APPENDIX L
ESTIMATED RESERVOIR VOLUME LOSSES ON THE SAVANNAH RIVER DUE TO SEDIMENTATION

Estimated Reservoir Volume Losses on the Savannah River Due to Sedimentation

1.0 Background

The U.S. Army Corps of Engineers' (USACE) HEC-ResSim model is being used by HDR|DTA to evaluate potential changes to the 1968 Operating Agreement between the USACE, Duke Energy Carolinas, LLC (Duke Energy), and the Southeastern Power Administration (SEPA). This model simulates reservoir elevation changes and downstream flow releases based on a set of reservoir operating rules and input assumptions. Stage/volume curves for each of the five reservoirs on the mainstem of the Savannah River are used as input to the HEC-ResSim model. In 2010, Duke Energy collected bathymetry data on the two upper reservoirs in the basin (Lake Jocassee and Lake Keowee). As a result, a minor adjustment was made to the original 1967 Lake Keowee stage/volume curve based on this updated information. No changes were made to the Lake Jocassee stage/volume curve because the 2010 data was very similar to the original 1967 stage/volume curve.

In an attempt to provide consistency with HEC-ResSim model input assumptions, HDR|DTA has evaluated the need to revise the original stage/volume curves for Hartwell Lake, Richard B. Russell Lake (RBR Lake), and J. Strom Thurmond Lake (JST Lake) to year 2010 conditions. The alternative model scenarios will be run using both year 2010 and year 2060 input assumptions, including any necessary changes to reservoir stage/volume curves resulting from sedimentation.

This report outlines the methodology used to project year 2010 stage/volume curves for Hartwell Lake, RBR Lake, and JST Lake, and the year 2060 stage/volume curves for all five reservoirs. The methodology is based on using readily available sediment yield estimates from studies in the Savannah River Basin along with a USACE methodology for distributing sediment within each reservoir based on reservoir shape and size. Results of this analysis are also provided.

2.0 Sediment Yield

The weight of sediment accumulation in the five reservoirs was estimated using published sediment yields from studies conducted in the Savannah River Basin. Sediment yield results are commonly expressed in terms of tons per square mile of drainage area per year (ton/sq mi/yr). In the absence of site-specific stream sediment yield data for the Lake Jocassee and Lake Keowee sub-basins, sediment yield data collected in the Environmental Protection Agency's (EPA) Ecoregion 45 (upstate of Georgia and South Carolina) was used for Lakes Jocassee and Keowee. Sediment yields for EPA Ecoregion 45 are provided in Table 1 for stable, all streams, and unstable watershed conditions.

Table 1. Sediment Yields (tons/sq mi/yr) for EPA Ecoregion 45

Percentile	Stable	All Streams	Unstable
10	17	28	48
25	28	46	74
50	57	80	137
75	**83**	**154**	222
90	108	217	308

Source: Mukundan, Radcliffe, and Ritchie 2010

HDR|DTA's analysis used the 75 percentile values in Table 1 as an estimate of sediment yields in the Lake Jocassee and Lake Keowee sub-basins. As a result, it was assumed that the relatively undisturbed Lake Jocassee drainage basin has a sediment yield of 83 tons/sq mi/yr. The sediment yield for the Lake Keowee drainage basin was assumed to be 154 tons/sq mi/yr ('all streams').

To aid in the development of Total Maximum Daily Loads (TMDLs) for priority pollutants in streams and rivers, the EPA has also collected sediment yield data at various locations in the Hartwell Lake and JST Lake drainage basins. This information is summarized in Tables 2 and 3.

Table 2. Sediment Yields for Streams in the Hartwell Lake Drainage Area

Water Course	Drainage Area (sq mi)	Sediment Yield (tons/sq mi/yr)
Stekoa Creek	21.3	351
Scott Creek	6.1	177
Pool Creek	4.8	106
Chechero Creek	4.2	175
Saddle Gap Creek	2.7	392
Cutting Bone Creek	2.1	149
She Creek	5.5	231
Crawford Creek	7.2	432
Little Crawford Creek	2.7	309
Shoal Creek	29.6	471
Average	8.6	**279**

Source: EPA 2000, 2005a, 2005b, 2005c

Table 3. Sediment Yields for Streams in the JST Lake Drainage Area

Water Course	Drainage Area (sq mi)	Sediment Yield (tons/sq mi/yr)
Rocky Creek	32.4	190
Indian Creek	18.9	45
Upton Creek	23.5	154
South-Bigger Creek	36.4	263
Average	27.8	**163**

Source: EPA 2005b, 2005c

The average sediment yield for Hartwell Lake is 279 tons/sq mi/yr and the average sediment yield for JST Lake is 163 tons/sq mi/yr. For RBR Lake, the average for Hartwell Lake and JST Lake was used (221 tons/sq mi/yr).

