

Summary of the Survey of Groundwater Users in the Republican River Basin of Colorado

This document summarizes the recent survey of groundwater users that assessed current groundwater use practices and attitudes related to potential groundwater management strategies within the Republican River Basin of Colorado (the Basin). The survey was developed as a collaborative effort between the Water Preservation Partnership (WPP), the Republican River Water Conservation District (RRWCD), and a team of researchers at Colorado State University (CSU). This document describes the survey process and provides a summary of the key survey results. A complete summary of the responses for each survey question as well as the survey itself is provided at the end of the document.

Discussions between the CSU researchers and members of the WPP produced a draft of the survey, which was “pre-tested” amongst members of each groundwater management district at the end of September 2016. Survey recipients first received an announcement about the survey in mid-October 2016. Then, in the first week of November 2016, the survey was mailed to 1,204 individuals who own or manage irrigated land within the Basin, using a list of addresses provided by the Colorado Groundwater Commission. A second survey was sent to individuals who had not responded by the first week of December. As of February 1, 2017, 272 partially or fully completed surveys have been received, resulting in a response rate of 22.6%. We also heard from 38 individuals who received the survey but indicated that they were not eligible to participate, as well as several individuals who did not complete the survey but indicated resistance to any groundwater management research proceeding within the Basin.

The survey responses cover each county in the Basin, with Yuma (37% of responses) and Kit Carson (23%) Counties accounting for the largest proportion. Ten percent of responses are from Colorado (CO) counties outside the Basin, with an additional seven percent of responses coming from outside of CO. Survey responses have also come from each of the groundwater management districts (GWMDs) in the Basin, including East Cheyenne. The Plains and Arikaree GWMDs account for the largest share of responses with 23% and 19% respectively. Interestingly, a notable number of respondents incorrectly identify the Republican River Basin as their GWMD and in these cases their actual GWMD has been identified using well permit records.

The survey includes four main sections covering demographics, farm management, groundwater use, and attitudes related to groundwater conservation. In the demographic section, survey respondents reported an average age of 64, with 86% of respondents being male, and 49% having earned at least a Bachelor’s degree. The average respondent’s farm has been in the same family for 75 years, with 69% indicating they expect their family to continue farming in the Basin after they retire. Irrigated agriculture is essential to the livelihood of survey participants. More than half of all respondents indicate that 90% or more of their income comes from farming.

In the farm management section approximately one-third of respondents report renting at least some irrigated land from others in 2015. Among those renting land, the median

respondent rented 466 irrigated acres. Approximately 40% of respondents report renting irrigated land out to others, with the median respondent renting 260 irrigated acres to other producers. Respondents were also asked about crops grown and water use in the 2015 calendar year. The most frequently reported irrigated crops were corn (grain), with a reported average of 16.6 inches of water applied per acre, wheat, with a reported 12.2 inches applied per acre, and alfalfa, with a reported 19.1 inches applied per acre.

The median respondent owns and operates three irrigation wells, with 34% of wells pumping less than 600 gallons per minute (GPM), 26% of wells pumping 600 to 800 GPM, and 40% pumping more than 800 GPM. Sixty percent of respondents indicate they have experienced at least some declines in well capacity over the last 20 years. When asked about changes in production practices in response to well capacity declines, 70% of respondents indicate that they utilize new technologies to improve irrigation efficiency, with 39% reporting a change to crops requiring less water, and 39% applying less water per acre of land planted in a given crop. In addition, 50% of respondents indicate that they irrigate prior to planting crops in at least some years.

In the section related to water conservation attitudes, respondents show considerable concern about the future, with 62% of respondents indicating they are very concerned about the long-term availability of groundwater for irrigation and only 3% indicating no concern. Concern for groundwater availability is highest in W-Y District (95% concerned) and lowest in Sand Hills District (80% concerned). The three most common reasons cited for concerns related to future groundwater availability include concern for future generations (76% of respondents), future profitability (68%), and the community (48%). The survey responses also suggest that groundwater users are interested in groundwater conservation coordinated by GWMDs. Eighty six percent of respondents are at least somewhat supportive of their GWMD working to develop and promote strategies and practices that conserve groundwater, with the same percentage supportive of coordination of conservation efforts across GWMDs in the Basin.

In addition to eliciting general support for groundwater conservation measures, the survey requested feedback on several specific policies – an irrigated acreage fee, a fee on the quantity of groundwater pumped, and an annual groundwater quantity restriction. The levels of each policy necessary to achieve 10% and 25% reductions in groundwater use were provided, based on research by the CSU team. Respondents were asked to choose their most and least preferred policies out of this set and to indicate all of the policies they support relative to the current situation. The pumping fee that achieves a 10% reduction in groundwater use is most frequently selected as the most preferred policy (over 30% of respondents). An irrigated acreage fee that achieves a 25% reduction in groundwater use is the least preferred policy (nearly 60% of respondents). The policies most likely to receive support relative to the status quo are the quantity restriction and the pumping fee that achieve 10% reductions in groundwater use, with 34% and 26% of respondents supporting these policies respectively. The quantity restriction and pumping fee both receive the most support in the Plains District (65% and 40% respectively) and the least support in the W-Y District (19% and 9% respectively). The policy with the least support is the irrigated acreage fee (less than 10% of respondents). Although no

single policy was supported by a majority, 56% of respondents that participated in this section of the survey indicate support for at least one of the conservation policies over the current situation, with the highest support in the Plains District.

