SOUTH CAROLINA ELECTRIC & GAS COMPANY

COLUMBIA, SOUTH CAROLINA

SALUDA HYDROELECTRIC PROJECT

FERC PROJECT NO. 516

PROJECT OPERATIONS

EXHIBIT B

DECEMBER 2007

Prepared by:

Kleinschmidt

Energy & Water Resource Consultants

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PROJECT OPERATION AND RESOURCE UTILIZATION

1.0 PROJECT OPERATION

Saluda Hydro is operated primarily as a reserve generation facility in the Applicant's system. The plant normally operates with one unit on line at minimum gate to provide downstream flow in the Saluda River. In the event of a loss of generation, the remaining Saluda Hydroelectric Project units can be started and brought to full load within 10 to 15 minutes. This allows a rapid response to emergencies on the Applicant's system, and also fulfills the Applicant's reserve share obligation as a member of the Virginia-Carolinas Electric Reliability Council (VACAR) under the VACAR Reserve Sharing Arrangement (VRSA). It should be noted that, in order to be considered a reserve generation asset at any given time, Saluda Hydro must remain on standby and cannot be providing generation for other purposes.

In addition to reserve generation, Saluda Hydro is utilized to manage the reservoir elevation on a seasonal basis. Under the current license, the Applicant has managed the reservoir using monthly target elevations, which are subject to revision by the Applicant's management based on climatic conditions, reservoir level at the time, dam and reservoir maintenance requirements, or operational considerations. The reservoir is normally maintained between El. 348.5' NAVD88[1] (winter) and El. 356.5' (summer). Occasional reservoir drawdowns to El. 343.5' have occurred for project maintenance work or control of aquatic vegetation (primarily hydrilla) in the reservoir. The current license allows operation of the reservoir between El. 343.5' and El. 358.5'. Saluda Hydro units are occasionally dispatched on an economic basis when it is necessary to release water from the reservoir for seasonal or other drawdowns, or to pass inflow from precipitation in the drainage basin. During the relatively infrequent periods when Saluda Hydro is being utilized for reservoir management, the units being so utilized are not available for reserve generation, and other generation assets must be made available to meet the Applicant's obligation under the VRSA.

The Applicant proposes to continue to utilize Saluda Hydro primarily for reserve generation on an as-needed basis. Generation will also occur to provide downstream flow and for

[1] All elevation references in Exhibit B are given in North American Vertical Datum 1988 (NAVD 88); conversion to traditional plant datum (PD, used in numerous supporting studies for this license application and often erroneously referred to as MSL) requires the addition of 1.50 feet.

reservoir management when required. The main value of the Project to the Applicant's system is as a reserve generation asset, due to its rapid starting capability and overall excellent reliability.

1.1 Manual or Automatic Operation

The Saluda Hydroelectric Project units are normally remotely dispatched from SCE&G's System Control Center in Columbia. Once started, the units are under automatic control. Units can also be operated manually from the powerhouse. The plant is manned five days per week, eight hours per day, and personnel are available for call out should a problem arise during after normal business hours.

1.2 Estimate of Annual Plant Factor

The annual plant factor (the ratio of the average load on the plant for a certain period of time to the capacity rating of the plant) for Saluda Hydro is estimated to be 10 percent, based on annual gross generation data from 1988 through 2006, shown in Exhibit B-1.

1.3 Proposed Operation During Adverse, Mean, and High Water Years

A reservoir operation guide curve (Exhibit B-17) will be included in the final license application. Development of the guide curve will be based upon operations modeling results using constraints provided by the Resource Conservation Groups.

In adverse flow years, the reservoir may not reach the target elevation (*to be determined*) during the spring and summer months. As long as the reservoir is above an elevation of (*to be determined*), low inflow does not significantly impact the operation of Saluda Hydro for reserve generation, since these generation events are relatively brief and intermittent. Should the reservoir fall below an elevation (*to be determined*), reserve generation may be limited so as not to allow the reservoir to fall below elevation (*to be determined*).

Operation of Saluda Hydro in mean flow years will generally consist of continuous minimal generation to provide downstream flow; intermittent generation for reserve requirements throughout the year; occasional generation for reservoir level management; and some sustained generation in the fall if necessary to reduce the reservoir level to accommodate inflow from winter storms and spring runoff from the upper basin.

In high flow years, the need to pass higher inflow may require that Saluda Hydro be dispatched on an economic basis for several hours per day or for several days during the week. During these periods of extended generation, the units being so utilized are not available for reserve use, as described previously. Due to the relatively large hydraulic capacity through the powerhouse (approximately equal to the 1 percent exceeds flow), it is rarely necessary to use the spillway for reservoir level management.

In order to perform maintenance on project structures and the reservoir, it will occasionally be necessary to draw the reservoir down to el. 343.5'. Maintenance work requiring such a drawdown would include but not be limited to: control of aquatic vegetation in the reservoir, maintenance or repairs to the intake towers, spillway structure, and the upstream face of the original dam, in order to maintain the project in a safe and reliable condition.

2.0 ESTIMATE OF DEPENDABLE CAPABILITY

2.1 Gross Generation

Annual gross generation at Saluda Hydro for the years 1988 through 2006 is shown in Exhibit B-1. The average gross annual generation over this period was 184,302 MWH. Rated capacity of the plant is 207.3 MW, and dependable capability is estimated to be 206 MW.

2.2 Streamflow Data & Flow Duration Curves

The Saluda Hydroelectric Project is located on the Saluda River near Columbia, SC. The total contributing drainage area at the Saluda Dam is 2,420 square miles. The monthly and annual flow regime data was collected from two United States Geological Survey (USGS) gauges located along the lower Saluda River downstream of the dam. Gauge number 02169000 is located on the Saluda River near Columbia, about eight miles downstream from the Saluda Dam. It has remained in this location from the time it was first installed in 1925. The contributing drainage area for this gauge is 2,520 square miles and it has an average annual flow of 2,569 CFS. A second gauge, number 02168504, was installed along the Lower Saluda by USGS in 1988. This gauge records data immediately downstream from the Lake Murray Dam. Data from this gauge have shown that from the time period of 1988 to 2005, flows from Lake Murray have varied from 185 cfs to a recorded high of 24,000 cfs. Annual mean flow from gauge number 02168504 is 2,595 cfs. The contributing drainage area for this gauge is 2,420 square miles. Monthly and annual flow-duration curves were developed for the project using the mean daily flow data from the respective gages. The data from the two gages were combined to develop the curves shown in Exhibits B-2 through B-14. The data from the gages was pro-rated to their respective contributing drainage areas to make the mean daily flow site-specific. The period of record for the data that is used in these graphs dates from 1979 through 2003. Since gage number 02168504, directly downstream from the dam, was installed in 1988, data from gage 02169000 was used and pro-rated to that particular drainage area.

The flood of record for the Saluda River occurred during construction of the original Saluda Dam in October 1929, and was recorded at USGS gauge 02169000 at 67,000 CFS.

2.3 Area Capacity Curve

Area-capacity curves are given in Exhibit B-15, with a corresponding table presented as Exhibit B-16. The reservoir has gross storage of approximately 2,000,000 acre feet at full pool elevation 358.5’, and active storage of approximately 635,000 acre feet between elevation 358.5’ (full pool) and elevation 343.5’ (minimum allowed under current license). The reservoir area is approximately 50,900 acres at full pool elevation 358.5’, and is approximately 35,600 acres at an elevation of 343.5’. At maximum normal operating pool elevation 356.5’, the reservoir area is approximately 48,000 acres, with gross storage of about 1,909,000 acre feet. Previous stage–storage data included in the application for the current license represented usable storage above el. 298.5’. To obtain gross storage values, an estimated storage value below el. 298.5’ of 394,000 acre feet was added to the previously published usable storage values.

2.4 Reservoir Guide Curve

The guide curve for reservoir operation is given in Exhibit B-17. (*To be provided in the final license application.)*

2.5 Estimated Hydraulic Capacity

The estimated hydraulic capacity of the plant is 18,000 CFS at 180 feet of head and optimum gate opening.

2.6 Spillway Rating Curve

A spillway rating curve is given in Exhibit B-18.

2.7 Tailwater Rating Curve

A tailwater rating curve is given in Exhibit B-19.

2.8 Elevation – Capacity Curve

Elevation-capacity table and curve are given in Exhibits B-20 and B-21.

2.9 Generation Analysis

A Resource Utilization Study (Kleinschmidt 2005) was conducted to compare historical generation at Saluda Hydro with optimal generation based on available flow.

Monthly generation data were examined for the period 1988 to the present. Annual data were provided going back to 1931. An analysis of a sample period (10 years) was considered to be representative of project operations and generation. For this analysis, the period used ran from 1989-1999, inclusive. Data prior to 1988 was not used as only annual values were reported. Generation data for 1988 was not considered because it was a severe drought year. Data after 1999 was not used due to extraordinary reductions of the reservoir levels due to the backup dam construction and drought periods. The data for the period of consideration indicated an average annual project generation of 248,474 MWH. Exhibit B-29 summarizes the historical average data by month and year for the noted period. The minimum and maximum annual generation for the period was determined to be 209,182 MWHs in 1989 and 332,152 MWHs in 1999. The highest recorded generation since 1931 occurred in 1964 with an annual generation of 499,074 MWHs.

