Upper Rio Chama Water Master Report
Irrigation Season 2020

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I. Introduction

The Upper Rio Chama Basin (upper basin) encompasses the area north of Abiquiu Dam and south of the Colorado state line, in Rio Arriba County in north-central New Mexico. The United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) estimates approximately 30,000 acres of crop and pasture land in the upper basin with about 7,000 acres laying fallow based on 2018 aerial analysis. NASS identified the primary crops in the upper basin as grassland pasture and hay. This was confirmed through 2020 field observations. The most common hay crop in the upper basin is Timothy grass with a few fields growing alfalfa.

The New Mexico Office of the State Engineer (OSE) oversees curtailment operations in the upper basin. Curtailment occurs on approximately 9,000 acres of irrigated land located along the Rio Chama, Rio Brazos, Canones Creek, and Tierra Amarilla Creek. Curtailment operations currently do not occur in the Rio Nutrias, Rio Cebolla, and Canjilon Creek basins, all of which have irrigated acreage within the upper basin. Curtailment of upper basin water use is required to satisfy the senior native Rio Chama water rights in the Lower Rio Chama basin below Abiquiu Dam.

NASS published the "New Mexico Agricultural Statistics 2016 Annual Bulletin," which includes economic information on Rio Arriba County. The 2012 census data valued Rio Arriba's agricultural production at $18,979,000. The average farm earned only $10,000. In 2017, Rio Arriba had 27,500 cows and 3,400 sheep. Approximately 91% of Rio Arriba agricultural cash receipts in 2016 were from livestock sales. The upper basin is a significant contributor to Rio Arriba's ranching economy. Drought conditions and curtailment operations in the upper basin impact county agricultural production.

The 2020 irrigation season was a difficult year in the upper basin. Despite above average snow supply in the early winter, early spring conditions resulted in a premature and short-lived spring snowmelt. Summer baseflows and precipitation were below average. Crop demand across New Mexico was above average due to low soil moisture and high temperatures. These conditions were created by drought that is likely to continue into 2021, negatively impacting the farmers and ranchers in the upper basin. Despite these difficulties, the upper basin curtailed as required and maintained flows at the United States Geological Survey's (USGS) Rio Chama Near La Puente Gage 08284100 (USGS La Puente) for use by the senior Lower Rio Chama acequias. Without the cooperative and collective effort by upper basin irrigators, mayordomos, and OSE staff, the flow in the mainstem of the Rio Chama would have dropped to unusable levels for the lower basin users.

This Water Master Report is in accordance with requirements established in 19.25.13.26 New Mexico Administrative Code (NMAC) and Section 72-3-5 of the New Mexico Statutes Annotated (NMSA):

> *Annually, the water master shall submit a report including a record of total diversions and deliveries of direct flow water and storage water, as applicable, a statement of expenditures, a list of infrastructure and metering improvements needed or performed, problems*

encountered, and any other pertinent issues or aspects of administration. The report shall also address the amount of water needed to supply the water master district, the amount available, the works which are without their proper supply, the supply required during the period preceding the water master's next regular report and such other information as the state engineer may require. The report shall be submitted to the state engineer and be publicly available for inspection and copying at the requestor's expense. [19.25.13.26 NMAC – N, 12/30/2004]

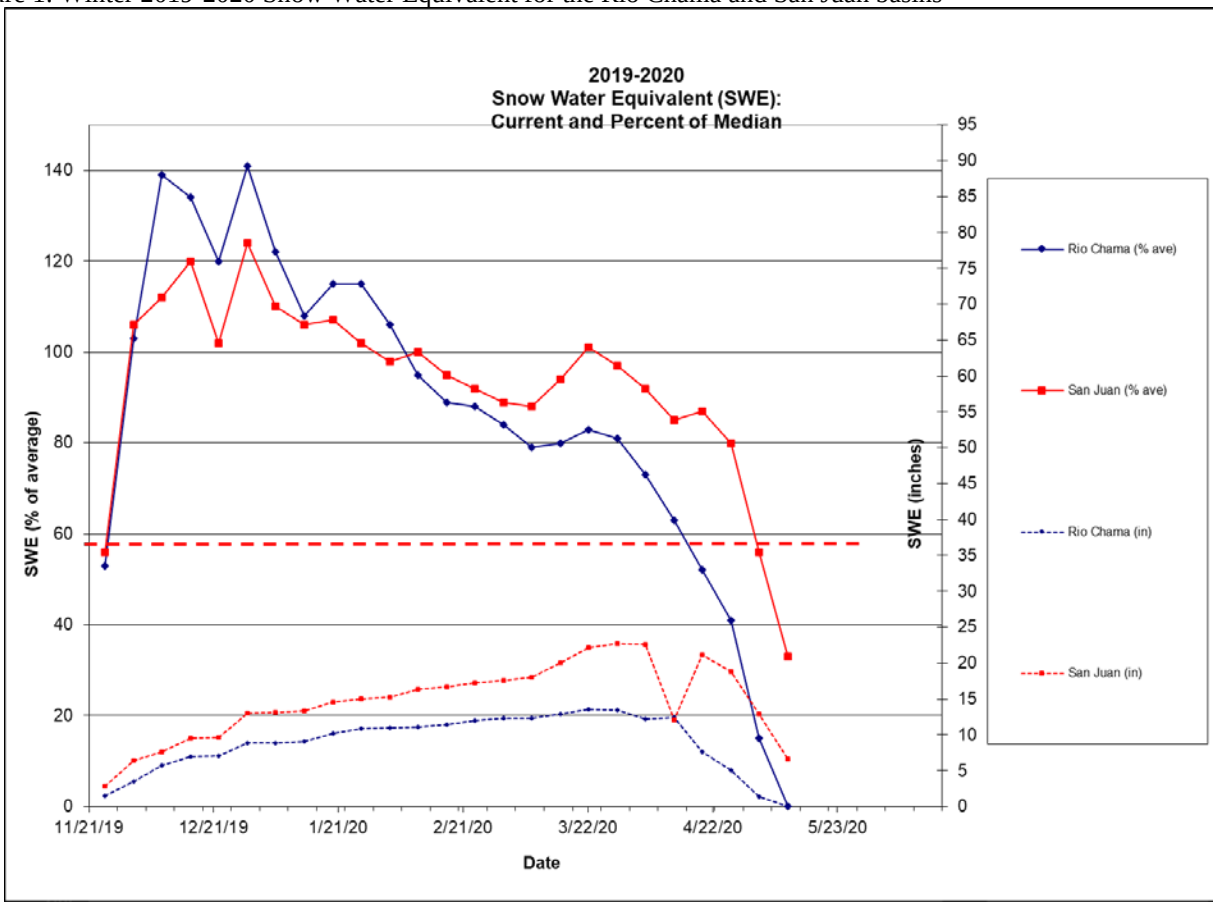
Each water master shall report to the state engineer, as often as may be deemed necessary by the engineer as to the amount of water needed to supply the requirements of his districts, the amount available, the works which are without their proper supply, the supply required during the period preceding his next regular report and such other information as the engineer may require. These reports shall, at the end of each irrigation season, be filed in the office of the state engineer. The state engineer shall give directions for correcting any errors of apportionments that may be shown by such reports. [NM Stat § 72-3-5 (1996 through 1st Sess 50th Legis)]

II. Winter 2019-2020 Snow Water Equivalent

The snow supply was above average for both the Chama and San Juan basins in the early winter of 2019, but the lack of significant spring snows combined with above average temperatures resulted in below average snow water equivalent (SWE) for the Rio Chama 2020 runoff.[1] By April, most federal agencies were changing their 2020 forecasts to show below average river conditions. What had looked like an average year quickly became dire as the below average spring snowmelt came early. Winter 2019-2020 SWE for the Rio Chama and San Juan Basins are shown in Figure 1.

[1] See Appendix A for more information on Snow Water Equivalent data sources.

Figure 1: Winter 2019-2020 Snow Water Equivalent for the Rio Chama and San Juan basins

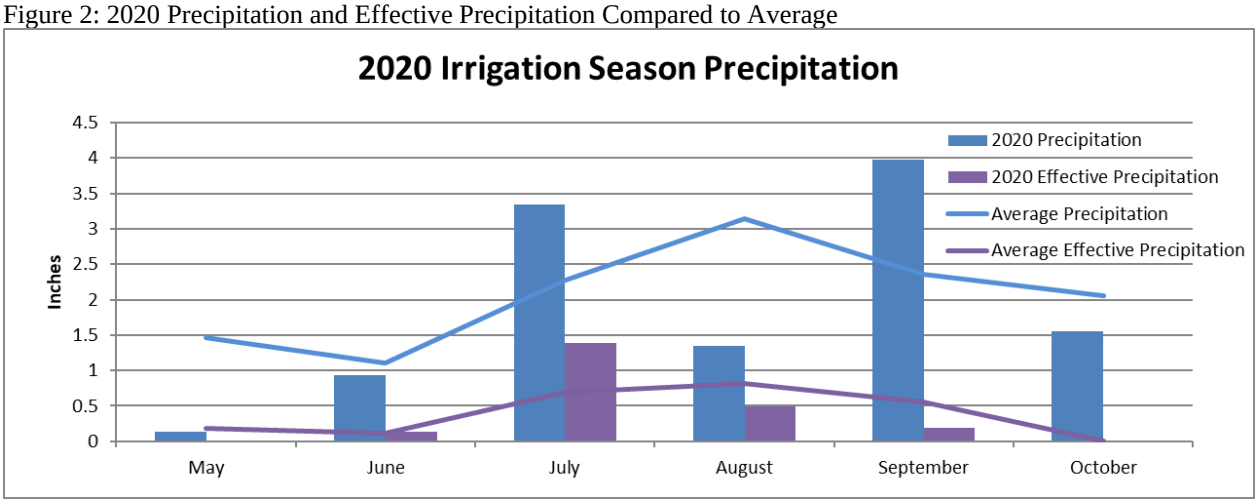


III. Precipitation and Growing Season

Spring precipitation was below average for May and June. The Chama, NM US station GHCND:US00291664 (weather station) reported no precipitation in April[2]. Precipitation, effective precipitation, average precipitation, and average effective precipitation, during irrigation season, for the weather station are shown in Figure 2. Average daily temperature and frost days as measured at the weather station are plotted with the average daily temperature required for sustained alfalfa growth for April in Figure 3. Dry spring weather conditions created dry early season soils which required extensive early irrigation to build up soil moisture. July precipitation was above average and came near the end of July. This was a fortunate event since irrigation ceased on July 15th due to curtailment operations and few fields had been cut. These rain events allowed for more growth prior to cutting. Below average precipitation in August, combined with the irrigation curtailment resulted in poor grazing conditions and greatly reduced growth after cutting. September had above average precipitation but below average effective precipitation. This was from a snow event on September 9th. This event also caused an early fall frost which limited the ability for fields to benefit from the increased soil moisture. Finally, October had below average precipitation with most events coming as snow. Growth opportunity was extremely limited in October.

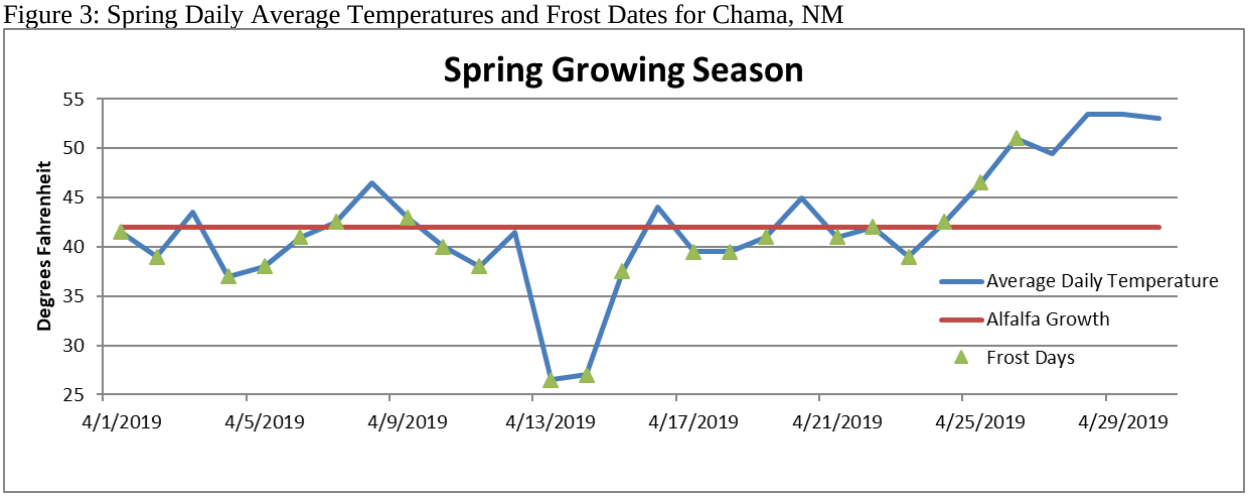
[2] See Appendix C fir more information regarding temperature and precipitation data.

Figure 2: 2020 Precipitation and Effective Precipitation Compared to Average



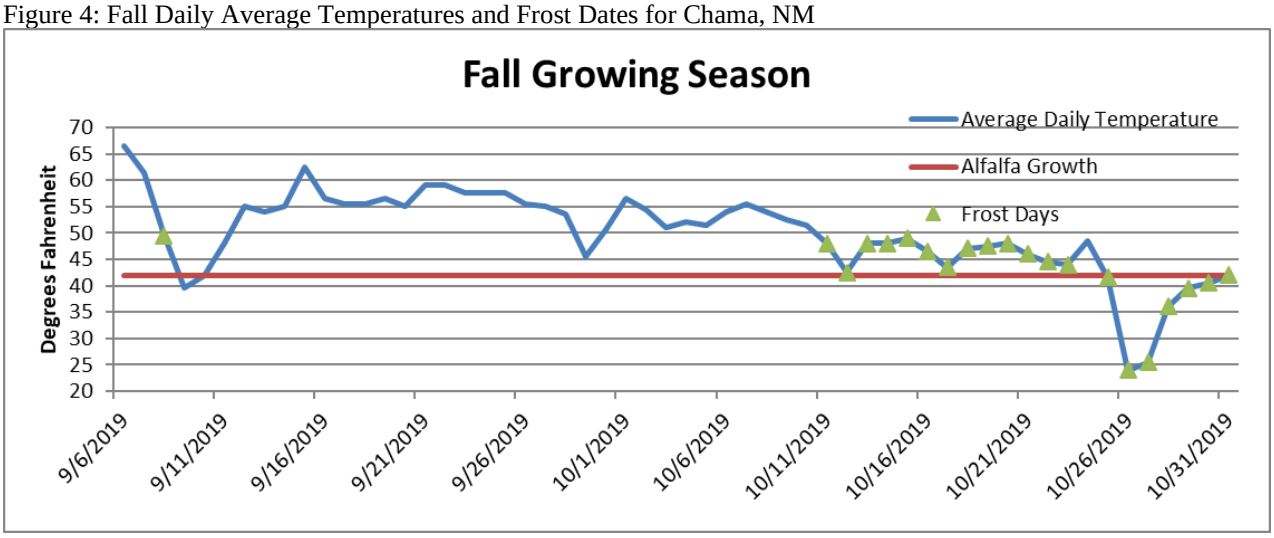
The first frost free day of the 2020 irrigation season was April 3rd, which is an average date for the first frost-free day in upper basin. Frost conditions returned and remained constant until April 28th. These frost days combined with dry soil conditions likely caused minimal April growth and impacted May growth.

Figure 3: Spring Daily Average Temperatures and Frost Dates for Chama, NM



Average daily temperature and frost days as measured at the weather station are plotted with the average daily temperature required for sustained alfalfa grown in September and October in Figure 4. Consistent frost came to the upper basin on October 11th and ended the growth season, however, the September 9th snow event discussed above caused an early season frost while also covering parts of the upper basin in 4 to 10 inches of snow. This early frost would have shocked the hay crops and reduced their September growth potential, especially the first week after the event. Most fields were in a poor condition following the below average August precipitation, above average temperatures, and lack of irrigation. The early frost prevented fall pasture recovery and negated the benefits of the improved September soil moisture conditions.

Figure 4: Fall Daily Average Temperatures and Frost Dates for Chama, NM



IV. Significant Basin Events

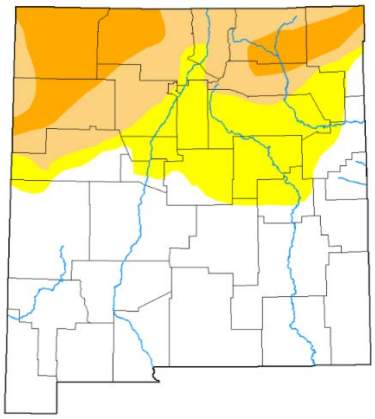
The following maps (Figure 5) show the progress of drought across New Mexico during the 2020 water year. The Upper Rio Chama was consistently in drought conditions. The upper basin began the season in D2 to D1 conditions. These conditions deteriorated as the summer progressed. The upper basin ended the irrigation season in D3 with conditions dropping to D4 in December.[3]

Figure 5: US Drought Monitor Condition Table and Drought Maps

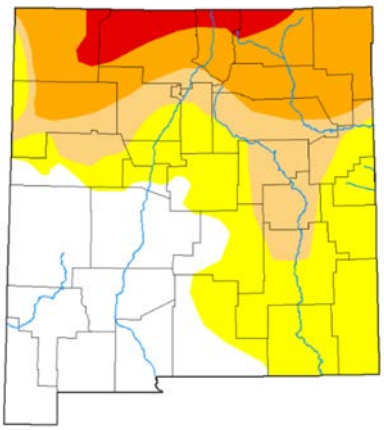
Category	Impact
D0	Soil moisture is low
	Fire danger increases
D1	Livestock need supplemental feed and water
	Burn bans and firework restrictions begin
D2	Pasture yield is limited; producers sell livestock
	Irrigated crops are stunted; dryland crops are brown
	Dust storms occur
	Abundance and magnitude of wildfires may increase; fuel mitigation practices are in effect
	Wildlife feeding patterns change
	Well water decreases
D3	Livestock are suffering; producers are selling herds; feed costs are high; emergency CRP grazing is authorized; crop yields are low
	Fire danger is extreme
	Irrigation allotments decrease
	Vegetation and native trees are dying
D4	Federal lands begin to close for fire precautions; burn bans increase
	Bears encroach on developed areas; migratory birds change patterns
	No surface water is left for agriculture, farmers use private wells
	Rio Grande and other large rivers are dry

[3] See Appendix B for more information on drought maps.

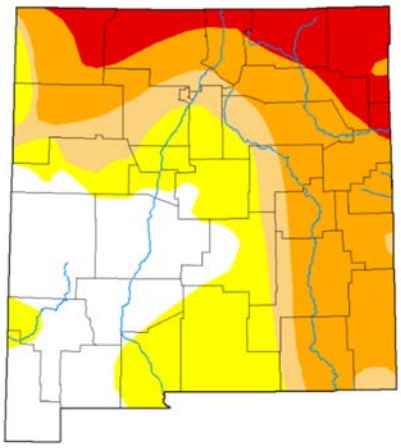
March 31, 2020



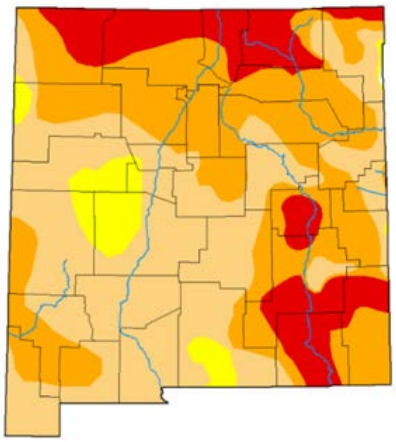
May 26, 2020



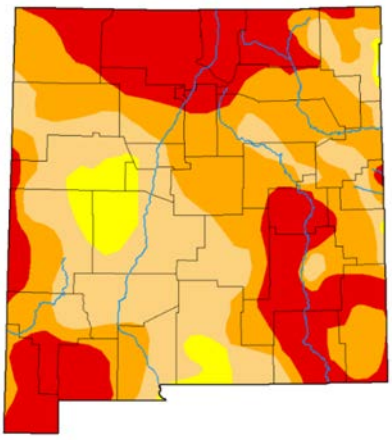
June 30, 2020



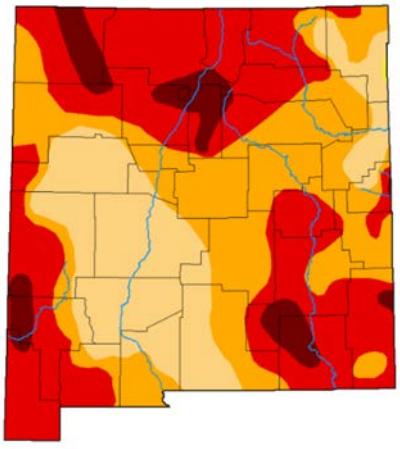
August 4, 2020



September 1, 2020



October 6, 2020



As described in the impact table in Figure 5, these drought conditions significantly impacted crop health and yield while also diminishing surface water and shallow groundwater supplies.

V. USGS River Gages

The two upper basin Rio Chama USGS irrigation season hydrographs are provided below in Figure 6 (USGS 09284100 Rio Chama Near La Puente, NM) and Figure 7 (USGS 08281400 Rio Chama Above Chama, NM). Both show below average streamflow across the entire season except for days with significant precipitation events. The Rio Chama peak flow came approximately three weeks earlier than usual and yielded significantly less water than a normal year. The 2020 runoff was about 25% of normal. Late season flows from August through October remained at or below 50% of normal.

