Hydraulic Interaction Between the Edwards and Trinity Aquifers

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Summary

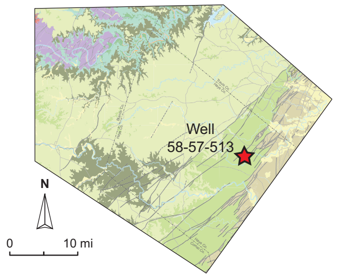
Within the Barton Springs/Edwards Aquifer Conservation District the Trinity Aquifer is increasingly used as a source of water as pumping limits have been placed on the Edwards Aquifer. Proper management of these aquifers requires an understanding of factors affecting the hydraulic relationship between the two aquifers.

To better understand the relationship between the various units of the Edwards and Trinity Aquifers, a multiport well was installed in Hays County, about 5 miles west of Buda (Figure 16-1), with 14 monitoring zones completed in the Edwards and Trinity Aquifers. Data collected from the multiport well include water levels, geochemistry, isotopes, and permeability. A wireline tool is used to collect samples and measure potentiometric pressures in each sample zone (Figures 16-2, 16-3). This tool and the equipment permanently installed in the well are manufactured by Westbay® Instruments (a Schlumberger company) of Vancouver, Canada.

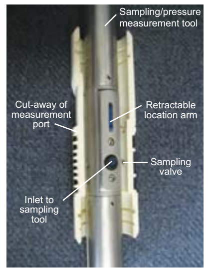
Water-chemistry and isotope data were collected from the 13 sampling zones of the multiport well. The results (Figures 16-5 and 16-6) can be grouped into three distinct hydrochemical facies: calcium bicarbonate, calcium sulfate, and an intermediate facies (Figure 16-4). The calcium sulfate facies has the highest levels of sulfate, magnesium, calcium, and total dissolved solids (TDS) and is associated with zones in the upper member of the Glen Rose Formation. The lowest TDS zones are in the Edwards Group units, the Cow Creek Limestone, and a rudist reef unit in the lower member of the Glen Rose Formation. Zones with low TDS generally have relatively higher hydraulic conductivity, which would conceivably enhance the flushing of dissolved constituents from groundwater within that zone (Figure 16-8). Tritium and percent modern carbon (pmC) indicate that the Edwards Group zones contain relatively young groundwater. The Trinity contains relatively old groundwater with no tritium values detected and less than 40% pmC (Figure 16-9).

Significant head differences, distribution of hydrochemical facies, and isotopic signatures suggest that there is very little, if any, vertical flow among most of the geologic units (Figure 16-7). Faults in the area do not appear to create pathways for vertical flow, nor do they appear to necessarily create barriers to lateral flow. Relay-ramp structures, which are common in the Balcones Fault Zone (Collins, 1995), appear to provide some lateral continuity within most lithologic units, and therefore, typically support the lateral flow of groundwater.

Similar head values and similar response to precipitation (recharge) suggest that the uppermost zone of the Upper Glen Rose (Zone 11) is in hydraulic connection with the Edwards Aquifer. Groundwater geochemistry in this zone also appears to change depending upon head values in relation to the zone below. The connection may be lateral (due to fault juxtaposition) or possibly localized by virtue of vertical flow, perhaps along faults.