In summary, the groundwater use survey indicates considerable concern about future groundwater availability, among both groundwater users and landowners across the Basin. There is also widespread support for conservation actions taken at the GWMD level, with coordination across districts. Respondents show more limited support for specific water conservation policies, including fees on water use and annual pumping restrictions, with no single policy preferred by a majority of users. Importantly, the support for policies varies across GWMDs. Based on the survey results, GWMD managers should continue to pursue water conservation strategies with the understanding that the acceptability of specific conservation policies is likely to vary across GWMDs.

Results of the Republican River Groundwater Survey

Demographics:

Gender (Q 36)

	Responses	Percentage
Male	212	86%
Female	34	14%
Observations	246	

Highest Level of Education Completed (Q 37):

	Responses	Percentage
Some Years of High School	4	2%
High School	51	21%
Some college	44	18%
Associate's Degree	27	11%
Bachelor's Degree	101	41%
Graduate Degree	19	8%
Observations	246	

Age (Q 38)

Observations	Mean	Median	Std. Dev.	Min	Max
241	63.83	64	13.41	29	97

How many years has your family been farming? (Q 39)

Observations	Mean	Median	Std. Dev.	Min	Max
242	75.2	75	31.6	0	150

Do you expect your family to continue farming in the basin after you have retired? (Q 40)

	Responses	Percentage
Yes	164	69%
No	54	23%
Not Applicable	19	8%
Observations	237	

Average annual adjusted gross income? (Q 41)

	Responses	Percentage
Less than \$30,000	8	4%
\$30,001-\$50,000	33	16%
\$50,001-\$100,000	53	26%
\$100,001-\$150,000	41	20%
\$150,001-\$200,000	32	16%
> \$200,000	36	18%
Observations	203	

Do you or anyone else have a job off farm? (Q 42)

	Responses	Percentage
Yes	108	44%
No	138	56%
Observations	246	

Do you currently have natural gas wells? (Q 43)

	Responses	Percentage
Yes	59	24%
No	185	76%
Observations	244	

Wind turbines? (Q 44)

	Responses	Percentage
Yes	7	3%
No	239	97%
Observations	246	

What percent of your total household income comes from farming? (Q 45)

Observations	Mean	Median	Std. Dev.	Min	Max
225	78.16	90.00	29.46	0	100

Your Farm

Total number of cropland acres that you planted in 2015 (Q 1)

Irrigated

Observations	Mean	Median	Std. Dev.	Min	Max
220	717.78	287.5	1154.55	0	8300

Dryland

Observations	Mean	Median	Std. Dev.	Min	Max
220	996.88	381	1658.41	0	12300

The number of cropland acres that you planted in 2015 was (Q 2):

Less than a typical year	6	3%
About the same as a typical year	182	92%
More than a typical year	10	5%
Observations	198	

Dryland Crops (Q 3)

	Observations	Mean Acres	Median Acres	Mean Bushels or Tons/Acre	Median Bushels or Tons/Acre
Corn Grain	76	522.7	295.8	77.9	71
Corn Silage	11	283.7	160	33.6	30
Wheat	120	718.0	348	59.9	50
Alfalfa	9	107.9	12	4.5	4

Irrigated Crops (Q 3)	Observations	Mean Acres	Median Acres	Mean	Median	Mean Inches/Acre	Median Inches/Acre
				Bushels or Tons/Acre	Bushels or Tons/Acre		
Corn Grain	131	727.59	360.00	208.65	210	16.58	18.00
Corn Silage	30	127.47	120.00	32.24	27	17.13	17.70
Wheat	56	168.40	125.00	75.73	80	12.20	8.00
Alfalfa	37	92.66	64.00	5.73	6	19.07	19.50
Dry Beans	22	200.68	140.50	159.67	32	14.52	15.50
Beets	10	317.27	242.85	35.51	35	19.52	16.20

How many irrigated acres did you rent or lease from someone else in 2015? (Q 4)

Observations	Mean	Median	Std. Dev.	Min	Max
244	273.72	0	667.54	0	6000

Summary for those who are renting from (positive summary) (Q4)

Observations	Mean	Median	Std. Dev.	Min	Max
82	771	466	937	94	6000

How many irrigated acres did your rent or lease to someone else in 2015? (Q 5)

Observations	Mean	Median	Std. Dev.	Min	Max
248	161.64	0	314.67	0	3200

Summary for those who are renting to (positive summary) (Q 5)

Observations	Mean	Median	Std. Dev.	Min	Max
102	385.19	260	391.57	30	3200

County with majority of irrigated acreage (Q 6)

	Responses	Percentage
Kit Carson	69	27%
Phillips	34	14%
Logan	5	2%
Yuma	112	45%
Washington	18	7%
Sedgwick	10	4%
Cheyenne	1	0%
Lincoln	2	1%
Observations	251	

County of residence (Q 9)

	Responses	Percentage
Kit Carson	58	23%
Phillips	29	12%
Logan	6	2%
Yuma	92	37%
Washington	13	5%
Sedgwick	7	3%
Cheyenne	1	0%
Front Range	17	7%
Other CO	8	3%
Kansas/NE	6	2%
Other State	11	4%
Observations	248	

In which GWMD is the majority of the irrigated acreage that you own located? (Q 7)

	Responses	Percentage	
Plains	59	22%	*Some respondents indicated either the RRWCD or their county of residence as their GWMD. In these cases well permit records were used to identify the GWMD.
Sand Hills	30	11%	
Arikaree	51	19%	
Frenchman	38	14%	
Central Yuma	33	13%	
W-Y	37	14%	
East Cheyenne	1	0%	
Marks Butte	14	5%	
Observations	263		