Figure 6: USGS La Puente 2020 Irrigation Season 15-minute Hydrograph

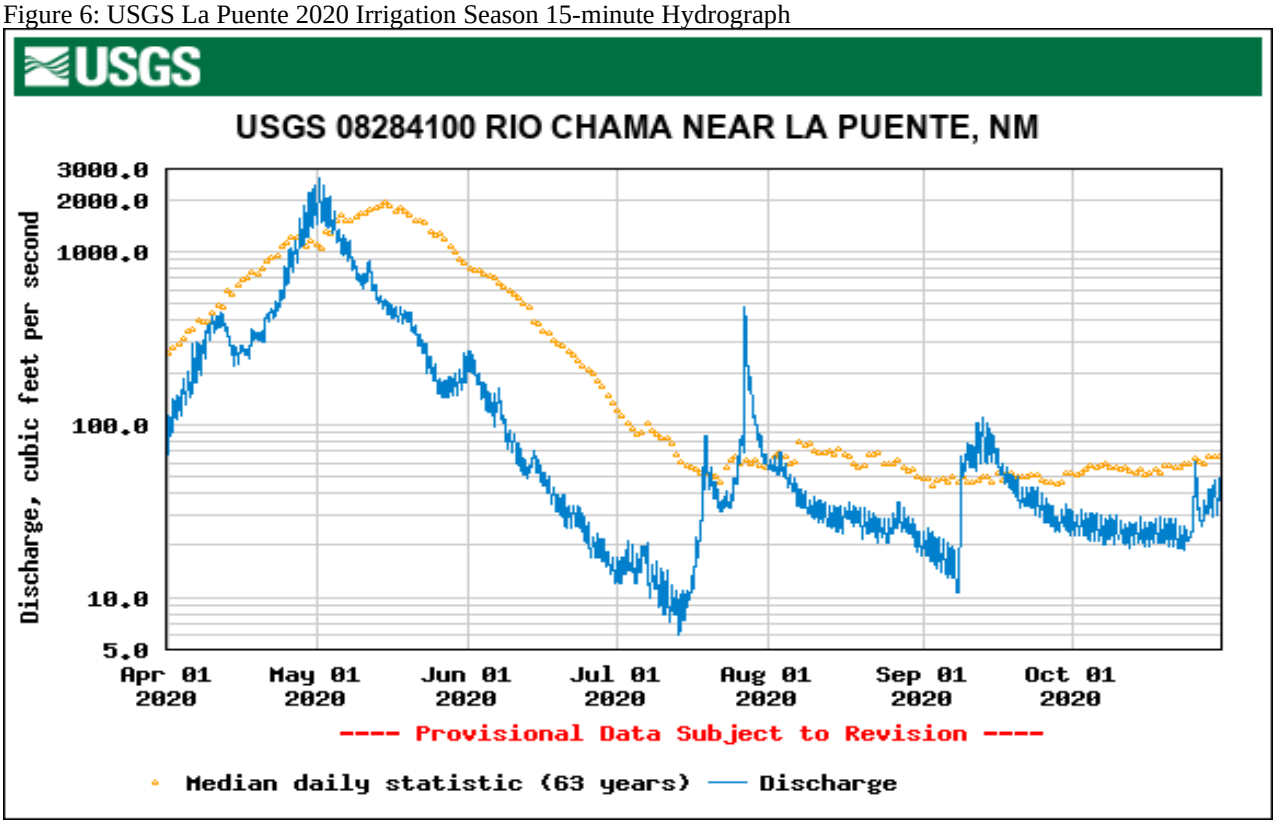
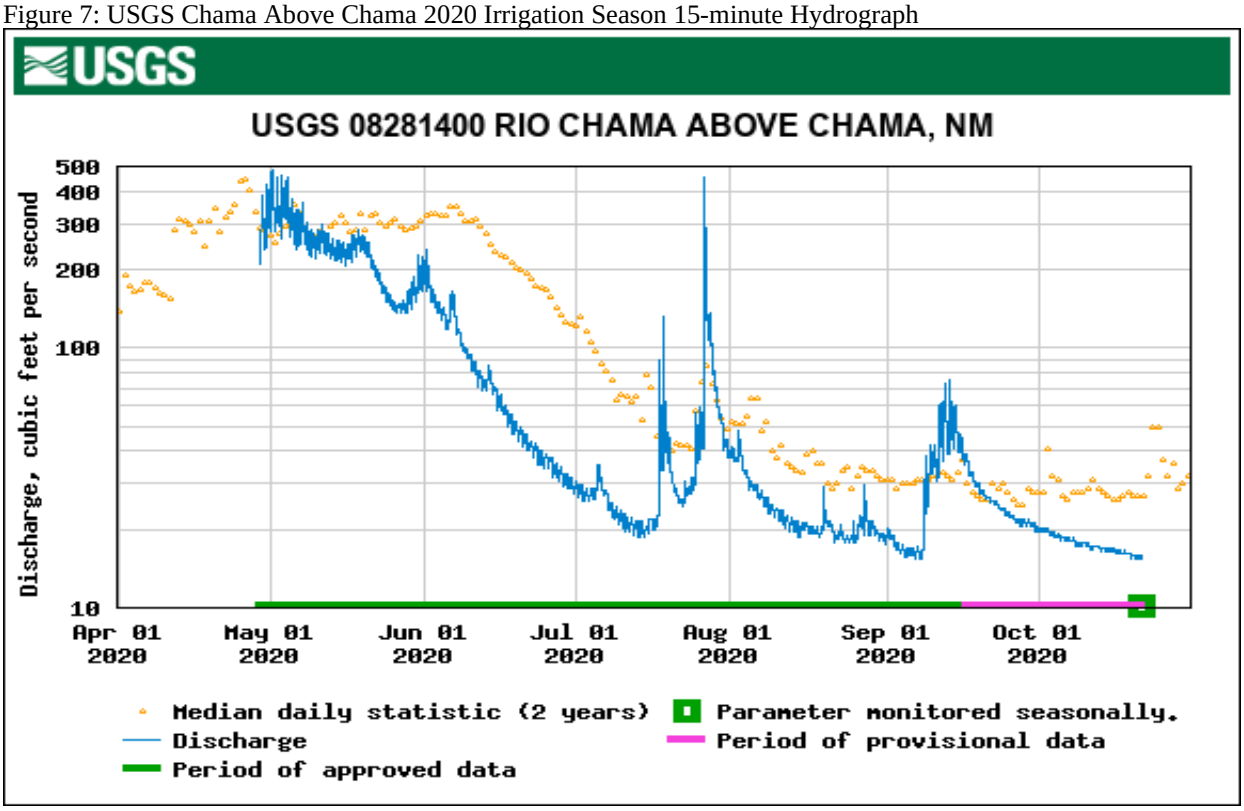
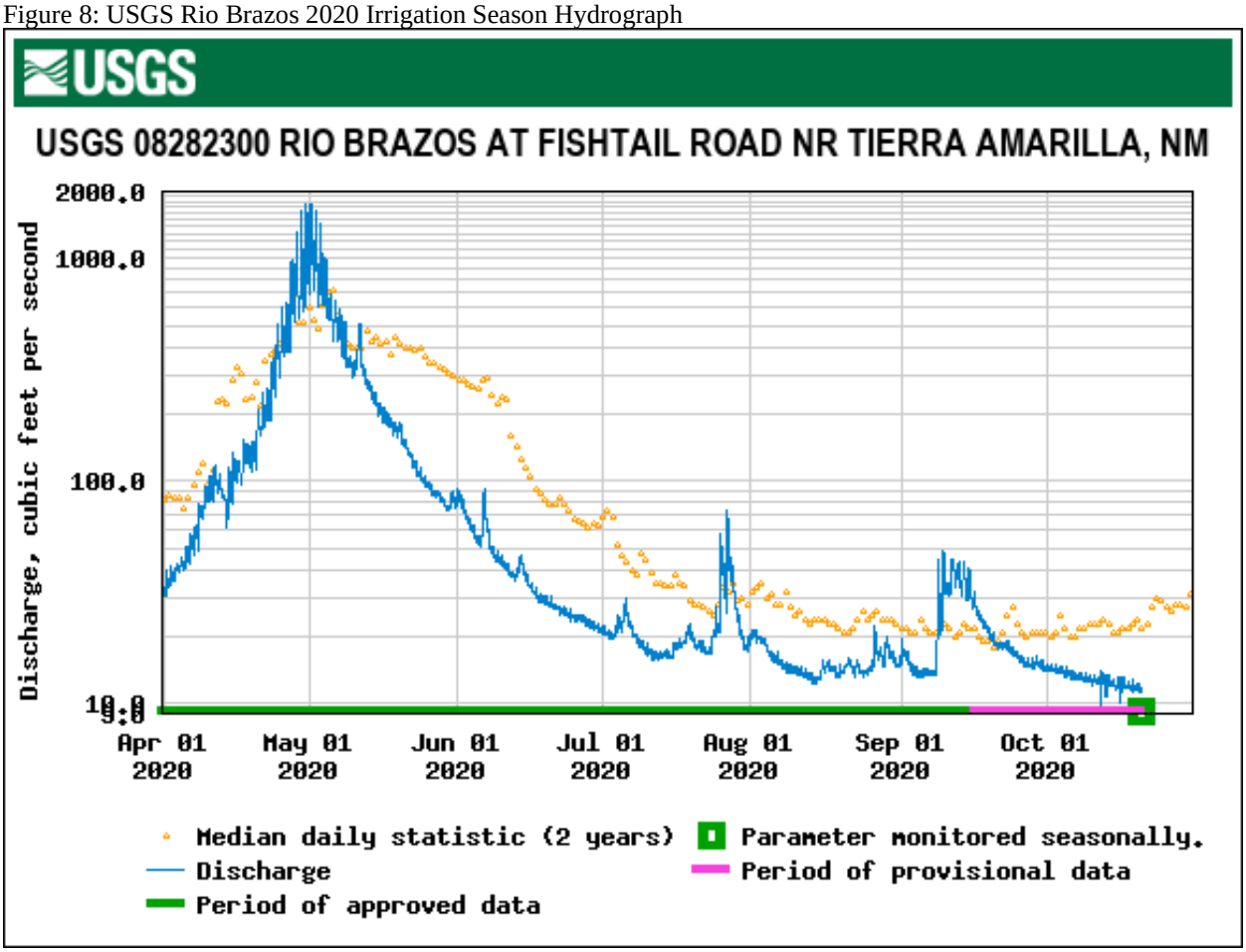


Figure 7: USGS Chama Above Chama 2020 Irrigation Season 15-minute Hydrograph



The Rio Brazos is the largest tributary to the Rio Chama and provides water to three of the largest and most senior ditches in the upper basin along with a few smaller ditches. Rio Brazos irrigated land exceeds 3,000 acres. Figure 8 shows discharge data at the USGS 08282300 Rio Brazos at Fishtail Road Near Tierra Amarilla, NM Gage. The peak flow came the first week of May. This is the normal timing for the Rio Brazos. The total runoff was less than normal. The below average conditions continued through the summer with the Rio Brazos flowing around 60% of normal. It is important to note that the Rio Brazos station has only a three-year period of record.

Figure 8: USGS Rio Brazos 2020 Irrigation Season Hydrograph



The poor runoff conditions and weak monsoon systems resulted in below average flows over the entire growing season. This led to reduced availability for irrigation water and an early and prolonged curtailment operation.

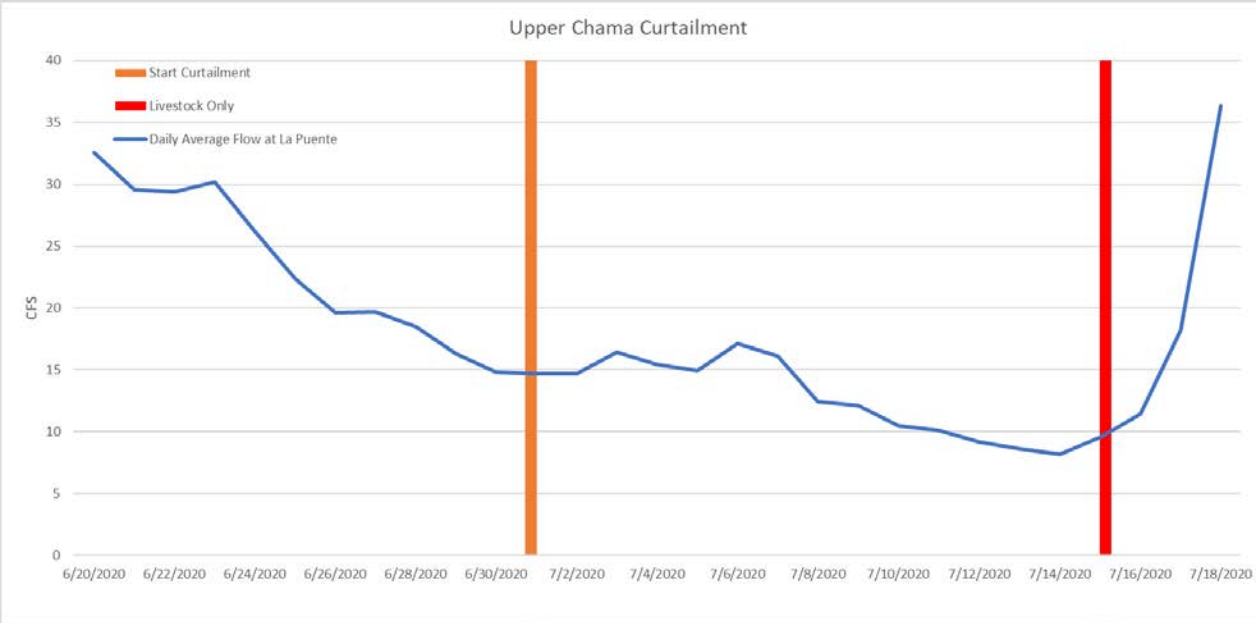
VI. Curtailment

USGS 08284100 Rio Chama near La Puente (USGS La Puente) hit the traditional OSE curtailment trigger of 50 CFS on June 16th. In normal years, OSE begins reducing upper basin diversions at this trigger point. The senior Rio Chama Acequia Association (RCAA) in the lower Rio Chama had purchased San Juan Chama Project water and agreed to allow the upper basin users to continue irrigating without oversight until July 1st. Beginning July 1st, upper basin users were cut to 40% or 50% of their recommended diversion rate based on water right priority. By this date, most of the smaller ditches in the upper basin were already off since their diversions cannot operate at low flows. As documented below, OSE action on July 1st halted the daily decrease in flows at USGS La Puente. Figure 9 shows mean daily flow at USGS La Puente plotted with curtailment actions from late-June through late-July.

The native inflow to the Rio Chama continued to drop on July 8th after running flat from July 1st to July 7th. The small cuts made to upper basin irrigation use on July 1st could no longer sustain flows at USGS La Puente which began to crash again around July 9th. Instantaneous flows at

USGS La Puente reached an annual minimum of 6 CFS on July 14th. Curtailment operations restricted diversions to only stock use on July 15th as the RCAA had used all their stored water and were now relying entirely on the native flows of the Chama at USGS La Puente. OSE actions to reduce diversions to only stock use flows on gaged and ungauged ditches from July 15th to July 17th raised the flows from the low of 6 CFS to 22 CFS. Fortunately, rain events on July 18th and July 19th boosted flows further providing the basin a chance to recover and allow for adequate RCAA diversions.

Figure 9: USGS La Puente Hydrograph at Upper Rio Chama Curtailment Actions



After July 20th, OSE curtailment operations consisted of two to three visits per week to check stations for accuracy and ditches for compliance with the livestock use only order. OSE field staff found irrigation on some ditches during this period. All ditches remedied the situation promptly. With the support of the upper basin irrigators and OSE field staff, flows at USGS La Puente recovered and remained between 20 and 30 CFS for the majority of the remaining irrigation season.

VII. Upper Chama Ditches

OSE station data from the upper basin for the 2020 irrigation season is provided below. Each ditch had the raw data corrected based on field notes and measurements. Values will differ from the data accessible on the OSE Real-time Measurement Site (RTMS) website. Each ditch has the monthly volume totaled for livestock and irrigation diversions, the daily average flow rate, and the monthly volume diverted for irrigation compared to the estimated 2020 Irrigation Water Requirement (IWR) for the ditch. Additional information and procedures are available in the addendum section.

A. Totals

The irrigation season is officially April 1st to October 31st. In that period, measured upper basin ditches diverted a total of 21,450.8 acre-feet from the Rio Chama and its tributaries. Of that total,

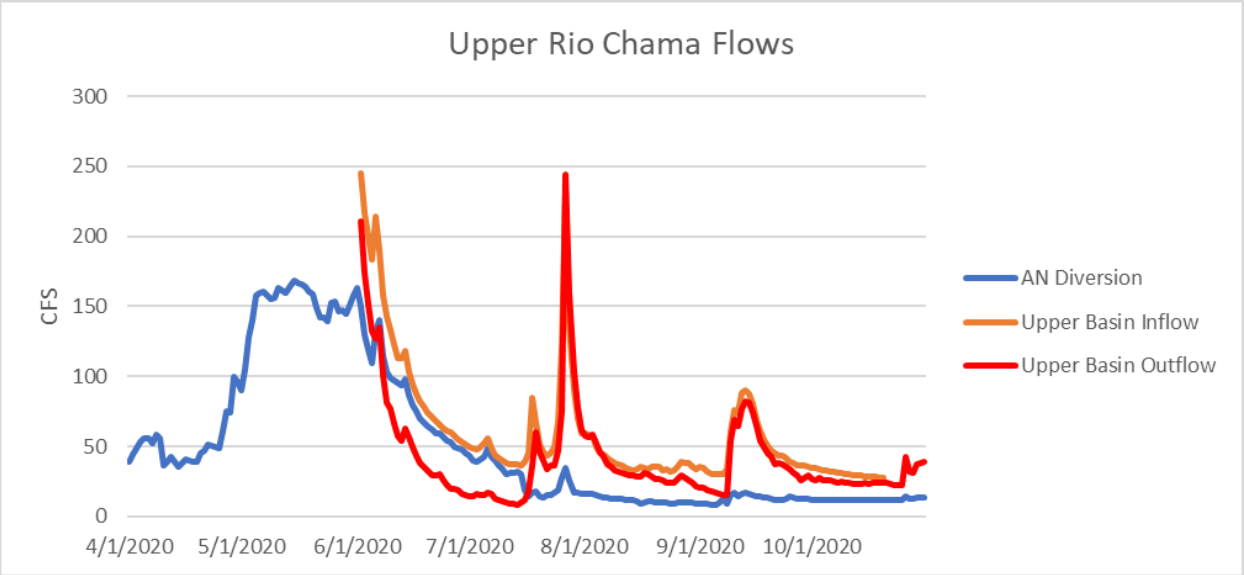
11.6% was for only stock use during curtailment and 88.4% was for irrigation. Most water was diverted in April, May, and June. As shown in the precipitation and growing season section, the growing season did not begin until April 28th. The water master observed very minimal irrigation in April and most water was returning to the Rio Chama. May diversions were the highest, and irrigation truly began in May. The high flows allowed full ditches and more efficient irrigation, but also resulted in significant return flows. High return flows were directly observed at Sanchez y Chavez, Parkview, Ensenada, and Porvenir. The early spring flows in April and May were needed to help rebuild soil moisture and prepare the ditch for the short irrigation season. Fields were abnormally dry entering the irrigation season after receiving no April precipitation and only 10% of the average May precipitation. Most growth occurred in June and July. Fields were cut in late July and early August. Return flows from July to the end of the season were minimal except for some ungauged ditches off the Rio Brazos, Parkview, and Porvenir.

Table 1: Upper Chama Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	3079.82	0.00
May	9260.71	0.00
June	5199.63	0.00
July	1275.80	434.30
August	148.32	559.77
September	0.00	754.87
October	0.00	737.58
	18964.28	**2486.52**

The hydrograph below (Figure 10) shows the total OSE measured diversions along with the USGS measured inflows (USGS Rio Chama above Chama and USGS Rio Brazos at Fishtail Rd) and USGS measured outflow (USGS La Puente). Prior to June 1st, the flows in the Rio Chama were above the maximum AN combined diversion total. The graph shows that beginning in mid-June the upper basin users were diverting almost the entire available native flow. The gap between inflow and outflow hydrographs demonstrates the significant basin loss occurring during this period. Once curtailment began, inflow and outflow hydrographs were more closely aligned. Most of curtailment showed minimal basin losses; however, the end of August saw losses climb until conditions were reset from a rain event. The increased losses at the end of August were likely from deteriorating basin conditions and not from diversions.

Figure 10: Combined USGS Rio Brazos and Rio Chama Above Chama Hydrographs with USGS La Puente and Total Measured Upper Rio Chama Diversions



The upper basin has not had formal loss studies published from USGS or OSE and the gages above USGS La Puente have only a few years of seasonal data available. Losses on the mainstem Chama would be expected to be minimal between Chama and La Puente. Based on the data available this year, most of the losses are explained by diversions. Outside a couple days in mid-July and at the end of August, basin losses were less than measured diversions. This suggests that natural losses are low and that return flows or other gains are occurring. Based on field observations, the more reasonable explanation is return flows. If no native losses or gains are assumed, the data suggests an average ditch loss rate of approximately 70% and a return rate of 30% of the ditch diversion. The estimated return rate would increase if there are native losses and decrease if there are native gains.

B. Chama Town

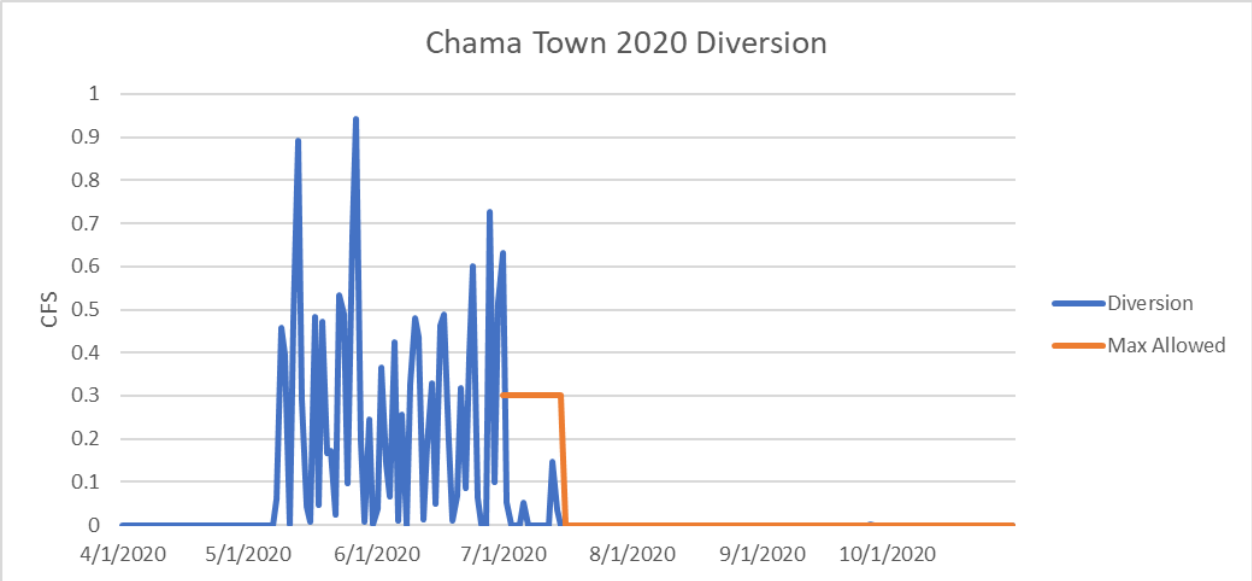
Chama Town is a small ditch serving 16.8 acres within the Village of Chama. Most of these acres are irrigated lawn. No livestock are watered from this ditch. Once irrigation water is no longer available, Chama Town users must rely on private wells or municipal water to maintain their lawns. Chama Town shares a river diversion and ditch with MB until Chama Town splits off. Table 2 shows monthly diversions for Chama Town.

Table 2: Chama Town Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	0.00	0.00
May	14.24	0.00
June	14.18	0.00
July	1.82	0.00
August	0.00	0.00
Septembe	0.00	0.00
October	0.00	0.00

Chama Town users should have been generally satisfied from April to June. Users had to utilize secondary water sources for their lawn in July, August, and September. Figure 11 is a graph of measured diversions into the Chama Town and the Curtailment Limit and Figure 12 shows monthly irrigation diversions into Chama Town and monthly estimated IWR for lands served by the ditch. Table 3 shows daily average diversions for Chama Town.

Figure 11: Chama Town Diversion Hydrograph and Curtailment Limit



Chama Town diversions were under their allotted curtailment amount except for July 1st. The Chama Town President locked the headgate in the afternoon on July 1st after a user left it open all night taking more than the curtailment limit. The ditch remained locked and off for the remainder of the summer with a few days showing leaks until MB ditch turned off in mid-July.

