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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: April 10, 2017

Subject: April 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. The current delivery capacity of the CCP pipeline project is approximately of 31 to 32 cfs. The following table summarizes the estimated delivery schedule:

Time Period	Amount of CCP Delivery (ac-ft)
January – March	5,700
October-December	5,800
Total	11,500

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 projections were made assuming water short year administration on Harlan County Reservoir, which results in Colorado’s Beaver Creek allocation being zero. The 5-run model approach was utilized in these projections. Bonny Reservoir was modeled as an accounting point for all years.

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				
		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	0	1,446	109	73	3,986
2011	19,722	0	19,722	1,930	354	15,689	0	3,899	41,594	1,074	0	1,830	170	93	3,167
2012	14,376	0	14,376	2,452	583	15,309	0	4,698	37,418	494	0	1,558	116	78	2,246
2013	18,433	0	18,433	1,536	377	15,649	0	3,362	39,357	66	0	458	214	126	864
2014	26,705	7,448	19,257	1,245	285	16,283	0	2,964	40,035	0	0	1,137	236	128	1,501
2015	28,768	10,760	18,008	1,451	511	16,424	0	3,299	39,693	142	0	2,823	189	107	3,261
2016	28,089	10,130	17,959	1,607	511	16,819	0	3,566	40,462	397	0	2,625	197	117	3,336
2017	28,000	11,500	16,500	1,520	460	16,892	0	3,459	38,831	300	0	2,076	174	106	2,656
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)

South Fork Basin Accounting								CO Compact Allocation				
Jan - Dec Calendar Year	Gaged Flow at Benkelman	Consumptive Use						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	Virgin Flow	North Fork	Arikaree	South Fork	Colorado Allocation of Beaver Creek (zero for any Water Short Year)	Total of All Basins
(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	1,940	30,411
2001	3,100	1,522	10,904	4,673	7,753	529	28,481	9,578	1,904	12,647	1,500	25,629
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	0	21,142
2004	0	770	12,874	3,158	6,084	1,202	24,088	9,474	1,007	10,696	0	21,177
2005	0	275	14,952	3,430	7,522	1,372	27,550	10,021	1,865	12,234	0	24,120
2006	0	518	11,757	3,031	4,723	1,040	21,069	9,137	1,394	9,356	0	19,887
2007	674	266	12,511	2,715	5,670	1,055	22,891	9,797	2,123	10,165	0	22,084
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	3,130	13,839	2,890	29,308
2011	9,916	177	13,092	1,965	6,153	941	32,245	9,305	2,487	14,319	2,580	28,690
2012	6,441	107	9,321	67	2,556	810	19,302	8,371	1,764	8,571	1,860	20,566
2013	0	45	12,321	0	5,177	473	18,016	8,805	679	8,000	0	17,483
2014	0	148	13,858	0	8,542	1,020	23,568	8,956	1,179	10,466	0	20,601
2015	4,816	421	13,838	0	5,516	930	25,520	8,880	2,561	11,333	0	22,773
2016	3,894	421	13,803	0	5,709	904	24,731	9,052	2,619	10,982	0	22,653
2017	4,000	410	13,459	0	6,078	901	24,848	8,687	2,086	11,034	0	21,807
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 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	4,334	0	4,334	
2001	16,857	1,324	17,099	293	569	-2,779	33,363	7,734	0	7,734	
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	12,318	0	12,318	
2004	17,395	353	16,802	348	39	-1,269	33,669	12,491	0	12,491	9,228
2005	17,530	811	18,656	367	42	-1,954	35,452	11,332	0	11,332	10,627
2006	17,441	1,116	15,306	383	43	-3,009	31,280	11,393	0	11,393	11,359
2007	17,805	1,143	15,492	406	55	-2,062	32,838	10,754	0	10,754	11,658
2008	15,675	1,536	16,739	429	370	-2,487	32,262	5,979	0	5,979	10,390
2009	16,050	4,011	16,193	451	2,917	-1,549	38,072	5,675	0	5,675	9,027
2010	15,804	1,446	14,777	472	3,030	-2,698	32,832	3,523	0	3,523	7,465
2011	16,043	1,830	15,234	492	2,554	-2,305	33,848	5,158	0	5,158	6,218
2012	15,892	1,558	9,495	513	1,485	-6,712	22,231	1,665	0	1,665	4,400
2013	16,026	458	12,366	531	1,125	-1,919	28,587	11,103	0	11,103	5,425
2014	16,568	1,137	14,006	553	951	-882	32,334	11,733	7,448	4,285	5,147
2015	16,935	2,823	14,259	582	1,688	-2,451	33,835	11,062	10,760	302	4,503
2016	17,330	2,625	14,224	607	1,451	-2,327	33,909	11,256	10,130	1,126	3,696
2017	17,352	2,076	13,869	624	1,073	-3,116	31,878	10,071	11,500	-1,429	3,078
2018	0	0	0	0	0	0	0	0	0	0	857
2019	0	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0	-61
2021	0	0	0	0	0	0	0	0	0	0	-286
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

