Recharge Rates for the Major Aquifers

The attached table contains recharge rates for 8 major aquifer including the Carrizo-Wilcox, Gulf Coast, High Plains, Edwards-Trinity, Trinity, Seymour, Cenozoic Pecos Alluvium, and Hueco-Mesilla Bolson aquifers. Recharge rates for the Edwards aquifer can be found in Slattery et al., 1998 and in annual reports published by the Edwards Aquifer Authority (e.g. EAA, 2000). Recharge data were compiled from reports published by the Texas Water Development Board, U.S. Geological Survey, and other publications. The table lists the study areas (counties or general area), underlying aquifers, recharge rates (units of mm/yr, inches/yr, or total recharge in acre-feet/yr), data sources, and techniques used to estimate recharge. Additional notes are provided in some cases. The full reference citations are listed separately.

The main techniques for estimating recharge are Darcy's law, groundwater modeling, and baseflow discharge. Darcy's Law is widely applied in the confined sections of the Carrizo-Wilcox and Gulf Coast aquifers. Groundwater modeling is used in most aquifers. Baseflow discharge is used primarily in the Trinity, Edwards-Trinity, Seymour, and Cenozoic Pecos Alluvium aquifers. Environmental tracers so far have only been used to a limited (chloride mass balance, tritium, and carbon-14).

Estimates of recharge rates in the Carrizo-Wilcox aquifer range from 0.1 to 5.8 in/yr. The higher recharge rates occur in the sandy portions of the aquifer (i.e. Simsboro and Carrizo units). Recharge rates are generally lower in the Gulf Coast aquifer, ranging from 0.0004 to 2 in/yr. In both the Carrizo-Wilcox and Gulf Coast aquifers, higher recharge rates are in upland areas with sandy soils. Regional recharge rates in the High Plains aquifer, outside irrigated areas, are generally low (0.004 to 1.7 in/yr) whereas playa-focused recharge rates are much higher (0.5 to 8.6 in/yr). Irrigated areas also have fairly high recharge rates (0.6 to 11 in/yr). Recharge rates in the Trinity and Edwards-Trinity aquifer generally range from 0.1 to 2 in/yr. The Seymour aquifer has recharge rates that range from 1 to 2.5 in/yr. Recharge rates for the Hueco-Mesilla Bolson and the Cenozoic Pecos Alluvium are represented as total recharge along mountain fronts and valley floors.

Major Aquifer	Location (County/Area)	Aquifer	Recharge rate (mm/yr)	Recharge rate (in/yr)	Total recharge (af/yr)	Reference	Technique	Notes
Carrizo Wilcox	Atascosa, Frio	Carrizo sand	45.7	1.8		Alexander and White, 1966	^{14}C, Darcy's Law	
	Sabine, San Augustine	undifferentiated	50.8	2.0		Anders, 1967	Darcy's Law	
	Sabine, San Augustine	undifferentiated	25.4	1.0		Anders, 1967	baseflow discharge	
	Camp, Franklin, Morris, Titus	Carrizo Wilcox			12,000	Broom et al., 1965	baseflow discharge	
	Harrison	Cypress	7.9	0.3	15,000	Broom and Meyers, 1966	Darcy's Law	
	Harrison	Cypress	7.9	0.3	40,000	Broom and Meyers, 1966	baseflow discharge	
	Wood	Carrizo	12.7	0.5	3,000	Broom, 1968	Darcy's Law	
	Freestone	Calvert Bluff sands	100	3.9		Dutton, 1990	soil water budget	
	Bastrop, Lee, Milam	Simsboro, Carrizo	51 - 102	2.0 - 4.0		Dutton, 1999	groundwater modeling	
	Bastrop	Carrizo, Wilcox sand	38	1.5		Follett, 1981	Darcy's Law	
	Winter Garden area	undifferentiated	5 - 127	0.2 - 5.0		Guyton & Assoc. and HDR, 1998	modeling, water budget	
	Bastrop, Lee, Milam, Robertson, Halls, Falls, Limestone, Freestone, Navarro	Carrizo, Simsboro	76 - 127	3.0 - 5.0		Harden, 2000	groundwater modeling	
	Bastrop, Lee, Milam, Robertson, Halls, Falls, Limestone, Freestone, Navarro	Calvert Bluff, Hooper,	12.7	0.5		Harden, 2000	groundwater modeling	
	Bexar	Hooper, Simsboro, Calvert Bluff	45.7	1.8		HDR Engineering Inc., 2000	groundwater modeling	
	Winter Garden area	undifferentiated			100,000	Klemt et al., 1976	groundwater modeling	
	Atascosa	Carrizo	147	5.8		Opfel and Elder, 1978	neutron probe logging	
	Rusk	Carrizo	<25.4	< 1.0		Sandeen, 1987	Darcy's Law	
	Navarro	Carrizo Wilcox	12.7	0.5		Thompson, 1972	estimate	
	Caldwell, Bastrop, Lee, Milam, Robertson, Limestone, Freestone	undifferentiated	25.4	1.0		Thorkildsen and Price, 1991	groundwater modeling	
	Bastrop, Lee, Fayette	undifferentiated	25.4	1.0		Thorkildsen et al., 1989	groundwater modeling	
	Atascosa, Bexar, Dimmit, Frio, Gonzales, Guadalupe, Medina, Uvalde, Wilson, Zavala	undifferentiated			25,000	Turner et al., 1960	Darcy's Law	
	Rains, Van Zandt	Carrizo Wilcox	3	0.1	5,000	White, 1973	Darcy's Law	
Gulf Coast	Matagorda, Wharton	Beaumont, Chicot, Evangeline	0 - 10	0.0 - 0.4		Dutton and Richter, 1990	groundwater modeling	
	Duval, Jim Wells	Evangeline	1.5	0.1		Groschen, 1985	groundwater modeling	
	Aransas, Bee, Brooks, Calhoun, De Witt, Duval, Goliad, Hidalgo, Jackson, Jim Hogg, Jim Wells, Karnes, Kenedy, Kleberg, Lavaca, Live Oak, McMullen, Nueces, Refugio, San Patricio, Starr, Victoria, Webb, Willacy	Chicot, Evangeline, Jasper	0.01 - 3.0	0.0004 - 0.12		Hay, 1999	groundwater modeling	
	Colorado, Lavaca, Wharton	Chicot, Evangeline	30 - 34	1.2 - 1.3		Loskot et al., 1982	Darcy's Law	
	Jim Wells	Evangeline	<2.5	< 0.1		Mason, 1963	Darcy's Law	
	Gulf Coast					Muller and Price, 1979	groundwater modeling	
	Brooks	Evangeline			5,600	Myers and Dale, 1967	Darcy's Law	
	Harris, Montgomery, Walker	Chicot, Evangeline	< 152.4	< 6.0		Noble et al., 1996	Tritium	
	Montgomery	Chicot,	43.2	1.7		Popkin, 1971	Transmission	
	Gulf Coast		18.8 (0 - 152)	0.7 (0.0 - 6.0)		Ryder, 1988	groundwater modeling	
	Washington	Jasper, Evangeline, Catahoula,	17.8	0.7		Sandeen, 1972	base flow discharge	