Figure 12: Chama Town Ditch Monthly Irrigation Diversion and Estimated Irrigation Water Requirement

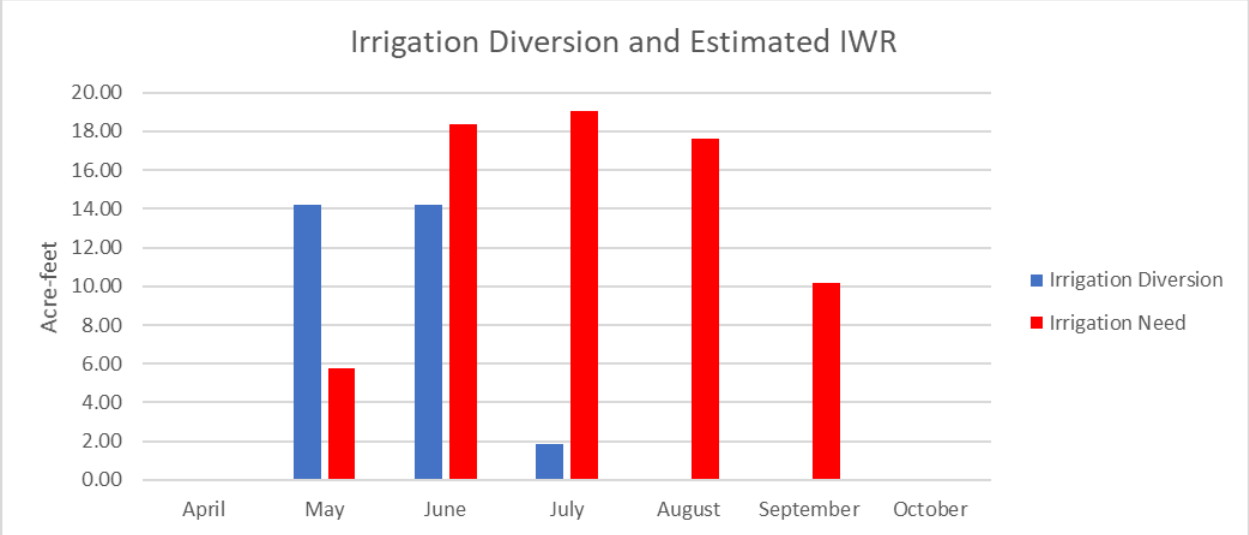


Table 3: Chama Town Daily Average Diversion Data

Chama Town Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.00	0.00	0.04	0.63	0.00	0.00	0.00
2	0.00	0.00	0.36	0.05	0.00	0.00	0.00
3	0.00	0.00	0.14	0.00	0.00	0.00	0.00
4	0.00	0.00	0.07	0.00	0.00	0.00	0.00
5	0.00	0.00	0.42	0.00	0.00	0.00	0.00
6	0.00	0.00	0.01	0.05	0.00	0.00	0.00
7	0.00	0.00	0.26	0.00	0.00	0.00	0.00
8	0.00	0.06	0.00	0.00	0.00	0.00	0.00
9	0.00	0.46	0.33	0.00	0.00	0.00	0.00
10	0.00	0.39	0.48	0.00	0.00	0.00	0.00
11	0.00	0.00	0.44	0.00	0.00	0.00	0.00
12	0.00	0.48	0.01	0.00	0.00	0.00	0.00
13	0.00	0.89	0.19	0.15	0.00	0.00	0.00
14	0.00	0.29	0.33	0.03	0.00	0.00	0.00
15	0.00	0.04	0.05	0.00	0.00	0.00	0.00
16	0.00	0.01	0.46	0.00	0.00	0.00	0.00
17	0.00	0.48	0.49	0.00	0.00	0.00	0.00
18	0.00	0.05	0.19	0.00	0.00	0.00	0.00
19	0.00	0.47	0.01	0.00	0.00	0.00	0.00
20	0.00	0.17	0.07	0.00	0.00	0.00	0.00
21	0.00	0.17	0.32	0.00	0.00	0.00	0.00
22	0.00	0.02	0.09	0.00	0.00	0.00	0.00
23	0.00	0.53	0.39	0.00	0.00	0.00	0.00
24	0.00	0.49	0.60	0.00	0.00	0.00	0.00
25	0.00	0.10	0.06	0.00	0.00	0.00	0.00
26	0.00	0.67	0.00	0.00	0.00	0.00	0.00
27	0.00	0.94	0.00	0.00	0.00	0.00	0.00
28	0.00	0.20	0.73	0.00	0.00	0.00	0.00
29	0.00	0.01	0.10	0.00	0.00	0.00	0.00
30	0.00	0.25	0.52	0.00	0.00	0.00	0.00
31		0.00		0.00	0.00		0.00
Average (CFS)	0.00	0.23	0.24	0.03	0.00	0.00	0.00

C. Chama Valley

Chama Valley is a small ditch located in the Village of Chama along the western floodplain of the Rio Chama that serves one industrial user and 48.5 irrigated acres. This ditch is a private ditch with no formal association. The main users are Mr. Pettingill and the Cumbres and Toltec Scenic Railroad. Most of Mr. Pettingill's acres are currently under a gravel mining operation. Mr. Pettingill does still irrigate a few acres and runs some cattle on the property. The other large acreage holder on the ditch is not actively irrigating and has been in the process of moving their 10.1 irrigated acres across the river to cover the evaporation of three pond developments. This ditch has no headgate and experiences substantial beaver activity at low flows. The OSE measurement station is located down ditch of the industrial railroad use. The railroad fills a cistern with an estimated capacity of 20,000 gallons. This use is unmeasured but is minimal. The railroad use is allowed throughout the season even during livestock only curtailment operations. Table 4 shows monthly diversions for Chama Valley.

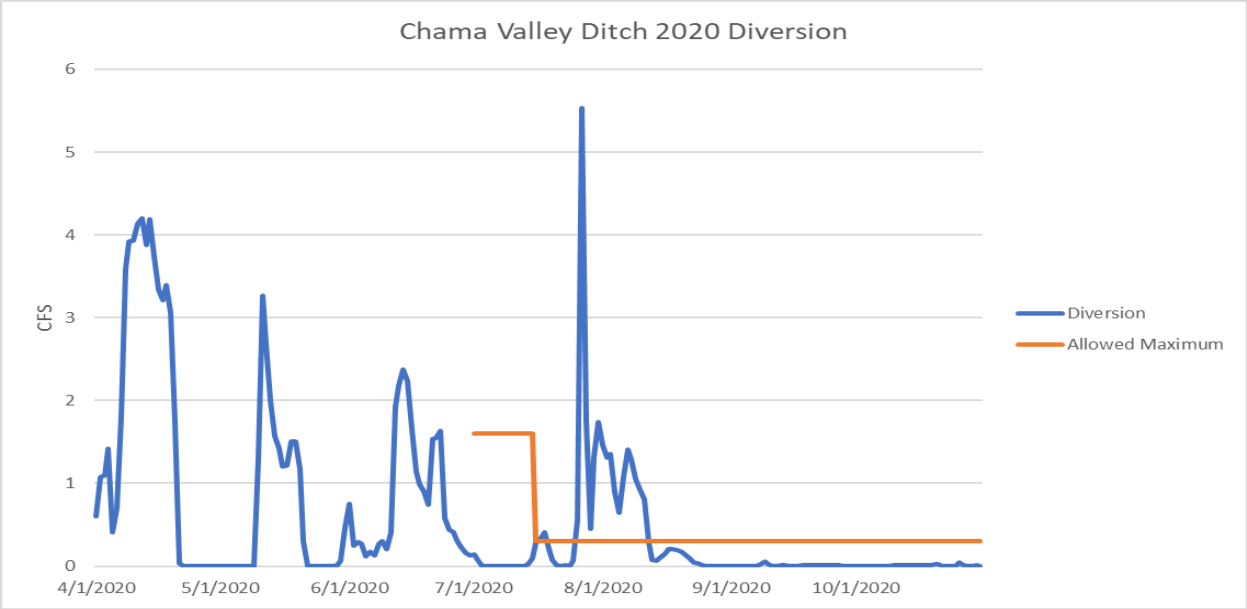
Table 4: Chama Valley Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	106.01	0.00
May	38.98	0.00
June	48.13	0.00
July	0.68	25.20
August	0.00	27.79
September	0.00	0.49
October	0.00	0.48

The April use was the result of the spring runoff elevating Rio Chama flows. Since this ditch has no diversion or control structure, when the river goes up so does the ditch. Chama Valley could run water for livestock, but Mr. Pettingill, who acts as the mayordormo even though the ditch has no formal association, decided to close off the ditch with gravel fill in July. All users on the ditch have stock water impoundments that could satisfy livestock needs. Running the ditch at low flows allow beavers to dam the ditch causing damage. The railroad still required water and the ditch was reopened days later. This caused the July and August livestock diversions. After working with the railroad, all water was returned to the Rio Chama below the railroad's cistern. OSE will ensure that the railroad returns all water when the ditch does not require it in future years. The railroad is considering a diversion structure below their cistern to better manage these flows moving forward. Water sent down the ditch filled ponds off Chama Valley and did not return to the Rio Chama.

Figure 13 is a graph of measured diversions into Chama Valley and the curtailment limit and Figure 14 shows monthly irrigation diversions into Chama Valley and monthly estimated IWR for lands served by the ditch. Table 5 shows daily average diversions for Chama Valley.

Figure 13: Chama Valley Diversion Hydrograph and Curtailment Limit



OSE does not know the active irrigated acres on the ditch. At least 50% of the irrigated acres were not in agricultural production in 2020. Figure 14 assumes all acres are actively irrigated. Water diverted and not used to irrigate would have filled ponds located off the ditch.

Figure 14: Chama Valley Monthly Irrigation Diversion and Estimated irrigation Water Requirement

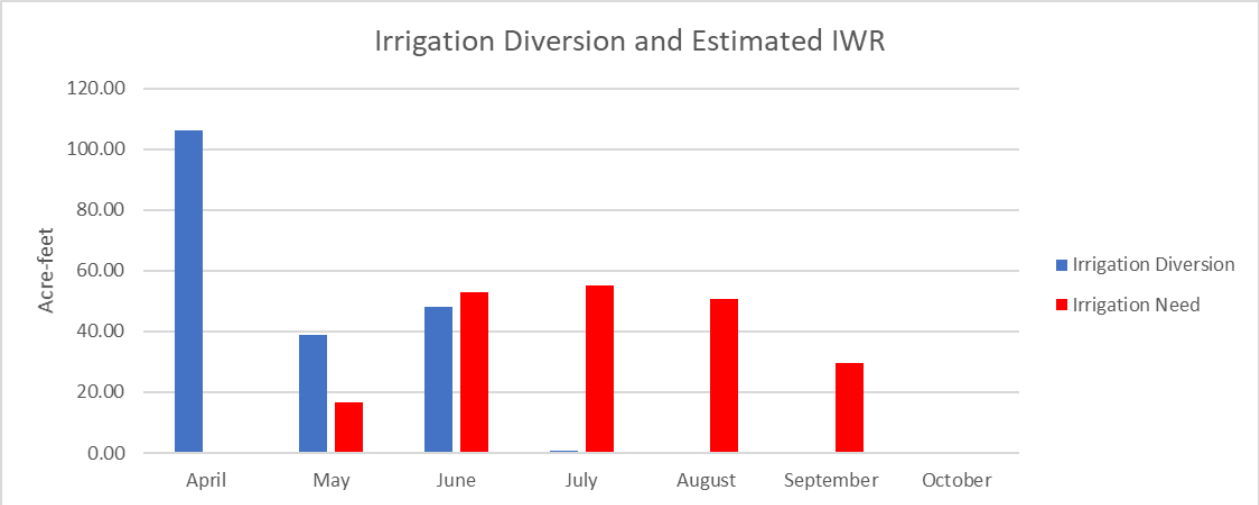


Table 5: Chama Valley Daily Average Diversion Data

Chama Valley Ditch Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.61	0.00	0.75	0.15	1.46	0.00	0.00
2	1.07	0.00	0.24	0.08	1.31	0.00	0.00
3	1.09	0.00	0.29	0.01	1.35	0.00	0.00
4	1.42	0.00	0.27	0.00	0.89	0.00	0.00
5	0.41	0.00	0.12	0.00	0.65	0.00	0.00
6	0.70	0.00	0.17	0.00	1.08	0.00	0.00
7	1.81	0.00	0.13	0.00	1.40	0.00	0.00
8	3.58	0.00	0.27	0.00	1.29	0.02	0.00
9	3.92	0.00	0.30	0.00	1.06	0.05	0.00
10	3.93	1.29	0.20	0.00	0.93	0.03	0.01
11	4.14	3.26	0.41	0.00	0.80	0.00	0.01
12	4.19	2.69	1.92	0.00	0.29	0.00	0.01
13	3.88	1.99	2.19	0.00	0.08	0.01	0.01
14	4.19	1.57	2.37	0.02	0.06	0.01	0.01
15	3.73	1.42	2.24	0.10	0.11	0.01	0.01
16	3.34	1.20	1.66	0.28	0.15	0.00	0.01
17	3.21	1.22	1.14	0.32	0.21	0.00	0.01
18	3.39	1.50	0.99	0.40	0.20	0.01	0.01
19	3.06	1.51	0.90	0.21	0.19	0.01	0.01
20	1.74	1.17	0.75	0.08	0.17	0.01	0.03
21	0.03	0.30	1.53	0.01	0.13	0.01	0.03
22	0.00	0.00	1.55	0.00	0.10	0.01	0.01
23	0.00	0.00	1.63	0.01	0.04	0.01	0.00
24	0.00	0.00	0.58	0.00	0.04	0.01	0.00
25	0.00	0.00	0.44	0.07	0.02	0.01	0.01
26	0.00	0.00	0.40	0.56	0.00	0.01	0.04
27	0.00	0.00	0.31	5.53	0.00	0.01	0.01
28	0.00	0.00	0.23	1.75	0.00	0.00	0.00
29	0.00	0.01	0.16	0.46	0.00	0.00	0.01
30	0.00	0.06	0.13	1.31	0.00	0.00	0.01
31		0.47		1.74	0.00		0.00
Average (CFS)	1.78	0.63	0.81	0.42	0.45	0.01	0.01

D. Chama Valley 1

Chama Valley 1 is a small private ditch off the Rio Chama between the Village of Chama and the Rio Brazos. This ditch serves 30.1 acres of irrigated land. The diversion does not operate well at low flow conditions and was off by the start of curtailment operations. Chama Valley 1 received no water for irrigation beginning on June 26th and did not take stock water. Table 6 shows monthly diversions for Chama Valley 1.

Table 6: Chama Valley 1 Monthly Diversion in acre-feet

	Irrigation Volume	Stock Volume
April	0.00	0.00
May	56.24	0.00
June	22.63	0.00
July	0.11	0.00
August	0.00	0.00
Septembe	0.00	0.00
October	0.00	0.00

Chama Valley 1 reported 122 small square bales produced in 2020. Their average yield is approximately 1,000 bales. The price of a small square bale out of Colorado in 2020 was about $9.50 according to Upper Rio Chama users. Most growers on smaller ditches and smaller tributaries had to haul in hay this summer since local production was limited and below average.

Figure 15 is a graph of measured diversions into Chama Valley 1 and the curtailment limit and Figure 16 shows monthly irrigation diversions into Chama Valley 1 and monthly estimated IWR for lands served by the ditch. Table 7 shows daily average diversions for Chama Valley 1.

Figure 15: Chama Valley #1 Diversion Hydrograph and Curtailment Limit

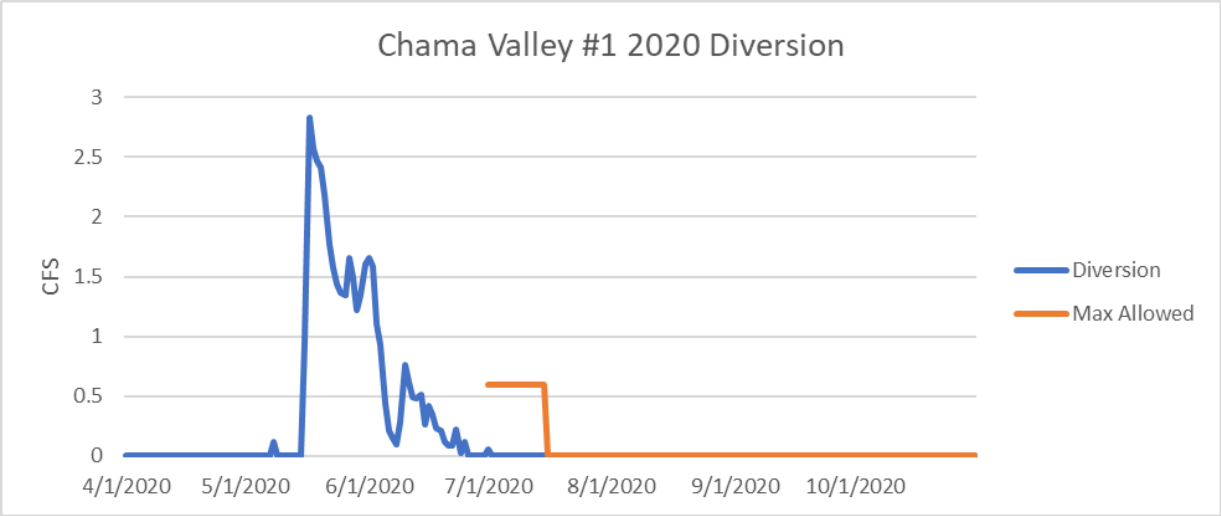


Figure 16: Chama Valley #1 Monthly Irrigation Diversion and Estimated Irrigation Water Requirement

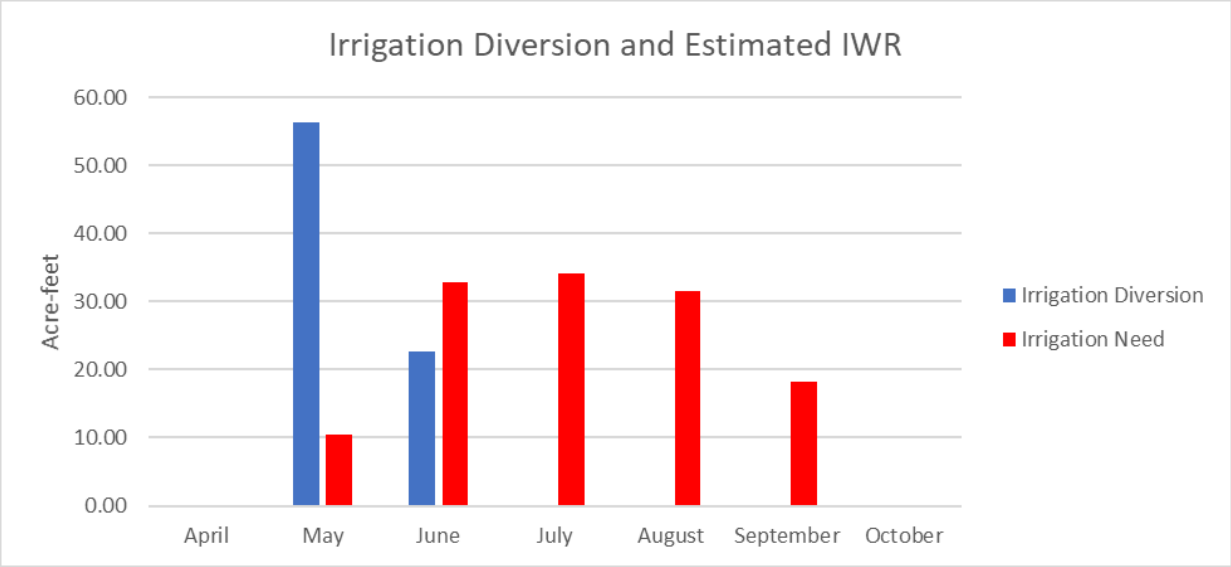


Table 7: Chama Valley #1 Daily Average Diversion Data

Chama Valley 1 Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.00	0.00	1.66	0.06	0.00	0.00	0.00
2	0.00	0.00	1.58	0.00	0.00	0.00	0.00
3	0.00	0.00	1.10	0.00	0.00	0.00	0.00
4	0.00	0.00	0.93	0.00	0.00	0.00	0.00
5	0.00	0.00	0.44	0.00	0.00	0.00	0.00
6	0.00	0.00	0.21	0.00	0.00	0.00	0.00
7	0.00	0.00	0.14	0.00	0.00	0.00	0.00
8	0.00	0.12	0.09	0.00	0.00	0.00	0.00
9	0.00	0.00	0.28	0.00	0.00	0.00	0.00
10	0.00	0.00	0.77	0.00	0.00	0.00	0.00
11	0.00	0.00	0.62	0.00	0.00	0.00	0.00
12	0.00	0.00	0.49	0.00	0.00	0.00	0.00
13	0.00	0.00	0.48	0.00	0.00	0.00	0.00
14	0.00	0.00	0.52	0.00	0.00	0.00	0.00
15	0.00	0.00	0.26	0.00	0.00	0.00	0.00
16	0.00	0.95	0.41	0.00	0.00	0.00	0.00
17	0.00	2.83	0.34	0.00	0.00	0.00	0.00
18	0.00	2.57	0.23	0.00	0.00	0.00	0.00
19	0.00	2.47	0.21	0.00	0.00	0.00	0.00
20	0.00	2.41	0.11	0.00	0.00	0.00	0.00
21	0.00	2.18	0.08	0.00	0.00	0.00	0.00
22	0.00	1.78	0.08	0.00	0.00	0.00	0.00
23	0.00	1.57	0.22	0.00	0.00	0.00	0.00
24	0.00	1.44	0.02	0.00	0.00	0.00	0.00
25	0.00	1.37	0.11	0.00	0.00	0.00	0.00
26	0.00	1.34	0.00	0.00	0.00	0.00	0.00
27	0.00	1.66	0.00	0.00	0.00	0.00	0.00
28	0.00	1.49	0.00	0.00	0.00	0.00	0.00
29	0.00	1.22	0.00	0.00	0.00	0.00	0.00
30	0.00	1.35	0.00	0.00	0.00	0.00	0.00
31		1.61		0.00	0.00		0.00
Average (CFS)	0.00	0.91	0.38	0.00	0.00	0.00	0.00

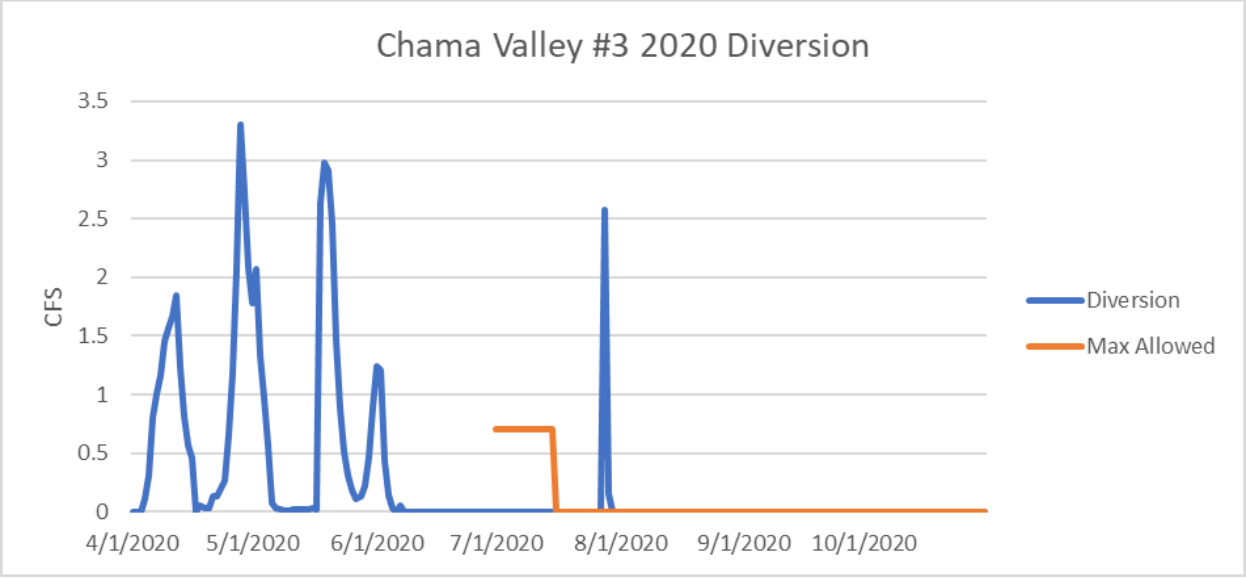
E. Chama Valley 3

Chama Valley 3 is a small private ditch between the Village of Chama and the Rio Brazos serving 33.1 acres. No contact was established with this ditch during the 2020 irrigation season. It seems to be out of use. The main river gate was left open and took water at high flows. During curtailment, rain caused the Rio Chama to rise enough for some water to enter this ditch on July 28th and 29th totaling 5.41 acre feet. Table 8 shows monthly diversions for Chama Valley 3. Figure 17 is a graph of measured diversions into Chama Valley 3 and the curtailment limit and Figure 18 shows monthly irrigation diversions into Chama Valley 3 and monthly estimated diversions for lands served by the ditch. Table 8 shows daily average diversions for Chama Valley 3.

Table 8: Chama Valley #3 Monthly Diversion in acre-feet

	Irrigation Volume	Stock Volume
April	51.37	0.00
May	46.08	0.00
June	6.20	0.00
July	5.41	0.00
August	0.00	0.00
September	0.00	0.00
October	0.00	0.00

Figure 17: Chama Valley #3 Diversion Hydrograph and Curtailment Limit



Based on field observations and diversion data, production on the 33.1 acres served by Chama Valley 3 is very limited. This ditch received the least amount of irrigation water per acre in the upper basin. This extreme shortage was not due to curtailment operations but from the ditch management.

