

APPENDIX 1 – LISTING OF OBSERVED WATER-YEAR AVERAGE FLOWS

Colorado R. at Lees Ferry, AZ, is a natural flow series produced by the Bureau of Reclamation and provided by James Prairie. Likewise for the Green R. at Green River, UT, San Juan R. near Bluff, UT, and Colorado R. at Cisco, UT. The natural flow data from the Bureau of Reclamation end with water year 1995. For several gages, the record was extended through subsequent water years by adding to observed USGS gage data the average difference of natural flow and gaged flow for the period of overlap. The incremental amount added to the observed gaged record to form these estimated natural flow for water years after 1995 are:

Green R. at Green River, UT: 31.859 cms (USGS gage 09315000)
Colorado R. near Cisco, UT: 50.7892 cms (USGS gage 09180500)
San Juan R. near Bluff, UT: 9.7591 cms (USGS gage 09379500)

Gage data for the Gila, Salt, Verde and Tonto Rivers were downloaded from the USGS in the form of monthly mean values and converted to water-year-average flow.

These USGS gage records were used:

Gila: 09448500, at head of Safford Valley, nr Solomon.

To obtain a continuous series of water-year (WY) flow back to water year 1916, the following steps were taken: (1) 1915-20, 1934 and 1949 water-year (WY) totals estimated by simple linear regression on Gila River nr Solomon, (2) 1934 WY total estimated by simple linear regression on sum of WY totals at Gila R. nr Redrock and San Francisco R. nr Glenwood (regression on log-transformed flows), (3) October 1934 through April 1935 total estimated from sum of the mean daily flows of Gila R. nr Redrock and San Francisco R. nr Glenwood

Salt: 09498500, nr Roosevelt

Tonto: 09499500, nr Roosevelt; 09499000 abv Gun Creek starting with Jan 1941

Verde: 09510000, blw Bartlett Dam; 9508500 blw Tangle Creek, abv Horseshoe Dam starting with Sept 1945

Salt + Verde + Tonto and **Salt + Tonto** are the arithmetic sums of the flows at the individual gages listed above

Colorado at Lees Ferry

Observed average daily (natural) flows for water year in cfs

1906	NaN	NaN	NaN	NaN	NaN	NaN	24970	29629	16926	30384
1910	20492	20694	26286	19990	29099	19528	26431	32942	21756	17890
1920	30206	31359	25788	25338	20165	18524	22258	25625	24214	29569
1930	21111	11923	24169	16755	9154	16962	19954	19561	24753	16186
1940	12921	25304	26836	18819	21369	19217	15281	21985	21875	23015
1950	18396	17246	28790	15476	11559	13530	15848	27846	23344	12753
1960	16495	12774	24544	12790	14879	26060	16054	16311	18608	20512
1970	21195	21008	16945	26802	18365	22280	14755	6928	20229	23894
1980	23256	10816	22657	32605	32388	27849	30227	23377	15953	12635
1990	11748	15868	14502	24233	14335	27337	19672	28085	23796	23385
2001	15713	15121	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

NaN = "not a number" (no value)

Salt + Verde + Tonto

Observed average daily flows for water year in cfs

1914	NaN	NaN	NaN	NaN	1279	3665	5317	2361	1236	2118
1920	4348	1182	2033	1588	2000	817	1795	2455	869	1191
1930	1099	1440	3071	958	580	1861	1348	2585	1153	873
1940	756	4721	1248	1213	1166	1275	765	729	1004	1832
1950	635	675	2802	679	940	681	493	1114	1777	623
1960	2015	488	1528	853	751	2036	2639	893	2175	1476
1970	879	537	960	4822	547	1300	1118	512	3292	4585
1980	4049	741	1863	3599	1717	2992	1450	1596	1699	656
1990	562	2364	2279	6020	952	2788	477	940	1845	674
2002	403	1068	387	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Gila at head of Safford Valley

Observed average daily flows for water year in cfs

1915	NaN	NaN	NaN	NaN	NaN	2171	1776	833	176	698
1920	679	416	188	456	540	293	464	408	239	327
1930	346	460	698	344	192	264	301	583	236	205
1940	318	1226	471	212	191	313	162	157	175	804
1950	132	101	455	125	245	222	102	294	622	243
1960	440	125	614	395	225	254	888	302	980	169
1970	153	135	347	1413	128	482	224	177	457	1683
1980	616	198	302	1071	996	1266	571	536	590	222
1990	171	872	1117	2229	206	1196	227	465	504	286
2002	133	595	141	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Green near Green River, UT