To convert sediment yield (in tons) to sediment volume (in acre-feet [ac-ft]), the compressed density of the sediment was determined. The composition of the sediment samples collected in the North Fork Broad River, which drains a sub-basin stretching from the mountains to the piedmont in Georgia, is 27% sand, 54% silt, and 19% clay (Mukundan and Radcliffe 2009). Compression of the sediments on the reservoir bottom is based on years of inundation. Using the method outlined in EM 1110-2-4000 (USACE 1989), the calculated average compressed sediment densities are provided in Table 4.

Table 4. Average Sediment Density

Reservoir	Years of Inundation before 2010	Average Density (lb/ft^3)	Years of Inundation 2010–2060	Average Density (lb/ft^3)
Jocassee	37	N/A	50	70
Keowee	39	N/A	50	70
Hartwell	49	69.9	50	70
RBR	27	68.8	50	70
JST	58	70.3	50	70
Average	42	**70**	50	**70**

Based on the results provided in Table 4, an average density of 70 lb/ft^3 was used to convert the estimated sediment yields to estimated sediment deposition volumes. The resulting sediment deposition volumes for year 2010 and year 2060 are shown in Table 5.

Table 5. Reservoir Volumes Lost to Sedimentation

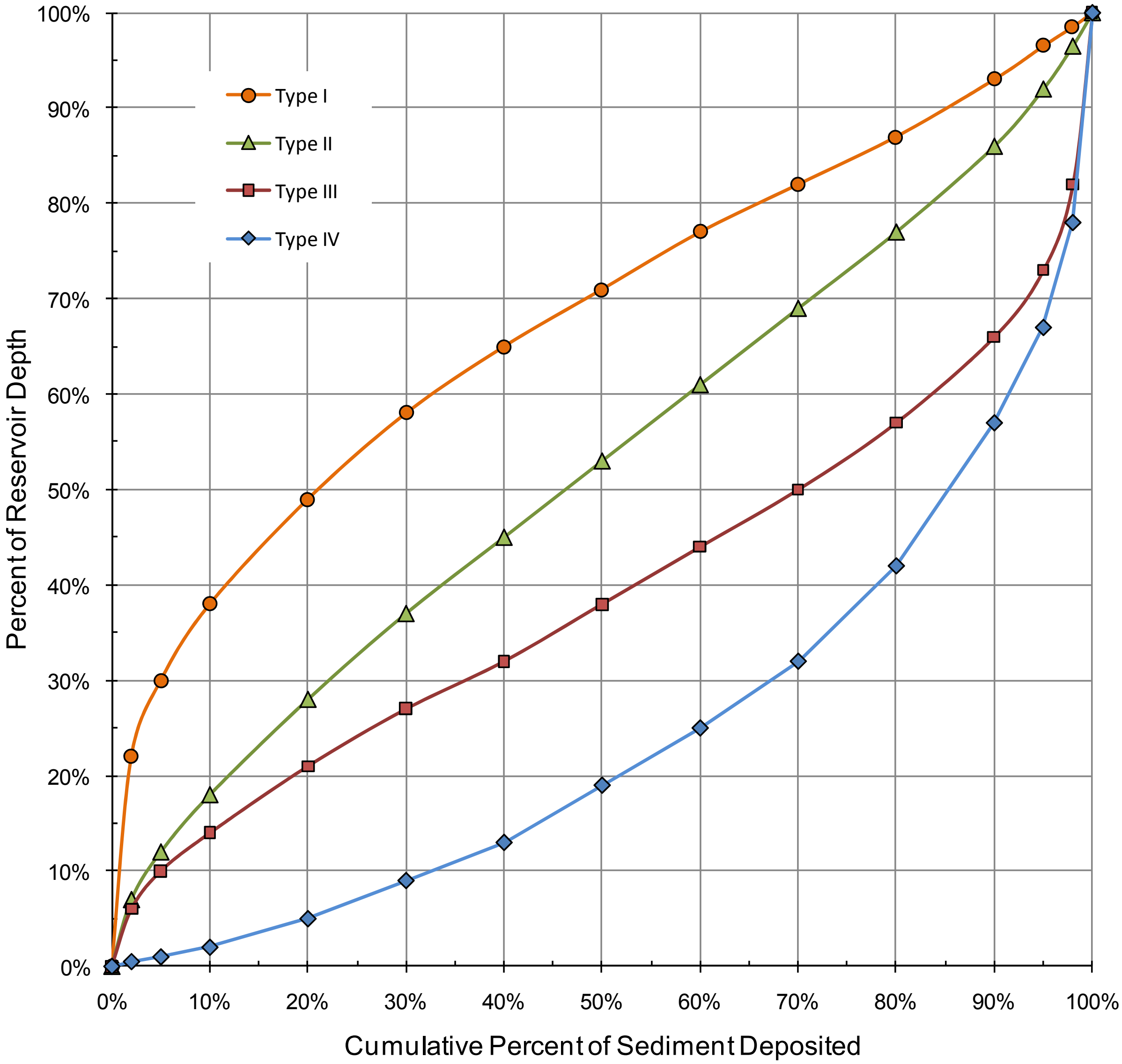
Reservoir	Sediment Yield (tons/sq mi/yr)	Drainage Area (sq mi)	Initial Fill year	Sediment Deposition to Year 2010 (ac-ft)	Sediment Deposition from 2010 to 2060 (ac-ft)
Jocassee	83	148	1973	N/A	403
Keowee	154	288	1971	N/A	1,455
Hartwell	279	1184	1961	10,617	10,834
RBR	221	742	1983	2,904	5,378
JST	163	3290	1952	20,401	17,587