Figure 18: Chama Valley #3 Monthly Irrigation Diversion and Estimated Irrigation Water Requirement

Figure 18: Chama Valley #3 Monthly Irrigation Diversion and Estimated Irrigation Water Requirement

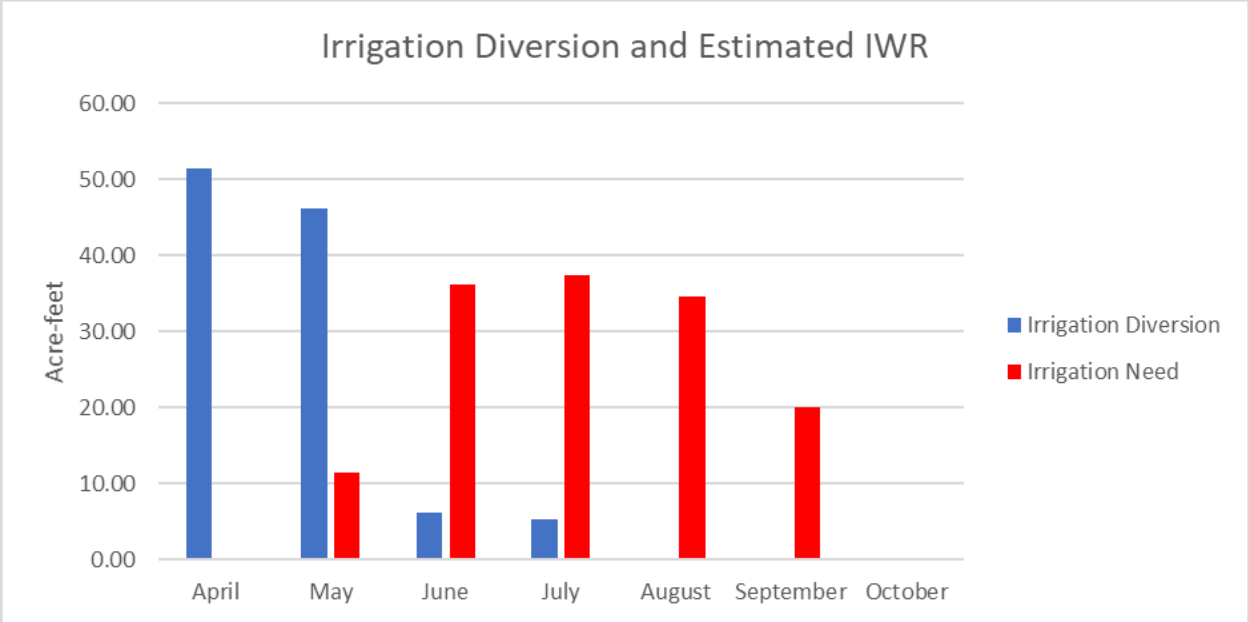


Table 9: Chama Valley #3 Daily Average Diversion Data

Chama Valley 3 Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.00	1.78	1.24	0.00	0.00	0.00	0.00
2	0.00	2.07	1.20	0.00	0.00	0.00	0.00
3	0.00	1.33	0.44	0.00	0.00	0.00	0.00
4	0.11	0.97	0.15	0.00	0.00	0.00	0.00
5	0.31	0.57	0.04	0.00	0.00	0.00	0.00
6	0.80	0.08	0.00	0.00	0.00	0.00	0.00
7	1.01	0.04	0.06	0.00	0.00	0.00	0.00
8	1.16	0.02	0.00	0.00	0.00	0.00	0.00
9	1.45	0.01	0.00	0.00	0.00	0.00	0.00
10	1.57	0.01	0.00	0.00	0.00	0.00	0.00
11	1.67	0.02	0.00	0.00	0.00	0.00	0.00
12	1.84	0.02	0.00	0.00	0.00	0.00	0.00
13	1.23	0.02	0.00	0.00	0.00	0.00	0.00
14	0.82	0.03	0.00	0.00	0.00	0.00	0.00
15	0.57	0.02	0.00	0.00	0.00	0.00	0.00
16	0.46	0.03	0.00	0.00	0.00	0.00	0.00
17	0.00	0.02	0.00	0.00	0.00	0.00	0.00
18	0.05	2.63	0.00	0.00	0.00	0.00	0.00
19	0.03	2.98	0.00	0.00	0.00	0.00	0.00
20	0.04	2.91	0.00	0.00	0.00	0.00	0.00
21	0.13	2.45	0.00	0.00	0.00	0.00	0.00
22	0.13	1.47	0.00	0.00	0.00	0.00	0.00
23	0.21	0.88	0.00	0.00	0.00	0.00	0.00
24	0.27	0.51	0.00	0.00	0.00	0.00	0.00
25	0.66	0.32	0.00	0.00	0.00	0.00	0.00
26	1.19	0.19	0.00	0.00	0.00	0.00	0.00
27	2.07	0.12	0.00	0.00	0.00	0.00	0.00
28	3.30	0.13	0.00	2.57	0.00	0.00	0.00
29	2.73	0.22	0.00	0.16	0.00	0.00	0.00
30	2.08	0.47	0.00	0.00	0.00	0.00	0.00
31		0.90		0.00	0.00		0.00
Average (CFS)	0.86	0.75	0.10	0.09	0.00	0.00	0.00

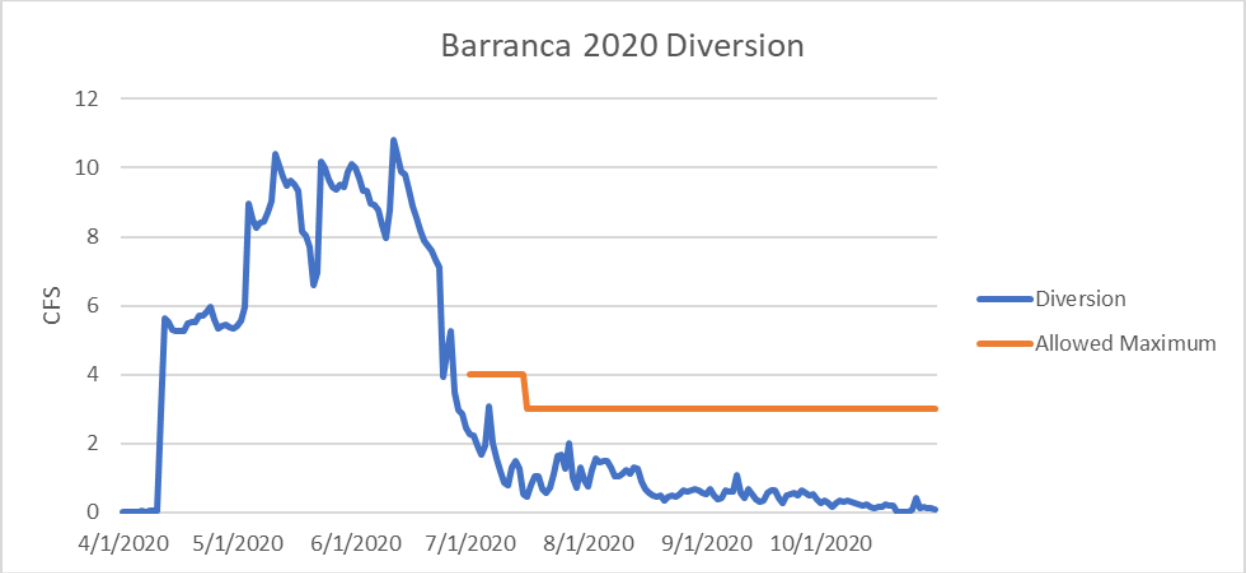
F. Barranca

Barranca is a medium sized ditch off the mainstem of the Rio Chama above the confluence of the Rio Chama and the Rio Brazos. The ditch members refer to this ditch as Barranca, but it is Barranco in all state adjudication documents. Barranca is used for this report. Barranca serves about 380 acres on the eastern terraced floodplain of the Rio Chama. Barranca benefits from some spring inflow and non-perennial inflow during rain events. It also receives some tailwater from Canones Creek 1 and Brazos Community ditches. Barranca did an excellent job of staying below their allotted flows during curtailment. Table 10 shows monthly diversions for Barranca. Figure 19 is a graph of measured diversions into Barranca and the curtailment limit and Figure 20 shows monthly irrigation diversions and estimated IWR for lands served by Barranca. Table 11 shows daily average diversions for Barranca.

Table 10: Barranca Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	213.32	0.00
May	536.51	0.00
June	454.48	0.00
July	47.90	33.58
August	0.00	53.48
September	0.00	31.55
October	0.00	11.70

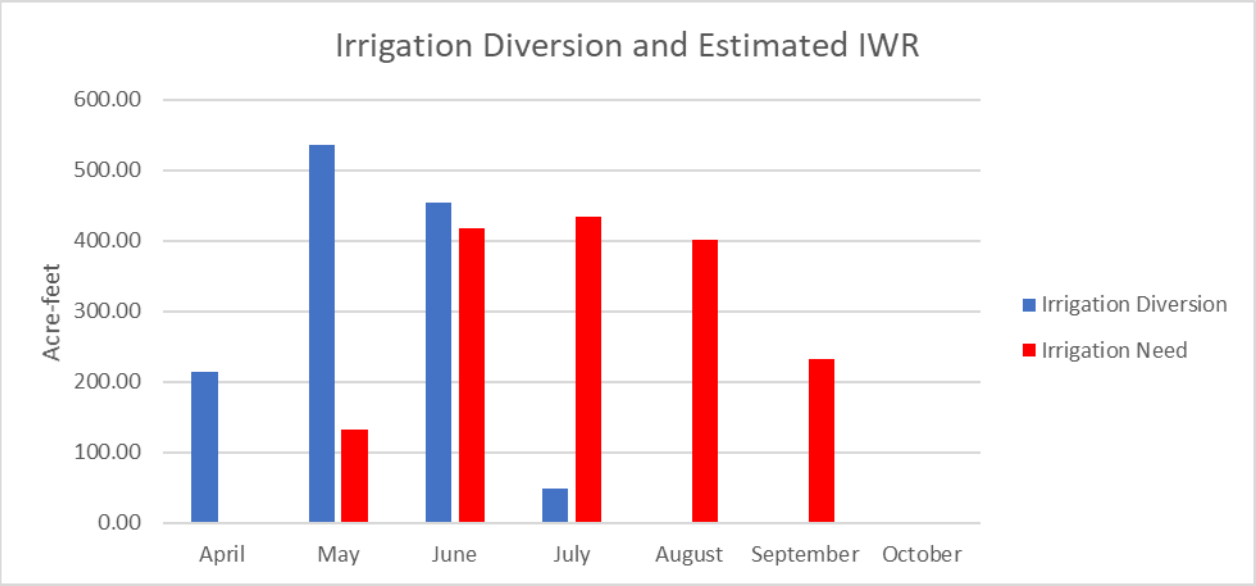
Figure 19: Barranca Diversion Hydrograph and Curtailment Limit



The Barranca remained under their reduced irrigation allotment and then under their stock water allotment throughout the curtailment period. Barranca would report very low to zero flows at night during low Rio Chama flows. This could have been a power supply issue at the measuring station resulting in low readings or from the diurnal rise and drop of the mainstem Rio Chama. Even if some nighttime readings were low, the Barranca was far below their maximum flow rates. Future curtailments should provide Barranca a maximum of 1 CFS for livestock instead of 3 CFS since the Barranca operated successfully at 1 CFS this year. Tailwater returns directly to

the Rio Chama, but the amount was not checked during curtailment. Spot checks of the livestock water along the ditch showed minimal losses, and the livestock diversion most likely returned to the Rio Chama.

Figure 20: Barranca Monthly Irrigation Diversion and Estimated Irrigation Water Requirement



The Barranca met the irrigation requirements in April, May, and June. Fields went underwatered in July and received no water in August, September, and October. Fields received their last irrigation in early to mid-July and benefited from a late July rain event prior to August cuttings. Barranca users reported approximately 50% of their average yields. Parcientes think that the shortage sharing schedule should be changed to provide more irrigation water to senior upper basin users in bad years.

Table 11: Barranca Daily Average Diversion Data

Barranca Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.01	5.42	10.01	2.25	0.75	0.53	0.25
2	0.02	5.54	9.69	2.24	1.23	0.69	0.34
3	0.02	5.95	9.33	1.95	1.56	0.50	0.26
4	0.01	8.95	9.33	1.66	1.45	0.39	0.16
5	0.02	8.53	8.94	1.92	1.51	0.40	0.29
6	0.03	8.28	8.94	3.10	1.48	0.65	0.34
7	0.03	8.40	8.77	2.03	1.32	0.61	0.30
8	0.03	8.46	8.35	1.58	1.03	0.61	0.33
9	0.03	8.71	7.96	1.21	1.03	1.07	0.30
10	0.04	9.02	8.78	0.86	1.14	0.57	0.27
11	2.89	10.39	10.81	0.78	1.25	0.42	0.25
12	5.65	10.06	10.35	1.29	1.11	0.69	0.21
13	5.52	9.75	9.89	1.47	1.29	0.53	0.22
14	5.31	9.48	9.80	1.29	1.27	0.39	0.15
15	5.25	9.64	9.38	0.54	0.89	0.31	0.14
16	5.27	9.51	8.89	0.47	0.68	0.33	0.14
17	5.27	9.35	8.55	0.79	0.55	0.56	0.16
18	5.48	8.15	8.19	1.03	0.48	0.66	0.23
19	5.51	8.03	7.87	1.03	0.45	0.65	0.19
20	5.52	7.71	7.73	0.69	0.50	0.41	0.20
21	5.71	6.61	7.59	0.56	0.34	0.27	0.02
22	5.72	6.98	7.33	0.70	0.44	0.49	0.00
23	5.83	10.20	7.11	1.12	0.48	0.52	0.01
24	5.95	9.98	3.92	1.64	0.47	0.55	0.01
25	5.58	9.67	4.65	1.66	0.54	0.51	0.08
26	5.33	9.45	5.26	1.26	0.64	0.64	0.43
27	5.40	9.38	3.48	2.02	0.61	0.58	0.12
28	5.45	9.51	2.97	1.03	0.63	0.50	0.16
29	5.37	9.46	2.86	0.71	0.67	0.54	0.13
30	5.34	9.87	2.47	1.30	0.65	0.37	0.12
31		10.11		0.94	0.55		0.09
Average (CFS)	3.59	8.73	7.64	1.33	0.87	0.53	0.19

G. Sanchez y Chavez

The Sanchez y Chavez is a private ditch just downstream of the Barranca headgate and upstream of the confluence of the Rio Chama and the Rio Brazos. This ditch serves approximately 150 acres of irrigation. The main diversion is set at an elevation where the ditch is incapable of operating when the Rio Chama drops below 50 CFS. Sanchez y Chavez does receive spring water as well as tailwater from the Barranca Ditch. These sources will cause the OSE gage to show flow when the river diversion is dry. The tailwater of Sanchez y Chavez returns directly to the Rio Chama. Sanchez y Chavez did not request stock water since it has river adjacent property and cannot operate at low Rio Chama flows. Lands served by Sanchez y Chavez is also crossed by the Barranca Ditch which was carrying stock water. Sanchez y Chavez reported approximately 50% or less of their average hay yield.

Table 12 shows monthly diversions for Sanchez y Chavez. Figure 21 is a graph of measured diversions and the curtailment limit and Figure 22 shows monthly irrigation diversions and

monthly estimated IWR for lands served by Sanchez y Chavez. Table 12 shows daily average diversions for Sanchez y Chavez.

Table 12: Sanchez y Chavez Monthly Diversion in acre-feet

	Irrigation Volume	Stock Volume
April	0.00	0.00
May	176.35	0.00
June	161.12	0.00
July	20.65	0.00
August	0.00	0.00
September	0.00	0.00
October	0.00	0.00

Figure 21: Sanchez y Chavez Diversion Hydrograph and Curtailment Limit

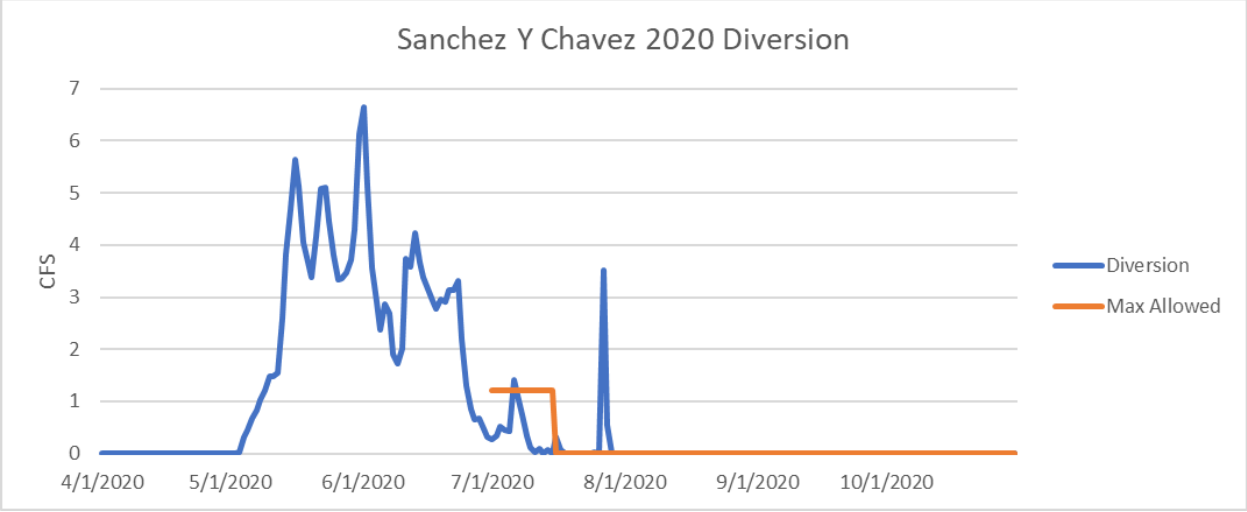


Figure 22: Sanchez y Chavez Monthly Irrigation Diversion and Estimated Irrigation Water Requirement

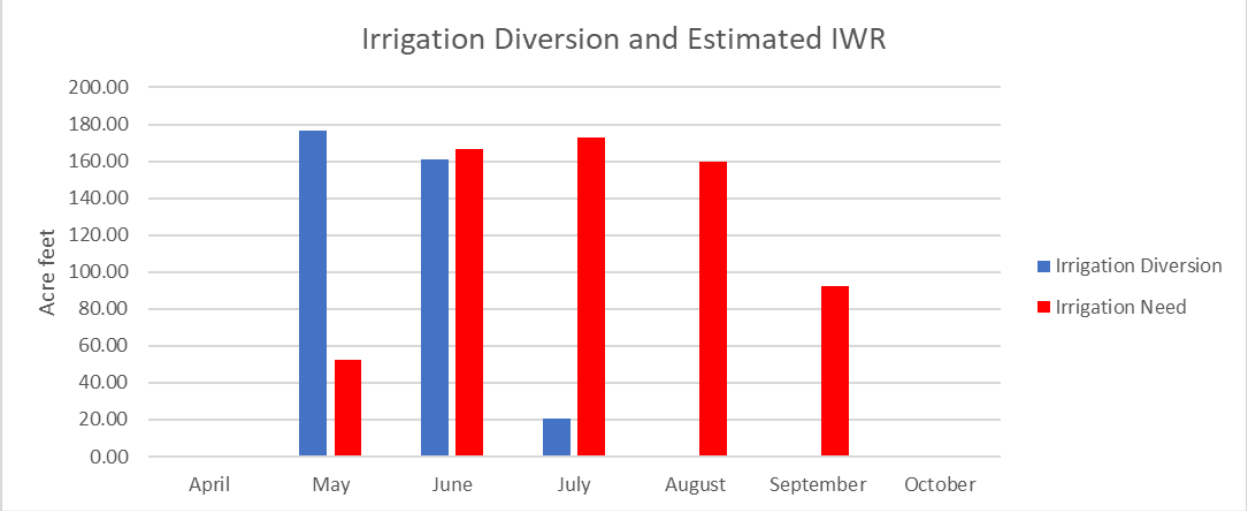


Table 13: Sanchez y Chavez Daily Average Diversion Data

Sanchez y Chavez Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.00	0.00	6.65	0.27	0.00	0.00	0.00
2	0.00	0.00	5.12	0.34	0.00	0.00	0.00
3	0.00	0.02	3.55	0.52	0.00	0.00	0.00
4	0.00	0.31	2.91	0.46	0.00	0.00	0.00
5	0.00	0.45	2.38	0.42	0.00	0.00	0.00
6	0.00	0.67	2.87	1.40	0.00	0.00	0.00
7	0.00	0.82	2.68	1.13	0.00	0.00	0.00
8	0.00	1.03	1.91	0.75	0.00	0.00	0.00
9	0.00	1.21	1.72	0.33	0.00	0.00	0.00
10	0.00	1.48	2.01	0.10	0.00	0.00	0.00
11	0.00	1.48	3.74	0.02	0.00	0.00	0.00
12	0.00	1.54	3.59	0.09	0.00	0.00	0.00
13	0.00	2.61	4.24	0.01	0.00	0.00	0.00
14	0.00	3.83	3.68	0.08	0.00	0.00	0.00
15	0.00	4.68	3.37	0.01	0.00	0.00	0.00
16	0.00	5.65	3.16	0.32	0.00	0.00	0.00
17	0.00	5.12	2.94	0.07	0.00	0.00	0.00
18	0.00	4.06	2.79	0.00	0.00	0.00	0.00
19	0.00	3.67	2.96	0.01	0.00	0.00	0.00
20	0.00	3.38	2.91	0.00	0.00	0.00	0.00
21	0.00	4.17	3.14	0.00	0.00	0.00	0.00
22	0.00	5.08	3.14	0.00	0.00	0.00	0.00
23	0.00	5.10	3.33	0.00	0.00	0.00	0.00
24	0.00	4.46	2.20	0.00	0.00	0.00	0.00
25	0.00	3.80	1.30	0.01	0.00	0.00	0.00
26	0.00	3.33	0.86	0.01	0.00	0.00	0.00
27	0.00	3.35	0.65	3.52	0.00	0.00	0.00
28	0.00	3.47	0.68	0.54	0.00	0.00	0.00
29	0.00	3.71	0.48	0.00	0.00	0.00	0.00
30	0.00	4.31	0.31	0.00	0.00	0.00	0.00
31		6.13		0.00	0.00		0.00
Average (CFS)	0.00	2.87	2.71	0.34	0.00	0.00	0.00

H. Plaza Blanca

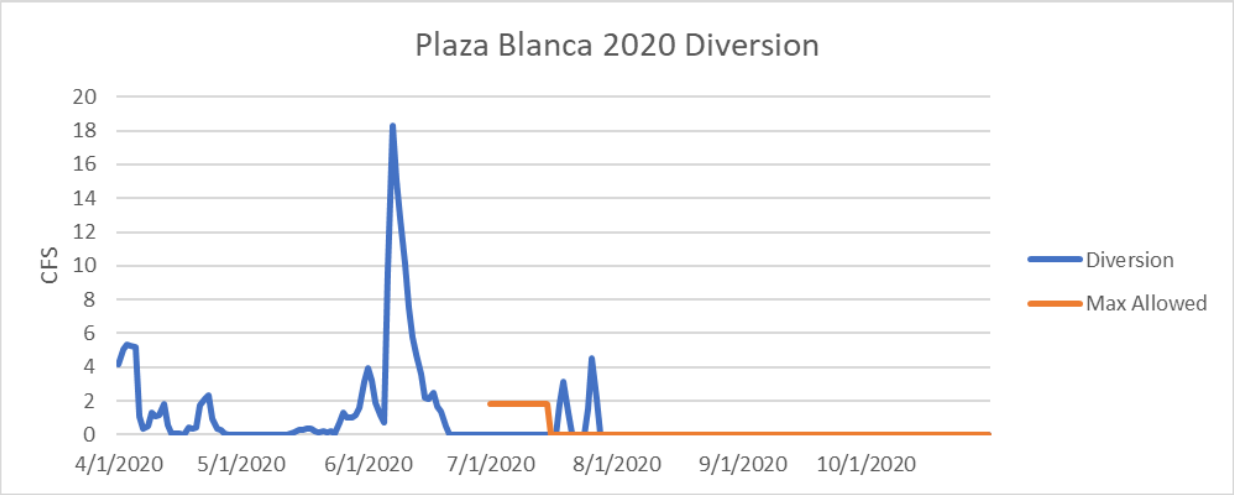
Plaza Blanca is a small ditch serving 170 acres. It is the furthest downstream ditch measured by OSE. The main river diversion was washed out from floods in previous years. The ditch now relies on the gravel company across the river to build a large rock dam each season after the spring snowmelt has passed. This structure typically washes out after the first major summer storm. This infrastructure issue drastically limits the amount of water Plaza Blanca can divert. The lack of a river gate also means that when the river rises during storm events, Plaza Blanca will receive some water in exceedance of their curtailment limits. Flood flows accounted for the 28.7 acre foot diversion in July. Plaza Blanca could not operate at low flows so did not receive livestock water. Irrigated parcels off Plaza Blanca are located directly along the Rio Chama.

Table 14 shows monthly diversions for Plaza Blanca. Figure 23 is a graph of measured diversions and the curtailment limit and Figure 24 shows monthly irrigation diversions and monthly estimated IWR for lands served by Plaza Blanca.