An energy model was developed to determine the optimal output of the station. To verify the model's accuracy and calibrate it to site conditions, the model was run using existing conditions and compared to the historical generation for years where both head pond levels and annual generation data were available. These years were 1993-1998, with the exception of 1997 which had incomplete head pond level data. Inputs to the model consisted of the average monthly flow, the average monthly head pond level, tailwater rating curve, head loss data and overall efficiency.

The results of the analysis comparing actual generation to computed generation for the years noted indicated close agreement of the model to actual values. This would indicate that the model accurately represented project generation. The results of the generation analysis are summarized in Exhibit B-22. Individual curves depicting computed vs. actual generation for 1993-1996 and 1998 are provided in Exhibits B-23 – B-28.

The energy model was then re-run using the 10 year average conditions both in regards to head pond level and flow, and the results were compared to the 10-year average generation. The model results indicated that the station output matches modeled output closely. The only variations occur during the summer period, May through September. The net computed values are within 3 percent of the historical average values. Note that the net values allow for a 5 percent reduction in generation to account for scheduled and unscheduled outages, station service, transformer and other minor losses. Because during typical operations no flow is lost due to spillage, there is not much that can be done to change flow utilization. Changes in impoundment and/or project operation potentially could result in some increases in project revenues due to time of day generation. This potential would need to be examined as part of another analysis. Further, some potential gains in equipment performance could also increase project generation. These however, would be relatively small. Exhibit B-29 presents the 10 year historical generation and a graph showing a comparison with the energy model analysis results.

3.0 POWER UTILIZATION

3.1 Generation for Reservoir Management

When Saluda Hydro is utilized to pass inflow from the drainage basin, or to reduce the reservoir level for maintenance or as part of normal seasonal operation, the power produced is used in the Applicant's system to serve customer demand, and thereby balance the Applicant's system load.

3.2 Generation for Applicant's System Reserve

When Saluda Hydro is utilized to replace the sudden loss of power from another generation asset on the Applicant's own system, the power produced is used in the Applicant's system to serve customer demand, usually for periods of several minutes to several hours, until such time as other generation assets can be brought on line, or purchased off-system power becomes available to balance the Applicant's system load.

3.3 Generation for Regional Reserve Sharing Obligations

When Saluda Hydro is utilized in fulfillment of all or a portion of the Applicant's reserve sharing obligation under the VRSA, the power produced by Saluda Hydro represents excess generation above the requirements of the Applicant's own customer demand. The excess power is made available through the interconnected regional transmission system (the "grid"), to balance generation and load over the interconnected system. Compensation to the Applicant for reserve generation provided to other VRSA member systems is made according to the terms of the VRSA.

4.0 FUTURE DEVELOPMENT

4.1 Potential for Future Development

A Resource Utilization Study (Kleinschmidt 2005) was performed to evaluate the potential for future development of the Saluda Project. The study concluded that the existing hydraulic capacity of the project corresponds to approximately the 1 percent exceeds flow at the project location, and greatly exceeds the average annual flow at the project location. This indicates that the project is fully developed hydraulically, and that no additional generating capacity is necessary to fully utilize the available flow.

Economically feasible future development will likely be limited to upgrading the turbines and/or generators in order to enhance efficiency, maintain reliability, and provide ancillary benefits such as enhancement of downstream dissolved oxygen levels. Some increase in rated capacity or energy may be realized, depending on the actual upgrades performed and the final operating regime for the project with regard to minimum flow, and reservoir operating range.

4.2 Potential Equipment Upgrades

The Applicant commissioned a Saluda Hydroelectric Project Upgrade Study (Kleinschmidt 2007) to evaluate the potential for upgrading the existing, original generating equipment. The upgrade study determined that significant increases in turbine performance could be obtained with modern runner designs. Upgraded turbine runners would also have the potential to significantly increase dissolved oxygen (DO) uptake at all operating conditions.

For the purposes of the upgrade study, the following alternatives were selected for detailed analysis:

<u>Alternative 0: (Base Case) Existing equipment Rehabilitated/Replaced In-Kind</u>

Alternative 0 represents the Base Case for rehabilitating the existing, original equipment. This option consists of installing in-kind replacement runners and restoring the original machine clearances to achieve the initial performance characteristics and reliability. This alternative would provide no increase in capacity over existing conditions.

<u>Alternative 1: Maximum Capacity, No Wheel Case or Generator Modifications</u>

Alternative 1 would maximize the installed capacity by installing new runners of modern design that offer higher efficiencies, output and DO uptake, and rewinding the generators. This alternative would increase the rated capacity of the project from 207.3 MW to about 242 MW.

<u>Alternative 2: Maximum Capacity, No Wheel Case or Generator Modifications</u>

Alternative 2 would include the upgrades described in Alternative 1, with additional capacity achieved by also modifying the water passages and generators. This alternative would increase the rated capacity of the project from 207.3 MW to about 254 MW.

<u>Alternative 3: Alternative 1 with a Minimum Flow Optimized Runner in One Unit</u>

Alternative 3 would include the upgrades described in Alternative 1, with the exception that one of the four smaller turbines would receive a runner optimized for highest efficiency at low flow (less than 1,200 CFS). This alternative would increase the rated capacity of the project from 207.3 MW to about 222 MW.

<u>Alternative 4: Alternative 2 with a New Minimum Flow Optimized Turbine in One Unit Bay</u>

Alternative 4 would include the upgrades described in Alternative 2, with the exception that one of the four smaller turbines would be replaced by a new turbine optimized for highest efficiency at low flow (less than 1,200 CFS). This alternative would increase the rated capacity of the project from 207.3 MW to about 222 MW.

<u>Comparison of Upgrade Alternatives</u>

Alternative 0, replacing the existing runners in-kind, represents the least cost option. No increase in rated capacity or energy is realized.

Alternative 1, which maximizes rated capacity without modifications to the wheel cases and generators, is the most attractive option studied by a significant margin. Alternative 1 would cost approximately 10 percent more than Alternative 0, would have an installed capacity of 242 MW and would produce approximately 8% more energy on an annual basis than the existing equipment.

Alternative 2, which results in the highest rated capacity (254 MW), would cost 40 percent more than Alternative 1, and adds only 6 percent more rated capacity. Alternative 3 would cost slightly more than Alternative 1 due to the modifications required to install a minimum flow optimized runner, and adds less rated capacity than Alternative 1. Alternative 4, the most expensive option (75 percent more than Alternative 1), reflects the additional costs for a complete new minimum flow turbine/generator along with the costs for generator and pressure case modifications to the remaining units, and also adds less rated capacity than Alternative 1.

Once a proposed set of plant upgrades has been selected, information describing the proposed upgrades will be included in the final license application.

EXHIBIT B-1

Saluda Hydroelectric Project P-516

Gross Annual Generation for the Period 1988 - 2006

YEAR	**GROSS ANNUAL GENERATION (MWH)**
1988	60,747
1989	209,182
1990	269,289
1991	222,560
1992	210,541
1993	286,302
1994	219,788
1995	297,211
1996	233,394
1997	204,329
1998	332,152
1999	49,826
2000	93,281
2001	50,260
2002	93,875
2003	301,240
2004	94,426
2005	205,898
2006	67,438
AVERAGE 1988 - 2006	**184,302**

