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NOTE

14 Dec 93

To: Ned Andrews, Jim Wilson, and Bill Jackson
From: Tim Randle
Subject: Colorado River Sand Storage in Grand Canyon

I have updated the historical sand storage computation to the end of water year 1993 for the reach from Lees Ferry to Phantom Ranch (see attachment). The mass balance computation indicates a significant increase in sand storage downstream from the Little Colorado River as a result of the 1993 winter floods. However, sand storage in the reach upstream did not increase nearly as much.

Sand storage in the reach from Lees Ferry to the Little Colorado River is still less than in October 1965. The amount of sand storage at the time of dam closure is unknown and was assumed to be zero at the beginning of the mass balance computation. Although the computed sand storage in the upper reach is negative at the end of water year 1993, there may actually be significant quantities of sand stored in the channel. [Note: *I am somewhat concerned that people will interpret the graph to mean that there is no sediment in the upper reach and therefore, a beach-building flow is out of the question. On the other hand, perhaps there is less sediment presently in this reach than previously thought*].

The sand mass balance computation for the historical period was performed with the use of sand-load-discharge rating curves, dam release records, and river discharge measurements. Sand loads were computed on an hourly basis for the Colorado River and on a daily basis for the Paria and Little Colorado Rivers.

The following assumptions were used in the analysis:

- The sand-load-discharge rating curves are accurate and do not change with time
- The effects of wave transformation and travel time can be ignored
- The sand contribution from ungauged tributaries can be ignored

For the Colorado River, sand loads were computed at Lees Ferry, above the Little Colorado River, and near Phantom Ranch. The same discharge values were used for these three stations (i.e. the effects of wave transformation and travel time were ignored). Hourly dam release records were used from October 1, 1965 through March 31, 1989 and all of June 1989. Hourly discharge values, recorded at the gauge below the dam, were used for the period October 1, 1989 through February 28, 1993. Monthly flow records (either at the dam or Lees Ferry) and a monthly-sand-load rating curve were used for the other periods.

For the Paria and Little Colorado Rivers, sand loads were computed using mean daily flow records at Lees Ferry and Cameron, AZ.

Hourly or daily sand loads for the Colorado River and tributaries were accumulated on a monthly

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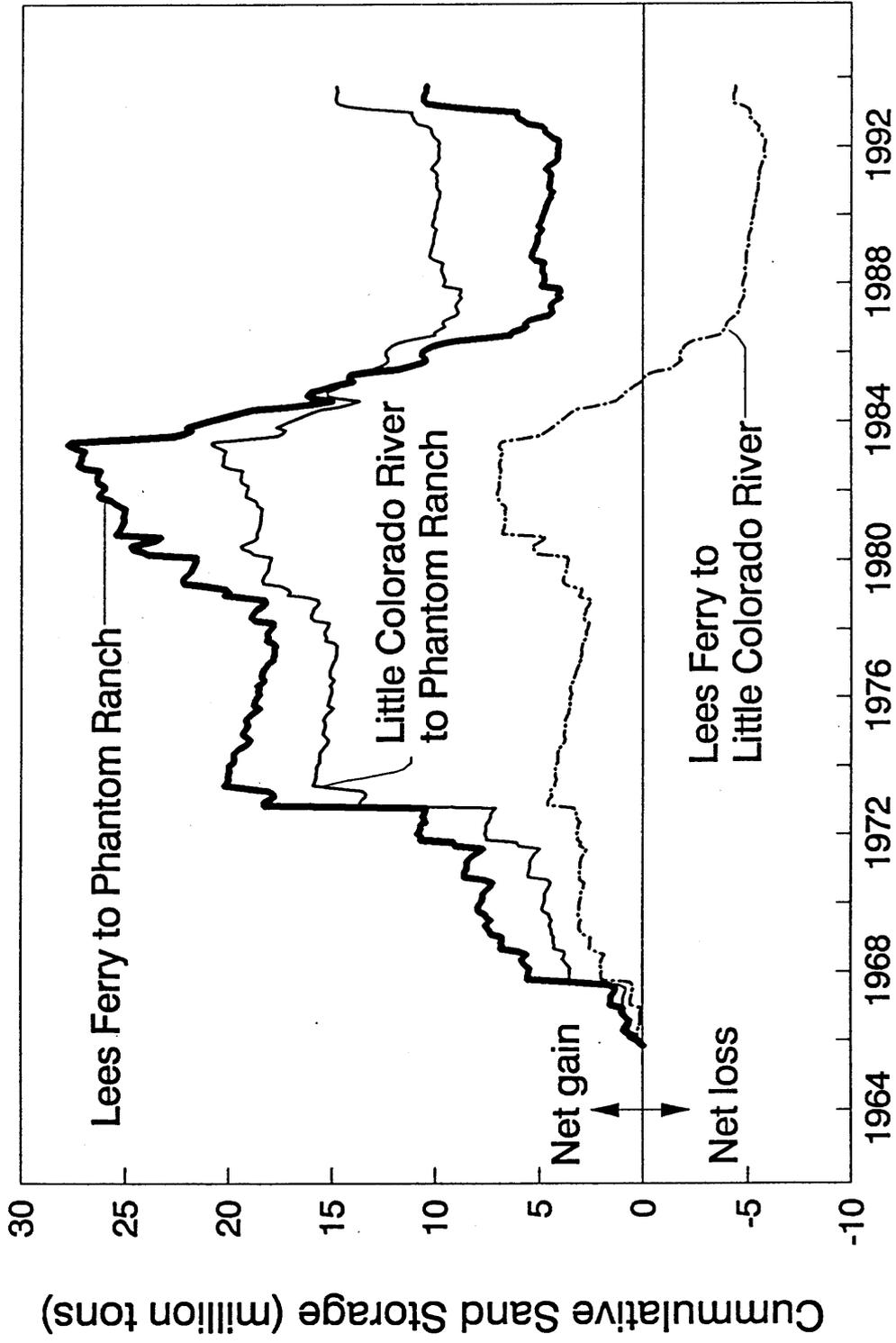
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basis and loaded into a spreadsheet (see attachment). The historical sand storage was then computed and plotted on a monthly basis.

I would appreciate any comments on this before I send it to the GCES office in Flagstaff.