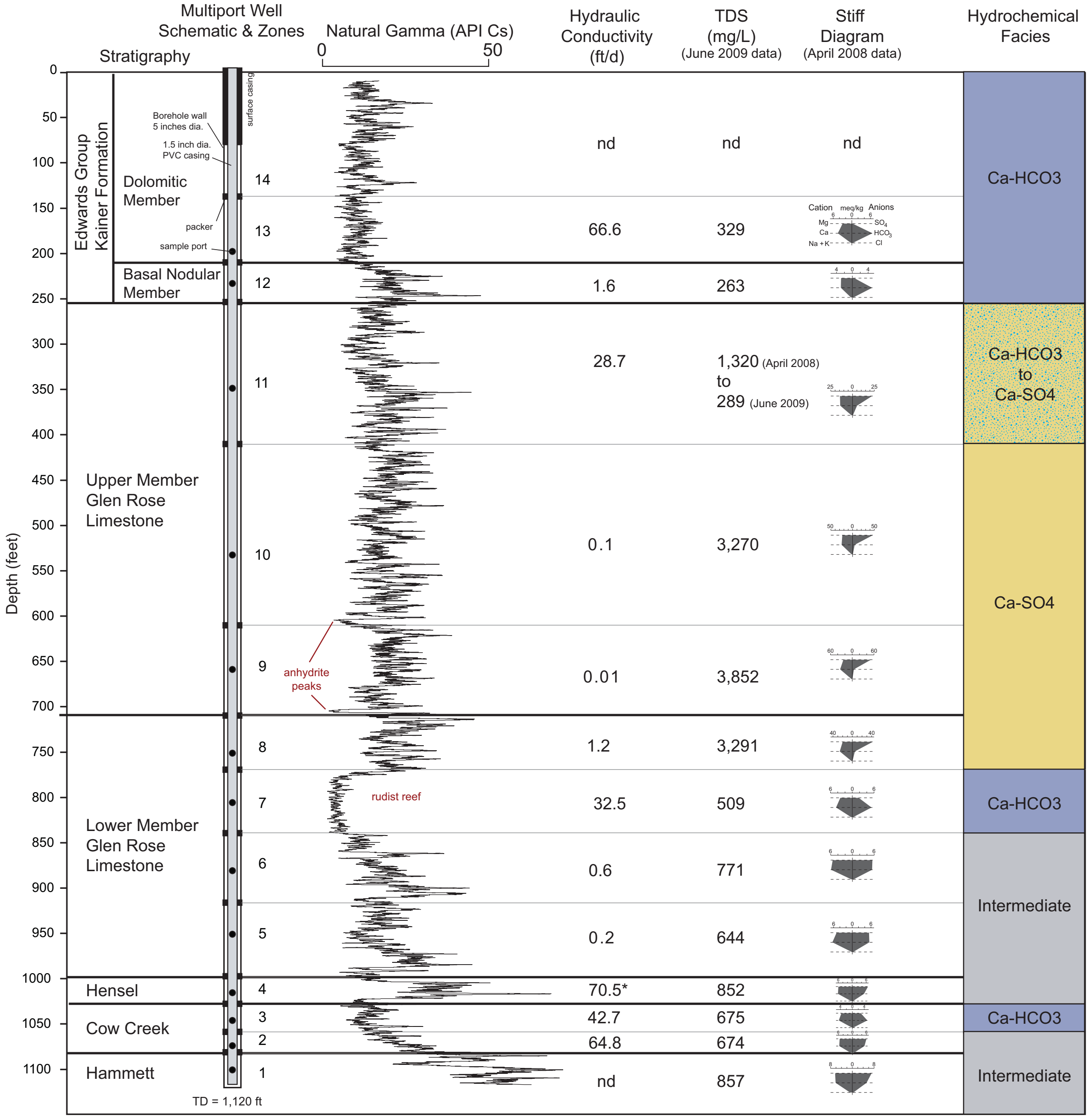
16-1 Location map of study area. Well location shown as star with state well number noted.



16-2 Close-up cut-away picture of Westbay® tool and sample port.

16-3 Photograph showing the winch and tripod used to raise and lower the wireline tool that measures pressures in each zone. The same tool also can collect up to 1 liter of sample from each zone. Photo by Brian B. Hunt.

16-4 Diagram Showing Multiport Well Construction, Sampling Zones, and Stratigraphy with Results from Hydrochemical Sampling and Hydraulic Testing.



