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To: Peter Ampe – Hill & Robbins, P.C – Counsel for the Republican River Water Conservation District

From: James E. Slattery
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Date: September 11, 2017

Subject: September 2017 Projected Delivery for the Colorado Compact Compliance Pipeline

The “Resolution by the Republican River Compact Administration Approving Operation and Accounting for the Colorado Compact Compliance Pipeline and Colorado’s Compliance Efforts in the South Fork Republican River Basin” was approved August 24, 2016. Colorado is operating the Compact Compliance Pipeline (CCP) in 2017 under the provisions described in that resolution.

The projected CCP delivery requirement to meet Colorado’s obligation under the Compact in 2017 is approximately 11,500 ac-ft and corresponds to a start-up date this fall of October 1 and run the deliveries through December 31. The current delivery capacity of the CCP project is approximately 31 to 32 cfs. The final deliveries will be different depending on production of the wells and any operational constraints that may occur. Colorado intends on running the CCP from October 1 continually until it stops deliveries near the end of March of 2018. The following table summarizes the estimated delivery schedule:

Time Period	Amount of CCP Delivery (ac-ft)
January – March (measured deliveries)	5,690
October 1 – December 31	5,810
Total	11,500

The 11,500 ac-ft represents an over delivery of approximately 2,200 ac-ft in 2017. As outlined below, this over delivery is a function of accounting changes made in the August 24, 2016 agreement. Some of these changes were made retroactively to the 2014-2016 accounting and others were made starting with the 2017 accounting. As a result, Colorado now has a calculated underdelivery on its Compact obligations for the four years the CCP has been running of about 1,800 acre-feet.

Data Utilized to Determine Delivery Amount

The attached Table 1 and Table 2 summarize the calculations used to derive the delivery amount. The RRCA Groundwater Model was run to obtain an estimate of the Groundwater CBCU. For all States' groundwater pumping, the 2016 data was repeated for 2017. Precipitation recharge was estimated using the long-term average monthly data at each station when historical data was not available. Reservoir stages and potential evapotranspiration values were estimated to be the same as the 2016 values.

The initial April 2017 projections we were made assuming water short year administration on Harlan County Reservoir. However, because of higher than expected runoff Harlan County Reservoir is now considered to be in non-water short year administration for the 2017 compact accounting. This change resulted in Colorado receiving its full Beaver Creek Allocation of 2,350 acre-feet in 2017.

The 5-run model approach was utilized for these projections. Bonny Reservoir was modeled as an accounting point for all years 2014-2017. For the initial 2014-2016 projections of Colorado's compact compliance, Bonny Reservoir was not used as an accounting point. However, the three States agreed that Bonny Reservoir will be used as an accounting point. The net effect of this change is that the Bonny Reservoir accounting Colorado had been using was changed from 2014-2016 estimates.

Table 1 (page 1 of 3)
Operation of the Colorado Compact Compliance Pipeline
(units of ac-ft)

Jan - Dec Calendar Year	North Fork Basin Accounting									Arikaree Basin Accounting					
	North Fork Gaged Flow	Consumptive Use								Gaged Flow	Consumptive Use				Virgin Flow
		CCP Deliveries	Net North Fork Gaged Flows for Virgin Flow Calculations	0.40 x Haigler Canal Divs Measured at Stateline	CO SW and Small Res Evap	CO GW Con Use	KS GW Con Use	NE GW and SW Con Use	Virgin Flow		CO SW	CO GW	KS GW and Non- Fed Res Evap	NE GW	Virgin Flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
2000	19,430	0	19,430	2,338	3,595	13,173	15	4,663	43,215	3,629	0	1,918	169	196	5,912
2001	19,748	0	19,748	1,971	3,320	13,537	18	4,221	42,815	552	0	1,324	231	317	2,424
2002	15,903	0	15,903	1,946	4,497	13,560	14	4,271	40,190	231	0	398	155	242	1,026
2003	17,700	0	17,700	1,986	2,615	14,023	17	4,381	40,722	1,060	0	242	100	507	1,909
2004	19,759	0	19,759	1,493	3,022	14,373	16	3,685	42,348	341	0	353	157	431	1,282
2005	21,060	0	21,060	1,898	3,171	14,359	17	4,290	44,795	1,151	0	811	163	250	2,375
2006	17,608	0	17,608	1,767	3,140	14,301	12	4,017	40,844	404	0	1,116	130	125	1,775
2007	20,566	0	20,566	1,809	3,015	14,790	0	3,612	43,792	1,331	0	1,143	117	112	2,703
2008	21,636	0	21,636	1,998	671	15,004	0	3,925	43,234	1,568	0	1,536	106	124	3,334
2009	24,408	0	24,408	1,677	267	15,783	0	3,468	45,603	779	0	4,011	162	153	5,106
2010	20,418	0	20,418	2,016	325	15,479	0	3,999	42,238	2,358	49	1,446	109	73	4,035
2011	19,722	0	19,722	1,930	354	15,689	0	3,899	41,594	1,074	33	1,830	170	93	3,200
2012	14,376	0	14,376	2,452	583	15,309	0	4,698	37,418	494	63	1,558	116	78	2,309
2013	18,433	0	18,433	1,536	377	15,649	0	3,362	39,357	91	45	458	214	126	934
2014	26,705	7,448	19,257	1,244	285	16,283	0	2,962	40,031	0	21	1,141	236	128	1,526
2015	28,768	10,760	18,008	1,467	512	16,424	0	3,324	39,736	142	23	2,829	192	108	3,294
2016	28,091	10,130	17,961	1,596	419	16,820	0	3,550	40,346	397	37	2,638	197	147	3,416
2017	28,000	11,500	16,500	1,596	419	16,957	0	3,570	39,042	300	37	2,225	165	144	2,871
2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1 (page 2 of 3)
Operation of the Colorado Compact Compliance Pipeline
(units of ac-ft)