Jim Randle

Colorado River Sand Storage



COLORADO RIVER HISTORICAL SAND BALANCE

Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at Lees Ferry		above LCR		near Phantom Ranch		Little Colorado River		Reach 1		Reach 2		Reaches 1 and 2	
					Release	Storage	Change	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
10 1965	716344	11650	3350	19450	3056	23476	46296	10405	2137	-10015	-10015	-10015	-20683	-20683	-30698	-30698	-30698	-30698
11 1965	650848	10938	4125	17900	2518	19424	38137	227261	48615	210355	200340	200340	29902	29902	9219	240257	240257	209559
12 1965	597137	9712	1725	19400	2231	17191	33789	62721	69258	47761	248101	248101	52660	52660	61879	100421	100421	309980
1 1966	530085	8621	1300	20750	2093	16001	31708	13218	341783	-690	247411	247411	326076	326076	387955	325386	325386	635366
2 1966	550522	9913	1325	19750	2419	18477	36644	17098	4336	1040	248451	248451	-13831	-13831	374124	-12791	-12791	622575
3 1966	692032	11255	2550	19650	3332	25394	50475	23852	294064	1790	250241	250241	268983	268983	643107	270773	270773	893348
4 1966	830802	13962	6979	20582	4744	36033	71858	441	42278	-30848	219393	219393	6453	6453	649560	-24395	-24395	868953
5 1966	984921	16018	5353	21693	7649	57311	115864	67	27	-49595	169798	169798	-58526	-58526	591034	-108121	-108121	760832
6 1966	757379	12728	1907	20423	4313	32663	65335	13	0	-28337	141461	141461	-32672	-32672	558362	-61009	-61009	699823
7 1966	678034	11027	4540	18836	2561	19793	38795	13702	10048	-3530	137931	137931	-8954	-8954	549408	-12484	-12484	687339
8 1966	668491	10872	4377	17725	2699	20767	40889	10062	205564	-8006	129925	129925	185442	185442	734850	177436	177436	864775
9 1966	615245	10340	3463	18995	2547	19506	38588	18882	132932	1923	131848	131848	113850	113850	848700	115773	115773	980548
10 1966	532059	8653	1360	17873	1617	12551	24491	1341	44867	-9593	122255	122255	32927	32927	881627	23334	23334	1003882
11 1966	564260	9483	1480	20215	2122	16327	32142	1383	119	-12822	109433	109433	-15696	-15696	865931	-28518	-28518	975364
12 1966	511717	8322	1350	16920	1548	12029	23447	485984	117282	475503	584936	584936	105864	105864	971795	581367	581367	1556731
1 1967	565689	9200	2515	19550	1764	13702	26728	6798	10	-5140	579796	579796	-13016	-13016	958779	-18156	-18156	1538575
2 1967	507392	9136	1524	15600	1321	10370	20008	9807	12	758	580554	580554	-9626	-9626	949153	-8868	-8868	1529707
3 1967	645841	10504	4380	18450	2124	16512	32171	1465	0	-12923	567631	567631	-15659	-15659	933494	-28582	-28582	1501125
4 1967	867762	14583	5880	24400	6121	45914	92724	345	872	-39448	528183	528183	-45938	-45938	887556	-85386	-85386	1415739
5 1967	896126	14574	5740	21530	6456	48404	97790	4990	0	-36958	491225	491225	-49386	-49386	838170	-86344	-86344	1329395
6 1967	736558	12378	4178	21005	3856	29314	58405	566	24652	-24892	466333	466333	-4439	-4439	833731	-29331	-29331	1300064
7 1967	628669	10224	2362	18835	2564	19690	38835	43832	308432	26706	493039	493039	289287	289287	1123018	315993	315993	1616057
8 1967	617993	10051	2804	17400	2422	18636	36689	131418	1640822	115204	608243	608243	1622769	1622769	2745787	1737973	1737973	3354030
9 1967	526650	8851	2777	17575	1922	14797	29111	1414322	810642	1401447	2009690	2009690	796328	796328	3542115	2197775	2197775	5551805
10 1967	382832	6226	1242	15200	673	5343	10195	263	2822	-4407	2005283	2005283	-2030	-2030	3540085	-6437	-6437	5545368
11 1967	468775	7878	1760	19465	1612	12418	24411	1612	0	-9194	1996089	1996089	-11993	-11993	3528092	-21187	-21187	5524181

COLORADO RIVER HISTORICAL SAND BALANCE
 Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at Lees Ferry		above LCR		near Phantom Ranch		Little Colorado River		Reach 1		Reach 2		Reaches 1 and 2	
					Release tons	tons	tons	tons	tons	tons	Change	Storage	Cumm.	Sand	Change	Storage	Cumm.	Sand
12 1967	555083	9028	1920	20690	2261	17310	34256	4282	57	-10767	1985322	-16889	3511203	-27656	5496525			
1 1968	633444	10302	1937	21950	3443	26048	52152	9405	8949	-13200	1972122	-17155	3494048	-30355	5466170			
2 1968	467187	8122	1904	19150	1589	12269	24063	95835	124227	85155	2057277	112433	3606481	197588	5663758			
3 1968	840897	13676	3962	28125	5912	44240	89667	18960	159508	-19368	2037909	114081	3720562	94713	5758471			
4 1968	1037337	17433	7586	27800	11614	85302	183568	3138	255700	-70550	1967359	157434	3877996	86884	5845355			
5 1968	1003402	16319	4700	26600	9677	71508	148628	3760	26543	-58071	1909288	-50577	3827419	-108648	5736707			
6 1968	921739	15490	3728	25840	8397	62218	130078	11	0	-53810	1855478	-67860	3759559	-121670	5615037			
7 1968	807394	13131	2396	26360	7493	55319	118114	424874	85616	377048	2232526	22821	3782380	399869	6014906			
8 1968	673105	10947	2260	24800	4104	30808	62159	368154	532840	341450	2573976	501489	4283869	842939	6857845			
9 1968	624659	10498	3263	21670	3258	24676	49355	25	2	-21393	2552583	-24677	4259192	-46070	6811775			
10 1968	613493	9978	2232	19395	2489	19092	37695	295	70406	-16308	2536275	51803	4310995	35495	6847270			
11 1968	612828	10299	3025	19605	2637	20186	39949	730	825	-16819	2519456	-18938	4292057	-35757	6811513			
12 1968	622442	10123	1808	21250	2206	17031	33412	1345	0	-13480	2505976	-16381	4275676	-29861	6781652			
1 1969	568901	9252	1480	20970	2486	18940	37658	448256	134383	431802	2937778	115665	4391341	547467	7329119			
2 1969	466334	8397	2175	23000	1229	9572	18616	48392	14980	40049	2977827	5936	4397277	45985	7375104			
3 1969	752009	12230	4124	23320	3897	29610	59030	103583	48497	77870	3055697	19077	4416354	96947	7472051			
4 1969	907834	15257	5980	24720	7324	54596	110934	62403	135479	15131	3070828	79141	4495495	94272	7566323			
5 1969	801422	13034	2790	26800	6186	46013	94992	10284	901	-29543	3041285	-48078	4447417	-77621	7488702			
6 1969	907856	15257	5080	27950	8005	59335	122398	24	0	-51306	2989979	-63063	4384354	-114369	7374333			
7 1969	944089	15354	2583	25300	8785	65059	133524	120971	183964	64697	3054676	115499	4499853	180196	7554529			
8 1969	888015	14442	2090	26653	8861	65322	136391	102297	83570	45836	3100512	12501	4512354	58337	7612866			
9 1969	731943	12301	2481	23200	5964	44329	90334	35116	348960	-3249	3097263	302955	4815309	299706	7912572			
10 1969	590758	9608	2175	21635	2593	19781	39277	11522	60502	-5666	3091597	41006	4856315	35340	7947912			
11 1969	699030	11748	1584	22160	4533	34057	68658	7182	5518	-22342	3069255	-29083	4827232	-51425	7896487			
12 1969	814254	13243	1314	24800	6981	51757	105742	5371	6	-39405	3029850	-53979	4773253	-93384	7803103			
1 1970	720584	11719	1402	24040	4918	36759	74502	12118	13	-19723	3010127	-37730	4735523	-57453	7745650			