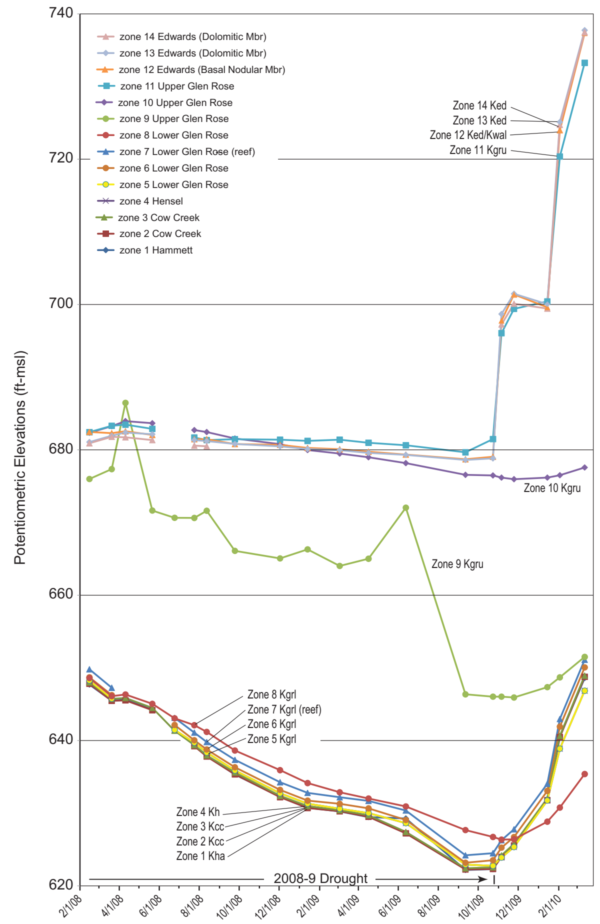
* value is likely too high, poor recovery data

16-5 Table of Major Ion Chemistry and Isotope Results (June 2009)

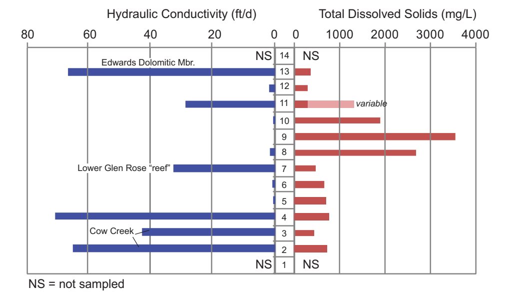
Name	Zone thickness (ft)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Sr (mg/L)	Bicarb (mg/L)	Sulfate (mg/L)	Cl (mg/L)	Fl (mg/L)	Nitrate (mg/L)	TDS (mg/L)	Tot Alk (mg/l)	tot hardness (mg/l CaCO3)	^{3}H, TU	^{3}H, TU +/-	C-14 +/-	δ^{13}C ‰	pmC-14	pmC-14	pmC-14 +/-	δ^{18}O ‰	δ^{2}H ‰	^{87}Sr/^{86}Sr	Strontium 86/87 +/-
Zone 13 Edwards (Dolomitic Mbr)	72	75.7	33.1	6.2	0.8	0.2	354	10.6	10	0.22	5.84	329	290	326	1.39	0.09	50	-7.3	73%	0.7331	0.0046	-3.95	-24.70	0.708078	0.000600
Zone 12 Edwards Basal Nodular	34	48.3	31	6.9	1.7	3.06	275	14.3	9.83	0.35	0.13	263	225	252	-0.03	0.09	80	-6.2	18%	0.1812	0.0018	-3.87	-24.80	0.707534	0.000700
Zone 11 Upper Glen Rose A	159	54.3	31	5.9	1.9	5.72	271	36.3	8.09	0.37	0.37	289	222	270	0.14	0.09	60	-5.6	37%	0.3692	0.0028	-3.91	-24.70	0.707505	0.000800
Zone 10 Upper Glen Rose B	197	464	305	33	24.4	11.9	276	2280	20.2*	3.92	< 0.02	3270	226	2429	0	0.09	160	-1.3	5%	0.0488	0.001	-4.37	-26.90	0.707802	0.000600
Zone 9 Upper Glen Rose C	97	592	324	34	28.1	12	273	2710	20.4*	4	< 0.02	3852	224	2827	0.18	0.09	150	-1.3	5%	0.0487	0.0009	-4.59	-27.10	0.707862	0.000900
Zone 8 Lower Glen Rose A	57	508	286	31.5	24	12.8	268	2280	16.6*	3.9	< 0.02	3291	220	2461	-0.05	0.09	60	-3.9	23%	0.2272	0.0017	-4.21	-26.20	0.708072	0.000600
Zone 7 Lower Glen Rose B (reef)	67	90.5	48.7	8.3	2.9	6.43	361	152	9.77	1.06	< 0.02	509	296	434	0.68	0.09	60	-3.1	26%	0.2645	0.002	-3.99	-25.00	0.707839	0.000700
Zone 6 Lower Glen Rose C	72	96	81.9	15.4	7.6	13.3	395	335	11.8	3.34	< 0.02	771	324	592	0.26	0.09	70	-1.8	18%	0.1837	0.0016	-4.07	-26.20	0.707967	0.000700
Zone 5 Lower Glen Rose D	77	91.6	68.9	12.7	6.5	14.6	329	263	10.2	2.8	< 0.02	644	270	529	0.26	0.09	60	-2.3	20%	0.2004	0.0015	-4.10	-25.60	0.708133	0.000600
Zone 4 Hensel	31	126	82.4	15	8.6	12	312	428	10.5	1.7	< 0.02	852	256	668	0.29	0.09	80	-2.6	16%	0.156	0.0016	-4.24	-26.50	0.708214	0.000500
Zone 3 Cow Creek	27	109	64.7	11.5	6.6	8.44	314	298	9.23	1.51	< 0.02	675	257	548	0.51	0.09	60	-3.6	26%	0.2554	0.0019	-4.14	-26.10	0.708075	0.001000
Zone 2 Cow Creek	20	105	66.3	11.7	8	9.25	314	296	9.21	1.86	< 0.02	674	257	546	0.73	0.09	60	-3.5	23%	0.2281	0.0017	-4.16	-26.40	0.708152	0.000800
Zone 1 Hammett	41	126	80.2	18.8	9.7	14.8	327	418	13.6	1.82	< 0.02	857	268	662	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