Do you own irrigated acreage in multiple groundwater management districts? (Q 8)

	Responses	Percentage
Yes	46	18%
No	213	82%
Observations	259	

Percentage of annual gross farm and ranch sales that came from irrigated farming? (Q 10)

Observations	Mean	Median	Std. Dev.	Min	Max
244	57.91	65.5	34.27	0	100

Percentage of crops that you produced used as inputs? (Q 11)

Observations	Mean	Median	Std. Dev.	Min	Max
235	14.70	0	29.35	0	100

Summary for those who use at least some crops as inputs

Observations	Mean	Median	Std. Dev.	Min	Max
83	38.01	25	35.93	0.5	100

Groundwater Use and Management

How many high capacity wells did you use for irrigation in 2015? (Q 12)

Observations	Mean	Median	Std. Dev.	Min	Max
241	4.98	3	7.10	0	53

High Capacity Wells for Irrigation Postive Summary

Observations	Mean	Median	Std. Dev.	Min	Max
222	5.28	3	7.29	1	53

How many high capacity wells are permitted to your enterprise? (Q 13)

Observations	Mean	Median	Std. Dev.	Min	Max
243	4.71	3	7.11	0	58

High Capacity Wells Permitted Positive Summary

Observations	Mean	Median	Std. Dev.	Min	Max
227	4.92	3	7.29	1	58

Categories of high capacity wells (Q 14):

	Responses	Percentage
Less than 200 GPM	44	3%
200 and 300 GPM	61	5%
300 and 400 GPM	137	10%
400 and 600 GPM	212	16%
600 and 800 GPM	352	26%
800 and 1000 GPM	306	23%
1000 and 1200 GPM	142	11%
More than 1200 GPM	86	6%
Number of wells	1340	

How has pumping capacity of the wells you operate changed over the last 20 years? (Q 15)

	Responses	Percentage
Decreased more than 300 GPM	21	9%
Decreased by 100-300 GPM	81	34%
Decreased less than 100 GPM	43	18%
Remained Stable	68	28%
Increased	2	1%
Unsure	26	11%
Observations	241	

How has pumping capacity of the wells you operate changed over the last 20 years? (Q 15)

	200-600 GPM		600-800 GPM		800+ GPM	
Decreased more than 300 GPM	12	14%	4	6%	5	6%
Decreased by 100-300 GPM	42	48%	20	31%	17	22%
Decreased less than 100 GPM	10	11%	13	20%	20	25%
Remained Stable	12	14%	18	28%	35	44%
Increased	1	1%	0	0%	1	1%
Unsure	11	13%	10	15%	1	1%
Observations	88		65		79	

How has depth to groundwater changed over the last 20 years? (Q 16)

	Responses	Percentage
Increased more than 20%	18	8%
Increased 10-20%	58	23%
Increased less than 10%	23	8%
Remained Stable	38	14%
Decreased	63	28%
Unsure	46	19%
Observations	246	

Rank the factors that you believe are most responsible for the declines in capacity that you have experienced - 1 is most important and 4 is least important (Q 17)

	Mean	Frequency indicated as most important
My own groundwater use	1.90	58
Groundwater use by neighbors in CO	1.73	69
Groundwater use in other states	2.50	37
Natural change	2.21	63
Observations	193	

How have you changed production practices in response to declines in well capacity? (Q 18)

	Responses	Percentage
Follow a portion of the land previously irrigated	19	9%
Change crop mix to crops requiring less water	87	39%
Plant dryland crops on a portion of the land previously irrigated	40	18%
Apply less water per acre of land planted in a given crop	88	39%
Utilize new technologies to improve efficiency of water use	156	70%
No declines have been experienced	44	20%
Other	30	13%
Answers Recorded	464	
Observations	223	

What is the maximum amount you would be willing to pay for a technology that could maintain the pumping capacity of all the wells you operate indefinitely (Q 19)

	Responses	Percentage
\$0	37	18%
\$500	13	6%
\$1,000	21	10%
\$5,000	46	22%
\$20,000	39	19%
\$50,000	21	10%
\$100,000	12	6%
More than \$100,000	21	10%
Observations	210	

WTP for new technology per well (\$150,000 was used for those who indicated more than \$100,000) (Q 19)

Mean	Median	Std. Dev.	Min	Max
\$9,032	\$1,667	18,350	0	150,000

If you were to experience a decline of an additional 25%, in the quantity of water that you could apply to your crops in a given year, how would you change your production practices? (Q 20)

	Responses	Percentage
Fallow a portion of the land previously irrigated	46	21%
Change crop mix to crops requiring less water	135	61%
Plant dryland crops on a portion of the land previously irrigated	73	33%
Apply less water per acre of land planted in a given crop	122	55%
Utilize new technologies to improve efficiency	147	66%
I don't know	37	17%
Other	34	15%
Answers Recorded	594	
Observations	223	

If electricity prices increase by 50%, how would this impact your operation? (Q 21)

	Responses	Percentage
Fallow a portion of the land previously irrigated	25	10%
Change crop mix to crops requiring less water	95	40%
Plant dryland crops on portion of the land previously irrigated	46	19%
Apply less water per acre of land planted in a given crop	97	41%
Utilize new technologies to improve efficiency	108	45%
It would not change my operational decisions	32	13%
I don't know	43	18%
Other	47	20%
Answers Recorded	493	
Observations	239	