COLORADO RIVER HISTORICAL SAND BALANCE

Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	SAND LOADS										Reaches 1 and 2	
					at Lees Ferry tons	above LCR tons	near Phantom Ranch tons	Paria River tons	Little Colorado River tons	Reach 1 Sand Storage Change tons	Reach 1 Cum. Sand Storage Change tons	Reach 2 Sand Storage Change tons	Reach 2 Cum. Sand Storage Change tons	Reaches 1 and 2 Sand Storage Change tons	Reaches 1 and 2 Cum. Sand Storage Change tons	
2 1970	431294	7766	1020	21635	1524	11718	23084	4197	0	-5997	3004130	-11366	4724157	-17363	7728287	
3 1970	498910	8114	1302	19920	1326	10361	20093	15620	8665	6585	3010715	-1067	4723090	5518	7733805	
4 1970	963586	16194	5200	27440	9279	68566	142956	354	6474	-58933	2951782	-67916	4655174	-126849	7606956	
5 1970	924379	15034	3484	27280	9201	67722	147966	43	0	-58478	2893304	-80244	4574930	-138722	7468234	
6 1970	851792	14315	3569	26840	8305	61217	126835	4018	0	-48894	2844410	-65618	4509312	-114512	7353722	
7 1970	774460	12595	2277	27760	6202	46041	96925	9205	6299	-30634	2813776	-44585	4464727	-75219	7278503	
8 1970	707555	11507	2107	27685	5739	42546	90459	271782	160147	234975	3048751	112234	4576961	347209	7625712	
9 1970	693802	11660	2872	27160	5506	40828	84138	35539	1004352	217	3048968	961042	5538003	961259	8586971	
10 1970	484239	7875	1060	18485	1390	10820	21057	150	3742	-9280	3039688	-6495	5531508	-15775	8571196	
11 1970	442464	7436	940	20200	1573	12077	23832	11627	18	1123	3040811	-11737	5519771	-10614	8560582	
12 1970	670814	10910	920	26000	5080	37786	77384	10497	10	-22209	3018602	-39588	5480183	-61797	8498785	
1 1971	497299	8088	1060	24000	2652	19922	40173	21341	10	4071	3022673	-20241	5459942	-16170	8482615	
2 1971	424567	7645	1010	21425	1430	11013	21669	3766	0	-5817	3016856	-10656	5449286	-16473	8466142	
3 1971	620641	10094	1060	21775	2758	21038	41782	4298	0	-13982	3002874	-20744	5428542	-34726	8431416	
4 1971	1025005	17226	2320	29200	12454	90531	200576	99	0	-77978	2924896	-110045	5318497	-188023	8243393	
5 1971	988729	16080	3501	28600	11267	82074	176908	366	0	-70441	2854455	-94834	5223663	-165275	8078118	
6 1971	998083	16773	2566	30000	12594	91236	209820	14	0	-78628	2775827	-118584	5105079	-197212	7880906	
7 1971	1013885	16489	3297	29500	11475	84077	183780	22485	539	-50117	2725710	-99164	5005915	-149281	7731625	
8 1971	922918	15010	2430	31200	11621	83777	189440	393837	1102875	321681	3047391	997212	6003127	1318893	9050518	
9 1971	802849	13492	2447	29750	9356	67400	153792	2669	214769	-55375	2992016	128377	6131504	73002	9123520	
10 1971	567683	9232	1230	22825	2195	16842	33250	176430	1430453	161783	3153799	1414045	7545549	1575828	10699348	
11 1971	731457	12293	870	27080	6950	51255	109769	3842	55065	-40463	3113336	-3449	7542100	-43912	10655436	
12 1971	890039	14475	1010	26600	9063	66754	141840	124787	177377	67096	3180432	102291	7644391	169387	10824823	
1 1972	807905	13139	1158	26400	7464	55175	115687	3189	13969	-44522	3135910	-46543	7597848	-91065	10733758	
2 1972	448942	7805	950	26560	2401	17984	37155	2990	110	-12593	3123317	-19061	7578787	-31654	10702104	
3 1972	379298	6169	950	16340	723	5732	10957	341	0	-4668	3118649	-5225	7573562	-9893	10692211	

COLORADO RIVER HISTORICAL SAND BALANCE

Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at Lees Ferry		above LCR		near Phantom Ranch		Little Colorado River		Reach 1		Reach 2		Reaches 1 and 2	
					tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
4 1972	801998	13478	2668	28960	7258	53232	114443	56	0	-45918	3072731	-61211	7512351	-107129	10585082			
4 1972	801998	13478	2668	28960	7258	53232	114443	28	0	-45946	3026785	-61211	7451140	-107157	10477925			
6 1972	918531	15436	2889	32100	12582	89488	203932	309284	798	232378	3259163	-113646	7337494	118732	10596657			
7 1972	905793	14731	2821	31900	11356	81818	189241	1173	128108	-69289	3189874	20685	7358179	-48604	10548053			
8 1972	1031343	16773	2838	32800	17965	123835	290706	153866	48986	47996	3237870	-117885	7240294	-69889	10478164			
9 1972	943035	15848	2549	29850	13187	94398	218507	171004	9419	89793	3327663	-114690	7125604	-24897	10453267			
10 1972	655047	10653	1206	27080	5642	41667	90382	1313021	6559108	1276996	4604659	6510393	13635997	7787389	18240656			
11 1972	685849	11526	1122	26200	6061	44830	96560	26928	113266	-11841	4592818	61536	13697533	49695	18290351			
12 1972	996978	16214	1266	30100	14138	100356	232945	11469	8957	-74749	4518069	-123632	13573901	-198381	18091970			
1 1973	1169404	19019	1753	30220	20144	140527	334056	1612	22777	-118771	4399298	-170752	13403149	-289523	17802447			
2 1973	762027	13721	1184	29502	8850	64188	144898	78974	63761	23636	4422934	-16949	13386200	6687	17809134			
3 1973	1076062	17500	1184	30076	19121	132717	317198	161405	359488	47809	4470743	175007	13561207	222816	18031950			
4 1973	1632204	27430	17929	29838	41919	283715	699202	63990	1691862	-177806	4292937	1276375	14837582	1098569	19130519			
5 1973	626383	10527	2366	28967	5620	39190	85979	6268	1153853	-27502	4265435	1107064	15944646	1079562	20210081			
6 1973	769005	12924	2450	30817	9133	65120	148587	958	14423	-55029	4210406	-69044	15875602	-124073	20086008			
7 1973	656656	10679	1115	28359	5300	39012	84496	91	167	-33621	4176785	-45317	15830285	-78938	20007070			
8 1973	575297	9356	987	26309	4426	32877	68325	83263	1106	54812	4231597	-34342	15795943	20470	20027540			
9 1973	432873	7275	1098	18734	1546	11906	23417	4181	142	-6179	4225418	-11369	15784574	-17548	20009992			
10 1973	497761	8365	973	21026	2053	15723	31091	148	0	-13522	4211896	-15368	15769206	-28890	19981102			
11 1973	422463	7100	973	24126	1766	13380	26744	1785	0	-9829	4202067	-13364	15755842	-23193	19957909			
12 1973	354633	5768	973	23048	1108	8500	16779	4586	0	-2806	4199261	-8279	15747563	-11085	19946824			
1 1974	866948	14100	1098	29924	12211	86442	201560	6121	433	-68110	4131151	-114685	15632878	-182795	19764029			
2 1974	323398	5823	973	21700	1162	8882	17608	6514	19	-1206	4129945	-8707	15624171	-9913	19754116			
3 1974	407098	6621	1098	23452	1433	10952	21700	10367	16415	848	4130793	5667	15629838	6515	19760631			
4 1974	516614	8682	2847	21430	1673	12904	25335	424	4982	-10807	4119986	-7449	15622389	-18256	19742375			
5 1974	817982	13303	2597	28375	7965	58292	130154	27	0	-50300	4069686	-71862	15550527	-122162	19620213			