Table 14: Plaza Blanca Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	83.85	0.00
May	24.70	0.00
June	215.67	0.00
July	28.70	0.00
August	0.00	0.00
September	0.00	0.00
October	0.00	0.00

Figure 23: Plaza Blanca Diversion Hydrograph and Curtailment Limit



Most of the June diversion came form June 7th to June 10th. The rock dam pushed too much water down ditch overtopping the ditch in some places. Plaza Blanca returns its tailwater directly back to the Rio Chama. Much of this surge went unused and returned directly to the Rio Chama as tailwater. The July diversions came from rain events. Its unknown if users were able to spread this water or if it all returned as tailwater.

Figure 24: Plaza Blanca Monthly Irrigation Diversion and Estimated Irrigation Water Requirement

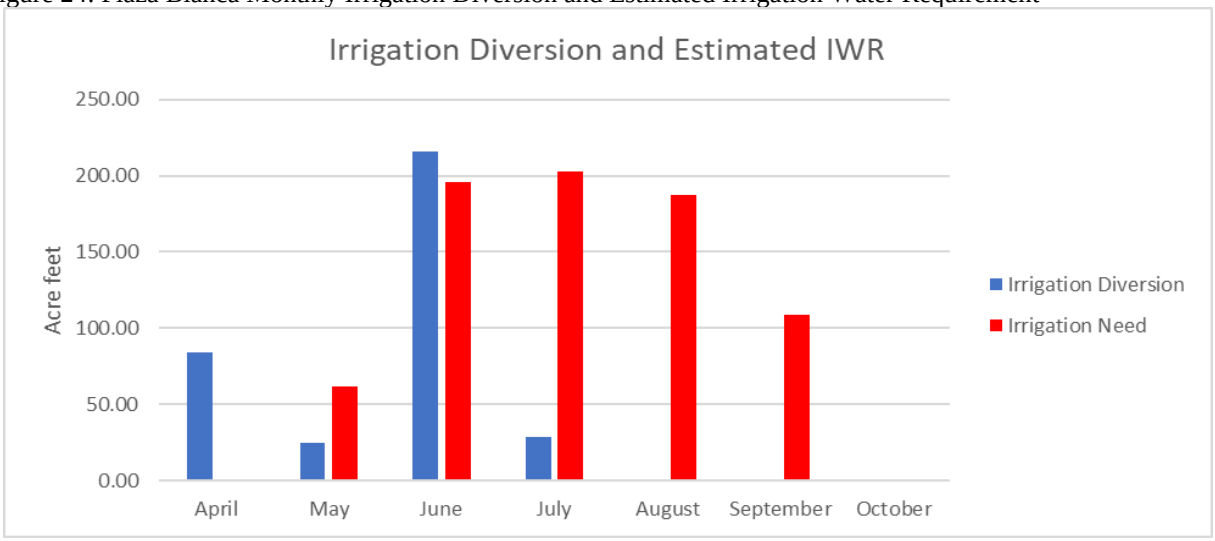


Table 15: Plaza Blanca Daily Average Diversion Data

Plaza Blanca Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	4.13	0.02	3.94	0.00	0.00	0.00	0.00
2	5.06	0.00	3.20	0.00	0.00	0.00	0.00
3	5.33	0.00	1.87	0.00	0.00	0.00	0.00
4	5.23	0.00	1.16	0.00	0.00	0.00	0.00
5	5.22	0.00	0.71	0.00	0.00	0.00	0.00
6	1.13	0.00	9.65	0.00	0.00	0.00	0.00
7	0.37	0.00	18.28	0.00	0.00	0.00	0.00
8	0.53	0.00	15.06	0.00	0.00	0.00	0.00
9	1.32	0.00	12.81	0.00	0.00	0.00	0.00
10	1.07	0.00	10.10	0.00	0.00	0.00	0.00
11	1.16	0.00	7.55	0.00	0.00	0.00	0.00
12	1.80	0.02	5.79	0.00	0.00	0.00	0.00
13	0.61	0.08	4.74	0.00	0.00	0.00	0.00
14	0.07	0.15	3.57	0.00	0.00	0.00	0.00
15	0.06	0.29	2.18	0.00	0.00	0.00	0.00
16	0.08	0.32	2.09	0.00	0.00	0.00	0.00
17	0.02	0.34	2.46	0.00	0.00	0.00	0.00
18	0.46	0.34	1.70	1.85	0.00	0.00	0.00
19	0.35	0.24	1.37	3.13	0.00	0.00	0.00
20	0.42	0.15	0.51	1.30	0.00	0.00	0.00
21	1.76	0.20	0.00	0.05	0.00	0.00	0.00
22	2.09	0.11	0.00	0.00	0.00	0.00	0.00
23	2.36	0.21	0.00	0.00	0.00	0.00	0.00
24	0.95	0.08	0.00	0.00	0.00	0.00	0.00
25	0.37	0.70	0.00	1.50	0.00	0.00	0.00
26	0.27	1.28	0.00	4.53	0.00	0.00	0.00
27	0.04	0.99	0.00	2.11	0.00	0.00	0.00
28	0.00	1.04	0.00	0.00	0.00	0.00	0.00
29	0.01	1.20	0.00	0.00	0.00	0.00	0.00
30	0.01	1.59	0.00	0.00	0.00	0.00	0.00
31		3.11		0.00	0.00		0.00
Average (CFS)	1.41	0.40	3.63	0.47	0.00	0.00	0.00

I. Canones Creek 1

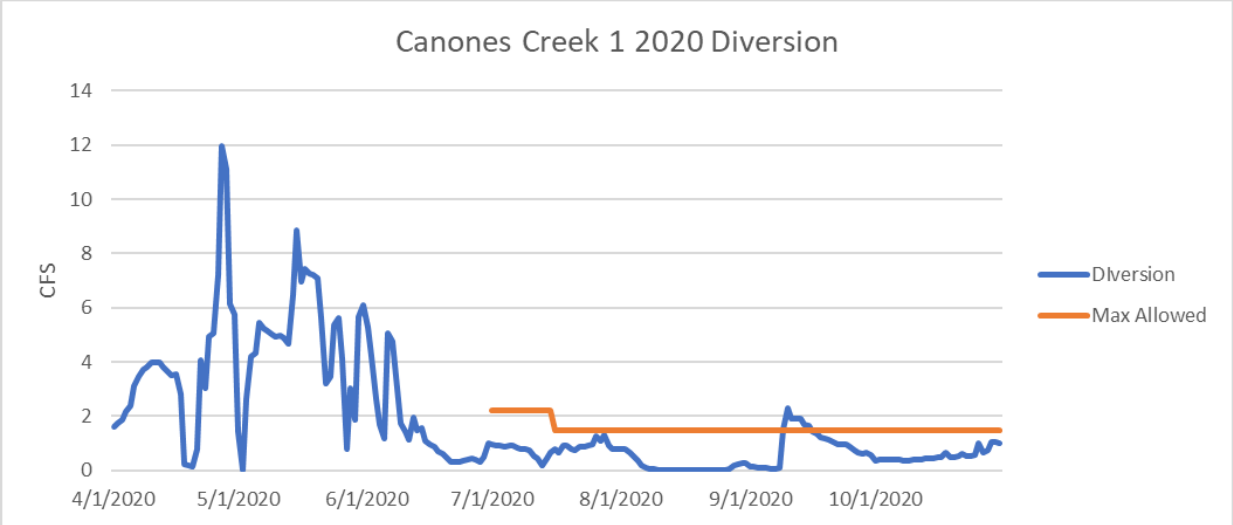
Canones Creek 1 is the largest ditch off Canones Creek, a perennial tributary to the Rio Chama. It is also the only Canones Creek diversion metered by OSE. The acreage listed in the adjudication for irrigated land served by Canones Creek 1 contains discrepancies when compared to acreages listed in the New Mexico Water Rights Reporting System. The ditch serves somewhere between 209 and 535 acres. This report will use 209 acres. Tailwater from Canones Creek 1 enters Barranca Ditch. This diversion takes the entire flow of Canones Creek at low flows.

Table 16 shows monthly diversions for Canones Creek 1. Figure 25 is a graph of measured diversions and the curtailment limit and Figure 26 shows monthly irrigation diversions and monthly estimated IWR for lands served by Canones Creek 1. Table 17 shows daily average diversions for Canones Creek 1.

Table 16: Canones Creek #1 Monthly Diversion in acre-feet

	Irrigation Volume	Stock Volume
April	225.49	0.00
May	295.60	0.00
June	91.91	0.00
July	21.72	28.95
August	0.00	9.08
September	0.00	55.82
October	0.00	33.61

Figure 25: Canones Creek 1 Diversion Hydrograph and Curtailment Limit



Measurement contained a period of zero flow from August 8th to the 27th. The water master believed this was due to drought conditions, but Canones Creek users complained of upstream diversions in mid-August. The water master investigated the complaint and found one person irrigating approximately five acres. Within one week, this person had to be turned off twice. The irrigator finally complied, and the issues ceased. This person had no livestock to support. The

water master will patrol upper Canones Creek diversions more often in 2021, especially if Canones Creek 1 approaches 0 CFS.

Figure 26: Canones Creek 1 Monthly Irrigation Diversion and Estimated Irrigation Water Requirement

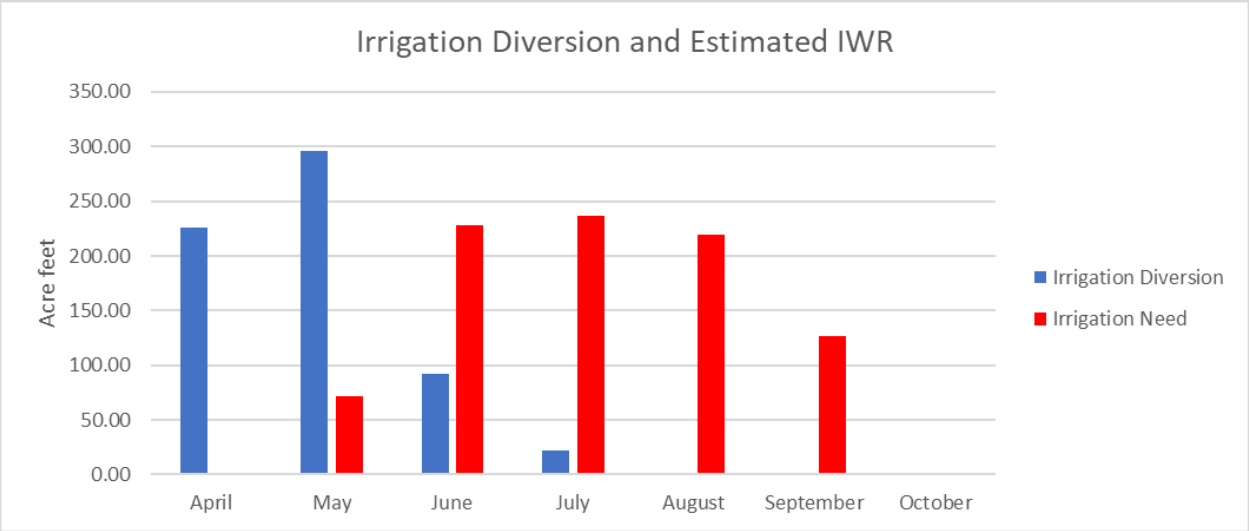


Table 17: Canones Creek 1 Daily Average Diversion Data

Canones Creek #1 Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	1.60	1.42	5.26	0.96	0.79	0.15	0.37
2	1.75	0.03	4.21	0.92	0.80	0.13	0.39
3	1.86	2.64	2.63	0.91	0.65	0.10	0.40
4	2.16	4.19	1.69	0.89	0.54	0.12	0.41
5	2.38	4.34	1.19	0.91	0.36	0.09	0.41
6	3.13	5.45	5.06	0.92	0.18	0.07	0.41
7	3.48	5.23	4.77	0.85	0.12	0.07	0.40
8	3.70	5.15	3.05	0.81	0.07	0.12	0.37
9	3.80	5.01	1.72	0.78	0.04	1.52	0.36
10	3.97	4.92	1.44	0.72	0.01	2.31	0.39
11	3.98	4.97	1.15	0.55	0.00	1.90	0.40
12	3.97	4.87	1.94	0.44	0.00	1.91	0.41
13	3.83	4.68	1.50	0.17	0.00	1.90	0.44
14	3.64	6.49	1.58	0.46	0.00	1.71	0.44
15	3.50	8.88	1.09	0.66	0.00	1.67	0.47
16	3.55	6.94	0.97	0.79	0.00	1.45	0.48
17	2.82	7.44	0.89	0.65	0.00	1.35	0.49
18	0.21	7.25	0.71	0.90	0.00	1.24	0.64
19	0.18	7.22	0.64	0.90	0.00	1.16	0.47
20	0.16	7.07	0.50	0.80	0.00	1.13	0.50
21	0.81	5.63	0.33	0.73	0.00	1.04	0.55
22	4.07	3.20	0.33	0.87	0.00	0.96	0.63
23	3.03	3.48	0.33	0.90	0.00	0.94	0.51
24	4.91	5.34	0.34	0.91	0.01	0.95	0.55
25	5.07	5.60	0.38	0.96	0.01	0.87	0.58
26	7.23	4.13	0.44	1.25	0.02	0.75	1.02
27	11.98	0.79	0.39	1.11	0.05	0.68	0.64
28	11.09	3.05	0.33	1.29	0.19	0.64	0.76
29	6.13	1.85	0.47	0.94	0.22	0.66	1.03
30	5.73	5.68	1.01	0.81	0.25	0.59	1.04
31		6.09		0.79	0.27		0.99
Average (CFS)	3.79	4.81	1.54	0.82	0.15	0.94	0.55

J. Parkview

Parkview is one of the larger and more senior ditches in the upper basin. Parkview shares its diversion on the Rio Brazos with Ensenada and Porvenir. La Puente Ditch also shares the diversion and uses Parkview to transport La Puente's share to the start of their ditch at the tail end of Parkview. Parkview worked well with OSE field staff to ensure only stock use by Parkview Ditch members. Table 18 shows monthly diversions for Parkview.

Table 18: Parkview Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	368.07	0.00
May	2078.98	0.00
June	1071.38	0.00
July	226.30	111.60
August	0.00	134.98
September	0.00	141.34
October	0.00	186.48
Total	3744.73	574.40

Parkview irrigates 979.73 acres. Parkview diverted a total of 4,319 acre-feet in 2020 with 3,745 acre-feet diverted for irrigation and 574 acre feet diverted for stock use. Parkview diverted 2,079 acre-feet in May. Although tailwater is unmeasured, it is likely a large portion of the May diversion returned directly to the Rio Chama.

The Parkview 2020 hydrograph (Figure 27) is provided below. Most diversions took place from May to the end of June. Once curtailment began on July 1st, Parkview remained at their allotted curtailment diversions. Only one user was found irrigating during the livestock use curtailment period. The user's irrigation was turned off and their four acres were monitored closely for the remainder of curtailment. The monthly diversion is graphed against the estimated IWR needs for the ditch (Figure 28). This graph shows that crop needs were met in April, May, and June. Crop needs were not met in July and no irrigation took place in August or September. Based on this graph, Parkview users should have had a 40% of average yield. The Parkview Mayordomo reported less than half his average yield.

Parkview stock water return flow was unmeasured. Parkview does gain from Ensenada tailwater. Visual checks estimated 1 to 3 CFS returning to the Rio Chama during the stock water only curtailment period.

Figure 27: Parkview Diversion Hydrograph and Curtailment Limit

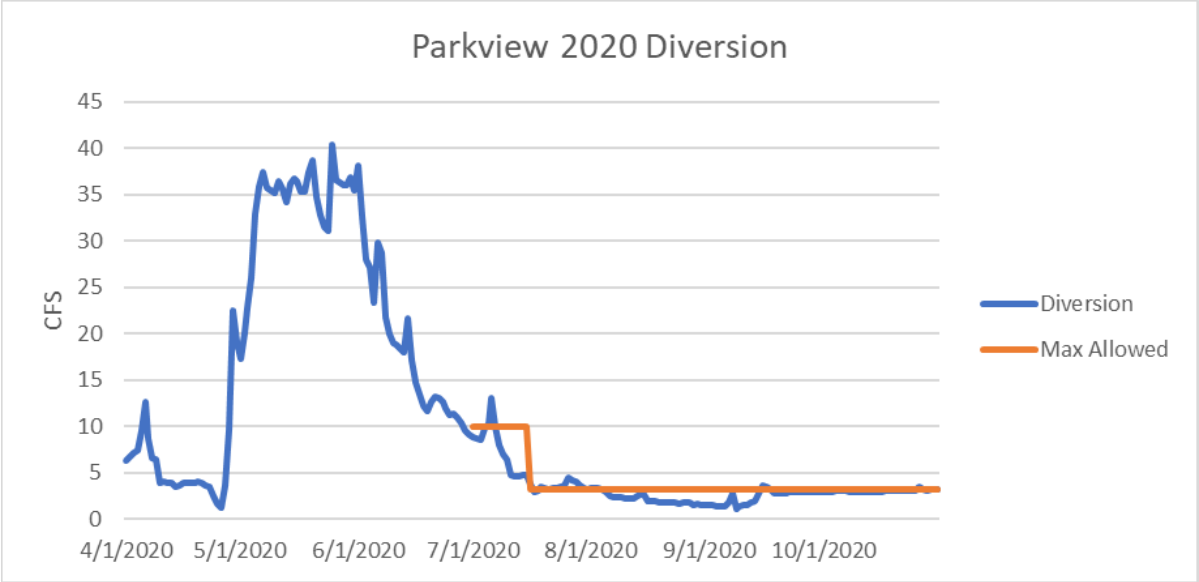


Figure 28: Parkview Monthly Irrigation Diversions and Estimated Irrigation Water Requirement

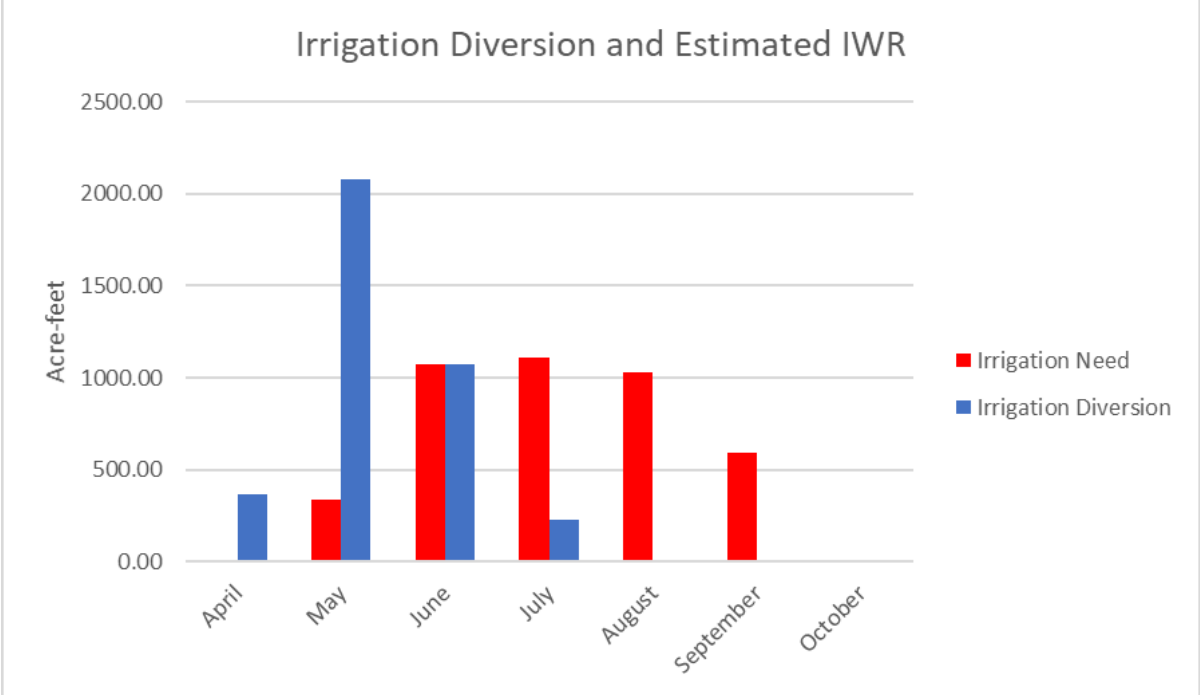


Table 19 shows daily average diversions for Parkview.

Table 19: Parkview Daily Average Diversion Data

Parkview Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	6.35	17.35	38.05	8.82	3.29	1.48	2.93
2	6.76	20.04	32.62	8.66	3.33	1.47	2.94
3	7.10	22.78	27.97	8.52	3.33	1.44	2.99
4	7.37	26.03	27.09	9.88	3.20	1.36	3.05
5	9.57	32.96	23.33	10.19	2.96	1.36	3.05
6	12.68	35.80	29.76	13.02	2.56	1.80	3.05
7	8.66	37.43	28.71	10.01	2.39	2.79	3.05
8	6.59	35.77	21.72	8.05	2.39	1.11	2.98
9	6.49	35.44	19.94	7.06	2.37	1.40	2.92
10	3.97	35.09	18.96	6.41	2.27	1.51	2.92
11	3.99	36.43	18.82	4.80	2.25	1.44	2.92
12	3.89	35.52	18.43	4.65	2.15	1.73	2.91
13	3.86	34.20	17.98	4.60	2.44	2.00	2.91
14	3.51	36.10	21.63	4.76	2.65	2.76	2.89
15	3.68	36.69	17.11	4.71	2.64	3.62	2.90
16	3.86	36.46	14.79	3.74	1.94	3.46	2.91
17	3.94	35.36	13.53	2.92	1.91	3.15	3.01
18	3.97	35.23	12.26	3.12	1.90	2.84	3.05
19	3.96	37.44	11.67	3.47	1.80	2.78	3.05
20	4.02	38.64	12.58	3.32	1.80	2.76	3.05
21	3.95	34.71	13.24	3.24	1.81	2.79	3.05
22	3.68	32.79	13.00	3.31	1.80	2.90	3.05
23	3.45	31.54	12.57	3.27	1.80	2.92	3.05
24	2.49	31.13	11.91	3.48	1.70	2.92	3.05
25	1.70	40.37	11.19	3.62	1.74	2.92	3.07
26	1.30	36.52	11.36	4.42	1.82	2.92	3.41
27	3.55	36.29	11.00	4.17	1.72	2.92	3.16
28	9.65	35.95	10.36	4.10	1.58	2.92	3.10
29	22.53	36.05	9.58	3.63	1.60	2.92	3.21
30	19.08	36.83	9.16	3.28	1.47	2.92	3.22
31		35.48		3.20	1.47		3.19
Average (CFS)	6.19	33.82	18.01	5.50	2.20	2.38	3.03

K. Ensenada

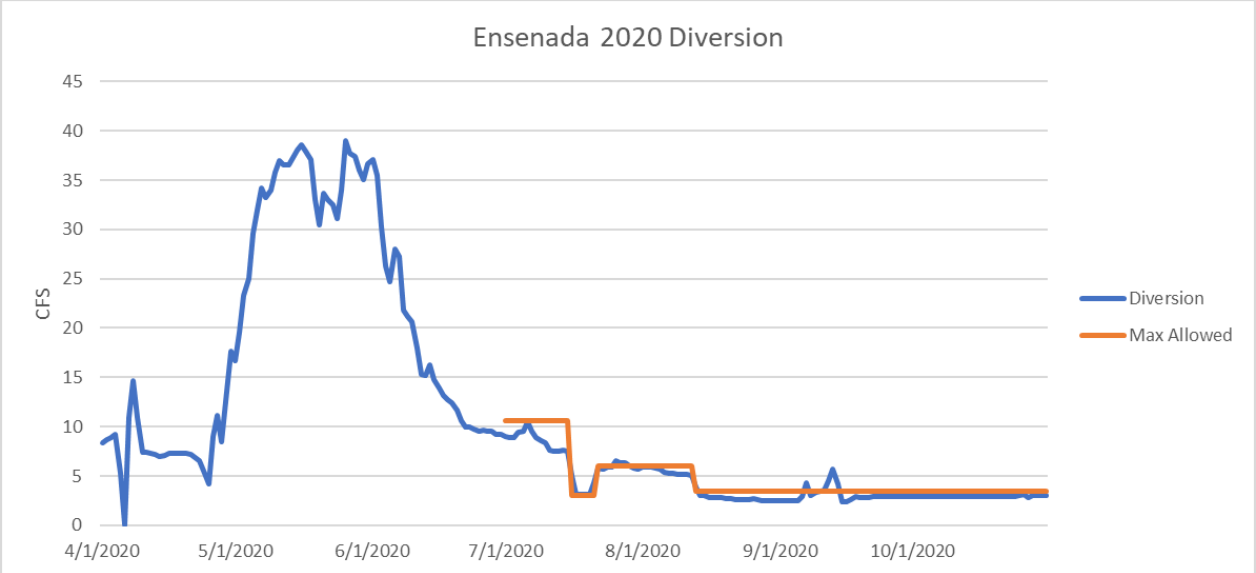
Ensenada is a large senior ditch off the Rio Brazos and shares a main diversion with Parkview and Porvenir. Ensenada has about 1,100 irrigated acres, and one of the few center pivot and side roll systems in the upper basin. The tailwater of Ensenada joins the very end of Parkview. Table 20 shows monthly diversions for Ensenada.

