begins (Fig. 1) near Dietz Elkhorn Road in northern Bexar County and ends approximately at Grissom Road near Leon Valley, Texas. However, Leon Creek continues well beyond its upper watershed, flowing through San Antonio's west side, Lackland AFB, and eventually joining the Medina River south of Loop 410.

Analysis of current land cover datasets<sup>1</sup> from the Texas Natural Resources Information System (TNRIS) show that 71% of the land is covered by evergreen forest. Van Auken, et. al.<sup>2</sup>



**Figure 1** Bexar County, showing location of Upper Leon Creek watershed.

determined that, on average, *Juniperus ashei* comprises 95% of evergreen forest in Central Texas. These trees, along with their associated soil, significantly reduce stormwater runoff into Leon Creek.

Stormwater management benefits of Ashe juniper were modeled using ESRI ArcGIS to create two hydrologic response raster datasets. One dataset was based on current USGS land cover data and soil maps from the State Soil

<sup>1</sup> [www.tnr.is.state.tx.us/DigitalData/data\\_cat.htm](http://www.tnr.is.state.tx.us/DigitalData/data_cat.htm)

<sup>2</sup> O.W. Van Auken, A.L. Ford, and J.L. Allen, An Ecological Comparison of Upland Deciduous and Evergreen Forests of Central Texas, Amer. J. Bot., 68(9): 1249-1256. 1981.

Geographic (STATSGO) database. A post-development hydrologic response raster was created by converting a portion of the evergreen and deciduous forest land covers to high-density residential land cover. The proportions of forest cover converted to residential

development were based on the Van Auken study. Table 1 provides a summary.

	<b>Evergreen forest (NLCD code 42)</b>	<b>Deciduous forest (not found in Upper Leon watershed)</b>	<b>Mixed Forest (NLCD code 43, average evergreen and deciduous in Van Auken)</b>
<i>Juniperus ashei</i>	38.6/40.8 = 94.6%	1.9/38.6 = 4.9%	40.5/79.4 = 51.0%
<b>Other species</b>	2.2/40.8 = 5.4%	36.7/38.6 = 95.1%	38.9/79.4 = 49.0%

**Table 1 Relative predominance of Ashe juniper in central Texas forests**

It was assumed that residential development would be randomly distributed, therefore the land cover dataset was recalculated to randomly convert evergreen and deciduous forest cover to residential development land cover based on the proportions from the Van Auken study. (see maps in Appendix)

ArcGIS was used to spatially combine land cover and soil type rasters for the two scenarios described above. Attribute tables for the two hydrologic response rasters were exported to Microsoft Excel for processing. Using the Soil Conservation Service (SCS) curve number approach, spatially weighted average curve numbers were calculated for the watershed. SCS curve numbers were based on a combination of soil hydrologic group and land cover using data from the Grove, et. al.<sup>3</sup> study. Average annual depth of runoff was

subsequently calculated for current land cover and fully-developed land cover scenarios. From these results, increases in total annual runoff and flow rates were calculated for the Grissom Road crossing.

After converting Ashe juniper land cover to high density residential land cover, the following changes in hydrology were determined:

- Weighted curve number for the watershed increased from 65 to 84.
- Runoff increased by 605 million cubic feet per year or by 13%, going from 4,833,000,000 cu.ft./year to 5,438,000,000 cu.ft./year.
- Average flow increased from 153 cu.ft./sec to 172 cu.ft./sec