COLORADO RIVER HISTORICAL SAND BALANCE

Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at Lees Ferry		above LCR		near Phantom Ranch		Paria River		Little Colorado River		Reach 1		Reach 2		Reaches 1 and 2		
					tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
6 1974	916171	15397	3753	28692	10718	77489	180431	14	0	-66757	4002929	-102942	15447585	-169699	19450514						
7 1974	1235536	20094	5431	29439	19214	136921	323593	23997	74943	-93710	3909219	-111729	15335856	-205439	19245075						
8 1974	1214389	19750	4118	29306	18291	131001	308391	13562	72826	-99148	3810071	-104564	15231292	-203712	19041363						
9 1974	816326	13719	2722	25744	6995	51860	107719	3772	28998	-41093	3768978	-26861	15204431	-67954	18973409						
10 1974	602610	9801	1098	24531	3404	25631	51565	69926	156237	47699	3816677	130303	15334734	178002	19151411						
11 1974	717729	12062	1093	28710	6717	49160	106595	36675	200197	-5768	3810909	142762	15477496	136994	19288405						
12 1974	582084	9467	973	28036	3921	29175	60774	2298	0	-22956	3787953	-31599	15445897	-54555	19233850						
1 1975	784172	12753	1098	29348	8098	58859	129126	5092	2	-45669	3742284	-70265	15375632	-115934	19117916						
2 1975	572899	10316	1098	27362	3811	28415	58290	13157	8	-11447	3730837	-29867	15345765	-41314	19076602						
3 1975	524495	8530	1098	23992	2644	19941	40045	28189	30345	10892	3741729	10241	15356006	21133	19097735						
4 1975	484525	8143	3097	21295	1508	11636	22848	6539	90460	-3589	3738140	79248	15435254	75659	19173394						
5 1975	906755	14747	2347	28845	9852	71855	159542	255	10312	-61748	3676392	-77375	15357879	-139123	19034271						
6 1975	998808	16786	3025	29306	13774	98888	229277	27	0	-85087	3591305	-130389	15227490	-215476	18818795						
7 1975	1232041	20037	3188	29435	22561	158641	396328	128975	110987	-7105	3584200	-126700	15100790	-133805	18684990						
8 1975	1014585	16501	2528	29566	14078	100754	236213	23228	6550	-63448	3520752	-128909	14971881	-192357	18492633						
9 1975	951328	15988	2642	28518	12223	88462	199306	101263	354685	25024	3545776	243841	15215722	268865	18761498						
10 1975	609107	9906	1158	28780	3661	27398	56565	215	830	-23522	3522254	-28337	15187385	-51859	18709639						
11 1975	423637	7119	1044	27994	2691	19990	42465	2211	0	-15088	3507166	-22475	15164910	-37563	18672076						
12 1975	525595	8548	816	28256	4148	30355	67826	5427	853	-20780	3486386	-36618	15128292	-57398	18614678						
1 1976	699300	11373	1044	28256	6586	48224	106202	3684	32	-37954	3448432	-57946	15070346	-95900	18518778						
2 1976	749070	13023	1044	25767	7396	54467	114234	100620	35336	53549	3501981	-24431	15045915	29118	18547896						
3 1976	684711	11136	944	28387	5349	39738	81942	12245	41226	-22144	3479837	-978	15044937	-23122	18524774						
4 1976	661501	11117	2238	24886	4527	33766	68567	18313	109865	-10926	3468911	75064	15120001	64138	18588912						
5 1976	1048564	17053	2826	29042	14583	105368	240058	2972	18079	-87813	3381098	-116611	15003390	-204424	18384488						
6 1976	748724	12583	2185	28911	8162	59100	135361	12	0	-50926	3330172	-76261	14927129	-127187	18257301						
7 1976	763757	12421	2185	29304	7234	52892	116013	513	246896	-45145	3285027	183775	15110904	138630	18395931						

COLORADO RIVER HISTORICAL SAND BALANCE

Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at		near		above		LOADS		Reach 1		Reach 2		Reaches 1 and 2	
					Lees Ferry tons	Paria River tons	Phantom Ranch tons	above LCR tons	near Phantom Ranch tons	at Lees Ferry tons								
8 1976	714802	11625	1957	28387	5834	43036	92402	45	48649	-37157	3247870	-717	15110187	-37874	18358057			
9 1976	843796	14180	1957	27732	8953	65738	141827	192	97020	-56593	3191277	20931	15131118	-35662	18322395			
10 1976	794228	12917	1062	25683	5905	44097	89889	2469	3005	-35723	3155554	-42787	15088331	-78510	18243885			
11 1976	895806	15055	1768	24886	7504	55808	113668	1124	185	-47180	3108374	-57675	15030656	-104855	18139030			
12 1976	803681	13071	1297	28738	6762	49942	105239	530	0	-42650	3065724	-55297	14975359	-97947	18041083			
1 1977	1003348	16318	1180	29760	13031	93297	215213	2242	7024	-78024	2987700	-114892	14860467	-192916	17848167			
2 1977	476974	8588	838	22662	2168	16475	32836	2020	293	-12287	2975413	-16068	14844399	-28355	17819812			
3 1977	470310	7649	959	29221	3021	22149	48767	356	4	-18772	2956641	-26614	14817785	-45386	17774426			
4 1977	170411	2864	959	17420	153	1228	2320	145	7792	-930	2955711	6700	14824485	5770	17780196			
5 1977	219868	3576	959	17420	350	2761	5298	1544	0	-867	2954844	-2537	14821948	-3404	17776792			
6 1977	478817	8047	959	29491	3492	25375	56205	485	0	-21398	2933446	-30830	14791118	-52228	17724564			
7 1977	874743	14226	2654	29221	9641	70050	156626	9556	229564	-50853	2882593	142988	14934106	92135	17816699			
8 1977	1185450	19279	4337	30250	18945	133469	315556	40267	575862	-74257	2808336	393775	15327881	319518	18136217			
9 1977	973718	16364	4462	30933	12009	85665	190830	1009	79348	-72647	2735689	-25817	15302064	-98464	18037753			
10 1977	381665	6207	974	21985	1006	7825	15244	6255	70949	-564	2735125	63530	15365594	62966	18100719			
11 1977	402083	6757	974	26727	1500	11390	23080	1352	3147	-8538	2726587	-8543	15357051	-17081	18083638			
12 1977	836817	13610	1116	26865	7678	56679	121717	2973	69	-46028	2680559	-64969	15292082	-110997	17972641			
1 1978	952538	15492	988	31155	11057	80046	175211	15622	325	-53367	2627192	-94840	15197242	-148207	17824434			
2 1978	617014	11110	1134	28425	3970	29719	61066	37364	8804	11615	2638807	-22543	15174699	-10928	17813506			
3 1978	585545	9523	1003	25654	2872	21720	43929	191028	731449	172180	2810987	709240	15883939	881420	18694926			
4 1978	489390	8224	2713	22914	1340	10412	20299	32164	170418	23092	2834079	160531	16044470	183623	18878549			
5 1978	649143	10557	2653	27280	4078	30471	63377	420	2220	-25973	2808106	-30686	16013784	-56659	18821890			
6 1978	757850	12736	2654	28475	7378	53953	119584	14	1266	-46561	2761545	-64365	15949419	-110926	18710964			
7 1978	706074	11483	2654	27066	5161	38414	79853	577	0	-32676	2728869	-41439	15907980	-74115	18636849			
8 1978	1083576	17623	3018	29895	14630	104711	242182	166	1389	-89915	2638954	-136082	15771898	-225997	18410852			
9 1978	985090	16555	2967	31069	12836	91342	206514	68	8589	-78438	2560516	-106583	15665315	-185021	18225831			