EXHIBIT B-2

Saluda Hydroelectric Project P-516

January Flow Duration Curve

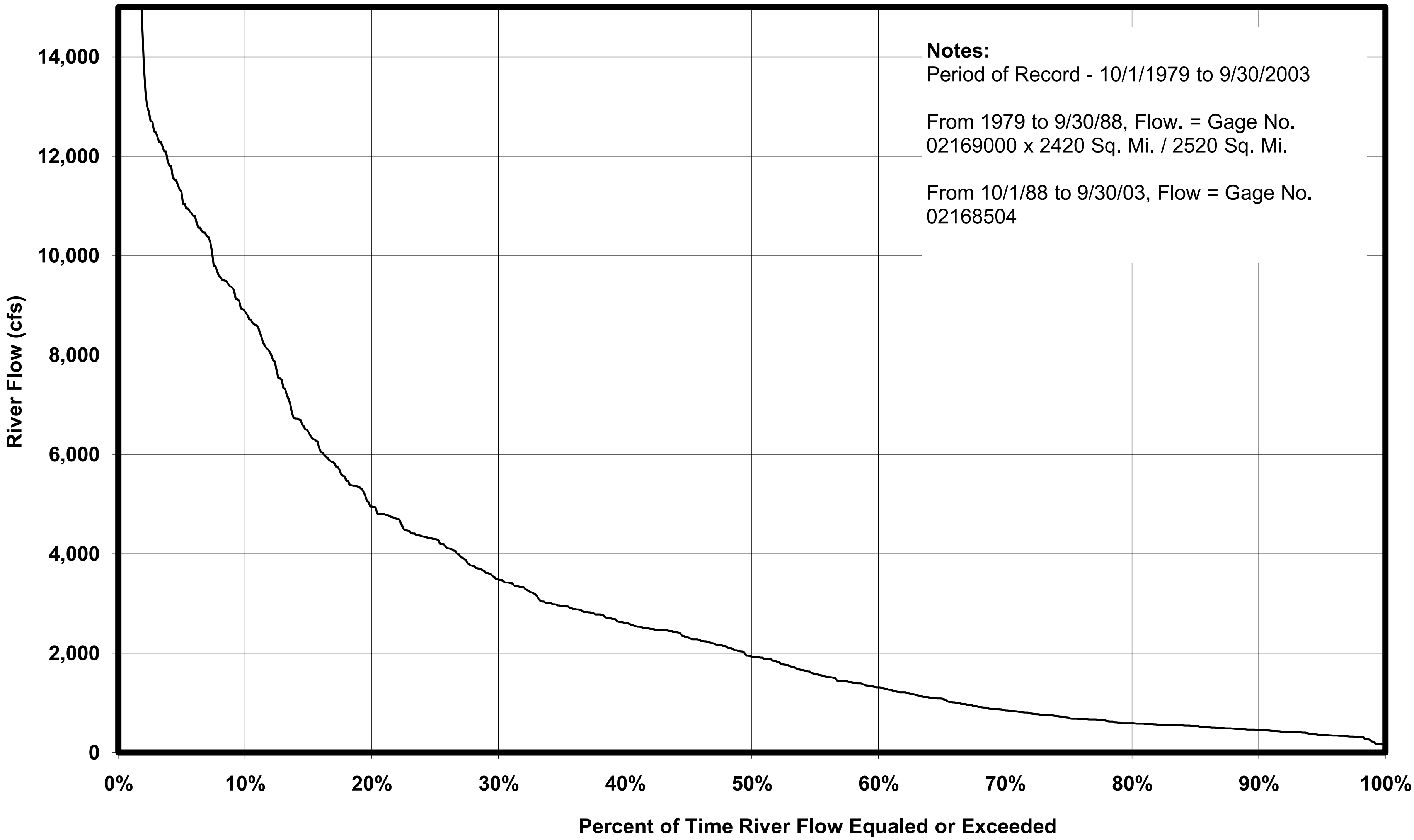

EXHIBIT B-3

Saluda Hydroelectric Project P-516

February Flow Duration Curve

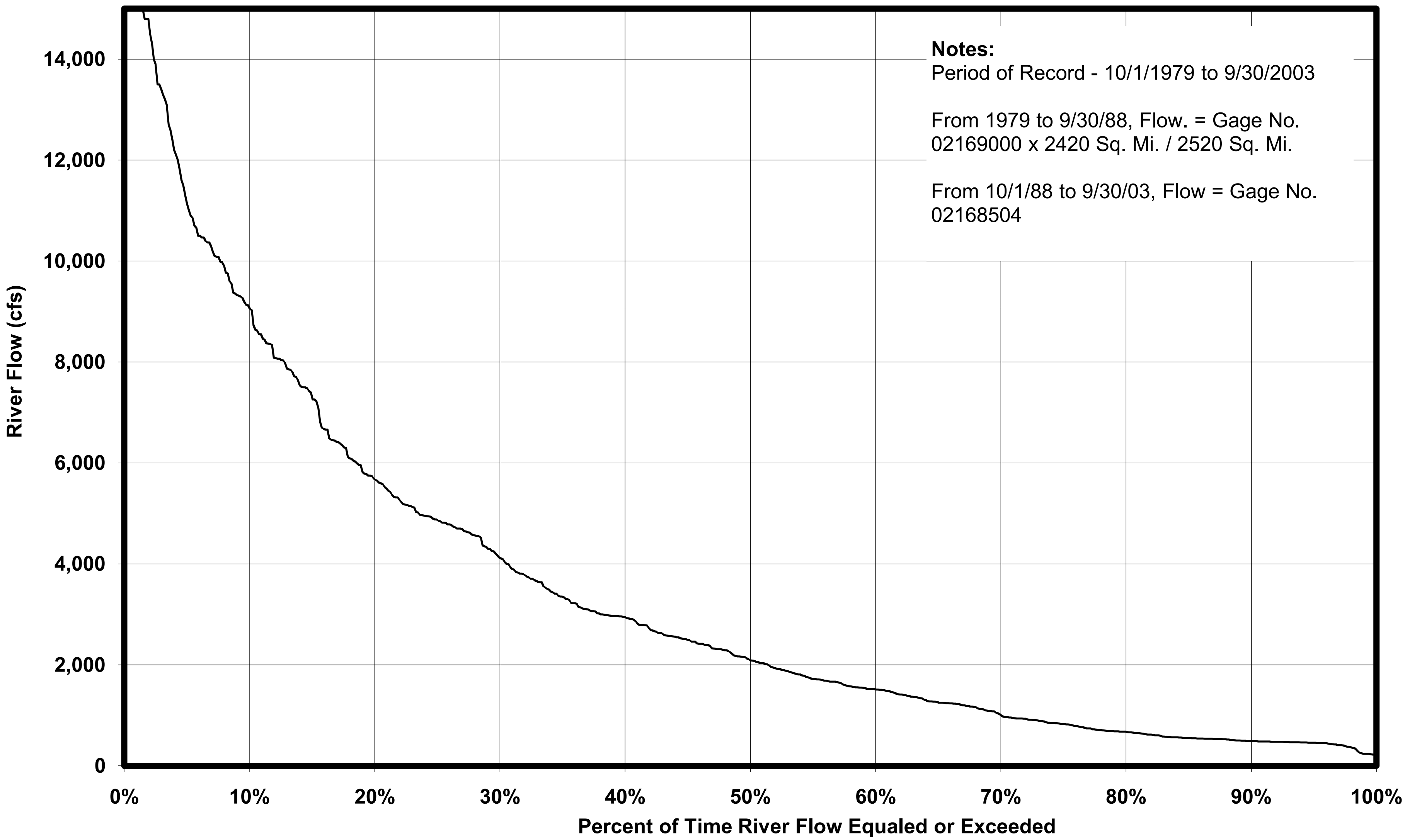

EXHIBIT B-4

Saluda Hydroelectric Project P-516

March Flow Duration Curve

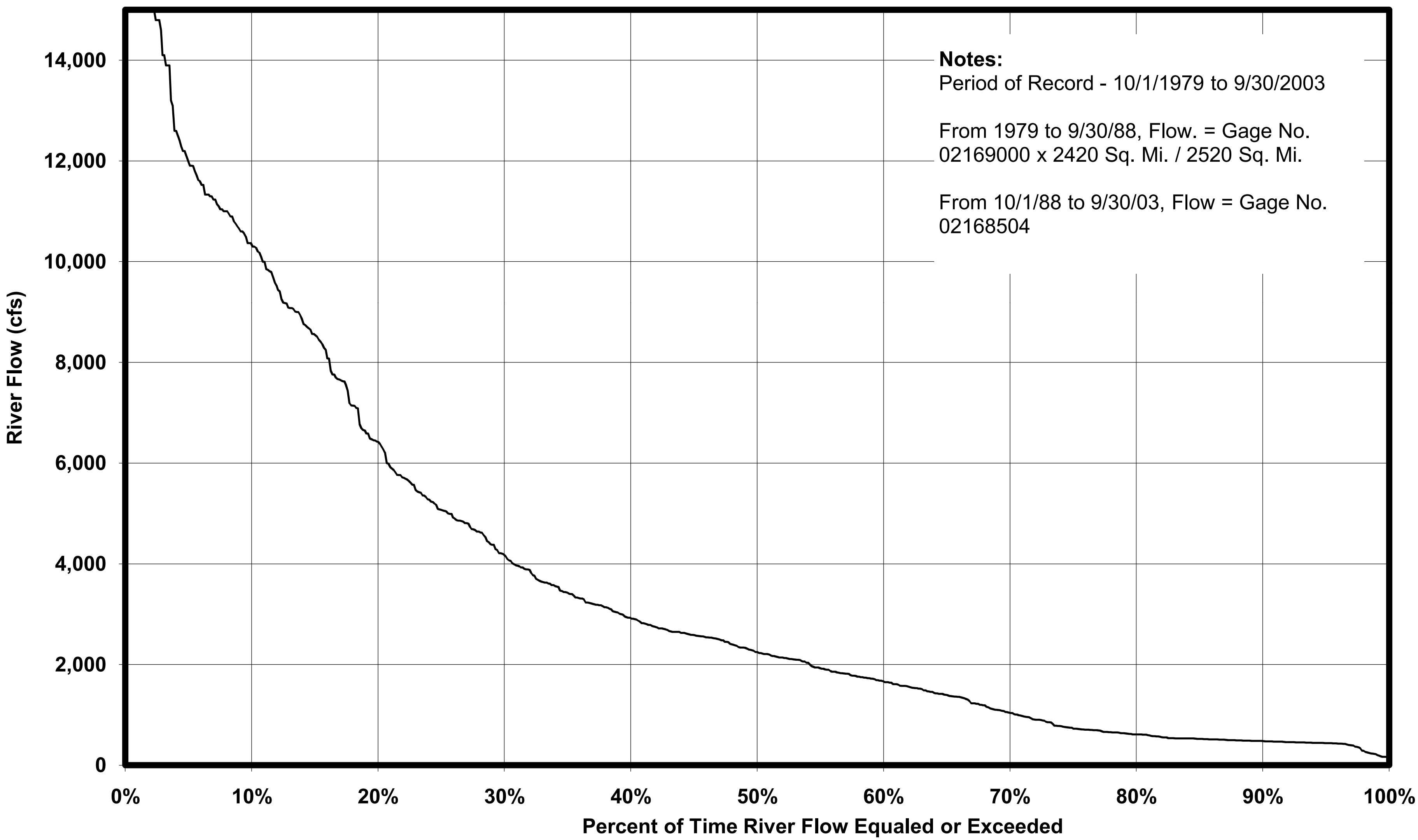

EXHIBIT B-5

Saluda Hydroelectric Project P-516

April Flow Duration Curve

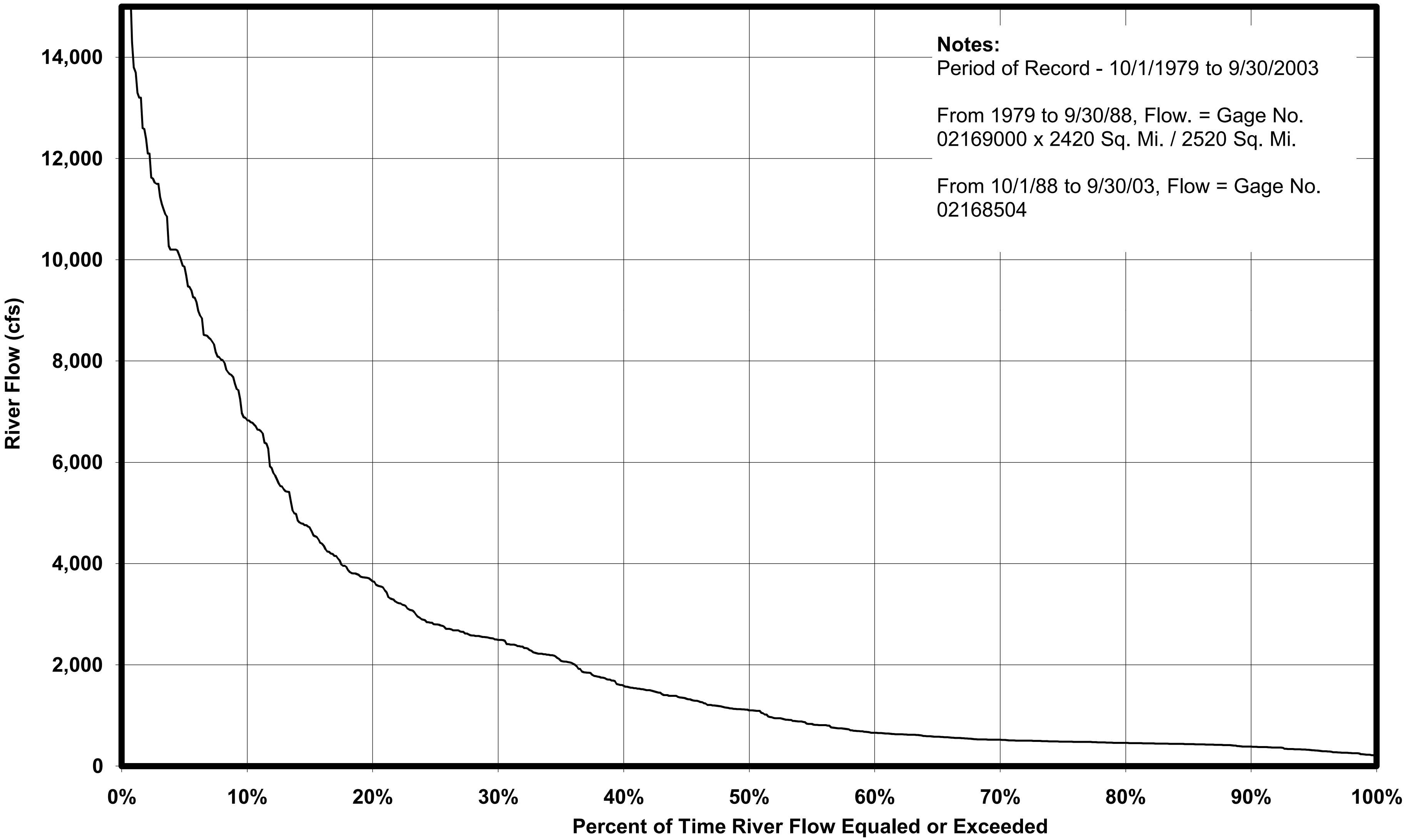

EXHIBIT B-6

Saluda Hydroelectric Project P-516

May Flow Duration Curve

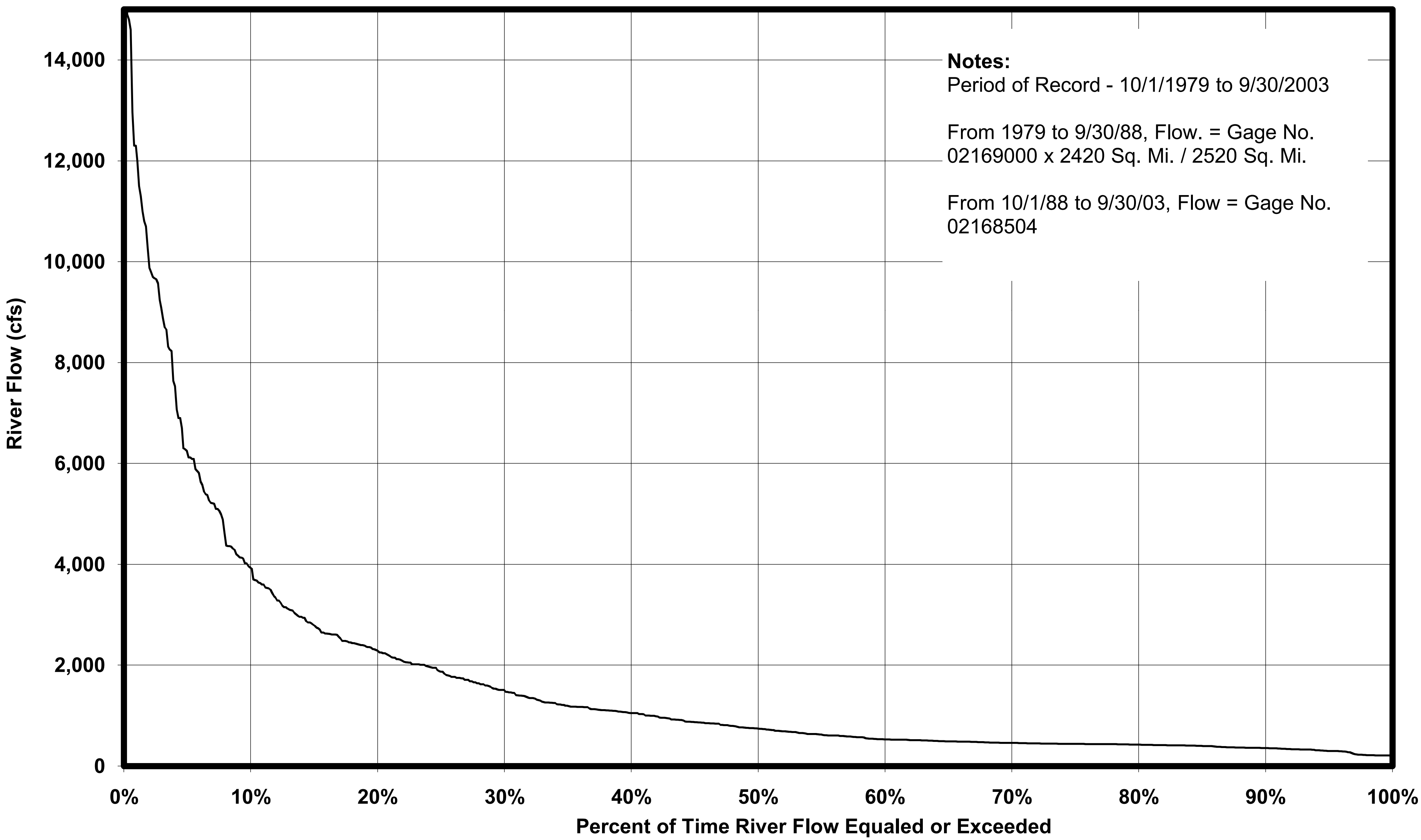

EXHIBIT B-7

Saluda Hydroelectric Project P-516

June Flow Duration Curve

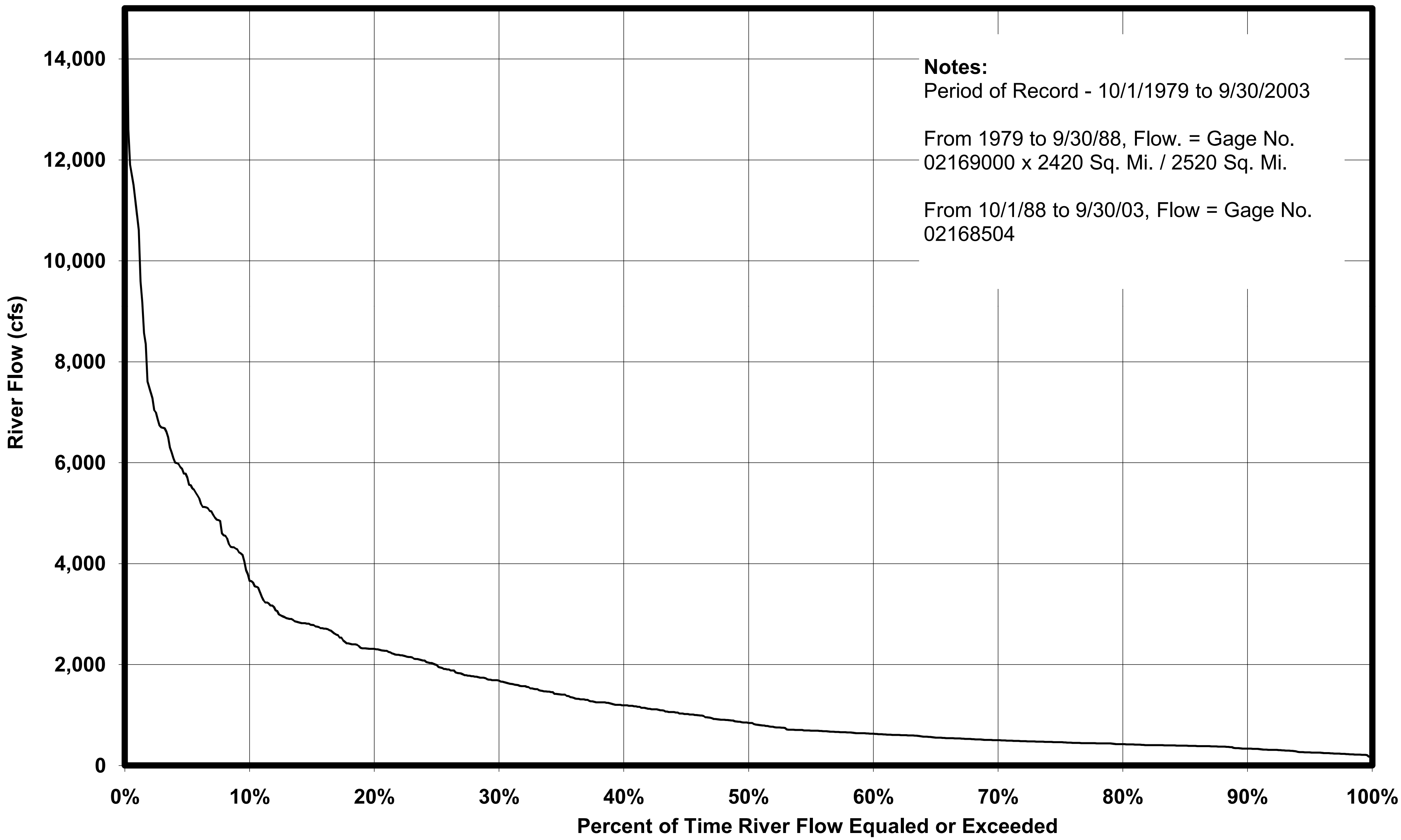

EXHIBIT B-8

Saluda Hydroelectric Project P-516

