## Edwards Aquifer – Upper Glen Rose Aquifer Hydraulic Interaction

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Currently, Texas Commission on Environmental Quality (TCEQ) regulations on the Edwards Aquifer Contributing Zone are limited, especially when compared with those for the Edwards Aquifer Recharge Zone. The rules are predicated on the premise that no water from the Contributing Zone directly recharges the Edwards Aquifer and that the role of the Contributing Zone is solely to convey surface water to the Edwards Aquifer Recharge Zone where it can then enter the subsurface.

In reality, the Edwards Aquifer is significantly recharged by water infiltrating the Contributing Zone. This infiltrated water is then conveyed to the Edwards Aquifer from the Trinity Aquifer by interformational flow. Recent studies support the supposition that hydraulic communication between the upper Glen Rose Aquifer (i.e., the upper most unit of the Trinity Aquifer) and the Edwards Aquifer is greater than previously believed. Because of this high level of hydraulic communication, the distinction between the Contributing Zone and the Recharge Zone of the Edwards Aquifer is not great, and in many localities, the Edwards Aquifer Contributing Zone effectively acts to recharge the Edwards Aquifer in a fashion indistinguishable to the Edwards Aquifer Recharge Zone.

There is ample evidence to support this refined conceptualization and virtually no evidence that suggests otherwise. Tracer tests have demonstrated that groundwater from the upper Glen Rose Aquifer can flow rapidly to the Edwards Aquifer crossing large faults in the process (Veni, 2004; Schindel and Johnson, 2005). Rapid recharge into river and stream beds and into karst features in the Edwards Aquifer Contributing Zone near the Edwards Aquifer Recharge Zone indicates that the upper portion of the Glen Rose Aquifer exhibits hydraulic properties similar to the permeable portions of the Edwards Aquifer (Ferrill et al., 2008; Schindel and Johnson, 2005; Veni, 2004). As a result, surface water flow in streams is often recharged into the subsurface in the Contributing Zone well before the streams and rivers enter the Recharge Zone. This attribute is seen in many rivers and streams that cross the San Antonio segment of the Edwards Aquifer (**Figure 1**) (Slade et al., 2002). Refined assessment of faulting along the Balcones Fault Zone (Ferrill et al., 2004, 2005, 2008) suggests that these faults do not impede cross flow as originally postulated by Maclay and Small (1983) and Maclay and Land (1988).

A gain/loss study was conducted October 2, 2010 on the reach of Helotes Creek located immediately upstream from the Edwards Aquifer Recharge Zone. The study entailed flow measurements at six locations where Helotes Creek overlies the upper Glen Rose Aquifer (**Figure 2**). Flow measurements ranged from 0.94 cubic feet per second (cfs) at the most upgradient location (3.6 km upstream from the Recharge Zone), increased to a maximum of 4.24 cfs at approximately 2.4 km upstream from the Recharge Zone, then decreased to no flow at a distance of approximately 0.25 km upstream of the Recharge Zone (**Figure 3**). Flow in this reach

of Helotes Creek occurred at a time when no flow was recorded in Helotes Creek where it enters the Edwards Aquifer Recharge Zone (**Figure 4**).

Lastly, a refined water budget assessment of the Uvalde sub-basin of the Edwards Aquifer indicates that interformation flow from the Trinity Aquifer has to be greater than previous estimates for the water budget of the Uvalde sub-basin to be balanced (Green et al., 2009). Recharge calculations based on a river gauge located on the Nueces River at the boundary of the Edwards Aquifer Contributing and Recharge Zones do not account for recharge that occurs upstream of the gauging station (Hamilton et al., 2007).

As a consequence of these recent studies and related assessments, the abrupt distinction currently assigned to the hydraulic transition of the Edwards Aquifer Contributing Zone to the Edwards Aquifer Recharge Zone is not accurate. Evidence cited here strongly indicates that the upper Glen Rose Aquifer performs similarly to the permeable portions of the Edwards Aquifer and that significant recharge of the Edwards Aquifer occurs in the Contributing Zone, up gradient to the Recharge Zone.