COLORADO RIVER HISTORICAL SAND BALANCE

Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at				near				Reach 1				Reach 2				Reaches 1 and 2			
					Lees Ferry tons	above LCR tons	Phantom Ranch tons	Paria River tons	Little Colorado River tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons					
10 1978	696722	11331	1098	26154	5435	40378	83621	8605	98229	-26338	2534178	54986	15720301	28648	18254479									
11 1978	678128	11396	1098	26563	5705	42180	88947	598489	562536	562014	3096192	515769	16236070	1077783	19332262									
12 1978	905104	14720	1116	29495	10196	74269	162728	2437	1017448	-61636	3034556	928989	17165059	867353	20199615									
1 1979	1046601	17021	988	31571	16122	113433	266195	5390	32172	-91921	2942635	-120590	17044469	-212511	19987104									
2 1979	760300	13690	1116	30602	8120	58443	129788	63206	177052	12883	2955518	105707	17150176	118590	20105694									
3 1979	225941	3675	988	26727	532	4065	8228	722293	330854	718760	3674278	326691	17476867	1045451	21151145									
4 1979	366868	6165	974	23061	810	6312	12268	160694	857074	155192	3829470	851118	18327985	1006310	22157455									
5 1979	535818	8714	2776	24886	2128	16152	32228	48257	55349	34233	3863703	39273	18367258	73506	22230961									
6 1979	620852	10434	2313	28518	4893	35889	79866	589	10308	-30407	3833296	-33669	18333589	-64076	22166885									
7 1979	863058	14036	2354	29194	10310	74732	172077	738	0	-63684	3769612	-97345	18236244	-161029	22005856									
8 1979	1070115	17404	2797	29194	15629	111002	265086	40576	49257	-54797	3714815	-104827	18131417	-159624	21846232									
9 1979	676794	11374	2465	28419	5782	42454	93216	29	0	-36643	3678172	-50762	18080655	-87405	21758827									
10 1979	608834	9902	915	25190	4271	31757	64916	772	1666	-26714	3651458	-31493	18049162	-58207	21700620									
11 1979	800504	13453	1501	25319	6614	49084	101082	13872	16458	-28598	3622860	-35540	18013622	-64138	21636482									
12 1979	646761	10519	1044	26946	4892	36297	74881	7515	420	-23890	3598970	-38164	17975458	-62054	21574428									
1 1980	606931	9871	930	28649	5053	37099	82624	72053	18262	40007	3638977	-27263	17948195	12744	21587172									
2 1980	621094	10798	1044	25898	3594	27052	54866	1507040	884494	1483582	5122559	856680	18804875	2340262	23927434									
3 1980	600237	9762	1026	24932	3390	25511	51357	152423	137866	130302	5252861	112020	18916895	242322	24169756									
4 1980	834404	14023	2354	25243	6747	50233	102881	100477	492899	56991	5309852	440251	19357146	497242	24666998									
5 1980	820726	13348	1651	25381	6868	50889	104481	39185	118492	-4836	5305016	64900	19422046	60064	24727062									
6 1980	1521195	25565	2649	48998	54908	318167	659378	294	380	-262965	5042051	-340831	19081215	-603796	24123266									
7 1980	1584782	25774	14014	37786	37730	254300	604230	2046	41	-214524	4827527	-349889	18731326	-564413	23558853									
8 1980	1244142	20234	4867	28691	18516	133761	312617	25149	49377	-90096	4737431	-129479	18601847	-219575	23339278									
9 1980	935216	15717	3259	27290	9545	70219	151331	2122373	128637	2061699	6799130	47525	18649372	2109224	25448502									
10 1980	740810	12048	1222	24872	4986	37254	75524	6368	0	-25900	6773230	-38270	18611102	-64170	25384332									
11 1980	919345	15450	2243	25448	8237	61083	125876	5039	0	-47807	6725423	-64793	18546309	-112600	25271732									

COLORADO RIVER HISTORICAL SAND BALANCE

Tim Randle December 13, 1993

Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at				near				Reach 1				Reach 2				Reaches 1 and 2			
					Lees Ferry tons	above LCR tons	Phantom Ranch tons	Paria River tons	Little Colorado River tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Sand Storage Change tons	Cumm. Sand Storage Change tons					
12 1980	743780	12096	1136	27515	5333	39676	83275	7574	1	-26769	6698654	-43598	18502711	-70367	25201365									
1 1981	718400	11684	1801	24932	4332	32570	65616	5607	13	-22631	6676023	-33033	18469678	-55664	25145701									
2 1981	603647	10869	1247	26869	3427	25754	52955	3932	23	-18395	6657628	-27178	18442500	-45573	25100128									
3 1981	423328	6885	1026	18925	883	6948	13376	15001	10	8936	6666564	-6418	18436082	2518	25102646									
4 1981	446637	7506	1026	22482	1170	9111	17721	6322	1656	-1619	6664945	-6954	18429128	-8573	25094073									
5 1981	529050	8604	2022	20068	1596	12378	24173	4552	39	-6230	6658715	-11756	18417372	-17986	25076087									
6 1981	511824	8601	1911	20450	1745	13454	26435	3296	18	-8413	6650302	-12963	18404409	-21376	25054711									
7 1981	836863	13610	2022	28935	8111	59486	130631	98880	285727	47505	6697807	214582	18618991	262087	25316798									
8 1981	882372	14350	3129	27773	8201	60493	128106	269223	52836	216931	6914738	-14777	18604214	202154	25518952									
9 1981	655758	11020	1729	26160	4495	33522	68939	85891	179676	56864	6971602	144259	18748473	201123	25720075									
10 1981	600402	9765	930	25243	3155	23763	48018	116944	473171	96336	7067938	448916	19197389	545252	26265327									
11 1981	581178	9767	1044	24981	3177	23893	48131	8712	130	-12004	7055934	-24108	19173281	-36112	26229215									
12 1981	835952	13595	2185	26029	7190	53234	112370	6332	1678	-39712	7016222	-57458	19115823	-97170	26132045									
1 1982	893161	14526	1501	26291	8774	64682	135045	5728	3951	-50180	6966042	-66412	19049411	-116592	26015453									
2 1982	676727	12185	944	27543	5974	44126	93367	26012	64788	-12140	6953902	15547	19064958	3407	26018860									
3 1982	504208	8200	944	22917	2009	15328	30434	11664	322835	-1655	6952247	307729	19372687	306074	26324934									
4 1982	596975	10033	1180	23440	2839	21545	43001	5541	92891	-13165	6939082	71435	19444122	58270	26383204									
5 1982	599393	9748	1729	29566	3359	24954	52816	4417	7860	-17178	6921904	-20002	19424120	-37180	26346024									
6 1982	615500	10344	1469	26352	3336	25130	50724	18	0	-21776	6900128	-25594	19398526	-47370	26298654									
7 1982	777603	12647	2509	27672	5850	43513	89918	461	963	-37202	6862926	-45442	19353084	-82644	26216010									
8 1982	877378	14269	1544	27163	7859	58153	122097	129684	679587	79390	6942316	615643	19968727	695033	26911043									
9 1982	581319	9769	2187	24872	2856	21588	43266	22731	359729	3999	6946315	338051	20306778	342050	27253093									
10 1982	759360	12350	1005	25763	4447	33537	67569	7654	1992	-21436	6924879	-32040	20274738	-53476	27199617									
11 1982	949199	15952	5617	25253	8220	61103	124962	5826	30210	-47057	6877822	-33649	20241089	-80706	27118911									
12 1982	945636	15379	3044	27418	8886	65562	138398	40663	88451	-16013	6861809	15615	20256704	-398	27118513									
1 1983	894470	14547	2797	28160	8109	59806	127722	21887	16320	-29810	6831999	-51596	20205108	-81406	27037107									