Table 20: Ensenada Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	489.38	0.00
May	2046.55	0.00
June	1017.37	0.00
July	375.81	43.38
August	130.05	104.12
September	0.00	183.92
October	0.00	180.88

Ensenada was originally provided 3 CFS for livestock use, but the ditch argued that this was not sufficient since the ditch splits into three ditches, all of which had livestock. On July 21st, their livestock rate was increased to 6 CFS. Soon after, irrigators on other ditches reported seeing irrigation and the water master found active flood irrigation. The livestock rate was reduced back to 3 CFS on August 13th. The ditch was turned up by someone from September 12th to the 14th. The water master discovered more flood irrigation on September 14th and turned the ditch back down to 3 CFS. The main ditch was measured immediately before it splits into three. The entire diverted flow was found at this location indicating minimal losses between the headgate and the split. Even when no irrigation was occurring, very little flow was seen leaving Ensenada. On livestock only days, Ensenada was losing approximately 80% of its flow. This high loss rate needs to be further explored in 2021. Figure 29 is a graph of measured diversions and the curtailment limit.

Figure 29: Ensenada Diversion Hydrograph and Curtailment Limit



Ensenada diversions were under the estimated IWR in all months except April and May. Field observations saw good cuts along the upper fields before the split in Ensenada. Fields down ditch of the split had little growth this year and some were never irrigated. Figure 30 shows monthly irrigation diversions and monthly estimated IWR ofr acres served by Ensenada. Table 21 shows daily average diversions for Ensenada.

Figure 30: Ensenada Monthly Irrigation Diversions and Estimated Irrigation Water Requirement

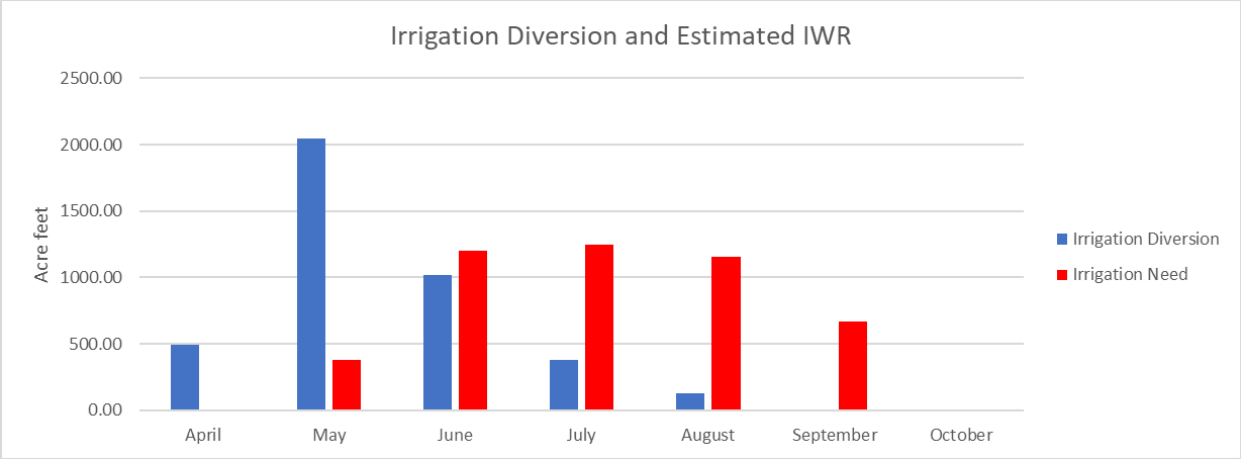


Table 21: Ensenada Daily Average Diversion Data

Ensenada Daily Average Flow (CFS)							
	April	**May**	**June**	**July**	**August**	**September**	**October**
1	8.40	16.73	37.11	8.96	5.86	2.52	2.92
2	8.73	19.59	35.53	8.91	5.88	2.52	2.92
3	8.94	23.29	30.27	8.90	5.88	2.48	2.92
4	9.22	25.00	26.25	9.41	5.77	2.52	2.92
5	5.29	29.64	24.64	9.54	5.70	2.52	2.92
6	0.00	31.95	28.00	10.47	5.42	2.96	2.92
7	10.95	34.19	27.30	9.55	5.30	4.27	2.92
8	14.62	33.28	21.82	8.87	5.24	2.99	2.92
9	10.96	33.98	21.21	8.61	5.19	3.38	2.92
10	7.43	35.84	20.62	8.32	5.19	3.45	2.92
11	7.39	36.97	17.95	7.59	5.15	3.56	2.92
12	7.24	36.58	15.26	7.52	5.02	4.57	2.92
13	7.18	36.53	15.16	7.52	3.89	5.70	2.92
14	6.98	37.25	16.29	7.62	3.05	4.24	2.92
15	7.12	38.06	14.81	7.54	3.05	2.41	2.92
16	7.25	38.61	13.87	5.05	2.79	2.39	2.92
17	7.28	37.95	13.20	3.13	2.78	2.64	2.92
18	7.35	37.05	12.74	3.11	2.78	2.91	2.92
19	7.28	32.99	12.45	3.18	2.78	2.83	2.93
20	7.25	30.42	11.66	3.10	2.68	2.79	2.92
21	7.17	33.67	10.60	4.31	2.71	2.85	2.92
22	6.84	33.01	9.95	5.79	2.65	2.92	2.92
23	6.54	32.50	9.94	5.70	2.65	2.92	2.92
24	5.30	31.12	9.74	5.88	2.65	2.92	2.92
25	4.18	33.95	9.53	5.96	2.65	2.92	3.04
26	9.00	38.99	9.62	6.52	2.67	2.92	3.12
27	11.15	37.77	9.54	6.37	2.60	2.92	2.83
28	8.48	37.35	9.49	6.36	2.53	2.92	3.05
29	13.61	36.00	9.27	6.06	2.53	2.92	3.07
30	17.65	35.09	9.22	5.84	2.52	2.92	3.05
31		36.70		5.72	2.52		3.05
Average (CFS)	8.23	33.29	17.10	6.82	3.81	3.09	2.94

L. MB

Martin and Borders (MB) is one of the largest and most junior ditches in the upper basin. MB serves 1,070 irrigated acres. The main diversion is located on the Rio Chama just north of the Village of Chama making MB the most upstream diversion in the basin. MB also has a second diversion point on the Rio Chamita which can provide additional water as the ditch crosses the stream. The Rio Chamita dried in July this year. MB also delivers water to Chama Town Ditch. The OSE station is located after the Rio Chamita crossing and does not include Chama Town ditch diversions which are measured by a different station. MB branches into two main ditches. The tailwater of one branch fills livestock ponds and then returns to the Rio Chama. The tailwater of the other fills livestock and recreational ponds before dropping into the Willow Creek basin. Any tailwater sent to Willow Creek is lost to the basin and cannot be used by the RCAA under the current accounting methods. Table 22 shows monthly diversions for MB.

Table 22: MB Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	11.32	0.00
May	937.83	0.00
June	653.90	0.00
July	232.30	0.00
August	0.00	0.00
September	0.00	0.00
October	0.00	0.00

MB was offered stock water at 3 CFS but turned it down. MB stated that at that flow rate the ditch experiences significant beaver issues. If MB were to accept water for livestock in future curtailment periods, it would reduce the native flow at USGS La Puente significantly. This year 3 CFS would have been an 8 to 15% reduction in native flow available to the RCAA on any given day. Figure 31 is a graph of measured diversions and the curtailment limit for MB.

Figure 31: MB Diversion Hydrograph and Curtailment Limit

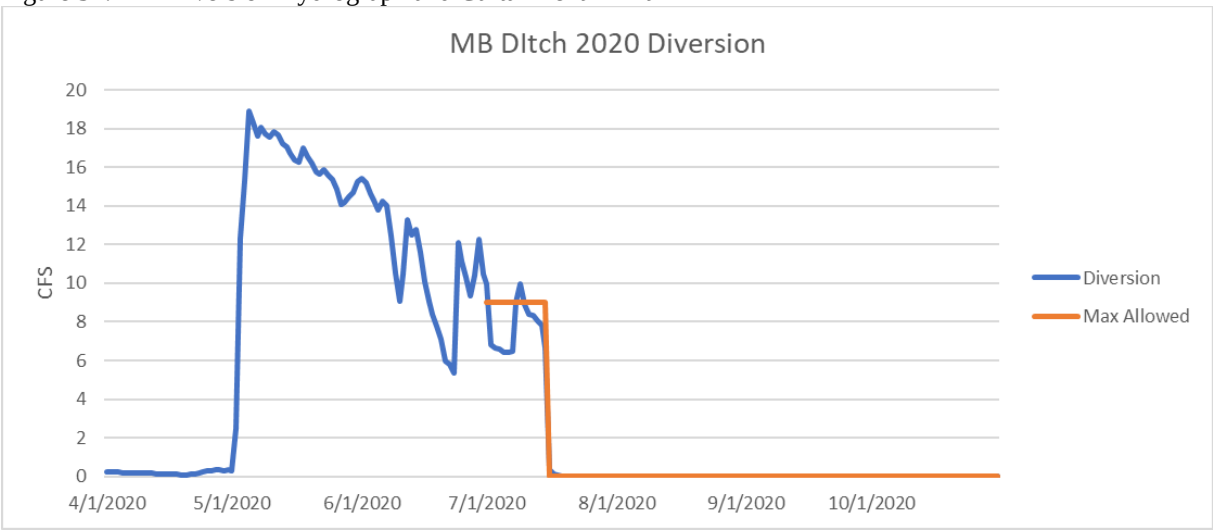
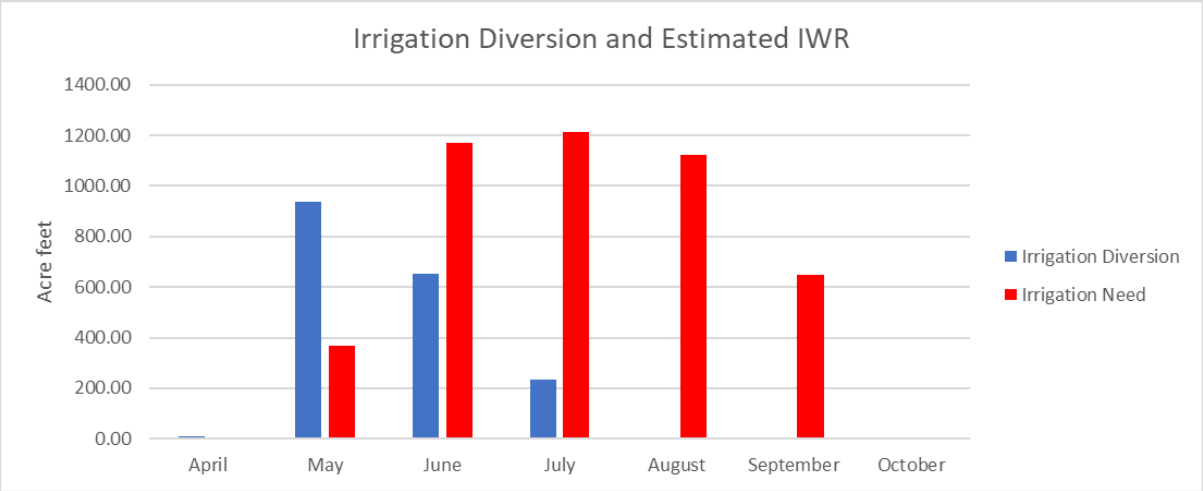


Figure 32 shows monthly irrigations diversions and monthly estimated IWR for lands served by MB.

Figure 32: MB Monthly Irrigation Diversions and Estimated Irrigation Water Requirement



MB diverted enough water to satisfy its estimated IWR only in May. No yields were reported, but crop growth would have been significantly reduced from insufficient irrigation. Table 23 shows daily average diversions for MB.

Table 23: MB Daily Average Diversion Data

MB Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.21	0.27	15.41	9.98	0.00	0.00	0.00
2	0.23	2.46	15.18	6.82	0.00	0.00	0.00
3	0.22	12.31	14.64	6.64	0.00	0.00	0.00
4	0.22	15.31	14.27	6.56	0.00	0.00	0.00
5	0.19	18.93	13.80	6.43	0.00	0.00	0.00
6	0.19	18.28	14.24	6.45	0.00	0.00	0.00
7	0.18	17.59	14.04	6.45	0.00	0.00	0.00
8	0.19	18.06	12.45	9.03	0.00	0.00	0.00
9	0.19	17.72	10.50	9.96	0.00	0.00	0.00
10	0.17	17.53	9.07	8.89	0.00	0.00	0.00
11	0.16	17.81	10.48	8.41	0.00	0.00	0.00
12	0.16	17.69	13.29	8.33	0.00	0.00	0.00
13	0.14	17.20	12.51	8.03	0.00	0.00	0.00
14	0.12	17.02	12.78	7.84	0.00	0.00	0.00
15	0.11	16.69	11.57	6.66	0.00	0.00	0.00
16	0.10	16.37	10.06	0.37	0.00	0.00	0.00
17	0.12	16.25	9.05	0.13	0.00	0.00	0.00
18	0.11	17.00	8.37	0.07	0.00	0.00	0.00
19	0.08	16.52	7.77	0.03	0.00	0.00	0.00
20	0.07	16.23	7.10	0.02	0.00	0.00	0.00
21	0.10	15.74	5.95	0.01	0.00	0.00	0.00
22	0.11	15.67	5.82	0.01	0.00	0.00	0.00
23	0.19	15.89	5.33	0.01	0.00	0.00	0.00
24	0.24	15.59	12.11	0.00	0.00	0.00	0.00
25	0.28	15.36	11.12	0.00	0.00	0.00	0.00
26	0.32	14.84	10.28	0.02	0.00	0.00	0.00
27	0.34	14.06	9.37	0.00	0.00	0.00	0.00
28	0.33	14.17	10.41	0.00	0.00	0.00	0.00
29	0.31	14.46	12.30	0.00	0.00	0.00	0.00
30	0.33	14.70	10.48	0.00	0.00	0.00	0.00
31		15.23		0.00	0.00		0.00
Average (CFS)	0.19	15.26	10.99	3.78	0.00	0.00	0.00

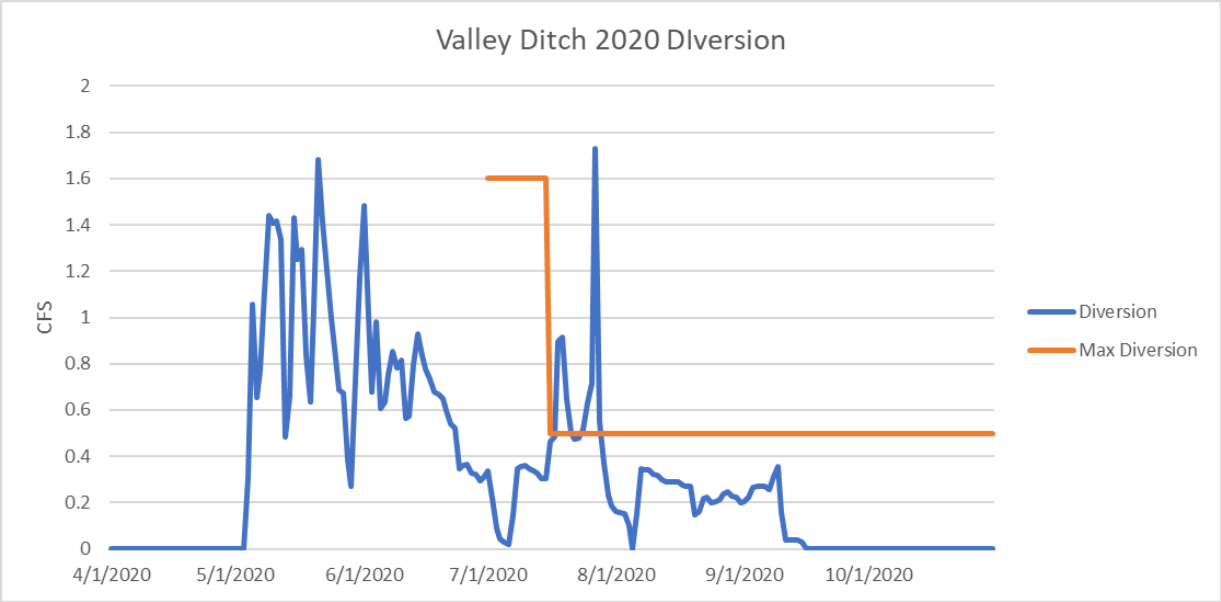
M. Valley

Valley is a small private ditch serving 150 acres with a diversion immediately downstream and south of the Village of Chama. No contact was made with this ditch in 2020. The water master did not observe much irrigation. A few livestock were present in pastures along the ditch. Contacts need to be established with this ditch in 2021 and the livestock use needs verified to determine an appropriate flow for only livestock. Table 24 shows monthly diversion for Valley. Figure 33 is a graph of measured diversions and the curtailment limit and Figure 34 shows monthly irrigation diversions and monthly estimated IWR for lands served by Valley.

Table 24: Valley Monthly Diversions in acre-feet

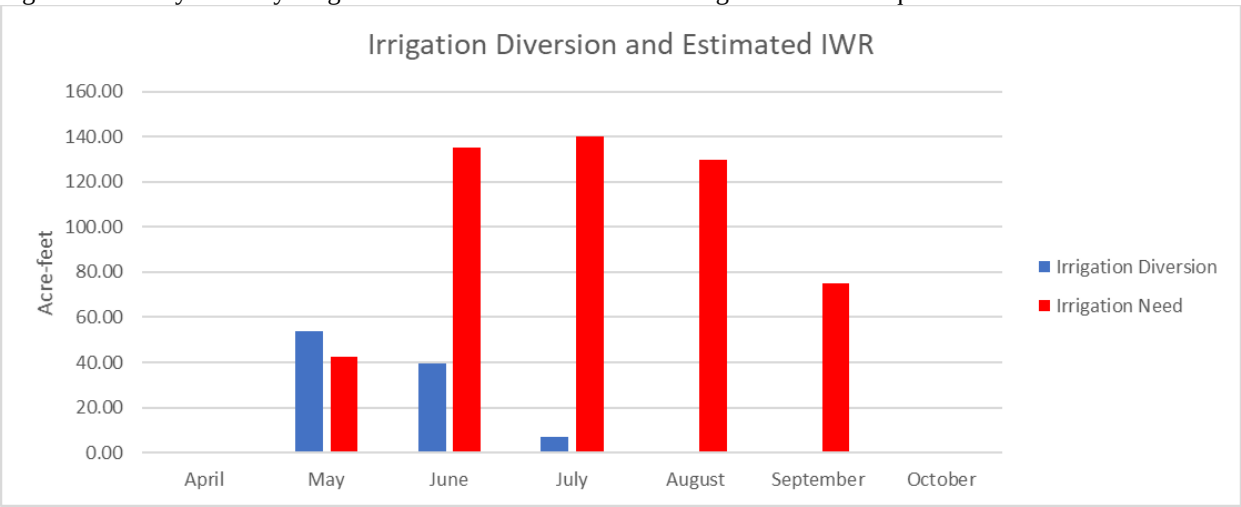
	Irrigation Volume	Stock Volume
April	0.00	0.00
May	53.96	0.00
June	39.26	0.00
July	7.06	19.42
August	0.00	14.21
September	0.00	5.48
October	0.00	0.00

Figure 33: Valley Diversion Hydrograph and Curtailment Limit



The discharge spikes in mid and late July were caused by elevated Rio Chama flows from rain events and not intentional changes at the river diversion.

Figure 34: Valley Monthly Irrigation Diversions and Estimated Irrigation Water Requirement



Valley diverted enough water to satisfy estimated IWR only in May. The water master did not observe any hay cuttings made on Valley acreage and no yields were reported. Table 25 shows daily average diversions for Valley.

Table 25: Valley Daily Average Diversion Data

Valley Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.00	0.00	1.49	0.34	0.16	0.20	0.00
2	0.00	0.00	1.01	0.22	0.16	0.22	0.00
3	0.00	0.00	0.68	0.09	0.15	0.27	0.00
4	0.00	0.31	0.98	0.05	0.10	0.27	0.00
5	0.00	1.06	0.61	0.03	0.00	0.27	0.00
6	0.00	0.66	0.64	0.02	0.15	0.27	0.00
7	0.00	0.77	0.75	0.15	0.35	0.26	0.00
8	0.00	1.11	0.86	0.35	0.34	0.31	0.00
9	0.00	1.44	0.78	0.36	0.34	0.36	0.00
10	0.00	1.41	0.81	0.36	0.32	0.16	0.00
11	0.00	1.42	0.56	0.35	0.32	0.04	0.00
12	0.00	1.34	0.57	0.34	0.30	0.04	0.00
13	0.00	0.48	0.80	0.33	0.29	0.04	0.00
14	0.00	0.66	0.93	0.30	0.29	0.04	0.00
15	0.00	1.43	0.83	0.30	0.29	0.03	0.00
16	0.00	1.25	0.78	0.46	0.29	0.00	0.00
17	0.00	1.30	0.74	0.48	0.28	0.00	0.00
18	0.00	0.83	0.68	0.90	0.27	0.00	0.00
19	0.00	0.64	0.67	0.92	0.27	0.00	0.00
20	0.00	1.03	0.65	0.64	0.15	0.00	0.00
21	0.00	1.68	0.60	0.50	0.16	0.00	0.00
22	0.00	1.41	0.54	0.47	0.22	0.00	0.00
23	0.00	1.20	0.52	0.48	0.22	0.00	0.00
24	0.00	1.00	0.35	0.52	0.20	0.00	0.00
25	0.00	0.87	0.36	0.63	0.20	0.00	0.00
26	0.00	0.69	0.37	0.71	0.21	0.00	0.00
27	0.00	0.67	0.33	1.73	0.23	0.00	0.00
28	0.00	0.38	0.32	0.55	0.25	0.00	0.00
29	0.00	0.27	0.30	0.37	0.23	0.00	0.00
30	0.00	0.73	0.31	0.23	0.22	0.00	0.00
31		1.17		0.18	0.20		0.00
Average (CFS)	0.00	0.88	0.66	0.43	0.23	0.09	0.00

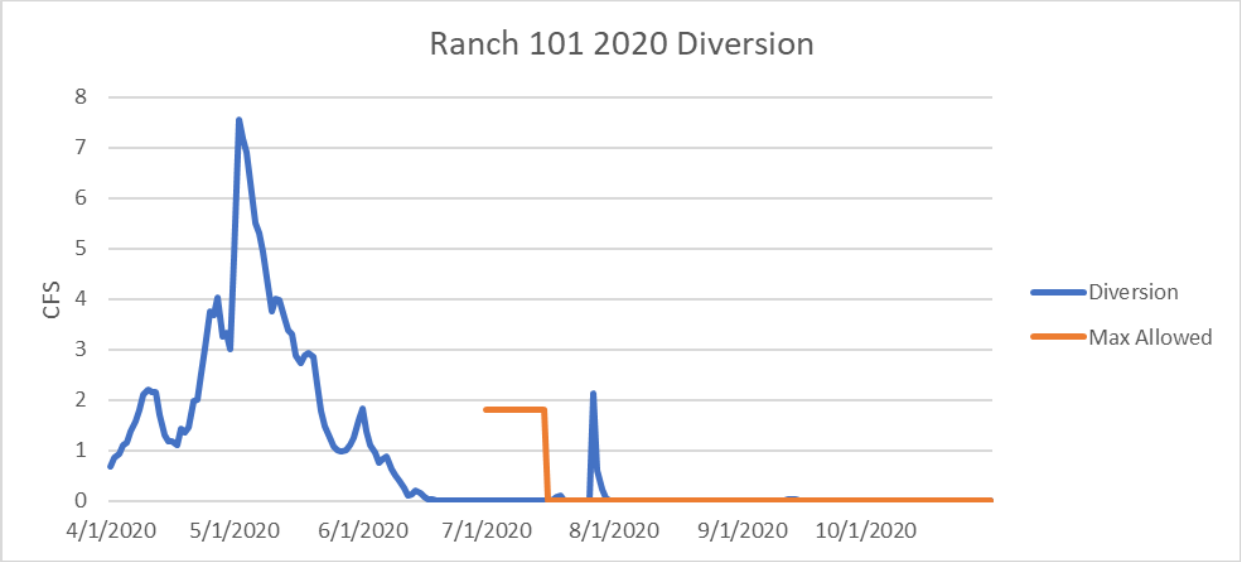
N. Ranch 101

Ranch 101 is a small private ditch off the Rio Chama serving 167.4 acres and a couple of fish and livestock ponds. The Ranch 101 diversion does not operate at low flows. Not all 167 acres were in production in 2020. One user reported having enough water to irrigate only half his acres. Those acres produced only 20 to 30% of the normal yield. The upper section of the ditch is overgrown and needs maintenance. Table 26 shows monthly diversions for Ranch 101. Figure 35 is a graph of measured diversions into Ranch 101 and the curtailment limit.