Major Aquifer	Location (County/Area)	Aquifer	Recharge rate (mm/yr)	Recharge rate (in/yr)	Total recharge (af/yr)	Reference	Technique	Notes
	Nueces, San Patricio				5,400	Shafer, 1968	Darcy's Law	
	Polk	Jasper and Evangeline	50.8	2.0		Tarver, 1968	Darcy's Law	
	Gulf Coast		0 - 16.8	0.0 - 0.7		Williamson et al., 1990	groundwater modeling	

Major Aquifer	Location (County/Area)	Aquifer	Recharge rate (mm/yr)	Recharge rate (in/yr)	Total recharge (af/yr)	Reference	Technique	Notes
High Plains		Southern	0.6 - 2	0.02 - 0.08		Brown and Signor,	Darcy's Law	regional
		Southern	13	0.5		Cronin, 1961	Darcy's Law	regional
			13 - 38	0.5 - 1.5		Dugan et al., 1994	water budget	regional
		Central	3.6 - 42.7	0.1 - 1.7		Dutton et al., 2000	groundwater modeling	regional
	Armstrong, Carson, Collingsworth, Donley, Gray, Hansford, Hemphill, Hutchinson, Lipscomb, Ochiltree, Potter, Roberts, Wheeler		152	6.0		Gould, 1906	observation	regional
	Lea Co., New Mexico		20.6	0.8		Havens, 1966	water budget	regional
			76 - 102	3.0 - 4.0		Johnson, 1901	observation	regional
		Central, Southern	4.8	0.2		Klemt, 1981	neutron probe logging	regional
		Central, Southern	2.8 - 5.1	0.1 - 0.2		Klemt, 1981	neutron probe logging	nonirrigated
		Central, Southern	15 - 279 (irrigated)	0.6 - 11.0		Klemt, 1981	neutron probe logging	irrigated
		Central, Southern	5.1 (1.5 - 20)	0.2 (0.06 - 0.8)		Knowles et al., 1984	groundwater modeling	regional
	Dallam, Hartley		16 - 24	0.6 - 0.9		Luckey and Becker, 1999	groundwater modeling	sand dunes
	Sherman Moore, Hansford, Hutchinson, Ochiltree, Lipscomb		1.6 - 2.1	0.06 - 0.08		Luckey and Becker, 1999	groundwater modeling	low permeability soils
		Southern	3.3 (2.5-25.4)	0.13 (0.1 - 1.0)		Luckey et al., 1986	groundwater modeling	regional
		Central	3.8 (1.5-	0.14 (0.06 -		Luckey et al., 1986	groundwater modeling,	regional
	Carson, Potter		205.5	8.1		Mullican et al., 1994	gw modeling	playa
	Carson, Potter		6.00	0.2		Mullican et al., 1994	gw modeling	Blackwater Draw
	Armstrong, Carson, Donley, Gray, Hemphill, Hutchinson, Potter, Randall, Roberts, Wheeler		9.00	0.4		Mullican et al., 1997	groundwater modeling	Ogallala outcrop area
	Armstrong, Carson, Donley, Gray, Hemphill, Hutchinson, Potter, Randall, Roberts, Wheeler		219.00	8.6		Mullican et al., 1997	groundwater modeling	playas Blackwater Draw
	Lubbock		41 (13 - 82)	1.6 (0.5 - 3.2)		Nativ, 1988	Tritium	playa
	Carson, Potter		60 - 100	2.4 - 3.9		Scanlon and	Chloride mass balance	playa
	Carson, Potter		0.1 - 4	0.004 - 0.16		Scanlon and Goldsmith, 1997	Chloride mass balance	interplaya
		Southern	71.1 (15.2-139.7)	2.8 (0.6 - 5.5)		Stovall et al., 2000	groundwater modeling	regional
		Central, Southern	3.2 - 17.0	0.1 - 0.7		Theis, 1937	Darcy's law	regional
			24	0.9		U.S. Bur. Reclamation, 1982		regional
		Central, Southern	2.5	0.1		Wood and Osterkamp, 1984	literature	regional
		Central, Southern	40	1.6		Wood and Osterkamp, 1984	literature	playa annulus
		N. half of Southern	11	0.4		Wood and Sanford, 1995	Chloride mass balance	regional
	Lynn		77	3.0		Wood et al., 1997	tritium	playa