July Flow Duration Curve

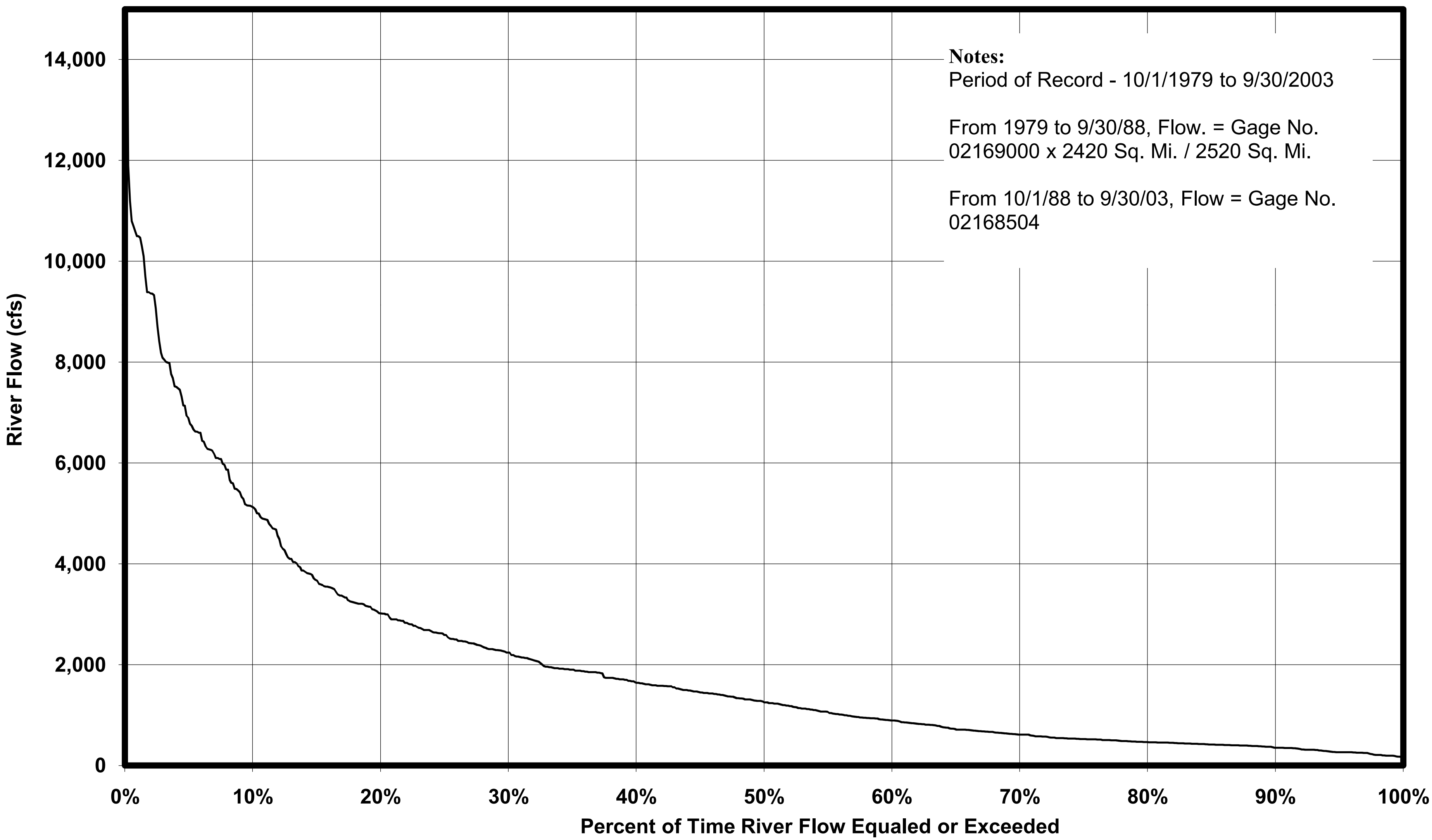

EXHIBIT B-9

Saluda Hydroelectric Project P-516

August Flow Duration Curve

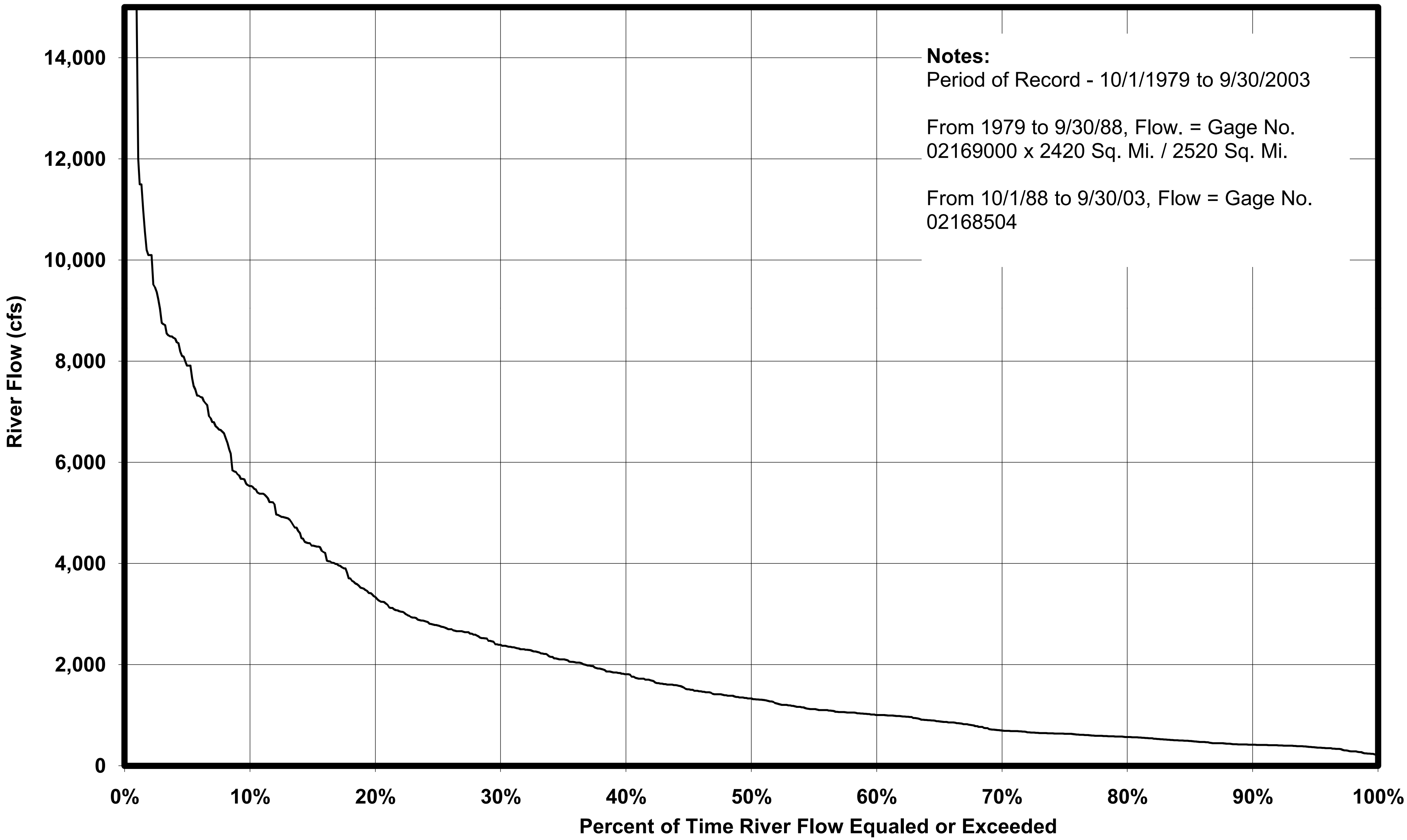

EXHIBIT B-10

Saluda Hydroelectric Project P-516

September Flow Duration Curve

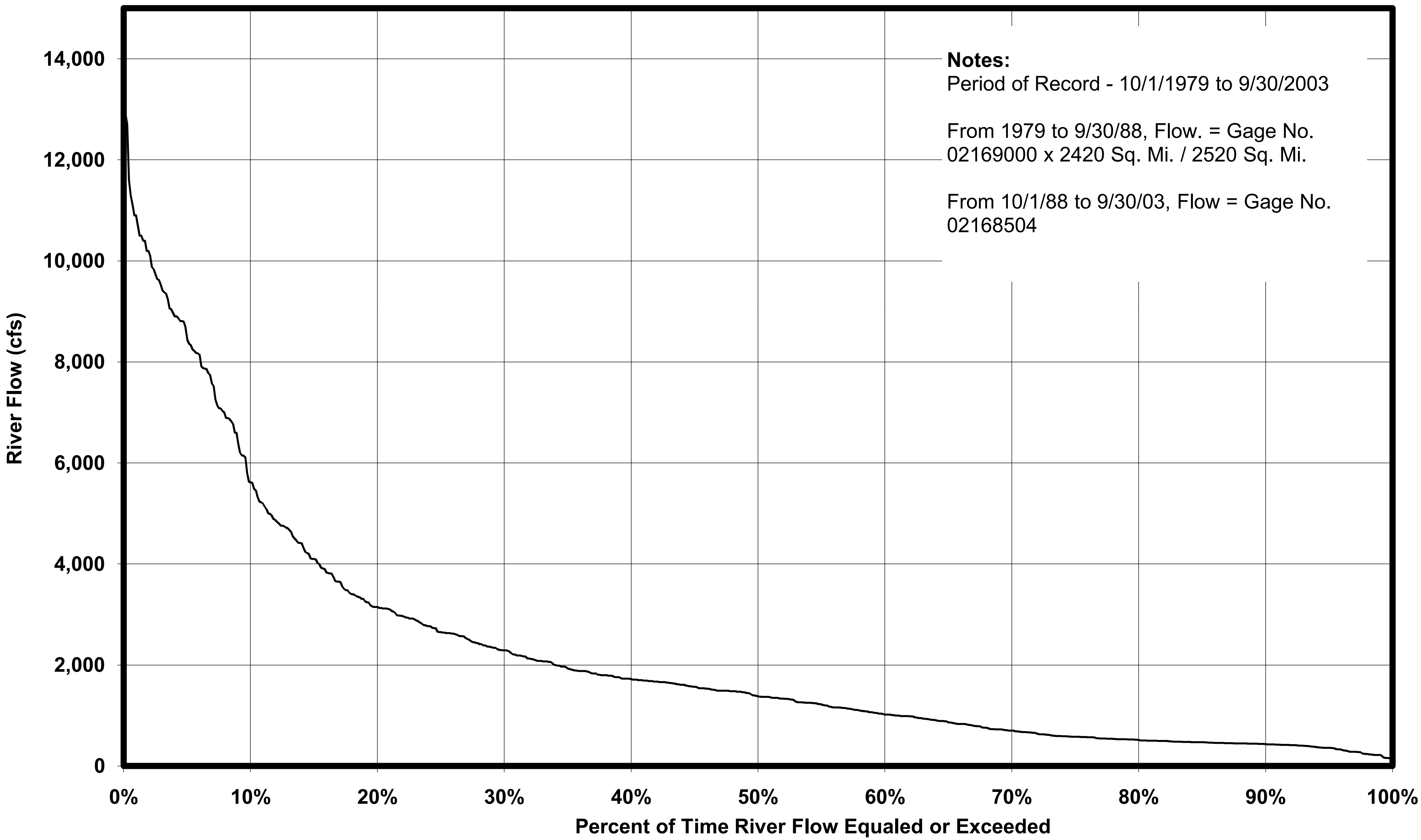

EXHIBIT B-11

Saluda Hydroelectric Project P-516

October Flow Duration Curve

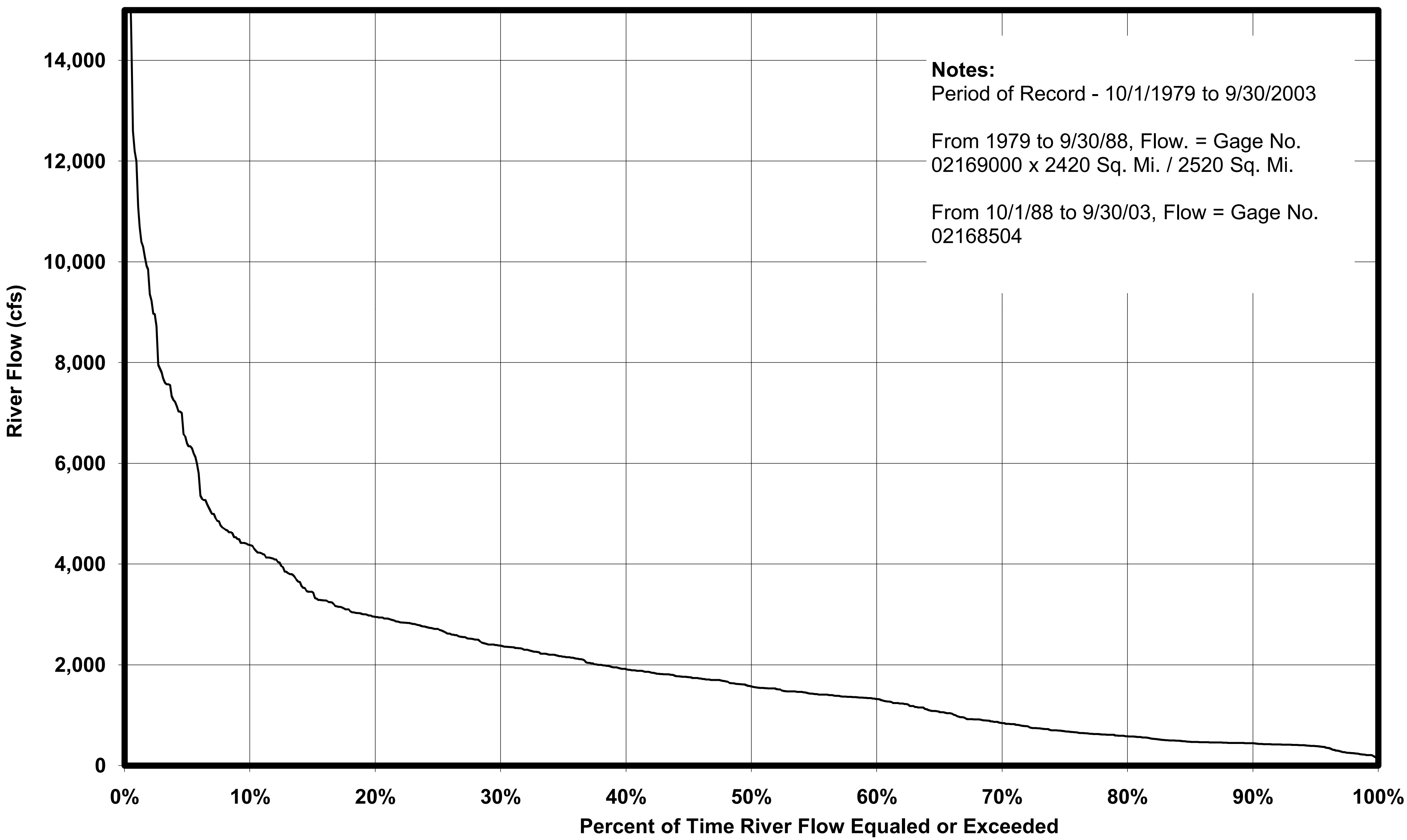

EXHIBIT B-12

Saluda Hydroelectric Project P-516

November Flow Duration Curve

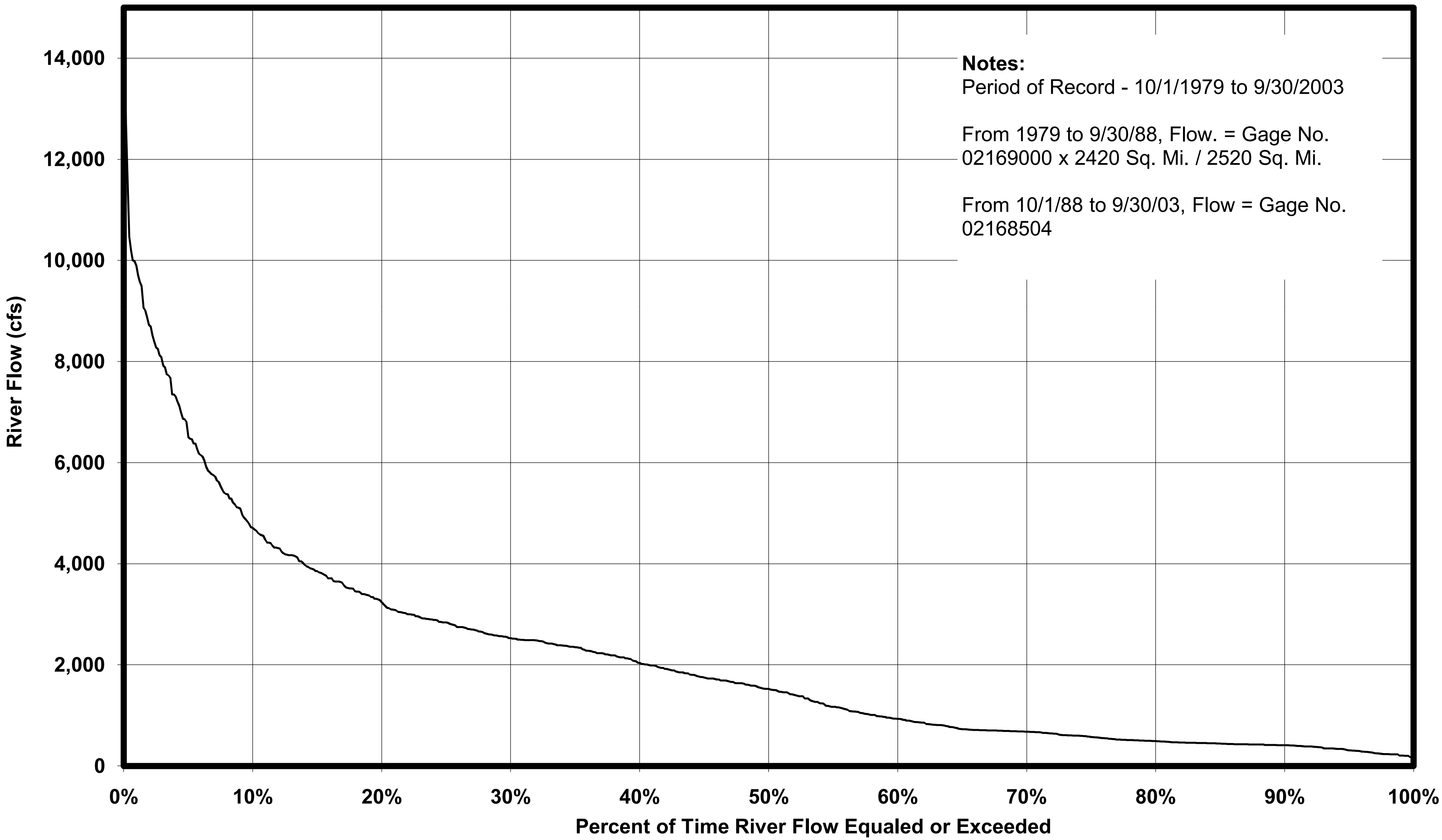

EXHIBIT B-13

Saluda Hydroelectric Project P-516

December Flow Duration Curve

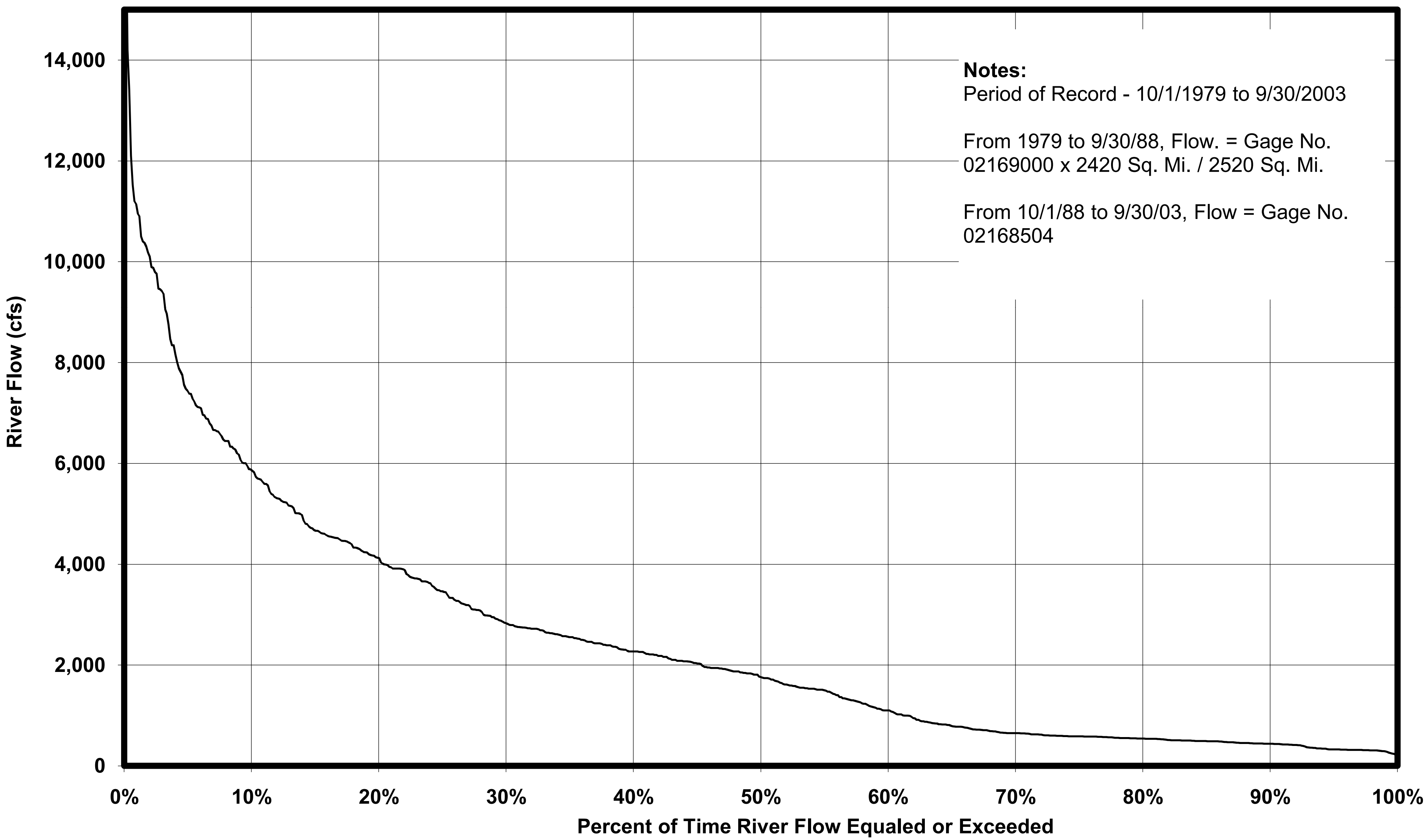

EXHIBIT B-14

Saluda Hydroelectric Project P-516

Annual Flow Duration Curve

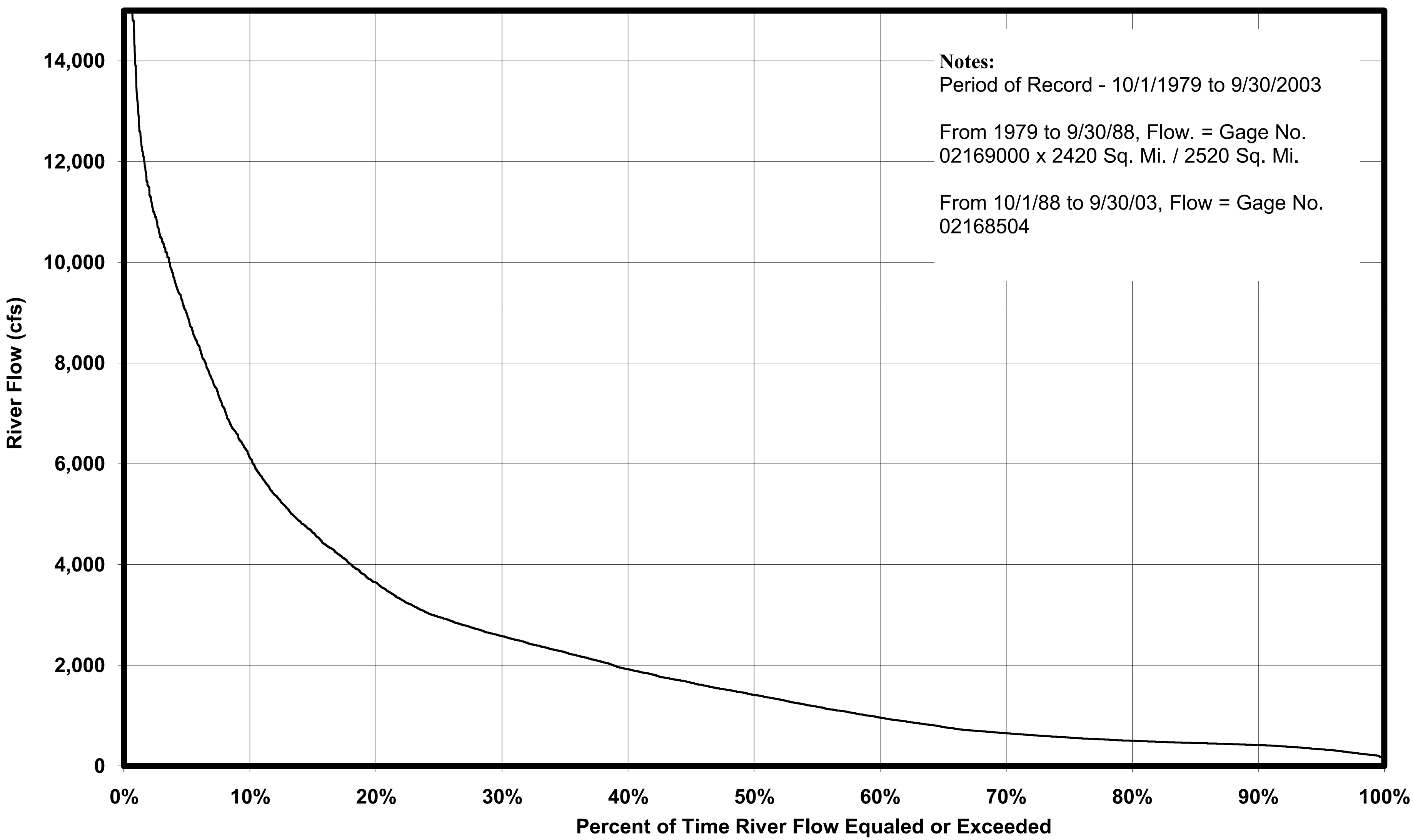