Table 26: Ranch 101 Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	117.61	0.00
May	206.07	0.00
June	20.21	0.00
July	0.00	6.41
August	0.00	0.00
September	0.00	0.21
October	0.00	0.00

Figure 35: Ranch 101 Diversion Hydrograph and Curtailment Limit



The flow spike at the very end of July was the result of a storm event that increased Rio Chama flows to an operable level for Ranch 101. These three days of flow during curtailment allowed the livestock and fish ponds to refill. The fish were beginning to die off on Yearout's property with about 50 to 100 dead fish reported. This incidental diversion may have prevented a full die off.

Figure 36 shows monthly irrigation diversions into Ranch 101 and monthly estimated IWR for lands served by the ditch. Table 27 shows daily average diversions for Ranch 101. Ranch 101 diverted enough to satisfy the estimated IWR only in April and May. Crop yield would have been expected to be far below average which is confirmed by one user on the ditch. Of the three largest parcels served by the ditch, the water master observed cutting on only one and a half of the fields.

Figure 36: Ranch 101 Monthly Irrigation Diversions and estimated irrigation Water Requirement

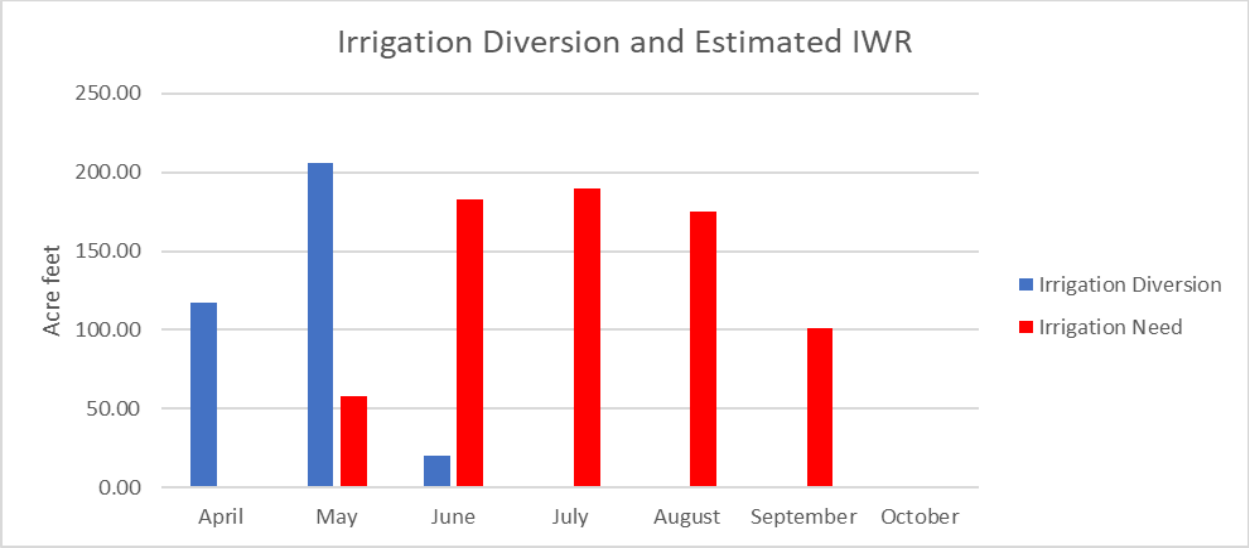


Table 27: Ranch 101 Daily Average Diversion Data

Ranch 101 Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.68	4.83	1.82	0.00	0.00	0.00	0.00
2	0.85	7.55	1.38	0.00	0.00	0.00	0.00
3	0.92	7.17	1.10	0.00	0.00	0.00	0.00
4	1.10	6.91	0.94	0.00	0.00	0.00	0.00
5	1.14	6.30	0.76	0.00	0.00	0.00	0.00
6	1.37	5.50	0.83	0.00	0.00	0.00	0.00
7	1.59	5.32	0.87	0.00	0.00	0.00	0.00
8	1.80	4.93	0.63	0.00	0.00	0.00	0.00
9	2.10	4.25	0.50	0.00	0.00	0.00	0.00
10	2.20	3.76	0.40	0.00	0.00	0.00	0.00
11	2.14	4.02	0.26	0.00	0.00	0.00	0.00
12	2.15	3.97	0.11	0.00	0.00	0.02	0.00
13	1.70	3.64	0.11	0.00	0.00	0.04	0.00
14	1.29	3.37	0.21	0.00	0.00	0.04	0.00
15	1.18	3.31	0.14	0.00	0.00	0.01	0.00
16	1.17	2.88	0.07	0.00	0.00	0.00	0.00
17	1.10	2.74	0.04	0.00	0.00	0.00	0.00
18	1.43	2.89	0.02	0.08	0.00	0.00	0.00
19	1.36	2.94	0.00	0.11	0.00	0.00	0.00
20	1.45	2.86	0.00	0.00	0.00	0.00	0.00
21	1.98	2.30	0.00	0.00	0.00	0.00	0.00
22	2.01	1.78	0.00	0.00	0.00	0.00	0.00
23	2.53	1.47	0.00	0.00	0.00	0.00	0.00
24	3.04	1.25	0.00	0.00	0.00	0.00	0.00
25	3.75	1.09	0.00	0.00	0.00	0.00	0.00
26	3.69	0.99	0.00	0.02	0.00	0.00	0.00
27	4.04	0.97	0.00	2.13	0.00	0.00	0.00
28	3.25	1.00	0.00	0.61	0.00	0.00	0.00
29	3.33	1.10	0.00	0.23	0.00	0.00	0.00
30	3.00	1.24	0.00	0.06	0.00	0.00	0.00
31		1.61		0.00	0.00		0.00
Average (CFS)	1.98	3.35	0.34	0.10	0.00	0.00	0.00

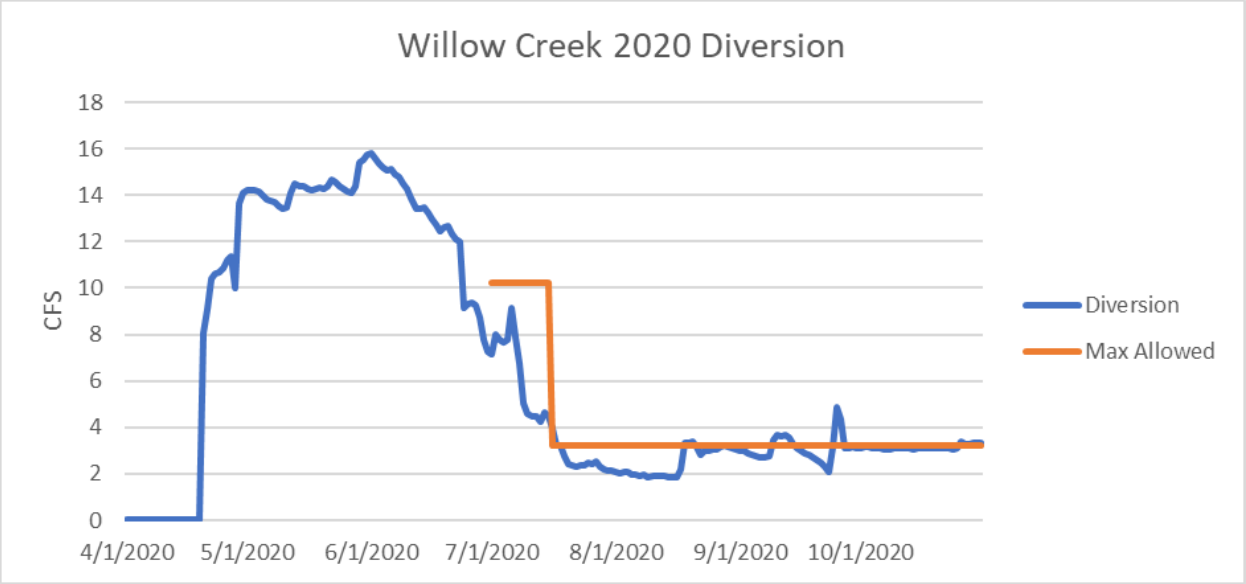
O. Willow Creek Ditch

Willow Creek Ditch is a junior ditch located off the Rio Chama upstream of the confluence with the Rio Brazos. Willow Creek Ditch serves over 1,200 acres making it the largest ditch in the upper basin. Most of Willow Creek Ditch tailwater returns to Willow Creek and Heron Lake. This water bypasses USGS La Puente and is not available to the RCAA for diversion. Willow Creek Ditch followed their curtailment flows very well with only one issue in August. Flows had dropped causing Willow Creek Ditch to fall to 2 CFS. This was not enough to provide livestock water to all users. The adjustment that was made overshot the allowed 3 CFS. Willow Creek Ditch ran at 5 CFS for Friday and Saturday until the ditch readjusted to 3 CFS. One user was reportedly irrigating on Saturday. Table 28 shows monthly diversions for Willow Creek Ditch and Figure 37 is a graph of measured diversions and the curtailment limit.

Table 28: Willow Creek Ditch Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	237.88	0.00
May	877.97	0.00
June	750.97	0.00
July	186.60	81.72
August	18.27	134.57
September	0.00	183.86
October	0.00	193.20

Figure 37: Willow Creek Ditch Diversion Hydrograph and Curtailment Limit



Willow Creek Ditch diversions met the ditch's estimated IWR only in May. Diversions in June reached about 50% of the IWR. Minimal irrigation occurred in July and no significant irrigation happened in August, September, or October. Field observations showed some growth, but few

fields were observed being cut. Figure 38 shows monthly irrigation diversions and monthly estimate IWR.

Figure 38: Willow Creek Ditch Monthly Irrigation Diversions and Estimated Irrigation Water Requirement

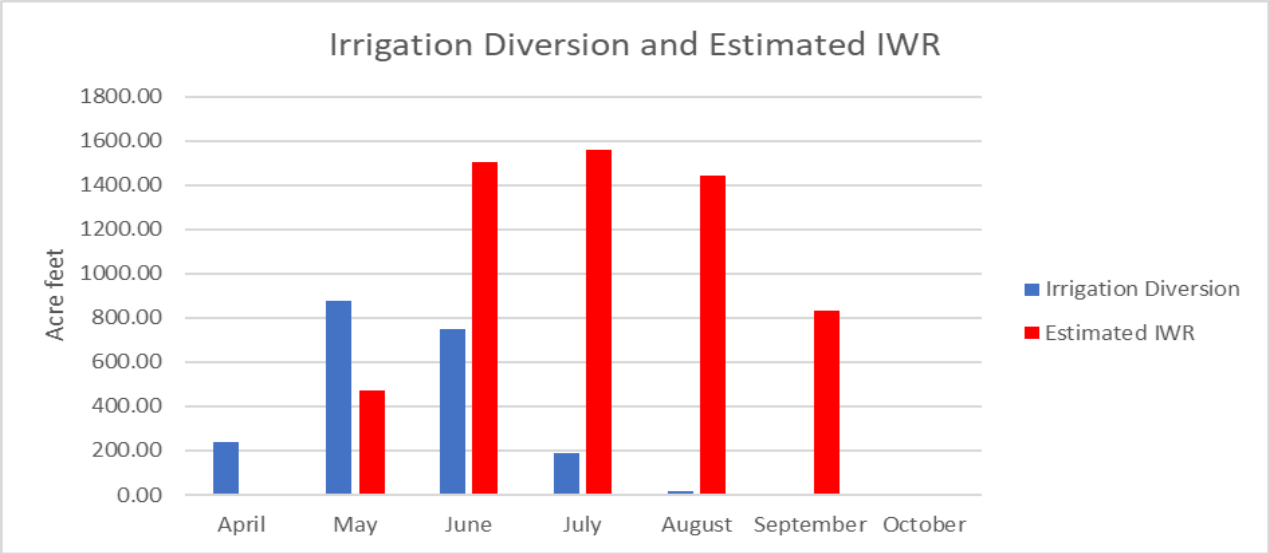


Table 29 shows daily average diversions for Willow Creek Ditch.

Table 29: Willow Creek Daily Average Diversion Data

Willow Creek Daily Average Flow (CFS)							
	April	May	June	July	August	September	October
1	0.00	14.22	15.80	7.16	2.06	3.00	3.10
2	0.00	14.21	15.58	8.01	2.05	3.00	3.14
3	0.00	14.20	15.38	7.79	2.06	2.89	3.16
4	0.00	14.14	15.21	7.66	2.07	2.82	3.11
5	0.00	14.01	15.07	7.78	1.94	2.78	3.10
6	0.00	13.81	15.12	9.13	1.94	2.69	3.08
7	0.00	13.76	14.89	7.91	1.94	2.69	3.06
8	0.00	13.67	14.77	6.74	1.95	2.79	3.06
9	0.00	13.52	14.48	5.03	1.88	3.42	3.11
10	0.00	13.44	14.26	4.59	1.91	3.65	3.12
11	0.00	13.47	13.86	4.45	1.93	3.61	3.10
12	0.00	14.09	13.40	4.48	1.91	3.66	3.11
13	0.00	14.51	13.40	4.26	1.91	3.55	3.09
14	0.00	14.39	13.46	4.63	1.87	3.26	3.08
15	0.00	14.36	13.22	4.46	1.84	3.13	3.10
16	0.00	14.28	12.95	3.96	1.87	2.99	3.10
17	0.00	14.24	12.74	3.20	2.20	2.90	3.11
18	0.00	14.30	12.47	3.21	3.33	2.80	3.11
19	0.00	14.32	12.64	2.77	3.32	2.69	3.12
20	8.03	14.25	12.69	2.43	3.37	2.62	3.11
21	9.10	14.38	12.34	2.35	3.16	2.47	3.09
22	10.37	14.66	12.09	2.33	2.80	2.31	3.08
23	10.63	14.54	11.99	2.35	3.00	2.10	3.08
24	10.70	14.41	9.16	2.37	2.99	3.16	3.07
25	10.83	14.26	9.33	2.45	3.05	4.86	3.09
26	11.21	14.16	9.39	2.42	3.04	4.35	3.38
27	11.35	14.12	9.27	2.55	3.14	3.09	3.25
28	9.99	14.40	8.75	2.31	3.22	3.11	3.27
29	13.63	15.40	7.78	2.22	3.16	3.19	3.34
30	14.12	15.52	7.25	2.16	3.12	3.12	3.35
31		15.74		2.13	3.03		3.35
Average (CFS)	4.00	14.28	12.62	4.36	2.49	3.09	3.14

P. Porvenir

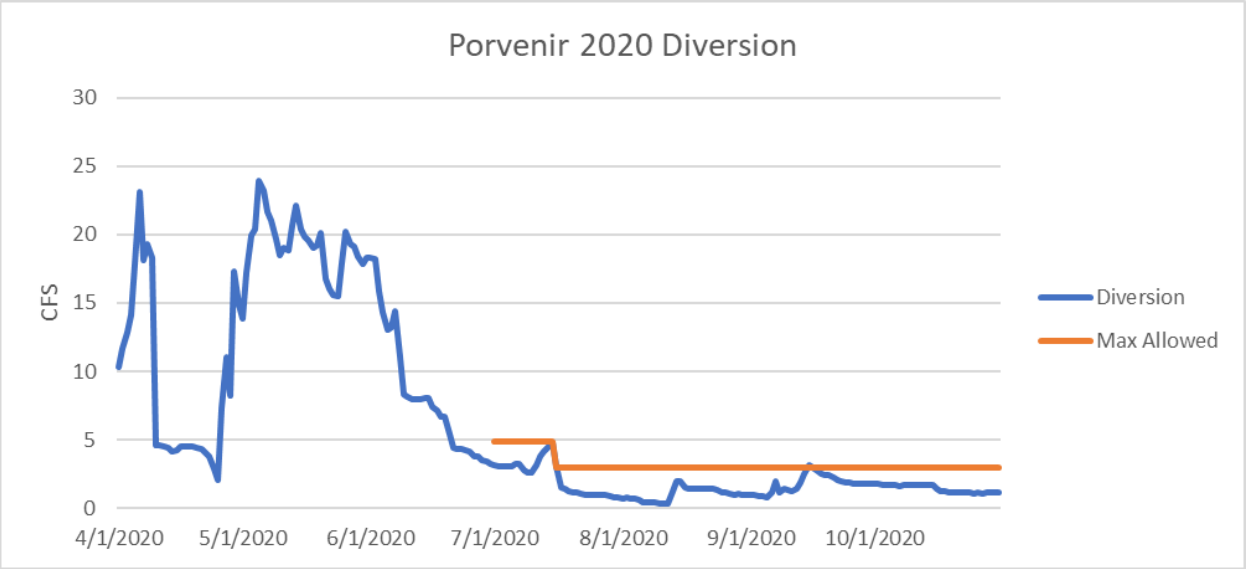
Porvenir is the smallest measured ditch on the Rio Braozs. Porvenir shares its diversion with Ensenada and Parkview. These three ditches have their own ratioed way to share flows with OSE setting a maximum rate during curtailment. Porvenir receives the smallest portion of available flow. Porvenir followed their curtailment allotments throughout the curtailment period. They were given 3 CFS but did not need that amount for livestock needs. Future curtailments should limit Porvenir to 1 CFS for livestock use. Porvenir tailwater returns directly to the Rio Brazos. Field checks showed tailwater reaching the Rio Brazos with minimal losses during shortage sharing. Porvenir may be a gaining ditch from Parkview irrigation return flows. Table 30 shows monthly diversions for Porvenir.

Table 30: Porvenir Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	536.73	0.00
May	1176.15	0.00
June	490.48	0.00
July	99.83	37.65
August	0.00	63.21
September	0.00	106.97
October	0.00	88.70

Figure 39 is a graph of measured diversions into Porvenir and the curtailment limit. Porvenir stayed below the ditch curtailment limit throughout the summer.

Figure 39: Porvenir Diversion Hydrograph and Curtailment Limit



Porvenir exceeded the estimated ditch IWR only in May. No irrigation occurred after July 15th. Porvenir fields looked greener that the diversions would suggest. This could be from gains down ditch from the OSE measurement station from Parkview irrigation or because Porvenir parcels are located directly along the Rio Brazos floodplain providing mature fields access to the shallow groundwater. Figure 40 shows monthly irrigation diversions into Porvenir and monthly estimated IWR for lands served by the ditch. Table 31 shows daily average diversions for Porvenir.

Figure 40: Porvenir Monthly Irrigation Diversions and Estimated Irrigation Water Requirement

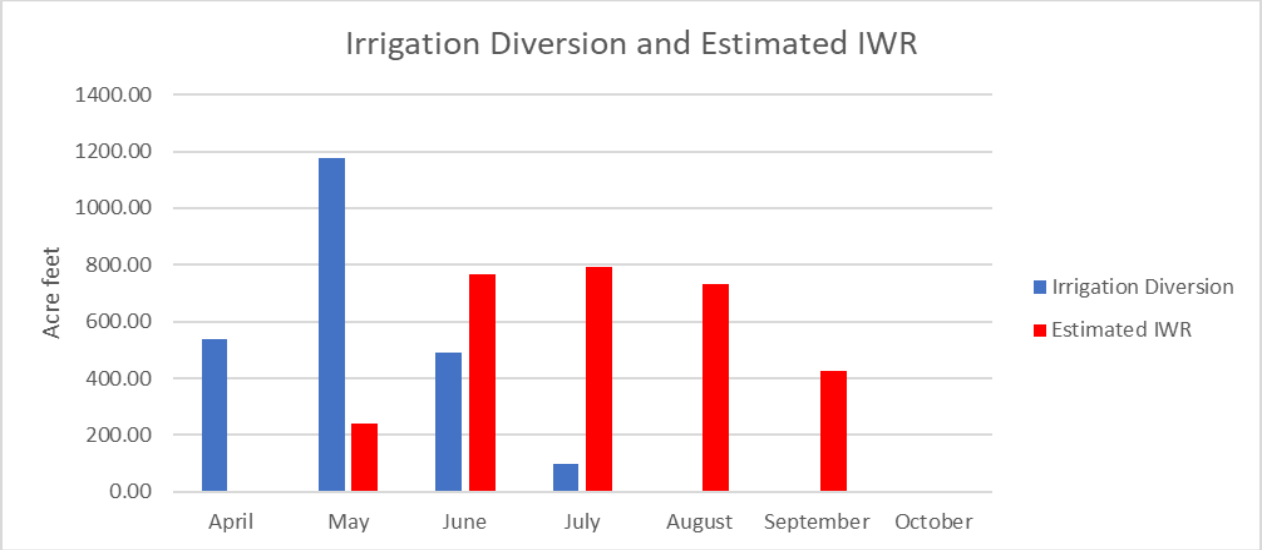


Table 31: Porvenir Daily Average Diversion Data

Porvenir Daily Average Flow (CFS)							
	April	**May**	**June**	**July**	**August**	**September**	**October**
1	10.36	13.83	18.30	3.19	0.74	0.97	1.82
2	11.67	17.26	18.23	3.08	0.75	0.95	1.82
3	12.82	19.97	15.88	3.03	0.69	0.89	1.74
4	14.15	20.42	14.29	3.06	0.67	0.89	1.73
5	17.87	23.92	13.01	3.09	0.58	0.82	1.73
6	23.11	23.20	13.20	3.25	0.46	1.15	1.68
7	18.10	21.67	14.36	3.21	0.43	1.96	1.63
8	19.30	21.00	11.05	2.81	0.43	1.19	1.69
9	18.30	19.63	8.29	2.64	0.39	1.41	1.73
10	4.63	18.53	8.13	2.61	0.38	1.37	1.73
11	4.62	19.01	7.95	3.15	0.38	1.22	1.73
12	4.51	18.81	7.97	3.76	0.38	1.46	1.66
13	4.40	20.65	7.97	4.18	1.25	1.90	1.69
14	4.11	22.13	8.10	4.51	2.01	2.48	1.70
15	4.25	20.35	8.06	4.77	2.01	3.13	1.68
16	4.53	19.88	7.42	3.08	1.48	2.98	1.43
17	4.50	19.56	7.13	1.53	1.46	2.76	1.29
18	4.56	19.06	6.73	1.46	1.43	2.50	1.20
19	4.48	19.22	6.66	1.24	1.45	2.42	1.20
20	4.44	20.14	5.43	1.14	1.46	2.41	1.20
21	4.35	16.75	4.41	1.11	1.46	2.21	1.20
22	4.06	16.01	4.31	1.04	1.46	2.09	1.20
23	3.80	15.59	4.31	1.01	1.44	1.94	1.20
24	2.90	15.49	4.22	1.01	1.37	1.92	1.13
25	2.06	17.92	4.17	0.99	1.15	1.84	1.10
26	7.31	20.20	3.82	0.97	1.14	1.82	1.18
27	11.04	19.28	3.74	0.96	1.06	1.82	1.02
28	8.27	19.13	3.52	0.96	0.97	1.79	1.14
29	17.35	18.41	3.40	0.91	1.08	1.82	1.17
30	14.83	17.81	3.28	0.83	0.98	1.82	1.16
31		18.28		0.75	0.96		1.14
Average (CFS)	9.02	19.13	8.24	2.24	1.03	1.80	1.44

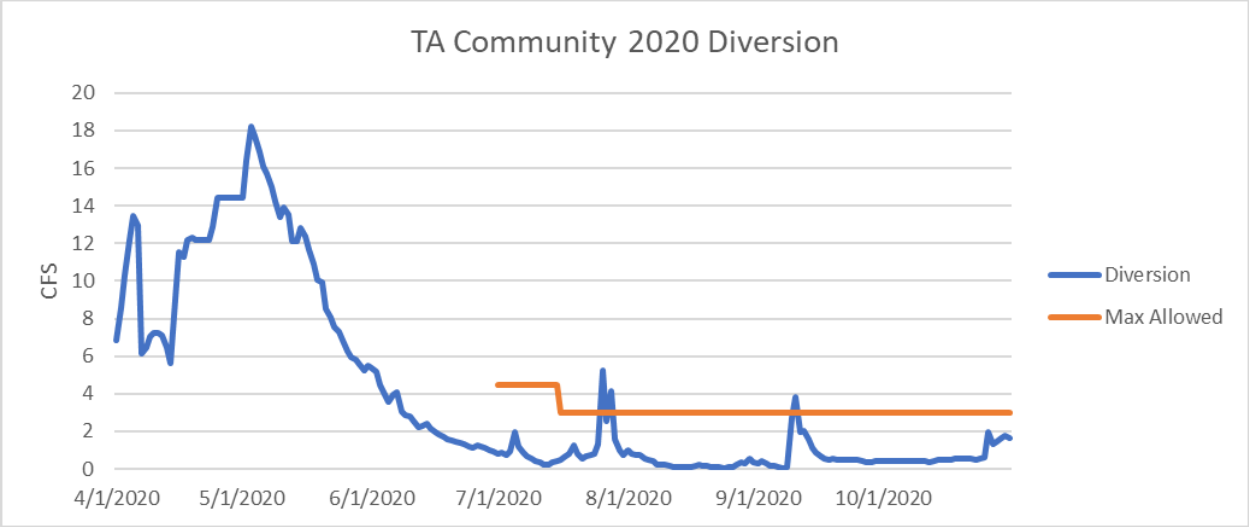
Q. TA Community Ditch

Tierra Amerilla (TA) Community Ditch is a small ditch that separates into three main laterals located in the community of Tierra Amarilla. The diversion is just east of Tierra Amarilla. TA Community Ditch diverted all available flow on TA Creek during curtailment. This flow was not enough to sustain stock use on all three laterals. Irrigation was limited during the growing season. Field observations found only two fields cut hay. These were located directly along TA Creek. TA Community Ditch exceeded curtailment limits only during rain events. Table 32 shows monthly diversions for TA Community Ditch. Figure 41 is a graph of measured diversions into TA Community Ditch and the curtailment limit.