COLORADO RIVER HISTORICAL SAND BALANCE

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Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at				near				SAND LOADS				Reach 1				Reach 2				Reaches 1 and 2			
					Lees Ferry tons	above LCR tons	Phantom Ranch tons	Paria River tons	Little Colorado River tons	Sand Storage Change tons	Cumm. Sand Storage Change tons	Reach 1 Sand Storage Change tons	Reach 2 Sand Storage Change tons	Reach 1 Sand Storage Change tons	Reach 2 Sand Storage Change tons	Reaches 1 and 2 Sand Storage Change tons	Reaches 1 and 2 Sand Storage Change tons											
2 1983	845372	15222	2797	29452	9343	67982	151060	61896	35334	3257	6835256	-47744	20157364	-44487	26992620													
3 1983	636807	10357	1469	25707	3407	25723	51820	154607	338898	132291	6967547	312801	20470165	445092	27437712													
4 1983	919825	15458	1651	26272	9883	72584	153682	28390	416290	-34311	6933236	335192	20805357	300881	27738593													
5 1983	1226411	19946	7005	28945	18124	130329	301525	6829	150343	-105376	6827860	-20853	20784504	-126229	27612364													
6 1983	3421519	57501	16351	93200	1E+06	2101096	3716277	751	40	-953686	5874174	-1615141	19169363	-2568827	25043537													
7 1983	3520913	57262	18601	87819	1E+06	2146851	3788538	149646	125153	-830943	5043231	-1516534	17652829	-2347477	22696060													
8 1983	1908743	31043	17092	44192	76802	456258	979957	86786	260623	-292670	4750561	-263076	17389753	-555746	22140314													
9 1983	1643387	27618	20299	29327	41817	285364	721308	41641	307048	-201906	4548655	-128896	17260857	-330802	21809512													
10 1983	1640372	26678	20669	29580	38813	267310	646096	21767	792083	-206730	4341925	413297	17674154	206567	22016079													
11 1983	1507131	25328	17061	29707	30667	218726	547862	14388	20749	-173671	4168254	-308387	17365767	-482058	21534021													
12 1983	1537882	25007	19189	26272	29353	214033	562347	8387	50247	-176293	3991961	-298067	17067700	-474360	21059661													
1 1984	1537882	25011	15520	26481	29985	217102	583162	6330	18529	-180787	3811174	-347531	16720169	-528318	20531343													
2 1984	1465616	25480	3239	26611	29593	213785	581564	4353	209	-179839	3631335	-367570	16352599	-547409	19983934													
3 1984	1561938	25402	15771	27077	31588	227135	607460	2578	12548	-192969	3438366	-367777	15984822	-560746	19423188													
4 1984	1593389	26778	19158	30975	37648	260957	674091	1680	1263	-221629	3216737	-411871	15572951	-633500	18789688													
5 1984	2490798	40509	25243	44208	215158	952571	1717688	41	0	-737372	2479365	-765117	14807834	-1502489	17287199													
6 1984	2445303	41095	33482	43672	205412	952635	1684172	17	0	-747206	1732159	-731537	14076297	-1478743	15808456													
7 1984	2172045	35325	21655	43055	142621	696857	1288420	84172	227122	-470064	1262095	-364441	13711856	-834505	14973951													
8 1984	1615024	26266	13771	75409	53826	288681	574981	92676	1391291	-142179	1119916	1104991	14816847	962812	15936763													
9 1984	1487519	24999	20052	29200	28563	207119	524226	12439	743949	-166117	953799	426842	15243689	260725	16197488													
10 1984	1409667	22926	4867	26526	27011	195677	526084	17428	352012	-151238	802561	21605	15265294	-129633	16067855													
11 1984	1522719	25590	21067	26781	30820	222559	596979	3635	845	-188104	614457	-373575	14891719	-561679	15506176													
12 1984	1538338	25019	16428	26611	30039	217037	573314	5582	84724	-181416	433041	-271553	14620166	-452969	15053207													
1 1985	1603342	26076	20831	27127	34320	244686	658380	11899	106840	-198467	234574	-306854	14313312	-505321	14547886													
2 1985	1492955	26882	22991	31229	35223	244899	639187	20064	55100	-189612	44962	-339188	13974124	-528800	14019086													
3 1985	1209611	19672	3759	26669	16859	122283	286745	17947	452844	-87477	-42515	288382	14262506	200905	14219991													