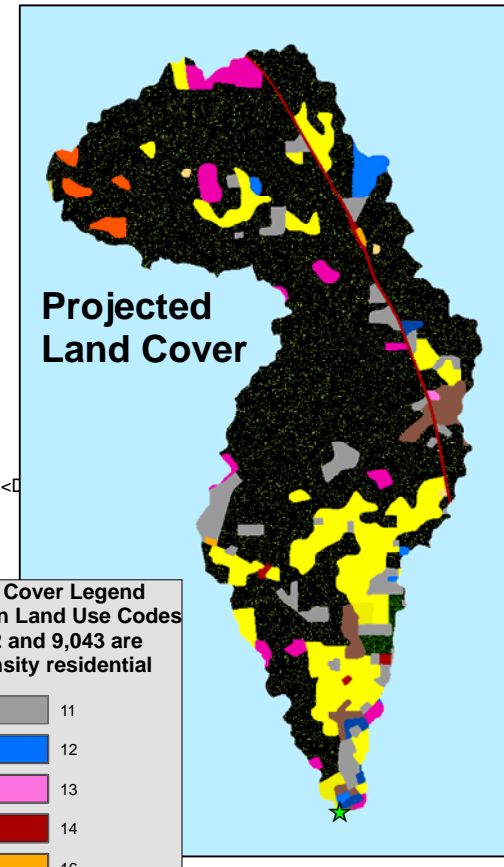
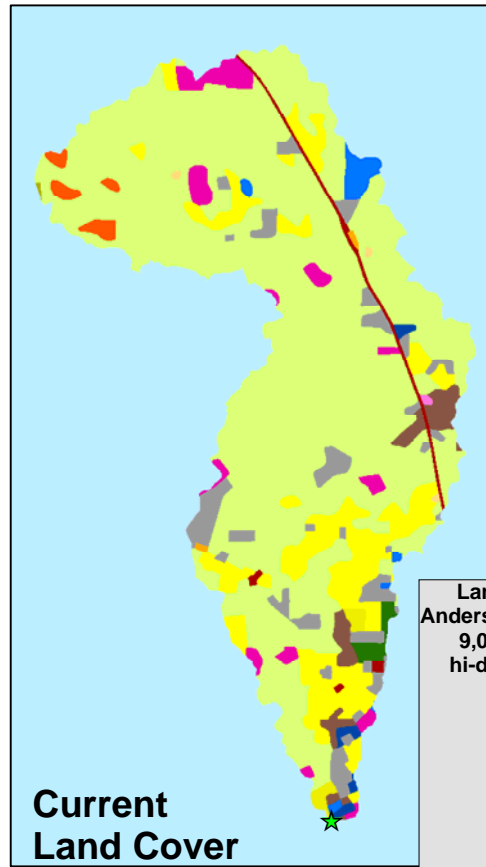
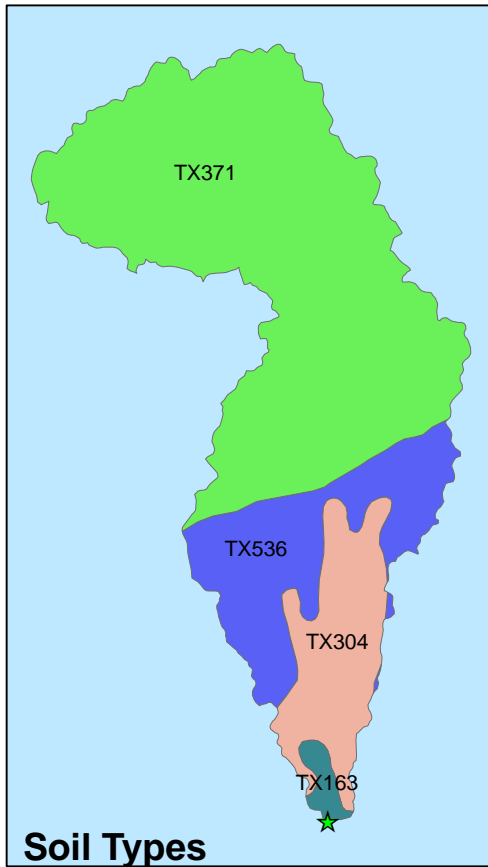
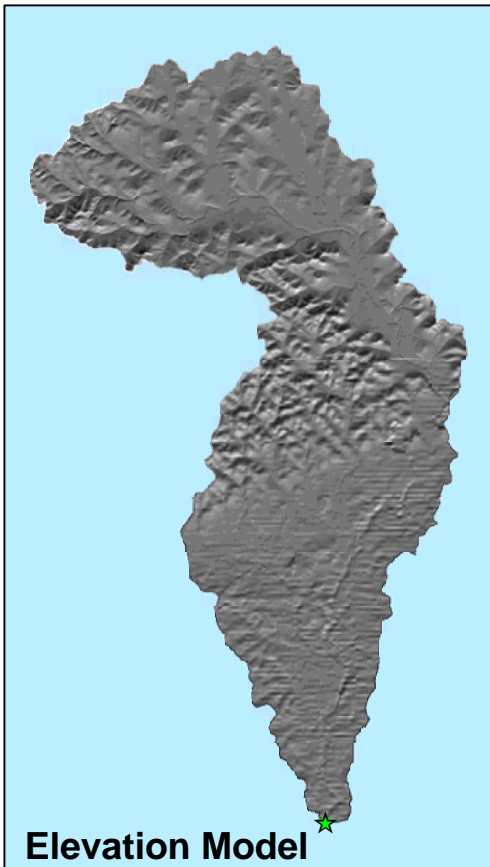
<sup>3</sup> Grove, M., Harbor, J., and Engle, B., 1998, Composite vs. distributed curve numbers: Effects on estimates of storm runoff depths: Journal of the American Water Resources Association, v. 34, no. 5, p. 1015-1023.

## APPENDIX

### UPPER LEON CREEK WATERSHED GIS MAPS

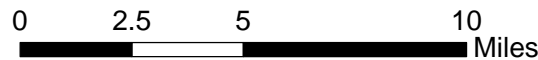
# Upper Leon Creek Watershed

## Projected change in land cover assuming Ashe juniper not preserved on development sites



**Land Cover Legend**  
Anderson Land Use Codes  
9,042 and 9,043 are hi-density residential

11	Gray
12	Blue
13	Pink
14	Red
16	Orange
17	Dark Blue
21	Yellow
24	Light Orange
31	Light Green
32	Yellow-Green
33	Orange-Red
42	Light Green
43	Dark Green
75	Brown
76	Magenta
9,042	Black
9,043	Black



### Upper Leon Creek Watershed - Bexar County, Texas

- Above maps, from left to right:
- TNRIS digital elevation model
  - STATSGO soil map
  - USGS land cover map
- Projected land cover map after Ashe juniper land cover is converted to high-density residential land cover

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December 13, 2005