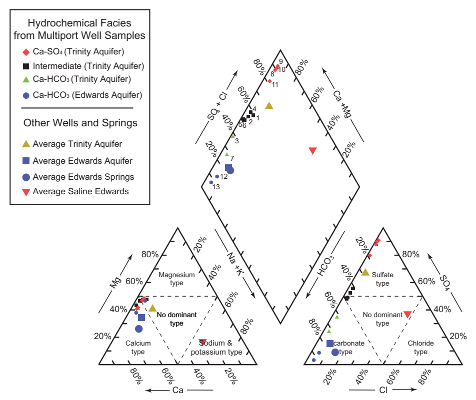
ns = no sample
zone 14 was not sampled

16-7. Hydrograph of Zones February 2008 to March 2010



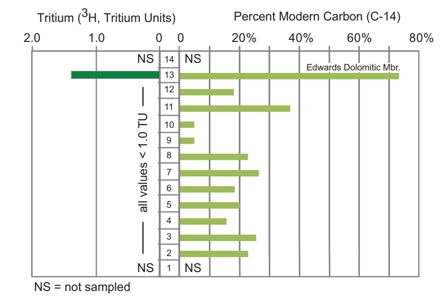
16-8. Hydraulic Conductivity Compared to Total Disolved Solids





16-6 Piper Diagram of Water Chemistry Results (2008 data)

16-9. Tritium Compared to Percent Modern Carbon



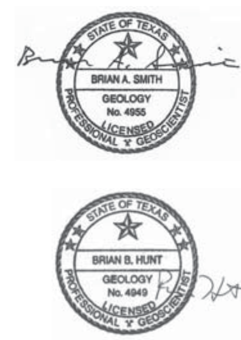


Plate 16 Hydraulic Interaction between the Edwards and Trinity Aquifers