Which irrigation management components do you currently use on your farm? (Q 22)

	Responses	Percentage
Remote well management	25	10%
Variable rate irrigation	95	40%
Advice from crop consultant	28	12%
Drop nozzles	201	84%
End gun removal	149	62%
LEPA	51	21%
Soil moisture sensors	78	33%
None of these are used	10	4%
Other	10	4%
Answers Recorded	647	
Observations	239	

How often do you irrigate the fields that you manage prior to planting crops? (Q 23)

	Responses	Percentage
Every Year	19	8%
Most Years	24	10%
Some Years	73	31%
Never	117	50%
Observations	233	

On what pct. of your irrigated land do you think dryland farming would be profitable? (Q 24)

	Responses	Percentage
0-20%	97	43%
20-40%	44	19%
40-60%	22	10%
60-80%	18	8%
80-100%	35	15%
Did not farm irrigated land	10	4%
Observations	226	

Did you participate in groundwater governance with GWMD, RRWCD, or state in last 5 years? (Q 25)

	Responses	Percentage
Yes	108	45%
No	133	55%
Observations	241	

In the future, how would you prefer to receive information from your GWMD? (Q 26)

	Responses	Percentage
Postal Mail	153	62%
E-mail	81	33%
Social Media	5	2%
GWMD Website	9	4%
Webinars	3	1%
Public Meetings	36	15%
Answers Recorded	287	
Observations	245	

Groundwater Management in the Basin

Level of concern about long-term availability of groundwater for irrigation? (Q 27)

	Responses	Percentage
Very Concerned	155	62%
Moderately Concerned	66	27%
Slightly Concerned	21	8%
Not Concerned	7	3%
Observations	249	

If you indicated some concern related to long-term groundwater availability in the previous question, check the two most important reasons (Q 28)

	Responses	Percentage
Future profitability of my operation	170	68%
The amount of water available for future generations	189	76%
The future viability of the community I live in	121	48%
The effect on the natural world	9	4%
Not concerned	2	1%
Answers Recorded	491	
Observations	250	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater? (Q 29)

	Responses	Percentage
Very supportive	80	33%
Somewhat supportive	127	53%
Somewhat opposed	23	10%
Very opposed	10	4%
Observations	240	

What is your opinion about your GWMD working to coordinate the conservation strategies they pursue with other GWMDs in the Basin? (Q 30)

	Responses	Percentage
Very supportive	72	30%
Somewhat supportive	135	56%
Somewhat opposed	27	11%
Very opposed	9	4%
Observations	243	

Would you be willing to give up some economic returns in order to increase the amount of groundwater available to you and other producers in your GWMD in the future? (Q 31)

	Responses	Percentage
Definitely yes	18	7%
Probably yes	71	29%
Not sure	95	39%
Probably no	41	17%
Definitely no	19	8%
Observations	244	

Specific Policy (Q 32)	Most preferred:		Least preferred:		Support policy over current situation:	
	Responses	Percentage	Responses	Percentage	Responses	Percentage
Irrigated acreage fee \$270/acre	10	5%	42	20%	17	8%
Irrigated acreage fee \$340/acre	8	4%	126	59%	14	7%
Pumping fee \$72/acre foot	66	31%	25	12%	56	26%
Pumping fee \$168/acre foot	16	7%	37	17%	35	16%
Quantity limit 240 AF/well	63	29%	30	14%	73	34%
Quantity limit 190 AF/well	30	14%	41	19%	50	23%
Blank	57	27%	48	22%	95	44%
Recorded Answers	250		349		340	
Observations	215		215		215	

*Some individuals indicated more than one policy for both their most and least preferred policy, thus, the number of observations is higher than the actual number of individuals who answered this question.

Percent of respondents who support at least one policy: 56%

Please indicate the reasons you selected your most preferred policy (check all that apply) (Q 33)

	Responses	Percentage
The policy is likely to have the smallest impact on my own groundwater use	60	36%
The policy is likely to have the greatest potential to reduce groundwater use	55	33%
The policy is the most likely to be found acceptable by others in my GWMD	67	40%
The policy seems to be the fairest way to reduce water use	97	58%
Answers Recorded	279	
Observations	166	

Please indicate the reasons you selected your least preferred policy (check all that apply) (Q 34)

	Responses	Percentage
The policy is likely to have the largest impact on my own groundwater use	52	34%
The policy is likely to have the lowest potential to reduce groundwater use	36	24%
The policy is the least likely to be found acceptable by others in my GWMD	82	54%
The policy seems to be the least fair way to reduce water use	59	39%
Answers Recorded	381	
Observations	153	

Further analysis of specific questions - This section evaluates how specific segments of the survey sample and individual GWMDs replied to questions related to concern for future groundwater availability, support for GWMDs engaging in groundwater conservation efforts, and support for specific policies.