Observed average daily (natural) flows for water year in cfs

1906	NaN	NaN	NaN	NaN	NaN	NaN	9177	12842	6522	12611
1910	7433	6563	9241	8320	10795	5823	8928	12649	8137	5449
1920	9297	11010	9791	9773	6269	6536	7022	8255	9074	10047
1930	7362	4308	7729	6025	2798	5099	6974	6826	7766	5760
1940	4317	6872	8022	6978	7275	6767	5935	8719	6835	7925
1950	8773	7671	10756	5779	4695	5021	7182	8788	7446	4846
1960	5271	3882	9474	4804	6145	9902	5687	7301	7256	7736
1970	7153	9009	7758	8571	8204	8449	6354	2616	7842	6983
1980	8409	4603	8523	12369	12492	9548	11902	7030	5863	4690
1990	4779	5761	4483	7601	4764	9143	7406	9370	9526	8573
2002	5541	4528	3152	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Colorado at Cisco, UT

Appendix 1 - Observed Water Year Flows

Observed average daily (natural) flows for water year in cfs

1906	NaN	NaN	NaN	NaN	NaN	NaN	11109	11812	7151	12473
1910	9099	10017	12898	8424	12291	8324	11493	13346	10157	8128
1920	13650	13540	11027	11390	9547	8347	10582	11701	11880	13335
1930	10006	5495	10823	8040	4599	8124	9733	8045	12061	7584
1940	6449	10762	12333	8868	9813	9216	7243	10053	10537	10303
1950	7429	7478	12783	7377	4794	6397	6975	13938	10689	6222
1960	7852	6280	11354	5574	6672	11375	6997	6640	8229	8914
1970	10468	9235	6661	11098	7957	9735	6609	3578	9767	11466
1980	10905	5367	10222	15165	17261	14322	13441	10569	7117	6524
1990	5691	7720	7182	12430	7102	13172	9397	12427	9765	8432
2002	7104	5941	4351	NaN	NaN	NaN	NaN	NaN	NaN	NaN

San Juan near Bluff, UT

Observed average daily (natural) flows for water year in cfs

1906	NaN	NaN	NaN	NaN	NaN	NaN	3475	2984	2747	4376
1910	2903	4335	4163	2555	4080	4292	4751	5083	2454	3526
1920	5753	4427	4049	3507	3182	2826	3349	4941	2641	4483
1930	2662	1608	4369	2053	1320	3302	2533	3505	3661	2038
1940	1647	6168	4560	2242	3384	2577	1468	2360	3424	3723
1950	1497	1255	3872	1599	1708	1663	1528	3933	3866	1207
1960	2768	2009	2464	1754	1506	3704	2727	1751	2435	2912
1970	2733	1844	1721	5632	1250	3778	1807	810	2093	5086
1980	3882	1325	3258	3974	3301	4448	4237	4622	2459	2105
1990	1902	2558	2750	3988	2078	3711	1444	2960	2263	2882
2002	1499	1949	1086	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Salt + Tonto

Observed average daily flows for water year in cfs

1914	NaN	NaN	NaN	NaN	733	2462	3558	1128	546	1369
1920	2603	754	951	846	1245	453	1087	1325	437	652
1930	704	883	1921	654	353	1163	952	1454	551	527
1940	427	3133	841	822	562	778	469	457	679	1145
1950	307	384	1942	406	537	387	304	626	1141	374
1960	1471	261	1084	604	416	1203	1746	434	1522	843
1970	495	309	642	3114	315	926	578	290	2012	3190
1980	2443	471	1059	2294	1225	2266	944	1111	1069	409
1990	304	1725	1453	3791	621	1752	251	611	1082	389
2002	203	707	210	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Verde

Observed average daily flows for water year in cfs

1905	NaN	NaN	NaN	NaN	NaN	2167	1246	1188	628	1054
1910	NaN	NaN	NaN	NaN	546	1202	1759	1233	690	749
1920	1744	428	1082	742	754	364	708	1130	432	539
1930	396	557	1150	303	227	698	396	1131	602	345
1940	329	1588	406	391	604	497	297	272	325	687
1950	328	291	859	272	403	294	189	488	636	249
1960	544	227	443	249	334	834	892	458	653	633
1970	384	228	318	1709	233	373	540	222	1280	1394
1980	1606	270	804	1306	492	726	506	485	631	247
1990	258	639	826	2229	331	1036	226	329	762	286
2002	200	361	177	NaN	NaN	NaN	NaN	NaN	NaN	NaN