Explanation of Columns in Table 1 (page 4 of 4)

(Gaged or RRCA Accounting data used when available, remaining data is estimated)

Column Number	Section Title	Column Title	Explanation
(1)		Jan - Dec Calendar Year	Accounting on a calendar year of January through December
(2)	North Fork Basin Accounting	North Fork Gaged Flow	USGS Gage 06823000 North Fork Republican River at Colorado-Nebraska Stateline
(3)		CCP Deliveries	Colorado Compact Compliance Pipeline deliveries to the North Fork as measured by the Parshall flume at the outfall.
(4)		Net North Fork Gaged Flows for Virgin Flow Calculations	Calculated as Col(2) - Col(3). The CCP deliveries are subtracted out of the North Fork Gage flow for purposes of virgin flow calculations.
(5)		0.40 x Haigler Canal Divs Measured at Stateline	Calculated as .40 x Haigler Canal Deliveries at Stateline. Accounts for return flow in Nebraska as the result of a Nebraska diversion in Colorado.
(6)		CO SW and Small Res Evap	Colorado consumptive use from surface water diversions (multiplied by 60%) and reservoir evaporation occurring in the North Fork basin upstream of the stateline. Values from RRCA Accounting.
(7)		CO GW Con Use	Colorado Groundwater Consumptive use in the North Fork Basin upstream of the Stateline. Values from RRCA Accounting.
(8)		KS GW Con Use	Kansas Groundwater Consumptive Use on the North Fork Basin Upstream of the Stateline. Values from RRCA Accounting.
(9)		NE GW and SW Con Use	Nebraska surface water diversions in Colorado times 0.60 (Haigler Canal at Stateline). Plus Nebraska Groundwater Consumptive use on the North Fork Basin Upstream of the Stateline. Values from RRCA Accounting.
(10)		Virgin Flow	Calculated as Col(4) + Col(5) + Col(6) + Col(7) + Col(8) + Col(9)
(11)	Arikaree Basin Accounting	Gaged Flow	USGS Gage 06821500 Arikaree River at Haigler, Nebr.
(12)		CO SW	Colorado consumptive use from surface water diversions (multiplied by 60%) in the Arikaree basin. Values from RRCA Accounting.
(13)		CO GW	Colorado groundwater consumptive use in the Arikaree Basin. Values from RRCA Accounting.
(14)		KS GW and Non-Fed Res Evap	Kansas groundwater consumptive use and reservoir evaporation in the Arikaree Basin. Values from RRCA Accounting.
(15)		NE GW	Nebraska groundwater consumptive use in the Arikaree Basin. Values from RRCA Accounting.
(16)		Virgin Flow	Calculated as Col(11) + Col(12) + Col(13) + Col(14) + Col(15)
(17)	South Fork Basin Accounting	Gaged Flow at Benkelman	USGS Gage 06827500 South Fork Republican River near Benkelman, Nebr.
(18)		CO SW + CO Small Res Evap	Colorado consumptive use from surface water diversions (multiplied by 60%) and reservoir evaporation occurring in the South Fork basin. Values from RRCA Accounting.
(19)		CO GW + Bonny Res Seepage	Colorado Groundwater Consumptive use in the South Fork Basin. Values from RRCA
(20)		CO Bonny Res Evap	Reservoir Evaporation on Bonny Reservoir charged to Colorado.
(21)		KS GW, Non-Fed Res Evap, SW CU	Kansas groundwater consumptive use, reservoir evaporation, and consumptive use of surface water diversions (60%) in the South Fork Basin. Values from RRCA Accounting.
(22)		NE GW	Nebraska groundwater consumptive use in the South Fork Basin. Values from RRCA Accounting.
(23)		Virgin Flow	Calculated as Col(17) + Col(18) + Col(19) + Col(20) + Col(21) + Col(22)
(24)	CO Compact Allocation	North Fork	Calculated as Col(10) x 22.37%
(25)		Arikaree	Calculated as Col(16) x 78.53%
(26)		South Fork	Calculated as Col(23) x 44.41%
(27)		Colorado Allocation of Beaver Creek (zero for any Water Short Year)	Values from RRCA Accounting and the BOR designation of water short years.
(28)		Total of All Basins	Calculated as Col(24) + Col(25) + Col(26) + Col(27)
(29)	CO Consumptive Use	North Fork	Calculated as Col(6) + Col(7)
(30)		Arikaree	Calculated as Col(12) + Col(13)
(31)		South Fork	Calculated as Col(18) + Col(19) + Col(20)
(32)		Buffalo and Rock Creek	Values from RRCA Accounting.
(33)		French-man Creek	Values from RRCA Accounting.
(34)		Rep River Mainstem	Values from RRCA Accounting.
(35)		Total Colorado Con Use	Calculated as Col(29) + Col(30) + Col(31) + Col(32) + Col(33) + Col(34)
(36)	Colorado Compact Compliance Accounting	Annual Amount Colorado Exceeded Compact Entitlement BEFORE CCP Delivery	Calculated as Col(35) - Col(28)
(37)		CCP Deliveries	Colorado Compact Compliance Pipeline deliveries to the North Fork as measured by the Parshall flume at the outfall.
(38)		Annual Amount Colorado Exceeded Compact Entitlement after Accounting for CCP Delivery	Calculated as Col(36) - Col(37)
(39)		5-year Running Average of the Amount Colorado Exceeded Compact Entitlement after Accounting for CCP Delivery	Calculated as the average of this year and the four previous years.