Table 32: TA Community Ditch Monthly Diversions in acre-feet

	Irrigation Volume	Stock Volume
April	638.79	0.00
May	694.50	0.00
June	141.72	0.00
July	20.90	46.39
August	0.00	18.33
September	0.00	45.23
October	0.00	42.53

Figure 41: TA Community Ditch Diversion Hydrograph and Curtailment Limit



TA Community Ditch met the ditch estimated IWR only in May. Minimal irrigation occurred in June and July. No Irrigation occurred after July 15th. Figure 42 shows monthly irrigation diversions and monthly estimated IWR for lands served by TA Community Ditch.

Figure 42: TA Community Ditch Monthly Irrigation Diversions and Estimated Irrigation Water Requirement

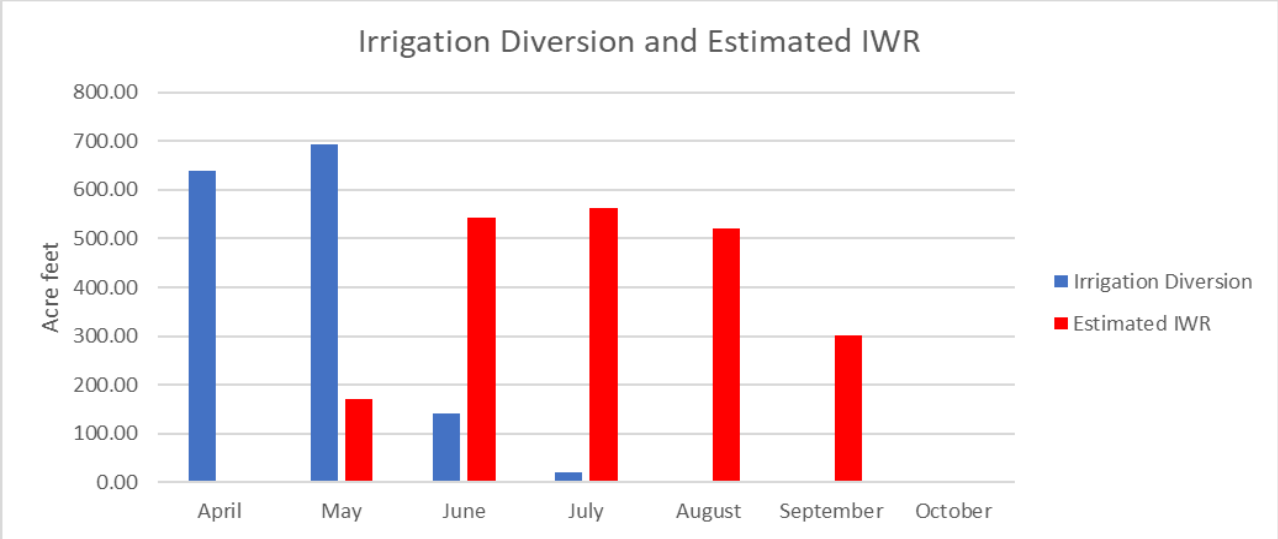


Table 33: TA Community Ditch Daily Average Diversion Data

TA Community Daily Average Flow (CFS)							
	April	**May**	**June**	**July**	**August**	**September**	**October**
1	6.87	14.43	5.38	0.84	1.00	0.32	0.43
2	8.55	16.41	5.14	0.86	0.80	0.41	0.40
3	10.34	18.25	4.45	0.71	0.76	0.32	0.43
4	12.17	17.72	3.95	0.93	0.71	0.16	0.42
5	13.47	16.88	3.55	1.99	0.56	0.14	0.40
6	12.96	16.11	3.98	1.16	0.47	0.07	0.40
7	6.16	15.68	4.07	0.86	0.44	0.02	0.43
8	6.48	15.01	3.03	0.65	0.25	0.12	0.40
9	7.01	14.23	2.85	0.54	0.24	2.75	0.39
10	7.22	13.43	2.81	0.44	0.25	3.79	0.42
11	7.21	13.93	2.51	0.34	0.18	1.95	0.42
12	7.09	13.56	2.24	0.24	0.12	2.02	0.38
13	6.47	12.09	2.26	0.26	0.11	1.59	0.40
14	5.62	12.14	2.43	0.33	0.10	1.11	0.48
15	9.01	12.82	2.16	0.40	0.07	0.85	0.50
16	11.55	12.35	1.99	0.47	0.08	0.71	0.47
17	11.31	11.65	1.87	0.69	0.16	0.56	0.49
18	12.16	10.89	1.67	0.83	0.22	0.50	0.53
19	12.29	10.04	1.60	1.23	0.16	0.52	0.52
20	12.20	9.93	1.54	0.81	0.17	0.47	0.57
21	12.15	8.52	1.43	0.53	0.12	0.47	0.56
22	12.17	8.05	1.36	0.70	0.10	0.47	0.53
23	12.19	7.54	1.33	0.75	0.09	0.50	0.52
24	12.90	7.31	1.21	0.83	0.06	0.51	0.56
25	14.43	6.87	1.14	1.33	0.09	0.49	0.62
26	14.43	6.29	1.25	5.21	0.12	0.41	1.93
27	14.43	5.95	1.22	2.53	0.22	0.37	1.33
28	14.44	5.84	1.14	4.15	0.35	0.36	1.46
29	14.44	5.55	1.01	1.60	0.30	0.41	1.63
30	14.44	5.26	0.91	1.00	0.55	0.45	1.79
31		5.49		0.76	0.38		1.64
Average (CFS)	10.74	11.30	2.38	1.09	0.30	0.76	0.69

R. Ungauged Ditches

Ungauged ditches divert from the Rio Chama and its tributaries. These can be grouped as Rio Chama ditches, Rio Brazos basin ditches, Canones Creek ditches, and TA Creek Ditches. Other ungauged ditches divert from even smaller tributaries in the upper basin, which will not be discussed in this section. Taken together, these ditches divert a substantial amount of water.

The known ungauged mainstream ditches are Rice Ditch, Unnamed Ditch to Yearout's ponds, SD-09808 and SP-04888. The Rice Ditch ran irrigation water until July 15th. It was too deep to complete a check measurement. During livestock use only, no livestock were present in adjacent pastures. The river gate was shut, and the return gate fully opened. The Rice fields have a spring fed ditch as well. This ditch continued to run water but was not used to irrigate. The natural springs cannot be turned off or bypassed directly to the Rio Chama. This spring fed ditch drops into the gravel operation where losses occur prior to finally returning to the Rio Chama. The ditch to Yearout's ponds was not known to the water master until after the 2020 irrigation season. It will be closely monitored during the 2021 shortage sharing to document how it operates. SD-09808 and SP-04888 are just above the USGS La Puente Gage. These fields are difficult to access and were checked once in August. They were not in use, and there was no sign they had been used earlier in the season.

The ungauged ditches in the Rio Brazos Basin are the Chavez Creek Ditch, Tres Plumas, Brazos Community Ditch, and diversions off Los Brazitos. Chavez Creek Ditch ceased irrigating by July 15th and turned off stock water. The owners agreed to use the creek directly instead of diverting the full flow for their livestock. Tres Plumas and Brazos Community took water the entire season. When checked in mid-July, after livestock use only curtailment began, both ditches were taking over 5 CFS each. The water master altered the diversions and kept the diversions between 0.5 and 1 CFS throughout curtailment. Check measurements showed flows just under 1 CFS. These two ditches drain into the Brazitos drainage. The tailwater from Brazitos users can either return to the Rio Chama or the Rio Brazos. One field check was made in August and no irrigation was discovered; however, the livestock use losses were very high off this ditch. La Puente Ditch is also ungauged; however, it shares its river diversion with Parkview. During curtailment, Parkview sent only 0.25 CFS to La Puente. La Puente is also sourced by the developed springs used at the Parkview Fish Hatchery. These springs provide a consistent 4 CFS to La Puente. La Puente was caught irrigating into August, but once this issue was addressed, maintained stock use only for the remainder of the season. La Puente users reported yields between 40 and 60%.

Many ditches divert from Canones Creek above Canones Creek 1. These ditches ran water early and got a good cutting. All these ditches turned off completely prior to curtailment except for Daggett Ditch 3, which irrigated a small field in mid-August. This irrigation caused Canones Creek 1 to go dry. After a week, the Daggett Ditch 3 user started to comply with the livestock only order. One ditch diverts below Canones Creek 1 and only diverts during the spring runoff.

TA Creek has a couple ungauged ditches below and above TA Community Ditch. The ditches below do not take water at low flows since TA Community Ditch takes the full creek. These ditches can be easily checked from the road. No irrigation during curtailment was observed. The

ditches above TA Community Ditch are difficult to check from the road and were not walked this field season. The largest ungauged ditch above TA Community Ditch is the Sena Ditch. A large portion of the Sena fields were adjudicated "No Right" and should be field checked in following seasons.

VIII. Basin Issues, Improvements, and Needs

The Upper Chama Water Master will continue to work with basin stakeholders to manage shortage sharing. The water master will improve 2021 administration by taking the follow steps:

1. Install staff plates on ungauged ditches to track these diversions during curtailment;
2. Measure tailwater when time allows to determine returns and losses;
3. Strive for better communications with majordomos about approaching curtailment operations;
4. Establish a set trigger point using USGS La Puente to cut from limited irrigation to only livestock use, and a set flow at USGS La Puente to return to limited irrigation;
5. Allow limited irrigation on critical pasture lands late in the irrigation season following storm events and elevated river flows;
6. Correct ditch acreage totals to determine correct curtailment flow rates; and
7. Listen to irrigators suggestions for improvements to curtailment operations.

The upper basin needs to work on livestock water management and alternatives to leaving water in the ditches for livestock. A significant amount of water was diverted during curtailment for livestock use. While most ditches return a majority to the river, others experience significant losses. For example, this season Willow Creek diverted 593 acre-feet averaging 3 CFS a day during curtailment. All this water was lost to the system. Investment in community livestock wells could provide a substantial boost to Rio Chama summer base flows. A cow calf pair requires 30 gallons per day. Willow Creek consumed enough livestock water to provide for 64,627 cow calf pairs while having less than 1,000 head of stock relying on the ditch.

This year a few minor improvements were made to basin stations. Barranca received a second solar panel to help resolve some power issues at the station and the area velocity flow meter was replaced with a newer model. The Parkview voltage regulator was replaced. The Willow Creek radio was replaced. Finally, a staff plate was added to the Rio Brazos below all diversions. Tres Plumas Ditch, Chavez Creek Ditch, La Puente Ditch and Brazos Community Ditch need staff plates installed near their headgates to help manage diversions during shortage sharing.

IX. Summary and Outlook

The 2020 irrigation was difficult and impacted all surface water users in the upper basin. Yields were significantly reduced causing ranchers to buy and haul feed for their livestock. Drought conditions are worsening and The National Oceanic and Atmospheric Administration 2020-2021 winter forecast for Northern New Mexico is for above average temperatures and below average precipitation. The February 1, 2021 NRCS forecast predicts a basin yield of 63% of normal for April through July. OSE staff and upper basin users need to prepare for what is likely to be another hard year for the upper basin in 2021.

X. Appendices

A. SWE
B. NRCS Drought Maps
C. Precipitation, Effective Precipitation, and Estimated Alfalfa IWR
D. OSE Diversion Data Corrections
E. USGS Hydrographs

A. Snow Water Equivalent (SWE)

SWE data is shared weekly with OSE by the New Mexico Interstate Stream Commission. The data source of this is the United States Department of Agriculture's (USDA) Natural Resources and Conservation Service (NRCS) website for Snotel data and reporting (https://www.nrcs.usda.gov/wps/portal/wcc/home/snowClimateMonitoring/snowpack/).
OSE uses terminology directly from the NRCS and has made no alterations to the SWE data presented. OSE has no role in the data collection or data processing involved in creating this data set. For questions concerning SWE or snowpack data, contact the NRCS Office at 100 Sun Avenue NE, Suite 602, Albuquerque, NM 87109.

B. Drought Maps

Drought maps are taken directly from the U.S. Drought Monitor (https://droughtmonitor.unl.edu/), a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, USDA, and NOAA. OSE uses terminology directly from U.S. Drought Monitor and has made no alterations to the data presented. OSE has no role in the data collection or data processing involved in creating these products. Questions concerning drought data should be directed to the National Drought Mitigation Center at the University of Nebraska-Lincoln, PO Box 830988, Lincoln, NE 68583 (phone: 402-472-6707).

C. Precipitation, Effective Precipitation, and Estimated 2019 Alfalfa IWR

Precipitation, effective precipitation, and estimated delivery needs are critical pieces of data to include in any water master report. The OSE's January 18, 1960 *Proposed outline for watermaster reports* requires reports to identify "periods of time when direct flow was sufficient and periods when flow was insufficient", "the amount that could be beneficially used", total precipitation, precipitation departure from normal, and "effects of departure on irrigation practices". These requirements cannot be met without a determination of irrigation season precipitation, effective precipitation, and crop requirements.

Precipitation

Precipitation data is taken directly from the website of the National Weather Service Forecast Office in Albuquerque, NM (https://w2.weather.gov/climate/xmacis.php?wfo=abq). OSE uses terminology directly from the National Weather Service and has made no alterations to the precipitation data presented. OSE has no role in the data collection or data processing involved in creating this data set. Questions concerning precipitation data should be directed to Albuquerque

Weather Forecast Office, 2341 Clark Carr Loop SE, Albuquerque, NM 87106 (phone:505-243-0702).

Effective Precipitation

Effective precipitation is critical to understanding the impact of precipitation events on the agricultural center. While total precipitation is a significant factor for supply, it is effective precipitation that impacts crop stress, production, and irrigation requirements.

There are many formal methodologies that exist for converting precipitation to effective precipitation; however, OSE has severe data, time, and budget constraints that prohibit the use of these methods. Instead OSE has estimated effective precipitation from precipitation data using an estimation method promoted by Farmwest, an agricultural non-profit that provides information and resources to farmers in the American West. Average effective precipitation was obtained from USDA's Irrigation Water Requirement (IWR) Calculator using the "Normal Year" effective precipitation amounts for northern alfalfa (https://efotg.sc.egov.usda.gov/references/public/NM/chama-cu.pdf). Questions concerning IWR should be addressed toUSDA's NRCS New Mexico State Office, 100 Sun Avenue NE, Suite 602, Albuquerque, NM 87109 (phone:505-761-4400).

OSE followed these steps to produce effective precipitation estimates:

1. Any events identified as snow by the National Weather Service were zeroed out.
2. Remaining daily values were entered into this equation:
   Effective Precipitation = (Precipitation – 0.2 inches) * 0.75
   The assumption here is that there needs to be a minimum of 0.2 inches in an event to penetrate the soil to reach the root layer. Less than 0.2 inches is likely to remain in the top soil layers and open to evaporation or evapotranspiration from shallow-rooted non-crop vegetation. The 0.75 modifier assumes that only 75% of precipitation will reach the root zone and remain there available for crop use. The remaining 25% of precipitation is assumed to be lost to surface runoff or groundwater percolation.
3. Any negative results are zeroed out since the minimum value for any form of precipitation is 0.

This is a simple estimation, but it compares very well to IWR averages which were developed using more robust tools. The average effective precipitation for Chama, NM is 2.35 IN. OSE's 2019 estimate is 1.935 IN. From the precipitation data, 2019 had below normal precipitation (89% of normal) over the irrigation season. The 2019 estimate is 82% of IWR's normal. This estimate is reasonable but should not be used outside of this report.

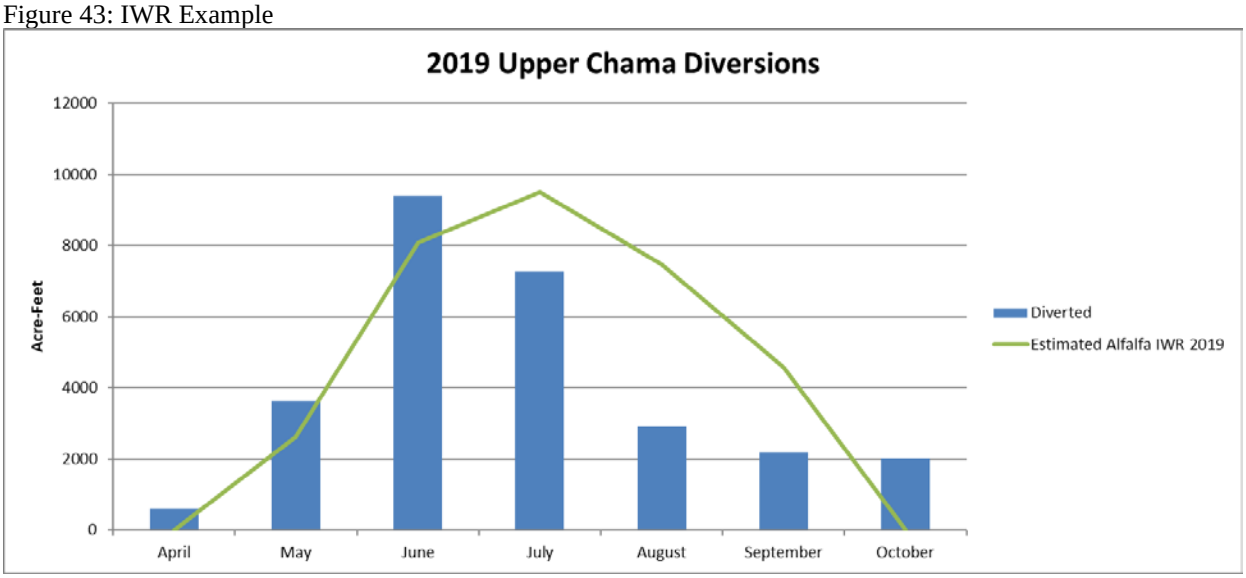
Estimated IWR

IWR is the standard for assessing monthly crops needs across the United States and was developed by the USDA. It allows OSE to determine times of sufficient water and insufficient water. Without this tool, OSE does not know the impact of water availability to the users or if ditches are taking an unreasonable amount of water for the time of year. The estimated IWR for each year should be viewed as a guide only. A ditch may exceed the estimated IWR for many reasons: the estimate is off for that part of the basin, the ditch needed significant flushing due to

excessive sediment built up, the ditch is being primed and building soil moisture while water is available but supply is dropping, and unaccounted needs such as livestock or domestic use from the ditch. Diversions that match the IWR estimate mean that the crops in that month are very likely getting their full needs met to produce normal yields. Diversions less than the IWR estimate indicate that crops are not receiving their full needs requiring users to drouth brown out some fields for the year, providing deficient irrigation, thereby reducing yields. Diversions below the IWR estimate suggests that water users were likely negatively impacted due to lack of supply. Excessive exceedance of the IWR estimate should be investigated by the watermaster, especially if it occurs when supply is short. It is far more illustrative than only considering the maximum allowable diversion. The IWR was used to develop the maximum diversion rates for each ditch. Figure 43 shows an example of estimated IWR used with a ditches diversion data.

The estimated IWR was calculated using the following steps:

Figure 43: IWR Example



1. Add the average monthly effective precipitation back into the IWR monthly irrigation requirement. This creates an IWR exclusive of precipitation.
2. Subtract the estimated effective precipitation from the total IWR calculated above.
3. This is the estimated IWR for each month.
4. Multiply by the ditch (off-farm) efficiency. A 50% efficiency is assumed for the upper basin.

The estimated IWR assumes all acreage is northern alfalfa, the most water intensive crop in the region. This causes the IWR estimate likely to be higher than actual ditch needs since not all acres are alfalfa.

As a comparison to check the validity of OSE's 2019 IWR, the estimated IWR can be compared to the basin's PDR. The current working PDR for the Upper Chama basin is 4.38 acre-feet per annum (afa) per acre. It will likely be lower by the end of adjudication since some ditches have already been adjudicated to a lower PDR. For example the MB ditch PDR is 2.45 afa. The 2019 estimated IWR equates to an estimated 2019 PDR of 4.26 afa per acre. This is less than a 3%

difference and demonstrates the estimated IWR is reasonable to use as an illustrative guide to explain the impact of supply and precipitation on the irrigation season.

D. OSE Diversion Data Corrections

OSE completes provisional corrections to field data logger collected data based on field notes (site visit revisions), noted calls/contacts from acequias, and field corrections. These were implemented through USGS standard Revisions: multipoint drifts (prorated changes), drift corrections (datum corrections), interpolation for missing data, zeroing out low flow numbers when there is standing water in the weir (site visit revision), and shifts that were implemented based on FlowTracker measurements. All provisional data was left as collected if there was not a noted event.

All USGS data revision policy and procedures can be found on the USGS website (https://water.usgs.gov/osw/RevisionsGuidance.html). USGS Shift and Measurement policy and procedures can be found on the USGS website (https://hydroacoustics.usgs.gov/memos/OSW2017-03.pdf). USGS uses Aquarius software and all procedures of data revisions that can be done by Aquarius software can be found online at (https://aquaticinformatics.com/products/aquarius/aquarius-time-series/).

Radio transmitted data can be obtained from the OSE RTMS website (http://meas.ose.state.nm.us/district6.jsp). Detailed provisional corrections are available for review in the OSE District 6 Office, Santa Fe, NM.

E. USGS Hydrographs

All USGS hydrographic data is taken directly from the USGS National Water Information System: Web Interface (https://waterdata.usgs.gov/nwis). USGS terminology is used when defining USGS data. No edits or alterations are performed by OSE to USGS data. OSE has no role in this data collection or processing. Questions concerning USGS data should be directed to USGS New Mexico Water Science Center, 6700 Edith Blvd NE, Albuquerque, NM 87113 (phone: 505-830-7900).

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District VI Office, Santa Fe, NM

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April 12, 2021

John R. D'Antonio Jr., P.E.
120 South Capitol Street
Concha Ortiz y Pino Building
P.O. Box 25102
Santa Fe, NM 87504-5105

Mr. D'Antonio,

I am pleased to submit the following Report of Water Master Activities on the Lower
Rio Chama during the 2020 irrigation season.

Sincerely,

Tyler Lystash
Upper Rio Chama Water Master
Water Rights Division