Responses for Basin vs. Non-Basin Residence

Non-Basin Responses	43
Basin Responses	209

Would support at least one of the policies:

	Responses	Percentage
Non-Basin Responses	14	52%
Basin Responses	97	57%

Indicated they are very concerned about long-term availability of groundwater:

	Responses	Percentage
Non-Basin Responses	21	75%
Basin Responses	119	61%

Indicated they are very supportive of GWMD's working to develop conservation strategies:

	Responses	Percentage
Non-Basin Responses	13	41%
Basin Responses	59	31%

Responses by Well Capacity

200-600 GPM Number of Responses	89
600-800 GPM Number of Responses	70
800+ GPM Number of Responses	79

Would support at least one of the policies:

	Responses	Percentage
200-600 GPM	46	68%
600-800 GPM	41	65%
800+ GPM	29	40%

Indicated they are very concerned about long-term availability of groundwater:

	Responses	Percentage
200-600 GPM	59	67%
600-800 GPM	43	62%
800+ GPM	44	56%

Indicated they are very supportive of GWMD's working to develop conservation strategies:

	Responses	Percentage
200-600 GPM	21	24%
600-800 GPM	26	38%
800+ GPM	21	28%

Responses by Ownership Type

Number of Respondents renting land FROM others (Rent From):	82
Rent land FROM others and do not own their own land (Non-owners):	13
Number of Respondents renting land TO others (Rent to):	104
Rent land TO others and do not farm themselves (Non-Farmers):	64

Would support at least one of the policies:

	Responses	Percentage
Rent From:	44	58%
Non-Owners:	7	58%
Rent To:	44	57%
Non-Farmers:	22	69%

Indicated they are very concerned about long-term availability of groundwater:

	Responses	Percentage
Rent From:	51	63%
Non-Owners:	8	62%
Rent To:	59	63%
Non-Farmers:	37	69%

Indicated they are very supportive of GWMD's working to develop conservation strategies:

	Responses	Percentage
Rent From:	25	32%
Non-Owners:	3	23%
Rent To:	34	37%
Non-Farmers:	23	44%

Central Yuma

I most prefer this strategy:					Support policy over	
	<u>Most preferred:</u>		<u>Least preferred:</u>		current situation:	
Irrigated acreage fee \$270/acre	4	12%	8	24%	4	12%
Irrigated acreage fee \$340/acre	0	0%	16	47%	2	6%
Pumping fee \$72/acre foot	15	44%	4	12%	11	32%
Pumping fee \$168/acre foot	1	3%	6	18%	3	9%
Quantity limit 240 AF/well	8	24%	6	18%	6	18%
Quantity limit 190 AF/well	1	3%	8	24%	6	18%
Blank	4	12%	4	12%	11	32%
Recorded Answers	33		52		43	
Observations	34		34		34	

Support at least one of the proposed policies:

Number of people: 19

Percentage: 56%

Describe your level of concern related to the long-term availability of groundwater for irrigation?

	Responses	Percentage
Very Concerned	20	65%
Moderately Concerned	9	29%
Slightly Concerned	2	6%
Not Concerned	0	0%
Observations	31	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater?

	Responses	Percentage
Very supportive	13	42%
Somewhat supportive	15	48%
Somewhat opposed	3	10%
Very opposed	0	0%
Observations	31	

Marks Butte

I most prefer this strategy:	<u>Most preferred:</u>		<u>Least preferred:</u>		Support policy over current situation:	
Irrigated acreage fee \$270/acre	0	0%	1	11%	1	11%
Irrigated acreage fee \$340/acre	0	0%	9	100%	1	11%
Pumping fee \$72/acre foot	5	56%	1	11%	3	33%
Pumping fee \$168/acre foot	0	0%	1	11%	4	44%
Quantity limit 240 AF/well	3	33%	1	11%	5	56%
Quantity limit 190 AF/well	1	11%	2	22%	2	22%
Blank	0	0%	0	0%	3	33%
Recorded Answers	9		15		19	
Observations	9		9		9	

Support at least one of the proposed policies:

Number of people: 6

Percentage: 67%

Describe your level of concern related to the long-term availability of groundwater for irrigation?

	Responses	Percentage
Very Concerned	5	45%
Moderately Concerned	4	36%
Slightly Concerned	1	9%
Not Concerned	1	9%
Observations	11	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater?

	Responses	Percentage
Very supportive	3	30%
Somewhat supportive	7	70%
Somewhat opposed	0	0%
Very opposed	0	0%
Observations	10	

Frenchman

I most prefer this strategy:	<u>Most preferred:</u>		<u>Least preferred:</u>		Support policy over current situation:	
	Count	Percentage	Count	Percentage	Count	Percentage
Irrigated acreage fee \$270/acre	3	12%	5	19%	2	8%
Irrigated acreage fee \$340/acre	0	0%	19	73%	1	4%
Pumping fee \$72/acre foot	10	38%	4	15%	10	38%
Pumping fee \$168/acre foot	4	15%	7	27%	3	12%
Quantity limit 240 AF/well	7	27%	5	19%	7	27%
Quantity limit 190 AF/well	3	12%	9	35%	4	15%
Blank	4	15%	1	4%	11	42%
Recorded Answers	31		50		38	
Observations	26		26		26	

Support at least one of the proposed policies:

Number of people: 15

Percentage: 58%

Describe your level of concern related to the long-term availability of groundwater for irrigation?

	Responses	Percentage
Very Concerned	19	56%
Moderately Concerned	10	29%
Slightly Concerned	3	9%
Not Concerned	2	6%
Observations	34	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater?

	Responses	Percentage
Very supportive	13	39%
Somewhat supportive	15	45%
Somewhat opposed	4	12%
Very opposed	1	3%
Observations	33	

W-Y

I most prefer this strategy:	<u>Most preferred:</u>		<u>Least preferred:</u>		Support policy over current situation:	
Irrigated acreage fee \$270/acre	2	6%	7	22%	3	9%
Irrigated acreage fee \$340/acre	3	9%	17	53%	3	9%
Pumping fee \$72/acre foot	6	19%	6	19%	3	9%
Pumping fee \$168/acre foot	1	3%	7	22%	1	3%
Quantity limit 240 AF/well	4	13%	7	22%	6	19%
Quantity limit 190 AF/well	6	19%	11	34%	4	13%
Blank	9	28%	5	16%	20	63%
Recorded Answers	31		60		40	
Observations	32		32		32	

Support at least one of the proposed policies:

Number of people: 12

Percentage: 38%

Describe your level of concern related to the long-term availability of groundwater for irrigation?