EXHIBIT B-15

Saluda Hydroelectric Project No. 516

Area-Capacity Curves

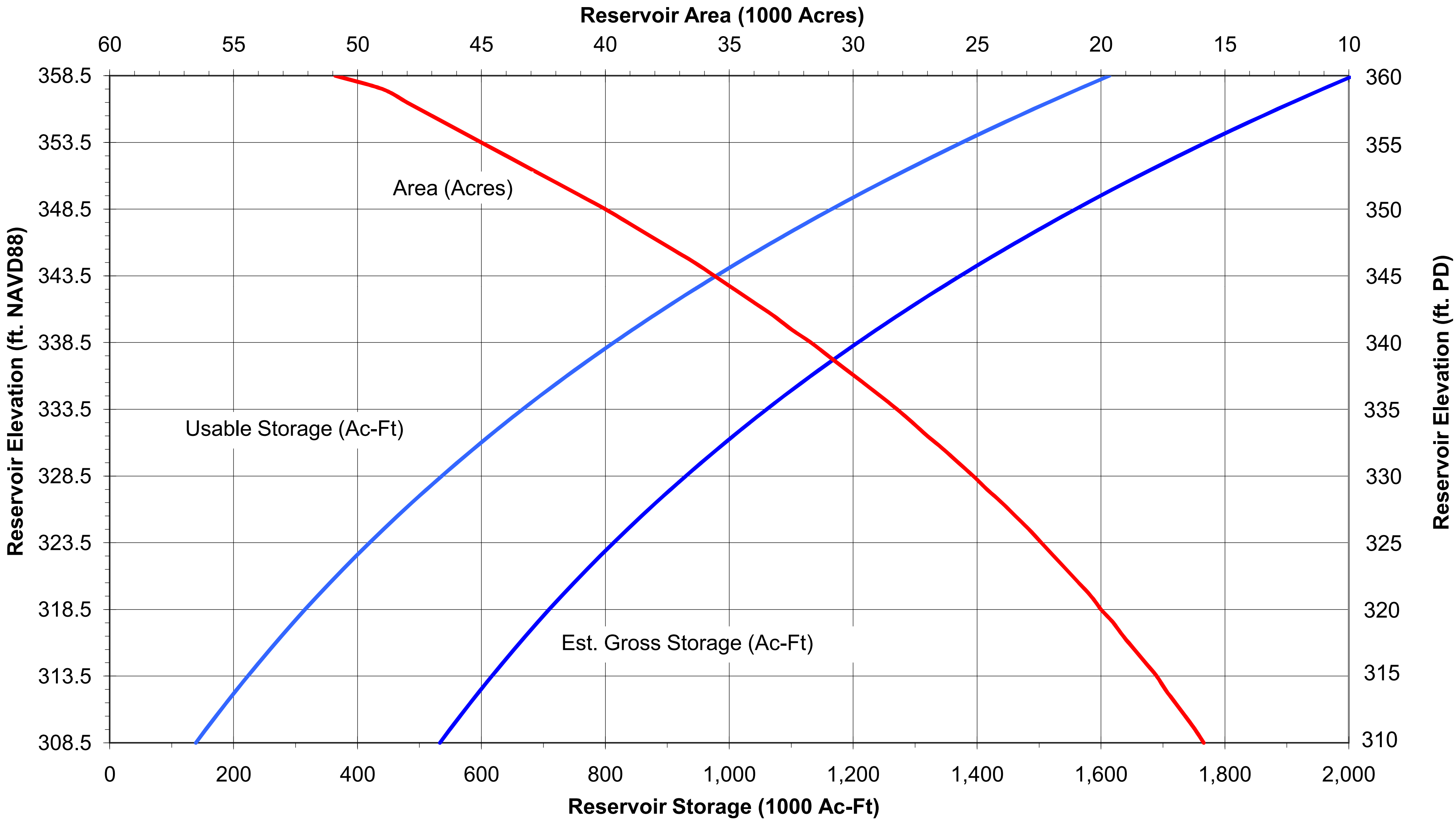

EXHIBIT B-16

Saluda Hydroelectric Project P-516

Elevation-Area-Storage Table

Reservoir Elevation (feet PD)	Reservoir Elevation (feet NAVD88)	Area (acres)	Usable Storage (BCF)	Usable Storage (ac-ft)	Est. Gross Storage (ac-ft)
360	358.5	50,900	70.305	1,613,981	2,007,981
359	357.5	49,000	68.127	1,563,981	1,957,981
358	356.5	48,000	66.001	1,515,174	1,909,174
357	355.5	47,000	63.928	1,467,585	1,861,585
356	354.5	46,000	61.907	1,421,189	1,815,189
355	353.5	45,000	59.938	1,375,987	1,769,987
354	352.5	44,000	58.017	1,331,887	1,725,887
353	351.5	43,000	56.139	1,288,774	1,682,774
352	350.5	42,000	54.305	1,246,671	1,640,671