COLORADO RIVER HISTORICAL SAND BALANCE

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Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at		near		Little Colorado River		Reach 1		Reach 2		Reaches 1 and 2	
					Lees Ferry	above LCR	Phantom Ranch	Paria River	Paria River	Sand Storage Change	Cumm. Sand Storage Change	Sand Storage Change	Cumm. Sand Storage Change	Sand Storage Change	Cumm. Sand Storage Change	Sand Storage Change
4 1985	1188919	19980	7090	26890	16274	118796	259139	7237	160574	-95285	-137800	20231	14282737	-75054	14144937	
5 1985	2018418	32826	8948	45613	128651	607636	1168137	806	74158	-478179	-615979	-486343	13796394	-964522	13180415	
6 1985	2297088	38604	21439	45195	181433	820254	1516532	171	0	-638650	-1254629	-696278	13100116	-1334928	11845487	
7 1985	1700431	27655	7049	30288	45525	305238	747878	27356	16669	-232357	-1486986	-425971	12674145	-658328	11187159	
8 1985	1573300	25587	17396	30267	34041	237555	581980	8610	67919	-194904	-1681890	-276506	12397639	-471410	10715749	
9 1985	1361924	22888	13948	30125	23617	168608	396623	8440	123898	-136551	-1818441	-104117	12293522	-240668	10475081	
10 1985	716863	11659	1101	25204	4076	30834	61966	79118	25181	52360	-1766081	-5951	12287571	46409	10521490	
11 1985	709765	11928	979	24715	4012	30331	60771	10566	185828	-15753	-1781834	155388	12442959	139635	10661125	
12 1985	688328	11195	611	29189	5624	41736	87899	8564	11530	-27548	-1809382	-34633	12408326	-62181	10598944	
1 1986	1030153	16754	855	28701	13556	98589	220220	4314	41	-80719	-1890101	-121590	12286736	-202309	10396635	
2 1986	1181420	21273	4543	27946	17966	130426	297892	16418	27431	-96042	-1986143	-140035	12146701	-236077	10160558	
3 1986	1531349	24905	7517	28697	32026	225306	571189	9820	59273	-183460	-2169603	-286610	11860091	-470070	9690488	
4 1986	1704209	28640	19100	31422	49631	325980	781818	10024	25976	-266325	-2435928	-429862	11430229	-696187	8994301	
5 1986	2558806	41615	17991	48034	270138	1027777	1871428	30	0	-757609	-3193537	-843651	10586578	-1601260	7393041	
6 1986	1968155	33076	22670	47978	99837	538628	1092996	53	0	-438738	-3632275	-554368	10032210	-993106	6399935	
7 1986	1237552	20127	5615	31053	20501	144732	345782	24911	234350	-99320	-3731595	33300	10065510	-66020	6333915	
8 1986	1503805	24457	4659	29007	32204	226637	590027	47743	104689	-146690	-3878285	-258701	9806809	-405391	5928524	
9 1986	1578752	28532	16644	30444	36909	255498	649357	166320	141641	-52269	-3930554	-252218	9554591	-304487	5624037	
10 1986	1112470	18093	7045	27695	11638	85912	180012	32372	199798	-41902	-3972456	105698	9660289	63796	5687833	
11 1986	1232865	20719	6085	30478	18726	134656	310940	14946	160046	-100984	-4073440	-16238	9644051	-117222	5570611	
12 1986	1522392	24759	9070	31209	32030	222760	539146	5514	18423	-185216	-4258656	-297963	9346088	-483179	5087432	
1 1987	1590689	25870	5555	31612	35643	248128	617431	9810	35401	-202675	-4461331	-333902	9012186	-536577	4550855	
2 1987	1095469	19725	4593	28677	14991	109210	250333	19421	26031	-74798	-4536129	-115092	8897094	-189890	4360965	
3 1987	790519	12857	1117	28621	5286	39541	80999	7352	99077	-26903	-4563032	57619	8954713	30716	4391681	
4 1987	763364	12829	2597	26815	5304	39632	81814	1386	109891	-32942	-4595974	67709	9022422	34767	4426448	
5 1987	746862	12147	1961	27011	5478	40729	84511	12317	13547	-22934	-4618908	-30235	8992187	-53169	4373279	

COLORADO RIVER HISTORICAL SAND BALANCE

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Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at Lees Ferry		above LCR		near Phantom Ranch		Little Colorado River		Reach 1		Reach 2		Reaches 1 and 2	
					tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
6 1987	997497	16763	2998	30521	12718	91730	208734	23	2875	-78989	-4697897	-114129	8878058	-193118	4180161			
7 1987	1098880	17872	3950	29739	14660	106108	243966	2158	10069	-89290	-4787187	-127789	8750269	-217079	3963082			
8 1987	1286848	20929	6379	31048	22697	158353	373003	154164	345421	18508	-4768679	130771	8881040	149279	4112361			
9 1987	960860	16148	2438	28059	10296	75591	167453	3213	1211	-62082	-4830761	-90651	8790389	-152733	3959628			
10 1987	500176	8135	1221	19907	1582	12217	23969	34413	8688	23778	-4806983	-3064	8787325	20714	3980342			
11 1987	726506	12209	975	25434	4688	35193	71673	116470	883612	85965	-4721018	847132	9634457	933097	4913439			
12 1987	809338	13163	2080	27162	6205	46125	95772	1834	1	-38086	-4759104	-49646	9584811	-87732	4825707			
1 1988	836125	13598	3438	26843	6338	47153	98421	2877	1882	-37938	-4797042	-49386	9535425	-87324	4738383			
2 1988	796585	13849	1232	30173	6631	49104	102551	7527	105288	-34946	-4831988	51841	9587266	16895	4755278			
3 1988	692292	11259	1232	26000	4007	30176	60891	2140	54323	-24029	-4856017	23608	9610874	-421	4754857			
4 1988	557589	9371	1725	22254	2077	15951	31463	34972	110548	21098	-4834919	95036	9705910	116134	4870991			
5 1988	553009	8994	1270	20408	1891	14567	28650	695	7904	-11981	-4846900	-6179	9699731	-18160	4852831			
6 1988	526870	8854	1996	19703	2002	15365	30320	268	8198	-13095	-4859995	-6757	9692974	-19852	4832979			
7 1988	718745	11689	2604	29652	5609	41435	87973	77	16237	-35749	-4895744	-30301	9662673	-66050	4766929			
8 1988	774318	12593	2775	26893	6709	49635	103839	59514	490550	16588	-4879156	436346	10099019	452934	5219863			
9 1988	687625	11556	954	27627	5296	39272	83352	7853	239699	-26123	-4905279	195619	10294638	169496	5389359			
10 1988	516043	8393	982	24416	2394	18176	36258	2463	0	-13319	-4918598	-18082	10276556	-31401	5357958			
11 1988	608154	10220	982	29693	3814	28441	58329	3657	197	-20970	-4939568	-29691	10246865	-50661	5307297			
12 1988	644158	10476	1039	27454	4120	30782	63969	2855	5	-23807	-4963375	-33182	10213683	-56989	5250308			
1 1989	753693	12258	1063	26569	5848	43432	90200	3053	55	-34531	-4997906	-46713	10166970	-81244	5169064			
2 1989	665326	11980	1049	26894	5873	43311	94357	51747	210	14309	-4983597	-50836	10116134	-36527	5132537			
3 1989	599189	9745	1101	25323	2895	21931	44076	9879	21106	-9157	-4992754	-1039	10115095	-10196	5122341			
4 1989	540700	9087	from USGS	water data rep.	22312	44729	44729	197	5118	-22115	-5014869	-17299	10097796	-39414	5082927			
5 1989	527600	8581	from USGS	water data rep.	21094	42128	42128	115	0	-20979	-5035848	-21034	10076762	-42013	5040914			
6 1989	750861	12619	1634	28224	6981	51372	111032	17	0	-44374	-5080222	-59660	10017102	-104034	4936880			
7 1989	810600	13180	from USGS	water data rep.	56348	120241	23325	21651	-33023	-5113245	-42242	9974860	-75265	4861615				