	Responses	Percentage
Very Concerned	20	61%
Moderately Concerned	11	33%
Slightly Concerned	2	6%
Not Concerned	0	0%
Observations	33	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater?

	Responses	Percentage
Very supportive	13	39%
Somewhat supportive	17	52%
Somewhat opposed	2	6%
Very opposed	1	3%
Observations	33	

Sand Hills

I most prefer this strategy:	<u>Most preferred:</u>		<u>Least preferred:</u>		Support policy over current situation:	
Irrigated acreage fee \$270/acre	0	0%	4	19%	1	5%
Irrigated acreage fee \$340/acre	0	0%	12	57%	1	5%
Pumping fee \$72/acre foot	8	38%	2	10%	1	5%
Pumping fee \$168/acre foot	1	5%	2	10%	2	10%
Quantity limit 240 AF/well	7	33%	3	14%	4	19%
Quantity limit 190 AF/well	0	0%	8	38%	0	0%
Blank	5	24%	5	24%	15	71%
Recorded Answers	21		36		24	
Observations	21		21		21	

Support at least one of the proposed policies:

Number of people: 6

Percentage: 29%

Describe your level of concern related to the long-term availability of groundwater for irrigation?

	Responses	Percentage
Very Concerned	16	64%
Moderately Concerned	4	16%
Slightly Concerned	2	8%
Not Concerned	3	12%
Observations	25	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater?

	Responses	Percentage
Very supportive	7	30%
Somewhat supportive	14	61%
Somewhat opposed	2	9%
Very opposed	0	0%
Observations	23	

Arikaree

I most prefer this strategy:	<u>Most preferred:</u>		<u>Least preferred:</u>		Support policy over current situation:	
Irrigated acreage fee \$270/acre	2	5%	11	28%	3	8%
Irrigated acreage fee \$340/acre	2	5%	23	58%	2	5%
Pumping fee \$72/acre foot	8	20%	4	10%	5	13%
Pumping fee \$168/acre foot	3	8%	9	23%	8	20%
Quantity limit 240 AF/well	14	35%	5	13%	14	35%
Quantity limit 190 AF/well	8	20%	7	18%	11	28%
Blank	9	23%	8	20%	17	43%
Recorded Answers	46		67		60	
Observations	40		40		40	

Support at least one of the proposed policies:

Number of people: 23

Percentage: 58%

Describe your level of concern related to the long-term availability of groundwater for irrigation?

	Responses	Percentage
Very Concerned	31	67%
Moderately Concerned	11	24%
Slightly Concerned	4	9%
Not Concerned	0	0%
Observations	46	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater?

	Responses	Percentage
Very supportive	14	30%
Somewhat supportive	25	54%
Somewhat opposed	5	11%
Very opposed	2	4%
Observations	46	

Plains

I most prefer this strategy:	<u>Most</u> preferred:		<u>Least</u> preferred:		Support policy over current situation:	
Irrigated acreage fee \$270/acre	0	0%	12	30%	3	8%
Irrigated acreage fee \$340/acre	3	8%	27	68%	3	8%
Pumping fee \$72/acre foot	8	20%	6	15%	16	40%
Pumping fee \$168/acre foot	5	13%	8	20%	11	28%
Quantity limit 240 AF/well	16	40%	3	8%	26	65%
Quantity limit 190 AF/well	9	23%	4	10%	21	53%
Blank	3	8%	5	13%	6	15%
Recorded Answers	44		65		86	
Observations	40		40		40	

Support at least one of the proposed policies:

Number of people: 34

Percentage: 85%

Describe your level of concern related to the long-term availability of groundwater for irrigation?

	Responses	Percentage
Very Concerned	36	64%
Moderately Concerned	13	23%
Slightly Concerned	6	11%
Not Concerned	1	2%
Observations	56	

What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater?

	Responses	Percentage
Very supportive	13	25%
Somewhat supportive	26	50%
Somewhat opposed	7	13%
Very opposed	6	12%
Observations	52	

4. How many irrigated acres did you rent or lease **FROM** someone else in 2015? _____ acres
5. How many irrigated acres did you rent or lease **TO** someone else in 2015? _____ acres
6. In which Colorado county is the majority of the irrigated acreage that you own located? _____
7. In which groundwater management district is the majority of the irrigated acreage that you own located?

8. Do you own irrigated acreage in multiple groundwater management districts?
 Yes No
9. In what county do you currently reside? _____
10. In 2015, what *percentage* of your annual gross farm and ranch sales came from irrigated farming?
_____%
11. In 2015, what *percentage* of the crops that you produced was used as inputs (ex., feed) in other parts of your operation?
_____%

SECTION 2: Your Groundwater Use and Management

In this section we seek to gain a better understanding of how you utilize and manage groundwater on your operation.