This evidence supports the premise that the Edwards Aquifer Contributing Zone is more hydraulically connected with the Edwards Aquifer Recharge Zone than reflected by the TCEQ Edwards Aquifer rules. The rules need to be changed to better protect the Edwards Aquifer by protecting the Contributing Zone. This means extending Recharge Zone protections into the Contributing Zone, otherwise, lack of protection of the Contributing Zone renders protections of the Recharge Zone ineffective.

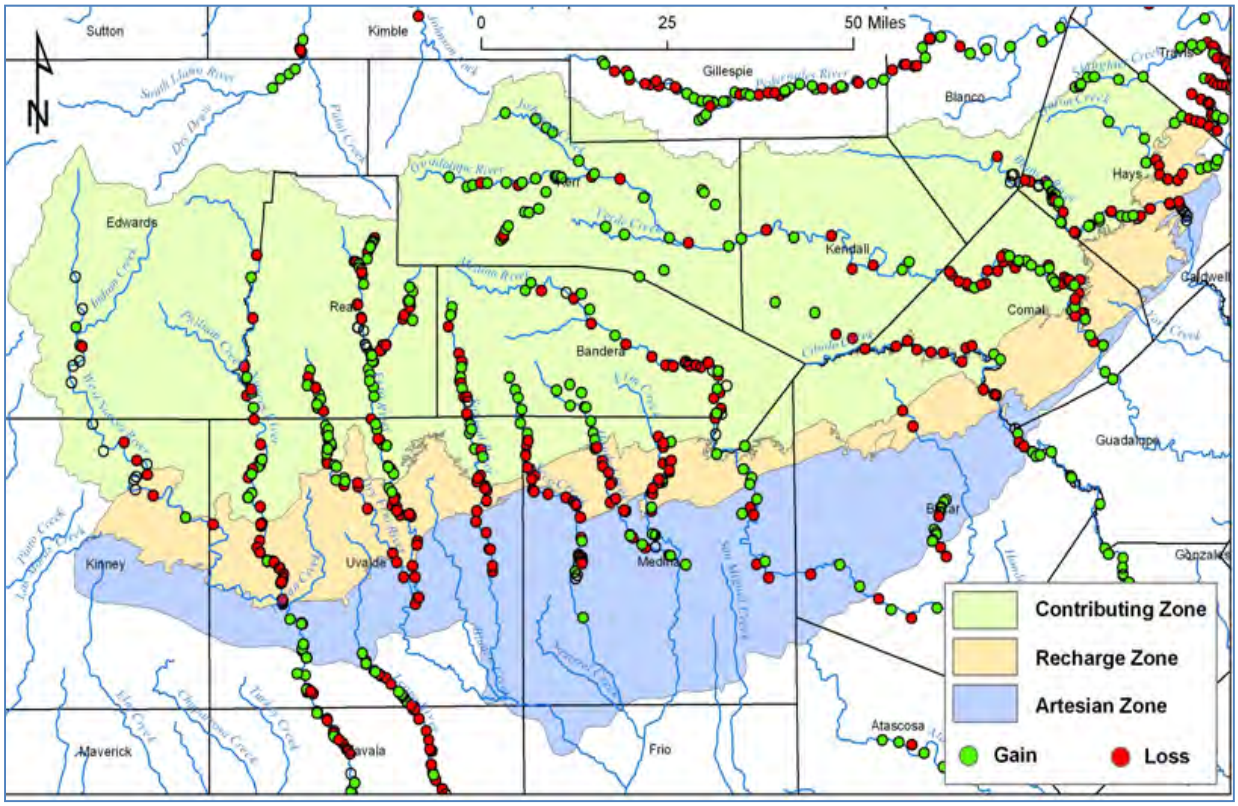

*Figure 1. Compilation of gain/loss measurements in the greater Edwards Aquifer region. Red dots denote loss of flow from rivers to the subsurface. Green dots denote gain. Data are from Slade et al. (2002).*