Source: USACE 2010a, 2010b, 2010c

3.0 Sediment Distribution

The estimated amount of sediment deposition in each reservoir was distributed at the appropriate levels within each reservoir. The USACE has developed the "Empirical Area Reduction Method" as described in EM 1110-2-4000 (USACE 1989) to accomplish this task. To use this method, the reservoir type was first determined based on the size and shape of the impoundment. The “m” value (i.e., the change in the log of reservoir storage capacity divided by the change in the log of the reservoir depth) was calculated for each reservoir as an initial step in determining the reservoir type. The “m” values are summarized in Table 6. The reservoir type was used in conjunction with Figure H-4 in EM 1110-2-4000 (USACE 1989), reproduced as Figure 1 below, to distribute the sediment volume within each reservoir. The results are shown in Table 6 as the cumulative percent of sediment volume distributed at percent of depth (bottom to top).

Figure 1. Distribution of Sediment Deposits in Reservoirs



Source: USACE 1989

Table 6. Cumulative Percent of Sediment at Percent of Depth

Reservoir	M	Type	Percent of Depth						
			0	10	20	50	80	90	100
Jocassee	2.35	III	0	5	18	70	97	99	100
Keowee	2.67	II	0	4	12	46	83	93	100
Hartwell	2.84	II	0	4	12	46	83	93	100
RBR	2.72	II	0	4	12	46	83	93	100
JST	3.04	I	0	1	2	21	66	85	100

4.0 Estimated Reservoir Storage Curves

Volumes of sediment in Table 5 were distributed in each reservoir based on the percentages in Table 6, resulting in stage/volume curves for each reservoir for year 2010 and year 2060 (Tables 7 through 11). The volume change percentages (final column in each table) represent the entire reservoir below the corresponding reservoir elevation presented in column 1. Note that the 2010 volume estimates for Lakes Jocassee and Keowee are based on bathymetry data collected in 2010 and not the sediment yield and sediment distribution methodologies described above.