12. How many high capacity (>50 gallons per minute) groundwater wells did you use for irrigation in 2015?
 _____ wells
13. How many high capacity (>50 gallons per minute) groundwater wells are permitted to your enterprise?
 _____ wells
14. How many of the wells that you currently operate fall into the following well capacity categories, measured in gallons per minute (GPM)? (List the number of wells that fall in each of the following ranges)
- | | | | |
|-------------------------|-------|---------------------------|-------|
| Less than 200 GPM | _____ | Between 600 and 800 GPM | _____ |
| Between 200 and 300 GPM | _____ | Between 800 and 1000 GPM | _____ |
| Between 300 and 400 GPM | _____ | Between 1000 and 1200 GPM | _____ |
| Between 400 and 600 GPM | _____ | More than 1200 GPM | _____ |
15. On average, how has the pumping capacity of the groundwater wells that you operate changed over the last 20 years? (please check one)
- | | | |
|--|---|--|
| <input type="checkbox"/> Decreased more than 300 GPM | <input type="checkbox"/> Decreased by 100 – 300 GPM | <input type="checkbox"/> Decreased less than 100 GPM |
| <input type="checkbox"/> Remained Stable | <input type="checkbox"/> Increased | <input type="checkbox"/> Unsure |
16. On average, how has the depth to groundwater at the wells that you operate changed over the last 20 years? (please check one)
- | | | |
|--|--|--|
| <input type="checkbox"/> Increased more than 20% | <input type="checkbox"/> Increased by 10 - 20% | <input type="checkbox"/> Increased less than 10% |
| <input type="checkbox"/> Remained stable | <input type="checkbox"/> Decreased | <input type="checkbox"/> Unsure |

17. If you have experienced declines in well capacity over the last 20 years, please rank the factors that you believe are most responsible for the declines that you have experienced (1 indicates the factor that is most responsible)?

- My own groundwater use
 No changes experienced
 Groundwater use by neighbors in CO
 Groundwater use in other states
 Natural changes (ex. changes in precip.)
 Other: (please explain) _____

18. If you have experienced declines in well capacity over the last 20 years, how have you changed your production practices in response? (please check all that apply)

- Follow a portion of the land previously irrigated
 Change crop mix to crops requiring less water
 Plant dryland crops on a portion of the land previously irrigated
 Apply less water per acre of land planted in a given crop
 Utilize new technologies to improve efficiency of water use
 No declines have been experienced
 Other: (please explain) _____

19. Suppose that researchers develop a technology that could maintain the pumping capacity of all the wells that you operate indefinitely. What is the maximum one-time amount you would pay to obtain this technology for all of your wells? (please check one)

- \$0
 \$500
 \$1,000
 \$5,000
 \$20,000
 \$50,000
 \$100,000
 More than \$100,000

20. If you were to experience a decline of an additional 25% in the quantity of water that you could apply to your crops in a given year, how would you change your production practices? (please check all that apply)

- Follow a portion of the land previously irrigated
 Change crop mix to crops requiring less water
 Plant dryland crops on a portion of the land previously irrigated
 Apply less water per acre of land planted in a given crop
 Utilize new technologies to improve efficiency
 I don't know
 Other: (please explain) _____

21. Suppose that electricity prices were to increase by 50% compared to the prices that you faced in 2015 but the price of commodities that you raise and other input prices stay the same as in 2015. How would this increase in electricity prices impact your operation? (please check all that apply)

- Fallow a portion of the land previously irrigated
- Change crop mix to crops requiring less water
- Plant dryland crops on a portion of the land previously irrigated
- Apply less water per acre of land planted in a given crop
- Utilize new technologies to improve efficiency
- It would not change my operational decisions
- I don't know
- Other: (please explain) _____

22. Which of the following irrigation management components do you currently use on your farm? (please check all that apply)

- Remote well management
- Variable rate irrigation
- Advice from crop/irrigation consultant
- Drop Nozzles
- End gun removal
- LEPA (Low-energy precise application)
- Soil moisture sensors
- Other _____
- None of these are used

23. How often do you irrigate the fields that you manage prior to planting crops? (please check one)

- Every year
- Most years
- Some years
- Never

24. Of the land that you irrigated in 2015, on approximately what percentage do you think dryland farming would be profitable? (please check one)

- 0 - 20%
- 20 - 40%
- 40 - 60%
- 60 - 80%
- 80 - 100%
- Did not farm irrigated land

25. Have you actively participated in groundwater governance in your groundwater management district, the Republican River Water Conservation District, or the State in the last five years? (please check one)

- Yes
- No

26. In the future, how would you most prefer to receive information related to groundwater governance from your groundwater management district? (please check one)

- Postal mail
- E-mail
- Social media
- GWMD Website
- Webinars
- Public meetings

SECTION 3: Groundwater Management in the Basin

In this section, we seek a better understanding of your thoughts on the role of groundwater management.

27. How would you describe your level of concern related to the long-term availability of groundwater for irrigation in your area? (please check one)
- Very concerned Moderately concerned Slightly concerned Not concerned
28. If you indicated some concern related to long-term groundwater availability in the previous question, check the two most important reasons for your concern.
- Concerned about the future profitability of my operation. Concerned about the amount of water available for future generations. Concerned about the future viability of the community I live in. Concerned about the effect on the natural world. Not concerned
29. What is your opinion about your groundwater management district working to develop and promote strategies and practices that seek to conserve groundwater? (please check one)
- Very supportive Somewhat supportive Somewhat opposed Very opposed
30. What is your opinion about your groundwater management district working to coordinate the conservation strategies they pursue with other groundwater management districts in the Republican River Water Conservation District? (please check one)
- Very supportive Somewhat supportive Somewhat opposed Very opposed
31. Would you be willing to give up some economic returns for your operation in order to increase the amount of groundwater available to you and other producers in your GWMD in the future? (please check one)
- Definitely yes Probably yes Not sure Probably no Definitely no

Questions 32-35 seek your opinions related to several policies that could be implemented to reduce groundwater use. Below is a description of each of the policies. The list of options includes the levels of each policy that are predicted to achieve 10% and 25% reductions in groundwater use across the Basin. The first two columns with check boxes on the following page ask you to indicate the policies that you would most and least prefer to see implemented in the Basin. The third column, asks you to indicate all of the policies that you would be willing to support relative to not implementing any new policy. In other words, in the last column you should check the box next to each policy that you would prefer to have in place over the current situation where the policy is not used.