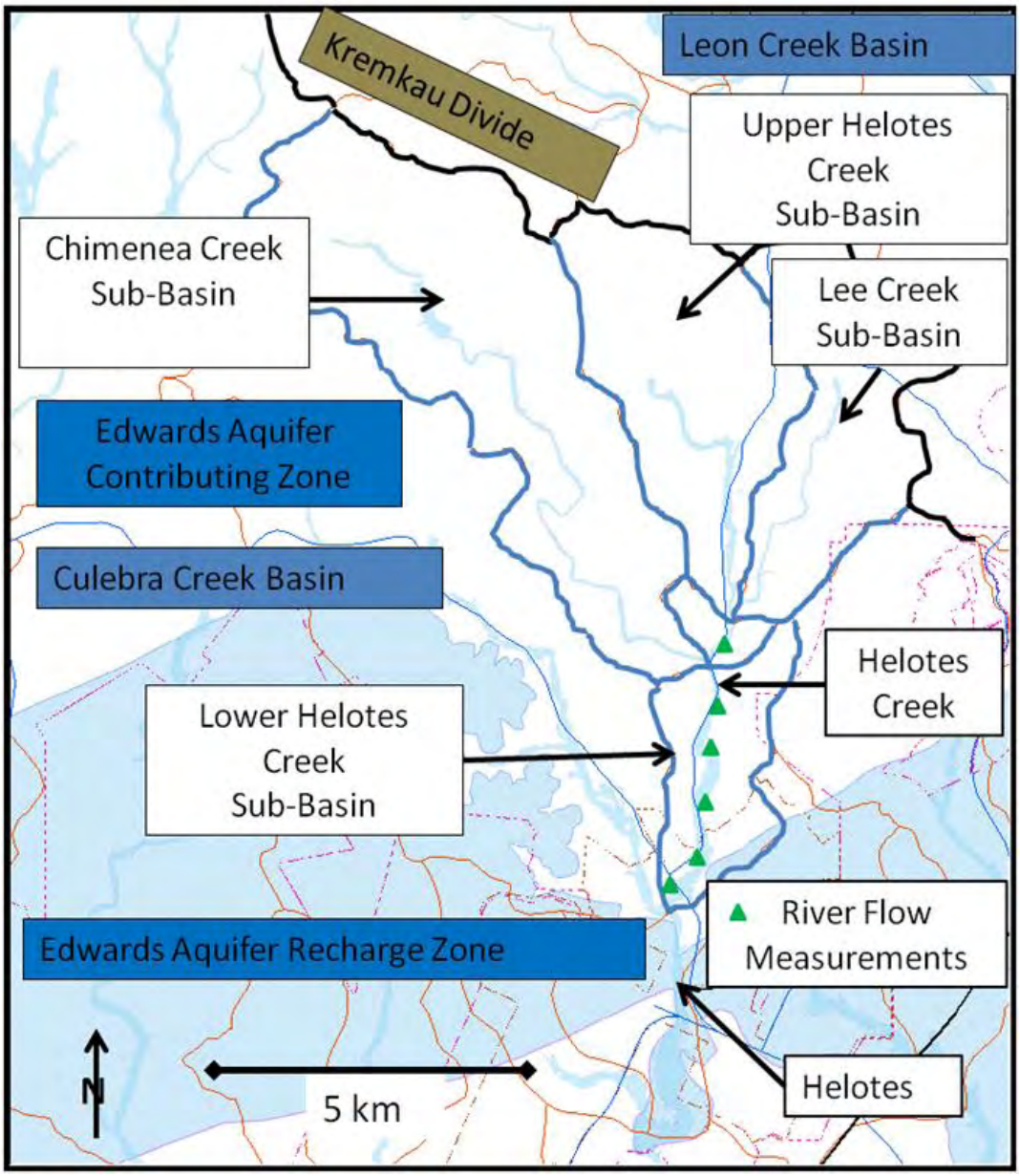


*Figure 2. Location of a gain/loss study conducted on Helotes Creek in the Edwards Aquifer Contributing Zone on October 2, 2010 at a time when there was flow in Helotes Creek in the Contributing Zone, but that all flow had infiltrated the Glen Rose Formation prior to arriving at the Edwards Aquifer Recharge Zone.*