351	349.5	41,000	52.515	1,205,579	1,599,579
350	348.5	40,000	50.768	1,165,473	1,559,473
349	347.5	39,100	49.064	1,126,354	1,520,354
348	346.5	38,200	47.399	1,088,131	1,482,131
347	345.5	37,300	45.774	1,050,826	1,444,826
346	344.5	36,400	44.189	1,014,440	1,408,440
345	343.5	35,600	42.644	978,972	1,372,972
344	342.5	34,800	41.136	944,353	1,338,353
343	341.5	34,000	39.662	910,514	1,304,514
342	340.5	33,200	38.220	877,410	1,271,410
341	339.5	32,500	36.811	845,064	1,239,064
340	338.5	31,700	35.435	813,476	1,207,476
339	337.5	31,000	34.092	782,645	1,176,645
338	336.5	30,300	32.780	752,525	1,146,525
337	335.5	29,600	31.499	723,118	1,117,118
336	334.5	28,900	30.250	694,444	1,088,444
335	333.5	28,225	29.032	666,483	1,060,483
334	332.5	27,600	27.843	639,187	1,033,187
333	331.5	27,000	26.680	612,489	1,006,489
332	330.5	26,350	25.543	586,387	980,387
331	329.5	25,750	24.432	560,882	954,882
330	328.5	25,150	23.348	535,996	929,996

EXHIBIT B-16

Saluda Hydroelectric Project P-516

Elevation-Area-Storage Table

Reservoir Elevation (feet PD)	Reservoir Elevation (feet NAVD88)	Area (acres)	Usable Storage (BCF)	Usable Storage (ac-ft)	Est. Gross Storage (ac-ft)
329	327.5	24,600	22.287	511,639	905,639
328	326.5	24,000	21.250	487,833	881,833
327	325.5	23,450	20.235	464,532	858,532
326	324.5	22,900	19.243	441,758	835,758
325	323.5	22,400	18.273	419,490	813,490
324	322.5	21,900	17.325	397,727	791,727
323	321.5	21,400	16.398	376,446	770,446
322	320.5	20,900	15.492	355,647	749,647
321	319.5	20,400	14.607	335,331	729,331
320	318.5	20,000	13.743	315,496	709,496
319	317.5	19,500	12.899	296,120	690,120
318	316.5	19,100	12.074	277,181	671,181
317	315.5	18,650	11.268	258,678	652,678
316	314.5	18,200	10.481	240,611	634,611
315	313.5	17,750	9.713	222,980	616,980
314	312.5	17,400	8.947	205,405	599,405
313	311.5	17,000	8.198	188,205	582,205
312	310.5	16,600	7.466	171,405	565,405
311	309.5	16,200	6.752	155,005	549,005
310	308.5	15,850	6.054	138,980	532,980
309	307.5	15,490	5.371	123,310	517,310
308	306.5	15,155	4.704	107,987	501,987
307	305.5	14,820	4.051	93,000	487,000
306	304.5	14,485	3.413	78,347	472,347
305	303.5	14,150	2.789	64,030	458,030
304	302.5	13,815	2.180	50,047	444,047
303	301.5	13,480	1.586	36,400	430,400
302	300.5	13,145	1.006	23,087	417,087
301	299.5	12,810	0.440	10,110	404,110
300	298.5	12,475	0.000	0	394,000