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	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)	(16)
2000	19,430	0	5,846	3,629	4,857	5,915	0	5,052	46	0	41	303	5,945	1,940	No
2001	19,748	0	4,927	552	3,100	5,457	0	2,536	46	0	41	303	4,673	1,500	No
2002	15,903	0	4,865	231	1,578	7,418	0	2,158	46	0	41	303	4,673	770	No
2003	17,700	0	4,965	1,060	905	4,358	0	996	0	0	0	29	3,375	260	Yes
2004	19,759	0	3,732	341	0	4,961	0	1,283	46	0	41	303	3,158	360	Yes
2005	21,060	0	4,745	1,151	0	5,213	0	458	43	0	41	295	3,430	910	Yes
2006	17,608	0	4,418	404	0	5,150	0	864	50	0	46	325	3,031	1,420	Yes
2007	20,566	0	4,522	1,331	674	4,961	0	443	38	0	18	143	2,715	2,320	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	0	1,336	41	117	11	98	1,921	2,890	No
2011	19,722	0	4,826	1,074	9,916	530	0	39	36	154	14	119	1,965	2,580	No
2012	14,376	0	6,129	494	6,441	886	0	0	51	107	24	213	67	1,860	No
2013	18,433	0	3,839	66	0	553	0	0	45	45	17	147	0	1,130	Yes
2014	26,705	7,448	3,113	0	0	412	0	184	38	38	11	100	0	1,250	Yes
2015	28,768	10,760	3,627	142	4,816	788	0	616	38	51	11	124	0	2,130	Yes
2016	28,089	10,130	4,018	397	3,894	788	0	616	38	51	11	124	0	2,430	Yes
2017	28,000	11,500	3,800	300	4,000	700	0	600	40	50	10	120	0	2,000	Yes
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.