Jan - Dec Calendar Year	South Fork Basin Accounting							CO Compact Allocation				
	Gaged Flow at Benkelman	Consumptive Use					Virgin Flow	22.37% 78.53% 44.41%				All Basins
		CO SW + CO Small Res Evap	CO GW + Bonny Res Seepage	CO Bonny Res Evap	KS GW, Non-Fed Res Evap, SW CU	NE GW		North Fork	Arikaree	South Fork	Colorado Allocation of Beaver Creek (See Table 5F in Water Short Year)	
(1)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
2000	4,857	3,031	10,450	5,945	6,623	982	31,889	9,668	4,643	14,160	0	28,471
2001	3,100	1,522	10,904	4,673	7,753	529	28,481	9,578	1,904	12,647	0	24,129
2002	1,578	1,295	11,044	4,673	5,195	1,149	24,934	8,991	806	11,072	770	21,639
2003	905	598	12,115	3,375	5,380	1,347	23,720	9,110	1,499	10,533	260	21,402
2004	0	770	12,874	3,158	6,084	1,202	24,088	9,474	1,007	10,696	360	21,537
2005	0	275	14,952	3,430	7,522	1,372	27,550	10,021	1,865	12,234	910	25,030
2006	0	518	11,757	3,031	4,723	1,040	21,069	9,137	1,394	9,356	1,420	21,307
2007	674	266	12,511	2,715	5,670	1,055	22,891	9,797	2,123	10,165	744	22,828
2008	1,424	52	14,707	1,980	5,933	1,021	25,117	9,672	2,618	11,153	2,840	26,284
2009	8,487	100	14,976	1,117	7,856	1,302	33,837	10,202	4,010	15,025	3,160	32,397
2010	12,756	919	11,938	1,921	3,006	625	31,164	9,449	3,168	13,839	2,890	29,346
2011	9,916	177	13,092	1,965	6,153	941	32,245	9,305	2,513	14,319	2,580	28,716
2012	6,441	107	9,321	67	2,556	810	19,302	8,371	1,813	8,571	1,860	20,615
2013	0	52	12,321	0	5,177	473	18,023	8,805	733	8,003	1,054	18,595
2014	0	150	13,868	0	8,539	1,027	23,584	8,956	1,198	10,473	1,228	21,855
2015	4,819	408	13,865	0	5,514	918	25,524	8,889	2,587	11,334	1,406	24,216
2016	3,898	331	13,883	0	5,820	904	24,836	9,026	2,682	11,029	1,650	24,387
2017	2,000	331	14,009	0	5,169	738	22,247	8,734	2,255	9,879	2,350	23,218
2018	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0	0	0	0	0

Table 1 (page 3 of 3)
Operation of the Colorado Compact Compliance Pipeline
(units of ac-ft)