Table 7. Lake Jocassee Estimated Changes in Reservoir Volume due to Sedimentation

Reservoir Elevation (ft msl)	1967 Volume (ac-ft)	2010 Volume (ac-ft)	Volume Change 1967 – 2010 (%)	2060 Volume (ac-ft)	Volume Change 2010 – 2060 (%)
1,110	1,157,993	1,206,797	4.21	1,206,394	-0.033
1,109	1,150,442	1,198,830	4.21	1,198,429	-0.033
1,108	1,142,917	1,190,892	4.20	1,190,491	-0.034
1,107	1,135,416	1,182,987	4.19	1,182,586	-0.034
1,106	1,127,939	1,175,114	4.18	1,174,713	-0.034
1,105	1,120,488	1,167,273	4.18	1,166,872	-0.034
1,104	1,113,061	1,159,462	4.17	1,159,061	-0.035
1,103	1,105,660	1,151,682	4.16	1,151,281	-0.035
1,102	1,098,282	1,143,933	4.16	1,143,532	-0.035
1,101	1,090,930	1,136,213	4.15	1,135,812	-0.035
1,100	1,083,602	1,128,524	4.15	1,128,123	-0.036
1,099	1,076,299	1,120,864	4.14	1,120,463	-0.036
1,098	1,069,021	1,113,233	4.14	1,112,832	-0.036
1,097	1,061,768	1,105,632	4.13	1,105,231	-0.036
1,096	1,054,539	1,098,059	4.13	1,097,658	-0.037
1,095	1,047,336	1,090,516	4.12	1,090,115	-0.037
1,094	1,040,157	1,083,001	4.12	1,082,602	-0.037
1,093	1,033,003	1,075,516	4.12	1,075,117	-0.037
1,092	1,025,874	1,068,059	4.11	1,067,660	-0.037
1,091	1,018,770	1,060,642	4.11	1,060,243	-0.038
1,090	1,011,691	1,053,271	4.11	1,052,872	-0.038
1,089	1,004,637	1,045,936	4.11	1,045,537	-0.038
1,088	997,609	1,038,637	4.11	1,038,238	-0.038
1,087	990,606	1,031,372	4.12	1,030,973	-0.039
1,086	983,628	1,024,141	4.12	1,023,742	-0.039
1,085	976,676	1,016,943	4.12	1,016,544	-0.039
1,080	942,298	981,409	4.15	981,010	-0.041
1,060	811,349	845,564	4.22	845,169	-0.047
1,040	691,189	719,942	4.16	719,551	-0.054
1,020	581,761	604,370	3.89	603,987	-0.063
1,000	483,360	499,169	3.27	498,800	-0.074
980	393,873	404,853	2.79	404,505	-0.086
960	311,689	320,697	2.89	320,375	-0.100
940	238,724	247,057	3.49	246,767	-0.117
920	176,256	184,213	4.51	183,961	-0.137
900	124,721	132,347	6.11	132,133	-0.161
880	83,872	90,529	7.94	90,354	-0.194
860	52,917	57,740	9.11	57,607	-0.230
840	30,680	33,215	8.26	33,122	-0.279
820	15,742	16,544	5.10	16,488	-0.341
800	6,592	6,338	-3.85	6,312	-0.413
780	1,779	1,271	-28.55	1,265	-0.475
760	60	29	-00.00	29	-0.000
750	0	0	-00.00	0	-0.000