Irrigated acreage fee – With this policy, producers in the Republican River Basin of Colorado would pay a fee for each acre of irrigated land they operate above a specific threshold acreage per well. Producers who irrigate less than the threshold acreage would be paid an amount equal to the fee times the number of acres they plant below the threshold. The acreage threshold would be chosen in each GWMD so that the fees paid by producers who operate above the threshold would be approximately equal to the payments received by producers who operate below the threshold under average conditions.

Pumping fee – With this policy, producers in the Republican River Basin of Colorado would pay a fee for every acre-foot of groundwater that they pump above a specific threshold amount of water per well. Producers that use less groundwater than the threshold would be paid an amount equal to the fee times the number of acre-feet that they use below the threshold. The pumping threshold would be chosen in each GWMD so that the fees paid by producers who use more water than the threshold would be approximately equal to the payments received by producers who use less than the threshold under average conditions.

Quantity restriction – This policy would place an upper limit or cap on the amount of groundwater that can be pumped from each well in the Republican River Basin of Colorado over the course of a year.

Thresholds – The fee-based policies described above (pumping fee and irrigated acreage fee) are implemented with GWMD-specific thresholds. For the pumping fee, the average threshold for the basin is predicted to be 188 acre-feet per well. For the irrigated acreage fee, the average threshold for the basin is predicted to be 97 acres per well. Examples of each of these policies is provided below.

Irrigated acreage fee examples with fee of \$300 per acre and a threshold of 97 acres per well

Example 1: If a producer plants 110 irrigated acres for one well, he/she would **pay:**
 $\$300 \times (110 - 97) = \$3,900$

Example 2: If a producer plants 85 irrigated acres for one well, he/she would **receive:**
 $\$300 \times (97 - 85) = \$3,600$

Pumping fee examples with fee of \$100 per acre-foot and a threshold of 188 acre-feet per well

Example 3: If a producer pumps 220 acre-feet from a well, he/she would **pay:**
 $\$100 \times (220 - 188) = \$3,200$

Example 4: If a producer pumps 150 acre-feet from a well, he/she would **receive:**
 $\$100 \times (188 - 150) = \$3,800$

32. Please provide us your opinion of the following potential groundwater management strategies in the Basin:

Policy Type	Policy Level	Change in expected year 1 Basin-wide groundwater use	I <u>most</u> prefer this strategy (check one box in this column)	I <u>least</u> prefer this strategy (check one box in this column)	I would support this strategy over the current situation (check all that apply)
Irrigated acreage fee	\$270 /acre	-10%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Irrigated acreage fee	\$340 / acre	-25%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pumping fee	\$72 / acre foot	-10%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pumping fee	\$168 / acre foot	-25%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quantity restriction	240 acre feet per well	-10%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quantity restriction	190 acre feet per well	-25%	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

33. Please indicate the reason(s) you selected your most preferred policy. (check all that apply)

- The policy is likely to have the smallest impact on my own groundwater use
- The policy is likely to have the greatest potential to reduce overall groundwater use
- The policy is the most likely to be found acceptable by others in my GWMD
- The policy seems to be the fairest way to reduce water use
- Other _____

34. Please indicate the reason(s) you selected your least preferred policy. (check all that apply)

- The policy is likely to have the biggest impact on my own groundwater use
- The policy is likely to have the lowest potential to reduce overall groundwater use
- The policy is the least likely to be found acceptable by others in my GWMD
- The policy seems to be the least fair way to reduce water use
- Other _____

35. Describe other policies that you think your GWMD should consider.

SECTION 4: Demographic Information

In this section, we are interested in learning more about you and your operation. This information will help us to better understand how the characteristics of groundwater users vary across the Basin.

36. What is your gender?
 Male Female
37. What is the highest level of education that you have completed?
 Some years of high school Some college Bachelor's degree
 High school Associate's degree Graduate degree
38. In what year were you born? _____
39. Including your generation, for how many generations has your family been in farming in the Basin?
_____ years
40. Do you expect your kids or other family members to continue farming after you have retired?
 Yes No Not Applicable
41. Please check the range that best represents your average annual adjusted gross income over the last 10 years.
 Less than \$30,000 \$50,001-\$100,000 \$150,001-\$200,000
 \$30,001 - \$50,000 \$100,001-\$150,000 More than \$200,000
42. Do you or anyone else in your household have another job off the farm?
 Yes No
43. Do you currently have natural gas wells on land that you own?
 Yes No
44. Do you currently have wind turbines on land that you own?
 Yes No
45. What percent of your total household income comes from farming? _____%
-



Thank you very much for taking the time to complete this survey. Feel free to use the space below to share with us any additional comments you may have. Again, all information you have provided will be treated confidentially.