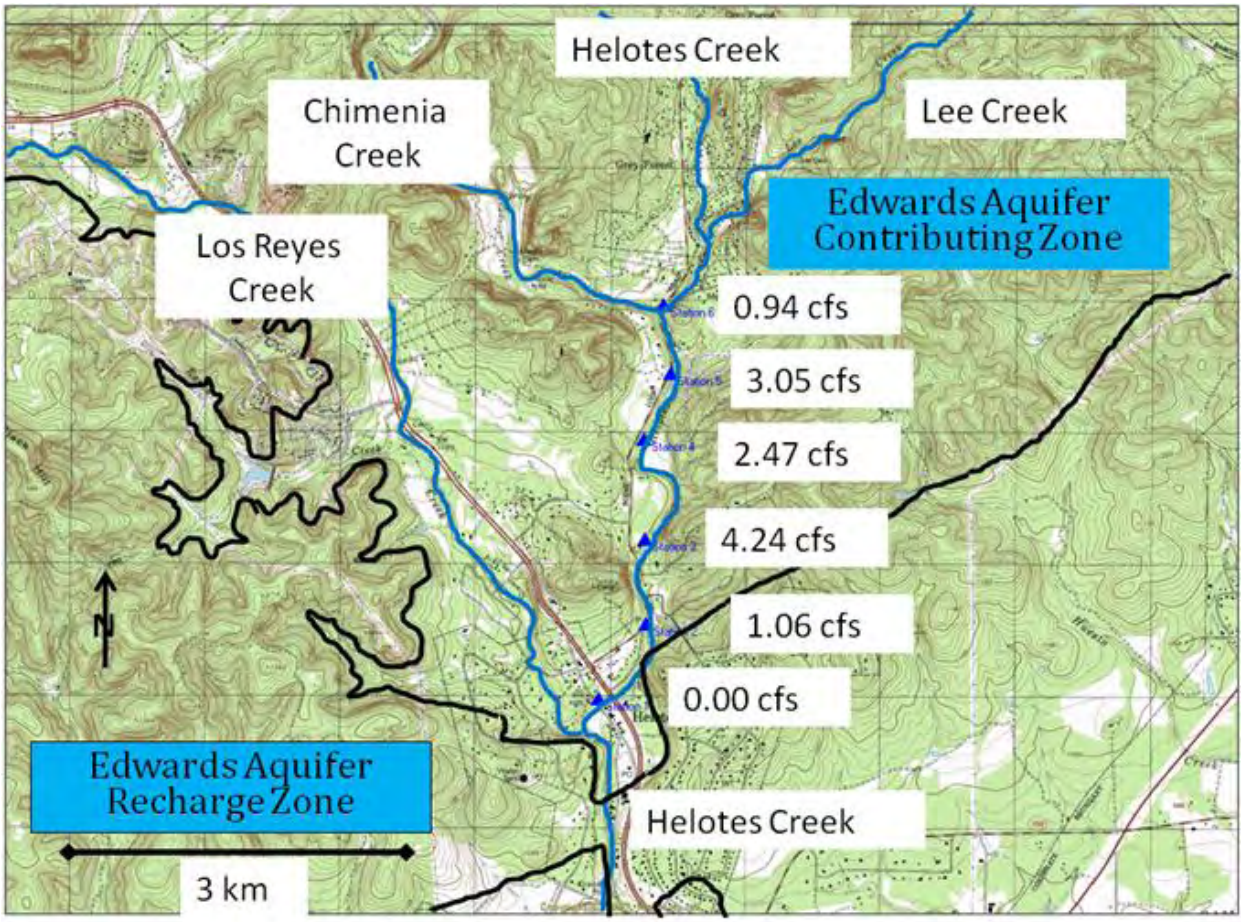


*Figure 3. River flow measurements made during the Helotes Creek gain/loss study conducted on October 2, 2010. Flow measurements were made at six locations denote by blue triangles.*