COLORADO RIVER HISTORICAL SAND BALANCE
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Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at Lees Ferry tons	SAND LOADS				Reach 1			Reach 2			Reaches 1 and 2		
						above LCR tons	near Phantom Ranch tons	Paria River tons	Little Colorado River tons	Reach 1 Sand Storage Change tons	Reach 1 Sand Storage Change tons	Reach 2 Sand Storage Change tons	Reach 2 Sand Storage Change tons	Reaches 1 and 2 Sand Storage Change tons				
8 1989	866100	14090	from USGS	water data rep.	65567	141350	65527	286969	-40	-5113286	211186	10186046	211146	5072761				
9 1989	794800	13360	from USGS	water data rep.	53867	114598	33	10	-53834	-5167119	-60721	10125326	-114555	4958206				
10 1989	557763	9071	1140	26200	3136	48134	687	813	-19672	-5186791	-23826	10101500	-43498	4914708				
11 1989	582074	9782	1110	24500	3401	51513	644	0	-21533	-5208324	-25935	10075565	-47468	4867240				
12 1989	633961	10310	1080	24600	3908	59192	1685	0	-23719	-5232043	-29880	10045684	-53599	4813641.				
1 1990	673525	10954	1040	24000	4268	64647	1892	2	-25820	-5257863	-32665	10013019	-58485	4755156.				
2 1990	589126	10608	1250	25300	3399	52393	5314	424	-16828	-5274691	-26428	9986591.	-43256	4711900.				
3 1990	628103	10215	1130	25800	3655	55782	1894	2	-21927	-5296618	-28304	9958287.	-50231	4661669.				
4 1990	579322	9736	1210	23500	2554	38682	205	49	-16685	-5313303	-19189	9939098.	-35874	4625795.				
5 1990	634739	10323	2960	23300	3076	46588	184	0	-20083	-5333386	-23245	9915853.	-43328	4582467.				
6 1990	760520	12781	3530	29200	8060	134511	7529	0	-42948	-5376334	-75974	9839879.	-118922	4463545.				
7 1990	797541	12971	3370	29900	10108	171579	87215	77796	25760	-5350574	-22220	9817659.	3540	4467085.				
8 1990	961212	15633	3120	30100	12875	215783	5614	107620	-74046	-5424620	-15628	9802031.	-89674	4377411.				
9 1990	715102	12018	1380	28700	8886	159365	30469	254711	-24969	-5449589	159670	9961701.	134701	4512112.				
10 1990	453383	7406	2200	12900	871	13199	14164	12921	8122	-5441467	6635	9968336.	14757	4526869.				
11 1990	487962	8200	1330	21800	1913	28985	381	13141	-12342	-5453809	-1208	9967128.	-13550	4513319.				
12 1990	572627	9313	1340	21100	2164	32787	635	5994	-13805	-5467614	-10189	9956939.	-23994	4489325.				
1 1991	669798	10893	1540	22300	3996	60525	1861	44404	-24181	-5491795	13917	9970856.	-10264	4479061.				
2 1991	588323	10593	1470	25400	3581	54681	4047	4972	-19257	-5511052	-22824	9948032.	-42081	4436980.				
3 1991	583839	9495	1100	21400	3108	47082	13947	91815	-6482	-5517534	68270	10016302	61788	4498768.				
4 1991	543636	9136	3190	19800	1958	29653	551	224647	-12554	-5530088	210057	10226359	197503	4696271.				
5 1991	749847	12195	2620	26700	7081	123368	23	4331	-44526	-5574614	-67407	10158952	-111933	4584338.				
6 1991	799436	13435	2430	30600	10717	177604	65	33	-64941	-5639555	-101848	10057104	-166789	4417549.				
7 1991	946778	15398	5200	29000	14819	249782	20	6	-88479	-5728034	-146458	9910646.	-234937	4182612.				
8 1991	891342	14496	9060	19400	5808	87974	4948	8454	-33048	-5761082	-35716	9874930.	-68764	4113848.				
9 1991	794141	13346	6890	19500	4583	69423	45448	48473	15322	-5745760	13759	9888689.	29081	4142929.				

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Month Year	Release Volume acre-ft	Mean Release cfs	Minimum Release cfs	Maximum Release cfs	at Lees Ferry		above LCR		near Phantom Ranch		Little Colorado River		Reach 1		Reach 2		Reaches 1 and 2	
					tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
10 1991	552685	8989	5459	14704	1201	9534	18190	459	0	-7874	-5753634	-8656	9880033.	-16530	4126399.			
11 1991	592801	9962	5821	14228	1629	12790	24668	12057	2163	896	-5752738	-9715	9870318.	-8819	4117580.			
12 1991	686917	11172	7660	15861	2411	18725	36520	2494	23970	-13820	-5766558	6175	9876493.	-7645	4109935.			
1 1992	774699	12599	8243	17350	3482	26748	52740	1562	4180	-21704	-5788262	-21812	9854681.	-43516	4066419.			
2 1992	626586	10893	6273	14554	2081	16205	31524	20801	38747	6677	-5781585	23428	9878109.	30105	4096524.			
3 1992	582742	9477	5705	14944	1404	11099	21267	131319	167347	121624	-5659961	157179	10035288	278803	4375327.			
4 1992	565280	9500	6153	13587	1307	10360	19795	47503	167187	38450	-5621511	157752	10193040	196202	4571529.			
5 1992	595601	9687	5163	14347	1448	11452	21937	156218	37044	146214	-5475297	26559	10219599	172773	4744302.			
6 1992	673301	11315	7377	15985	2389	18550	36184	1209	45011	-14952	-5490249	27377	10246976	12425	4756727.			
7 1992	857363	13944	8588	19716	5068	38394	76762	1735	174211	-31591	-5521840	135843	10382819	104252	4860979.			
8 1992	852526	13865	8174	19957	4982	37768	75467	243833	578929	211047	-5310793	541230	10924049	752277	5613256.			
9 1992	704200	11834	7638	16235	2726	21089	41294	64668	185767	46305	-5264488	165562	11089611	211867	5825123.			
10 1992	548591	8922	5366	13073	1103	8798	16702	215748	26333	208053	-5056435	18429	11108040	226482	6051605.			
11 1992	598647	10061	6434	13472	1617	12722	24496	9161	68724	-1944	-5058379	56950	11164990	55006	6106611.			
12 1992	685480	11148	6333	16141	2301	17924	34849	1269	37152	-14354	-5072733	20227	11185217	5873	6112484.			
1 1993	780888	12700	7971	17092	3637	27884	55091	128547	2197133	104300	-4968433	2169926	13355143	2274226	8386710.			
2 1993	636157	11455	7013	14733	2226	17318	33718	301591	1024258	286499	-4681934	1007858	14363001	1294357	9681067.			
3 1993	606000	9856	from USBR	24-month study	14096	14096	27282	390259	412949	376162.9	-4305771	399762.6	14762764	775925.5	10456992			
4 1993	595000	9999	from USBR	24-month study	13346	13346	25780	39553	122072	26206.85	-4279564	109637.8	14872402	135844.7	10592837			
5 1993	592000	9628	from USBR	24-month study	13146	13146	25381	18103	982	4956.674	-4274607	-11252.2	14861149	-6295.53	10586541			
6 1993	613000	10302	from USBR	24-month study	14588	14588	28269	668	0	-13919.6	-4288527	-13680.9	14847468	-27600.5	10558941			
7 1993	910000	14800	from USBR	24-month study	47429	47429	95887	190	0	-47239.1	-4335766	-48457.8	14799011	-95696.9	10463244			
8 1993	910000	14800	from USBR	24-month study	47429	47429	95887	31852	66970	-15577.1	-4351343	18512.12	14817523	2935.014	10466179			
9 1993	719000	12083	from USBR	24-month study	23480	23480	46286	776	36863	-22704.4	-4374048	14057.17	14831580	-8647.29	10457532			