Table 8. Lake Keowee Estimated Changes in Reservoir Volume due to Sedimentation

Reservoir Elevation (ft msl)	1967 Volume (ac-ft)	2010 Volume (ac-ft)	Volume Change 1967 – 2010 (%)	2060 Volume (ac-ft)	Volume Change 2010 – 2060 (%)
800	953,659	869,381	-8.84	867,927	-0.17
799	935,448	851,983	-8.92	850,535	-0.17
798	917,460	834,947	-8.99	833,507	-0.17
797	899,696	818,195	-9.06	816,762	-0.18
796	882,152	801,702	-9.12	800,277	-0.18
795	864,829	785,452	-9.18	784,027	-0.18
794	847,725	769,437	-9.24	768,019	-0.18
793	830,839	753,650	-9.29	752,239	-0.19
792	814,169	738,085	-9.35	736,681	-0.19
791	797,715	722,739	-9.40	721,343	-0.19
790	781,476	707,609	-9.45	706,220	-0.20
789	765,450	692,688	-9.51	691,306	-0.20
788	749,637	677,973	-9.56	676,591	-0.20
787	734,034	663,461	-9.61	662,094	-0.21
786	718,641	649,147	-9.67	647,787	-0.21
785	703,457	635,030	-9.73	633,677	-0.21
784	688,480	621,108	-9.79	619,762	-0.22
783	673,709	607,378	-9.85	606,040	-0.22
782	659,143	593,841	-9.91	592,510	-0.22
781	644,782	580,496	-9.97	579,172	-0.23
780	630,623	567,343	-10.03	566,027	-0.23
779	616,665	554,383	-10.10	553,074	-0.24
778	602,908	541,615	-10.17	540,320	-0.24
775	562,825	504,453	-10.37	503,187	-0.25
770	499,910	446,271	-10.73	445,064	-0.27
760	388,103	343,634	-11.46	342,543	-0.32
750	293,919	258,138	-12.17	257,163	-0.38
740	216,022	187,992	-12.98	187,141	-0.45
730	153,025	131,648	-13.97	130,920	-0.55
720	103,487	87,411	-15.53	86,800	-0.70
710	65,909	53,634	-18.63	53,146	-0.91
700	38,737	29,048	-25.01	28,677	-1.28
690	20,352	12,783	-37.19	12,514	-2.11
680	9,078	3,914	-56.89	3,739	-4.46
670	3,173	799	-74.82	712	-10.93
660	828	82	-90.05	61	-26.48
650	171	1	N/A	1	-00.00

Table 9. Hartwell Lake Estimated Changes in Reservoir Volume due to Sedimentation

Reservoir Elevation (ft msl)	1961 Volume (ac-ft)	2010 Volume (ac-ft)	Volume Change 1961 – 2010 (%)	2060 Volume (ac-ft)	Volume Change 2010 – 2060 (%)
665	2,842,700	2,832,083	-0.37	2,821,250	-0.38
664	2,781,900	2,771,336	-0.38	2,760,557	-0.39
663	2,722,200	2,711,689	-0.39	2,700,964	-0.40
662	2,663,600	2,653,089	-0.39	2,642,364	-0.40
661	2,606,100	2,595,642	-0.40	2,584,971	-0.41
660	2,549,600	2,539,195	-0.41	2,528,579	-0.42
659	2,494,200	2,483,795	-0.42	2,473,179	-0.43
658	2,439,700	2,429,349	-0.42	2,418,786	-0.43
657	2,386,300	2,375,949	-0.43	2,365,386	-0.44
656	2,333,800	2,323,502	-0.44	2,312,993	-0.45
655	2,282,400	2,272,155	-0.45	2,261,700	-0.46
654	2,231,800	2,221,608	-0.46	2,211,208	-0.47
653	2,182,200	2,172,008	-0.47	2,161,608	-0.48
652	2,133,600	2,123,461	-0.48	2,113,115	-0.49
651	2,085,900	2,075,814	-0.48	2,065,522	-0.50
650	2,039,100	2,029,014	-0.49	2,018,722	-0.51
649	1,993,200	1,983,167	-0.50	1,972,929	-0.52
648	1,948,200	1,938,220	-0.51	1,928,037	-0.53
647	1,904,100	1,894,173	-0.52	1,884,044	-0.53
646	1,860,900	1,851,026	-0.53	1,840,951	-0.54
645	1,818,600	1,808,779	-0.54	1,798,758	-0.55
644	1,777,100	1,767,332	-0.55	1,757,366	-0.56
643	1,736,500	1,726,732	-0.56	1,716,766	-0.58
642	1,696,700	1,686,986	-0.57	1,677,073	-0.59
641	1,657,800	1,648,139	-0.58	1,638,280	-0.60
640	1,619,700	1,610,092	-0.59	1,600,287	-0.61
639	1,582,500	1,572,945	-0.60	1,563,195	-0.62
638	1,545,900	1,536,398	-0.61	1,526,702	-0.63
637	1,510,100	1,500,651	-0.63	1,491,009	-0.64
636	1,475,100	1,465,704	-0.64	1,456,116	-0.65
635	1,440,800	1,431,457	-0.65	1,421,924	-0.67
634	1,407,200	1,397,963	-0.66	1,388,538	-0.67
633	1,374,300	1,365,116	-0.67	1,355,745	-0.69
632	1,342,100	1,332,970	-0.68	1,323,653	-0.70
631	1,310,500	1,301,423	-0.69	1,292,160	-0.71
630	1,279,600	1,270,576	-0.71	1,261,367	-0.72
629	1,249,300	1,240,329	-0.72	1,231,174	-0.74
628	1,219,600	1,210,735	-0.73	1,201,689	-0.75
627	1,190,500	1,181,688	-0.74	1,172,696	-0.76
626	1,162,000	1,153,241	-0.75	1,144,303	-0.78
625	1,134,100	1,125,394	-0.77	1,116,511	-0.79
610	780,000	772,303	-0.99	764,448	0.00
600	680,000	673,046	-1.02	665,950	-1.05
575	300,000	294,745	-1.75	289,382	-1.82
525	45,000	43,089	-4.25	41,139	-4.53
475	0	0	-0.00	0	-0.00

