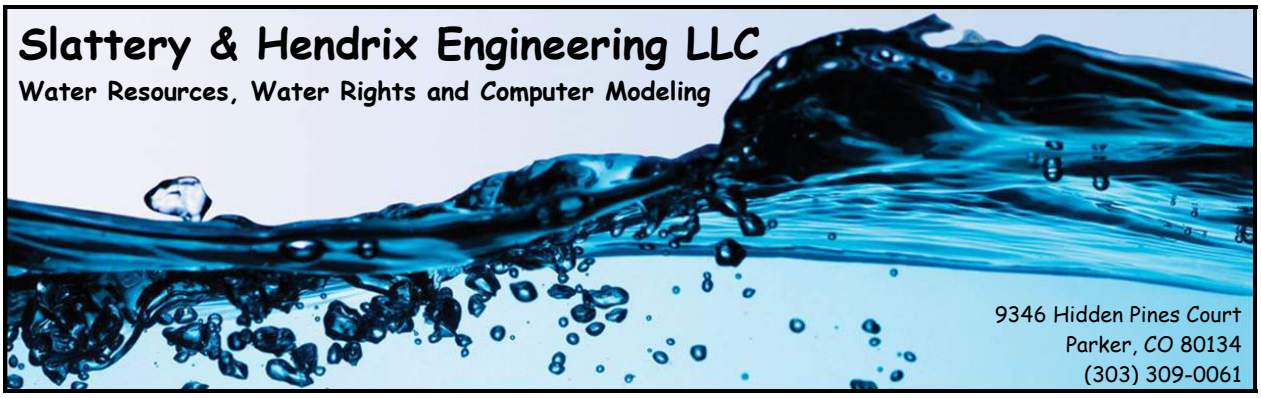

To: Peter Ampe – Hill & Robbins, P.C – Counsel for the Republican River Water Conservation District

From: James E. Slattery
Randy L. Hendrix
Willem Schreuder – Principia Mathematica

Date: March 31, 2016

Subject: March 2016 Projected Delivery for the Colorado Compact Compliance Pipeline

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The "Resolution by the Republican River Compact Administration Approving a Temporary Augmentation Plan and Related Accounting Procedures for the Colorado Compact Compliance Pipeline" was approved October 14, 2014. The delivery schedule for the Compact Compliance Pipeline (CCP) is described in that resolution and supporting attachments. Colorado is now delivering water in compliance with the schedule set forth in the resolution.

The projected CCP delivery requirement to meet Colorado's obligation under the Compact in 2016 is approximately 9,500 ac-ft. The capacity of the CCP pipeline project is approximately 2,000 ac-ft/month. Colorado delivered approximately 5,020 ac-ft to the North Fork from the CCP during the period January 1 through March 31, 2016. Colorado plans on delivering approximately 4,500 ac-ft of additional deliveries through the CCP starting October 20 and continuing deliveries through December 31.

The attached Table 1 and Table 2 summarizes the calculations used to derive the delivery amount. As shown in Column 38 of Table 1, Colorado is projected to be in compact compliance by a total of approximately 400 ac-ft for the three-year period of 2014-2016. Colorado started making CCP deliveries in 2014.

Data Utilized to Determine Delivery Amount

The footnotes of the attached Table 2 summarizes the source of the Colorado surface water data utilized in the projection.

The RRCA Groundwater Model was run to obtain an estimate of the Groundwater CBCU. For Kansas groundwater pumping, the 2014 data was repeated for 2015 and 2016. For Nebraska groundwater pumping the 2014 data was repeated for 2015 and 2015. For Colorado the pumping for 2014 data was repeated for 2015 and 2016.

Precipitation for the groundwater model run were estimated as 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 2015 values.

The model was run using the “Dry Bonny” approach, which restores the South Fork Model cells to the condition before Bonny Reservoir was built to reflect the current state of no impoundment of water behind Bonny Dam. 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.

Table 1 (page 1 of 3)

Operation of the Colorado Compact Compliance Pipeline

(units of ac-ft)

	North Fork Basin Accounting									Arikaree Basin Accounting					
		Consumptive Use									Consumptive Use				
Jan - Dec Calendar Year	North Fork Gaged 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	Gaged 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	14,762	0	4,135	44,287	1,331	0	1,143	117	112	2,703
2008	21,636	0	21,636	1,998	671	14,959	0	4,468	43,732	1,568	0	1,419	106	127	3,220
2009	24,408	0	24,408	1,677	267	15,741	0	3,468	45,561	779	0	3,672	162	153	4,767
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	91	0	458	214	126	889
2014	26,707	7,448	19,259	1,245	285	16,283	0	2,964	40,037	0	0	1,138	236	128	1,502
2015	27,913	10,760	17,153	1,867	511	16,661	0	3,923	40,115	150	0	2,823	182	105	3,260
2016	27,913	9,500	18,413	1,867	511	16,818	0	3,954	41,563	150	0	2,268	158	99	2,675
2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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				
		Consumptive Use						22.37%	78.53%	44.41%		All Basins
Jan - Dec Calendar Year	Gaged Flow at Benkelman	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	9,908	2,123	10,165	0	22,195
2008	1,424	52	12,895	1,980	5,933	1,030	23,314	9,783	2,529	10,353	2,840	25,505
2009	8,487	100	15,921	1,117	7,856	1,302	34,782	10,193	3,743	15,445	3,160	32,541
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	5,794	67	2,550	810	15,769	8,371	1,764	7,002	1,860	18,997
2013	0	45	2,108	0	2,002	471	4,626	8,805	698	2,054	0	11,557
2014	0	148	5,574	0	3,852	516	10,090	8,957	1,180	4,481	0	14,617
2015	4,820	421	11,124	0	6,955	578	23,898	8,974	2,560	10,612	0	22,146
2016	4,820	421	8,791	0	5,013	970	20,015	9,298	2,101	8,888	0	20,286
2017	0	0	0	0	0	0	0	0	0	0	0	0
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**	CCP Deliveries	Annual Amount Colorado Exceeded Compact Entitlement after Accounting for CCP Delivery	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	17,777	1,143	15,492	406	55	-2,033	32,839	10,644	0	10,644	11,636
2008	15,630	1,419	14,927	429	345	-2,185	30,565	5,060	0	5,060	10,184
2009	16,008	3,672	17,138	450	2,839	-1,650	38,456	5,915	0	5,915	8,869
2010	15,804	1,446	14,777	472	3,030	-2,699	32,831	3,522	0	3,522	7,307
2011	16,043	1,830	15,234	492	2,554	-2,306	33,847	5,157	0	5,157	6,060
2012	15,892	1,558	5,968	513	1,485	-6,712	18,704	-293	0	-293	3,872
2013	16,026	458	2,153	531	1,125	-1,929	18,364	6,807	0	6,807	4,222
2014	16,568	1,138	5,722	553	927	-884	24,025	9,408	7,448	1,960	3,430
2015	17,172	2,823	11,545	583	1,955	-2,309	31,768	9,622	10,760	-1,138	2,498
2016	17,329	2,268	9,212	602	2,145	-2,879	28,676	8,390	9,500	-1,110	1,245
2017	0	0	0	0	0	0	0	0	0	0	1,304
2018	0	0	0	0	0	0	0	0	0	0	-58
2019	0	0	0	0	0	0	0	0	0	0	-450
2020	0	0	0	0	0	0	0	0	0	0	-222
2021	0	0	0	0	0	0	0	0	0	0	0
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