	CO Consumptive Use							Colorado Compact Compliance Accounting			
	Instate			GW Con Use in Nebraska							
Jan - Dec Calendar Year	North Fork	Arikaree	South Fork	Buffalo and Rock Creek	French- man Creek	Rep River Mainstem	Total Colorado Con Use	Annual Amount Colorado Exceeded Compact Entitlement BEFORE CCP Delivery	Annual Amount Colorado Exceeded Compact Entitlement after Accounting for CCP Deliveries	5-year Running Average of the Amount Colorado Exceeded Compact Entitlement after Accounting for CCP Delivery	
(1)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
2000	16,768	1,918	19,426	276	599	-4,242	34,745	6,274	0	6,274	
2001	16,857	1,324	17,099	293	569	-2,779	33,363	9,234	0	9,234	
2002	18,057	398	17,012	294	620	-5,482	30,899	9,260	0	9,260	
2003	16,638	242	16,088	324	37	132	33,460	12,058	0	12,058	
2004	17,395	353	16,802	348	39	-1,269	33,669	12,131	0	12,131	9,792
2005	17,530	811	18,656	367	42	-1,954	35,452	10,422	0	10,422	10,621
2006	17,441	1,116	15,306	383	43	-3,009	31,280	9,973	0	9,973	10,769
2007	17,805	1,143	15,492	406	55	-2,062	32,838	10,010	0	10,010	10,919
2008	15,675	1,536	16,739	429	370	-2,487	32,262	5,979	0	5,979	9,703
2009	16,050	4,011	16,193	451	2,917	-1,549	38,072	5,675	0	5,675	8,412
2010	15,804	1,495	14,777	472	3,030	-2,698	32,880	3,534	0	3,534	7,034
2011	16,043	1,863	15,234	492	2,554	-2,305	33,881	5,165	0	5,165	6,073
2012	15,892	1,621	9,495	513	1,485	-6,712	22,294	1,678	0	1,678	4,406
2013	16,026	503	12,373	531	1,125	-1,919	28,639	10,043	0	10,043	5,219
2014	16,568	1,162	14,018	554	951	-1,162	32,092	10,237	7,448	2,789	4,642
2015	16,936	2,852	14,273	584	1,769	-2,649	33,765	9,549	10,760	-1,211	3,693
2016	17,239	2,675	14,214	608	1,600	-2,436	33,900	9,513	10,130	-617	2,536
2017	17,376	2,262	14,340	617	1,301	-3,416	32,480	9,262	11,500	-2,238	1,753
2018	0	0	0	0	0	0	0	0	0	0	-256
2019	0	0	0	0	0	0	0	0	0	0	-813
2020	0	0	0	0	0	0	0	0	0	0	-571
2021	0	0	0	0	0	0	0	0	0	0	-448
2022	0	0	0	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0	0	0	0

Table 2
Surface Water Data Used in Accounting
(units of acre-feet)

Calendar Year	Streamflow Gages					Colorado Surface Water Diversions			Reservoir Evaporation					Beaver Creek		
	North Fork at CO-KS Stateline Gage	Measured Compact Compliance Pipeline Delivery	Haigler Canal Stateline Flume	Arikaree at Haigler, NE Gage	South Fork at Benkelman Gage	Total North Fork Divs including CO Pioneer	Colorado Arikaree Divs	Colorado South Fork Divs	Colorado Non-Fed Res Evap in North Fork	Colorado Non-Fed Res Evap in South Fork	Kansas Non-Fed Res Evap in Arikaree	Kansas Non-Fed Res Evap and Small SW Div Con Use in South Fork	Bonny Res Evap	Colorado Compact Entitlement in non-water short years	Colorado Beaver Creek Reduced Allocation' Water Short Years	Water Short Year (Yes/No) CO receives no Beaver Creek Allocation in Water Short Year
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(15)	(16)
2000	19,430	0	5,846	3,629	4,857	5,915	0	5,052	46	0	41	303	5,945			
2001	19,748	0	4,927	552	3,100	5,457	0	2,536	46	0	41	303	4,673			
2002	15,903	0	4,865	231	1,578	7,418	0	2,158	46	0	41	303	4,673	770	770	Yes
2003	17,700	0	4,965	1,060	905	4,358	0	996	0	0	0	29	3,375	260	260	Yes
2004	19,759	0	3,732	341	0	4,961	0	1,283	46	0	41	303	3,158	360	360	Yes
2005	21,060	0	4,745	1,151	0	5,213	0	458	43	0	41	295	3,430	910	910	Yes
2006	17,608	0	4,418	404	0	5,150	0	864	50	0	46	325	3,031	1,420	1,420	Yes
2007	20,566	0	4,522	1,331	674	4,961	0	443	38	0	18	143	2,715	2,320	744	Yes
2008	21,636	0	4,995	1,568	1,424	1,055	0	87	38	0	14	121	1,980	2,840		No
2009	24,408	0	4,193	779	8,487	398	0	166	28	0	7	65	1,117	3,160		No
2010	20,418	0	5,041	2,358	12,756	474	81	1,336	41	117	11	98	1,921	2,890		No
2011	19,722	0	4,826	1,074	9,916	530	55	39	36	154	14	119	1,965	2,580		No
2012	14,376	0	6,129	494	6,441	886	105	0	51	107	24	213	67	1,860		No
2013	18,433	0	3,839	91	0	553	75	0	45	52	17	147	0	1,130	1,054	Yes
2014	26,705	7,448	3,110	0	0	412	35	184	38	40	11	100	0	1,250	1,228	Yes
2015	28,768	10,760	3,668	142	4,819	792	38	616	37	38	14	124	0	2,130	1,406	Yes
2016	28,091	10,130	3,991	397	3,898	636	62	510	37	25	14	118	0	2,430	1,650	Yes
2017	28,000	11,500	3,991	300	2,000	636	62	510	37	25	14	118	0	2,350	0	No
2018																
2019																
2020																
2021																
2022																
2023																
2024																
2025																

USGS, BOR, and RRCA Accounting records used when available. Missing data estimated from historical values using engineering judgement.