Table 10. RBR Lake Estimated Changes in Reservoir Volume due to Sedimentation

Reservoir Elevation (ft msl)	1983 Volume (ac-ft)	2010 Volume (ac-ft)	Volume Change 1983 – 2010 (%)	2060 Volume (ac-ft)	Volume Change 2010 – 2060 (%)
480	1,166,166	1,163,262	-0.25	1,157,884	-0.46
479	1,137,100	1,134,210	-0.25	1,128,859	-0.47
478	1,108,581	1,105,706	-0.26	1,100,382	-0.48
477	1,080,603	1,077,743	-0.26	1,072,445	-0.49
476	1,053,159	1,050,313	-0.27	1,045,043	-0.50
475	1,026,244	1,023,413	-0.28	1,018,169	-0.51
474	999,850	997,033	-0.28	991,817	-0.52
473	973,974	971,157	-0.29	965,941	-0.54
472	948,607	945,805	-0.30	940,615	-0.55
465	783,020	780,334	-0.34	775,359	-0.64
450	535,925	533,558	-0.44	529,175	-0.82
435	331,550	329,561	-0.60	325,877	-1.12
420	190,000	188402.8	-0.84	185444.9	-1.57
400	80,000	78925.5	-1.34	76935.69	-2.52
360	5,000	4811.237	-3.78	4461.675	-7.27
340	0	0	-0.00	0	-0.00

Table 11. JST Lake Estimated Changes in Reservoir Volume due to Sedimentation

Reservoir Elevation (ft msl)	1952 Volume (ac-ft)	2010 Volume (ac-ft)	Volume Change 1952 – 2010 (%)	2060 Volume (ac-ft)	Volume Change 2010 – 2060 (%)
335	2,900,000	2,879,599	-0.70	2,862,012	-0.61
334	2,822,000	2,801,803	-0.72	2,784,391	-0.62
333	2,744,000	2,724,007	-0.73	2,706,771	-0.63
332	2,666,000	2,646,211	-0.74	2,629,151	-0.64
331	2,588,000	2,568,313	-0.76	2,551,341	-0.66
330	2,510,000	2,490,517	-0.78	2,473,721	-0.67
329	2,440,000	2,420,721	-0.79	2,404,101	-0.69
328	2,370,000	2,350,925	-0.80	2,334,481	-0.70
327	2,300,000	2,281,129	-0.82	2,264,861	-0.71
326	2,230,000	2,211,333	-0.84	2,195,241	-0.73
325	2,160,000	2,141,435	-0.86	2,125,431	-0.75
324	2,100,000	2,081,639	-0.87	2,065,810	-0.76
323	2,040,000	2,021,843	-0.89	2,006,190	-0.77
322	1,980,000	1,962,047	-0.91	1,946,570	-0.79
321	1,920,000	1,902,251	-0.92	1,886,950	-0.80
320	1,860,000	1,842,455	-0.94	1,827,330	-0.82
319	1,808,000	1,790,659	-0.96	1,775,710	-0.83
318	1,756,000	1,738,965	-0.97	1,724,280	-0.84
317	1,704,000	1,687,169	-0.99	1,672,660	-0.86
316	1,652,000	1,635,373	-1.01	1,621,039	-0.88
315	1,600,000	1,583,577	-1.03	1,569,419	-0.89
314	1,555,000	1,538,781	-1.04	1,524,799	-0.91
313	1,510,000	1,493,985	-1.06	1,480,179	-0.92
312	1,465,000	1,449,291	-1.07	1,435,749	-0.93
311	1,420,000	1,404,495	-1.09	1,391,129	-0.95
310	1,375,000	1,359,801	-1.11	1,346,699	-0.96
309	1,334,000	1,319,005	-1.12	1,306,079	-0.98
308	1,293,000	1,278,311	-1.14	1,265,648	-0.99
307	1,252,000	1,237,515	-1.16	1,225,028	-1.01
306	1,211,000	1,196,821	-1.17	1,184,598	-1.02
305	1,170,000	1,156,025	-1.19	1,143,978	-1.04
304	1,138,000	1,124,331	-1.20	1,112,548	-1.05
303	1,106,000	1,092,535	-1.22	1,080,928	-1.06
280	510,000	501,636	-1.64	494,425	-1.44
255	200,000	195,716	-2.14	192,022	-1.89
240	130,000	127,552	-1.88	125,441	-1.65
230	100,000	98,470	-1.53	97,151	-1.34
220	50,000	49,184	-1.63	48,480	-1.43
175	0	0	0.00	0	0.00

