

Exhibit 2008 Groundwater Pumping Estimates - Preliminary

Table 1 - Acres Irrigated by Groundwater in 2006

Item	County (or portion of County in the Republican River Basin study area)									Total
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Sprinkler	10,532	141,342	1,996	5,721	64,254	21,806	36,230	261,596	543,478	
Flood	53	1,748	0	0	2,161	586	0	1,174	5,722	
Total	10,585	143,090	1,996	5,721	66,415	22,392	36,230	262,770	549,199	

Source: 2005 Aerial Photographs

Table 2 - Efficiency Factors for Estimating Pumping In Colorado

Year	Percent of CIR Met by Pumping (%)	Sprinkler Irrigation			Flood/Gated Pipe/Furrow Irrigation		
		Maximum Farm Efficiency (%)	Pumping Lost to Spray Loss (%)	Pumping to Deep Percolation (%)	Maximum Farm Efficiency (%)	Net Surface Water Runoff (%)	Pumping to Deep Percolation (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2006	75%	80%	3%	17%	65%	5%	30%

Source:

- (2) Data from "150 Well Water Right Change Study" (See Table 5 of Helton & Williamsen memorandum entitled)
- (3) Estimated
- (4) Estimated
- (5) Calculated as 100% - Column(3) - Column(4)
- (6) Estimated
- (7) Initial surface water runoff is estimated to be 10%. Estimated that 5% deep percolates back into aquifer after it leaves the end of the field and 5% returns to the stream or is consumed.
- (8) Calculated as 100% - Column(6) - Column(7)

Table 3 - Crop Irrigation Requirement (units of inches)

Year	County (or portion of County in the Republican River Basin study area)									Weighted Average Using Acres in Table 1
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
2006	21.52	20.90	20.47	21.41	20.01	20.93	18.76	14.25	17.49	

Sources:

- Potential consumptive use estimated using the Hargreaves equation calibrated to the Penman-Monteith equation.
- Effective rainfall estimated using procedure outlined in TR-21.
- Crop mix from NASS data was used to weight the CIR for each county.
- See memorandum by Helton & Williamsen entitled "Crop Consumptive Use Requirements - Republican River Basin in Colorado" dated November 19, 2002.

Table 4 - Gain in Soil Moisture from Winter and Spring Precipitation (units of inches)

Year	County (or portion of County in the Republican River Basin study area)									Average
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
2006	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	

Source:

- 1) "Republican River Basin Water Management Study - Working Paper - Farm Water Management", Steven J. Vandas, United States Bureau of Reclamation, March 1983
- 2) As a check on reasonableness
Average Monthly Precipitation for Yuma County in April and May = 4.8 inches
Average Monthly Consumptive Water Requirement for Corn Grain in Yuma County in April and May = 1.2 inches
Which results in 4.8" - 1.2" = 3.6" of precipitation that becomes surface water runoff, deep percolation, soil evaporation, or a gain to soil moisture storage.

Table 5 - Net Crop Irrigation Requirement (units in inches)

Year	County (or portion of County in the Republican River Basin study area)									Weighted Average Using Acres in Table 3
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
2006	19.52	18.90	18.47	19.41	18.01	18.93	16.76	12.25	15.49	

Calculated as Table3 minus Table 4

Table 6 - Irrigation Groundwater Pumping (acre-feet)

Year	County (or portion of County in the Republican River Basin study area)									Total
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Sprinkler	16,064	208,734	2,881	8,676	90,416	32,250	47,429	250,324	656,772	
Flood	100	3,177	0	0	3,743	1,066	0	1,382	9,468	
Total	16,164	211,911	2,881	8,676	94,159	33,316	47,429	251,706	666,241	

For each county pumping is calculated as

- Sprinkler Pump = Sprinkler Irrig Acres (Table 1) x % CIR (Table 2, column2) x Net CIR/12 (Table 5) / Sprinkler Efficiency (Table2, column3)
- Flood Pump = Flood Irrig Acres (Table 1) x % CIR (Table 2, column2) x Net CIR/12 (Table 5) / Flood Efficiency (Table2, column6)

Table 7 - Recharge From Groundwater Pumping in Colorado (acre-feet)

Year	County (or portion of County in the Republican River Basin study area)									Total
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Sprinkler	2,731	35,485	490	1,475	15,371	5,482	8,063	42,555	111,651	
Flood	30	953	0	0	1,123	320	0	415	2,840	
Total	2,761	36,438	490	1,475	16,494	5,802	8,063	42,970	114,492	

For each county recharge is calculated as

- Sprinkler Recharge = Sprinkler Pump (Table 6) x Sprinkler Pump to Deep Percolation (Table2, column5)
- Flood Recharge = Flood Pump (Table 6) x Flood Pump to Deep Percolation (Table2, column8)