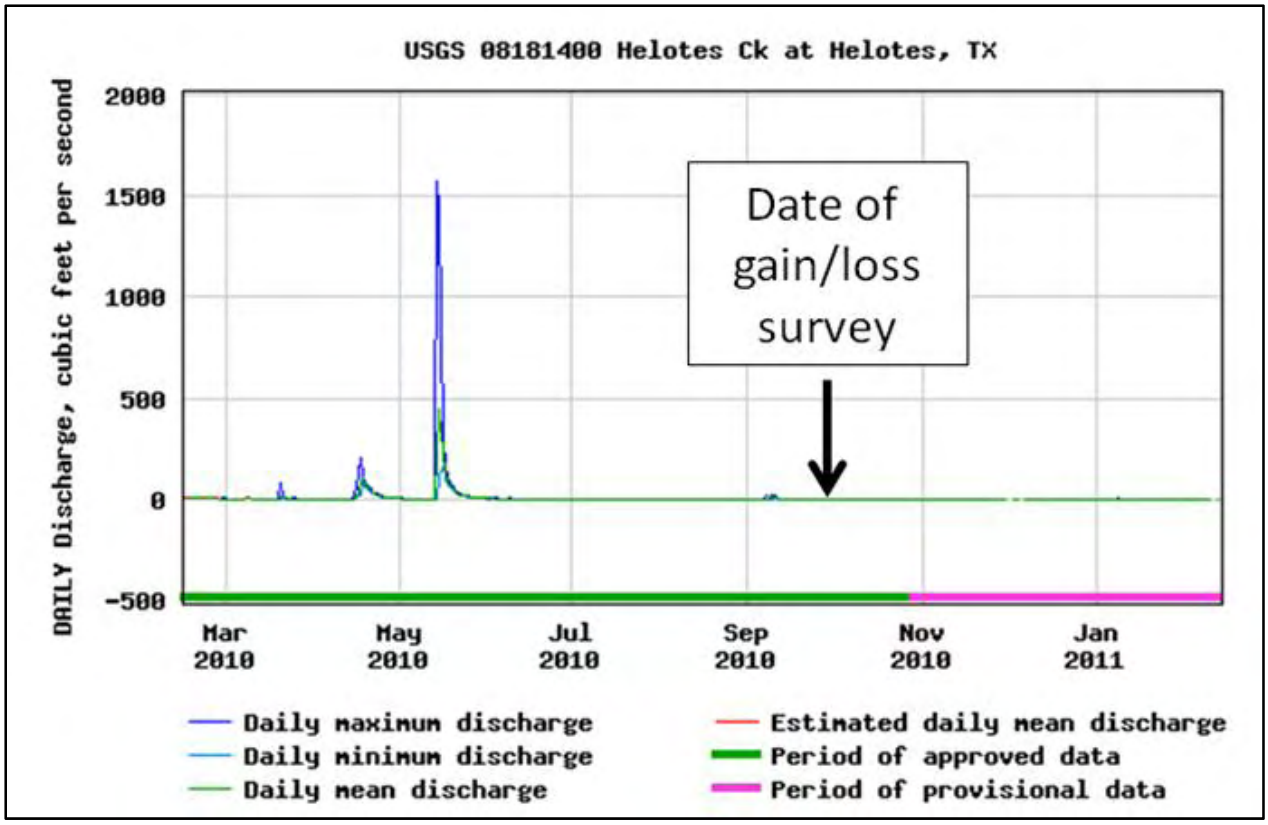


*Figure 4. River flow recorded by the U.S. Geological Survey at location 08181400 on Helotes Creek located approximately 100 m upstream from the Edwards Aquifer Recharge Zone.*

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