Major Aquifer	Location (County/Area)	Aquifer	Recharge rate (mm/yr)	Recharge rate (in/yr)	Total recharge (af/yr)	Reference	Technique	Notes
Trinity	Kendall		33	1.3		Ashworth, 1983	baseflow discharge	Comfort and Spring Branch on Guadalupe 1940 - 1960
	Bandera, Blanco, Comal, Gillespie, Hays, Kendall, Kerr, Medina, and Travis		38.1 (1.8 in 1956; - 116.8 in 1975)	1.5 (0.07 - 4.6)		Bluntzer, 1992	baseflow discharge	
	Dallas, Kaufman, Parker, Tarrant		111.8	4.4		Dutton et al., 1996	Cross section groundwater model	
	Bell, Brown, Callahan, Comanche, Cook, Coryell,		1.0 to 7.6	0.04 - 0.3		Dutton et al., 1996	groundwater modeling	
	Callahan, Comanche, Coryell, Eastland, Erath, Falls, Hamilton, Hill, Lampasas, Limestone, McLennan, Milam, Mills, Somervell, Williamson		30.5	1.2		Klemt et al., 1975	assumed	
	Bandera, Bexar, Comal, Gillespie, Hays, Kendall, Kerr, Travis		55.9	2.2		Kuniansky and Holligan, 1994	groundwater modeling	
	Bandera, Blanco, Gillespie, Kendall, Kerr		53 - 152	2.1 - 6.0		Kuniansky, 1989	baseflow	1974 - 1977
	Kendall		55.9	2.2		Mace et al., 2000	baseflow	Comfort and Spring Branch on Guadalupe, 1940 - 1997
	Bandera, Bexar, Comal, Gillespie, Hays, Kendall, Kerr, Travis		34.5	1.4		Mace et al., 2000	groundwater modeling	
	Kendall		38.1	1.5		Reeves, 1967	baseflow	
	Kerr		25.4	1.0		Reeves, 1969	baseflow	
Seymour	Haskell, Knox		55.9	2.2		Harden and Associates, 1978	water budget	
	Hardeman		25.4	1.0		Maderak, 1972	Darcy's Law	
	Baylor		66	2.6		Preston, 1978	baseflow	
	Jones		45.7	1.8		Price, 1978	baseflow	
	Wilbarger		63.5	2.5		Willis and Knowles, 1953	baseflow	
Hueco-		Hueco Bolson			5,640	Meyer, 1976	groundwater modeling	mountaln-front
Mesilla		Mesilla Valley			18,000	Leggat et al., 1962	Darcy's Law	
Bolson		Mesilla Valley			3,547	Frenzel et al., 1992	empirical	mountaln-front
Cenozoic Pecos	Reeves				10,000 - 50,000	Ogilbee and Osborne, 1962	baseflow	
Alluvium								
Edwards -	Kinney		35.6	1.4		Bennett and Sayre, 1962	baseflow	
Trinity	Crockett		7.6	0.3		Iglehart, 1967	baseflow	
	Real		50.8	2.0		Long, 1958	baseflow	
	Kerr		25.4	1.0		Reeves, 1969	baseflow	

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