As can be seen in Tables 7 through 11, the total loss due to estimated reservoir sedimentation, when taken as a percentage of the total reservoir volume, is very small (i.e., less than 1% in most cases).

Table 12 provides the volume lost due to estimated sedimentation just within the normal operating range of each reservoir between initial fill year and year 2010.

Table 12. Volume Change Within the Normal Operating Range from Initial Fill Year to 2010

Reservoir	Top of Operating Range (ft msl)	Bottom of Operating Range (ft msl)	Number of Feet (ft)	Volume Lost in Operating Range (ac-ft)	Percent Change (%)
Jocassee	1110	1086	24	8,291	4.755
Keowee	800	778	22	-22,985	-6.553
Hartwell	660	625	35	-1,699	-0.120
RBR	475	470	5	-62	-0.049
JST	330	312	18	-3,774	-0.361

Table 13 provides the volume lost due to estimated sedimentation just within the normal operating range of each reservoir between year 2010 and year 2060.

Table 13. Volume Change Within the Normal Operating Range from 2010 to 2060

Reservoir	Top of Operating Range (ft msl)	Bottom of Operating Range (ft msl)	Number of Feet (ft)	Volume Lost in Operating Range (ac-ft)	Percent Change (%)
Jocassee	1110	1086	24	-4	-0.002
Keowee	800	778	22	-160	-0.049
Hartwell	660	625	35	-1,733	-0.123
RBR	475	470	5	-114	-0.091
JST	330	312	18	-3,254	-0.312

5.0 Conclusions and Recommendations

The volume reductions within the normal operating ranges for each of the five reservoirs on the mainstem of the Savannah River due to estimated sedimentation are relatively small compared to the overall usable volumes.

For Lake Jocassee, the 2010 stage/storage curves that were developed using recently collected bathymetry data and GIS software tools are remarkably similar to the curves that were generated in 1967. The slight increase in total storage is likely the result of very small inaccuracies due to data collection and reduction techniques that were considered best practice in the late-1960's. For Lake Keowee, the 2010 stage/storage curves based on new bathymetry data show an 8.8% reduction in total storage and a 6.6% reduction in storage down to 778 ft msl. The volume loss since 1967 is likely the result of some sedimentation, but also similar inaccuracies in data collection and reduction as described for Lake Jocassee.

For the three USACE reservoirs, the incremental volume lost due to sedimentation from initial fill to 2010 is very small from a percentage standpoint (less than 1%). These sedimentation estimates are heavily influenced by sediment yields that have been measured in the Savannah River drainage basin. For this analysis, average to slightly greater than average sediment yield estimates were used. However, even if the sediment yield estimates used in this analysis were doubled, usable reservoir volume losses would still be very small.

Similarly, the sedimentation estimates projected out to year 2060 are also very small for all five reservoirs. Less than 1% additional volume is lost from the 2010 stage/storage curves. The lost volume is even smaller within the normal operating range as some of the sediment deposits below usable storage elevations.

For HEC-ResSim modeling purposes, the stage/volume changes for 2010 and 2060 are insignificant, and will not be incorporated into the "current case" and "future case" modeling scenarios.

6.0 References

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