FINAL LICENSE APPLICATION

Volume I of V

Exhibits A through D

Byllesby-Buck Hydroelectric Project
(FERC No. 2514)

February 28, 2022

Prepared by:

Prepared for:

Appalachian Power Company

An AEP Company

BOUNDLESS ENERGY

This page intentionally left blank.

BYLLESBY-BUCK HYDROELECTRIC PROJECT
FERC PROJECT NO. 2514
FINAL LICENSE APPLICATION

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

List of Tables

TABLE OF CONTENTS

Section **Title** **Page No.**

List of Figures

TABLE OF CONTENTS

Appendices

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
Buck	Buck Development
Byllesby	Byllesby Development
CFR	Code of Federal Regulations
cfs	cubic feet per second
COC	Columbus Operations Center
CWA	Clean Water Act
CEII	Critical Energy/Electric Infrastructure Information
CUI/PRIV	Controlled Unclassified Information/Privileged
DLA	Draft License Application
EAP	Emergency Action Plan
EL.	elevation
FERC or Commission	Federal Energy Regulatory Commission
FLA	Final License Application
ft	feet/foot
FPA	Federal Power Act
GSU	generator step-up transformer
hp	horsepower
HPU	hydraulic power unit
Hz	hertz
ILP	Integrated Licensing Process
kV	kilovolt
kW	kilowatt
MEP	most efficient point
MW	megawatt
MWh	megawatt hour
NGVD	Nation Geodetic Vertical Datum of 1929
PH	phase
POR	period of record
Project	Byllesby-Buck Hydroelectric Project
PM&E	protection, mitigation, and enhancement

rpm	rotations per minute
RSP	Revised Study Plan
SD	Scoping Document
USGS	U.S. Geological Survey
USACE	U.S. Army Corps of Engineers
USC	United States Code
V	volt
VAC	Virginia Administrative Code
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VWP	Virginia Water Protection

This page intentionally left blank.

FINAL LICENSE APPLICATION

BYLLESBY-BUCK HYDROELECTRIC PROJECT

(FERC NO. 2514)

EXECUTIVE SUMMARY

Executive Summary

Introduction

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the two-development Byllesby-Buck Hydroelectric Project (Project) (Federal Energy Regulatory Commission [FERC or Commission] Project No. 2514), located on the upper New River in Carroll County, Virginia.

The Project is currently licensed by FERC under the authority granted to FERC by Congress through the Federal Power Act, 16 United States Code (USC) §791(a), et seq., to license and oversee the operation of non-federal hydroelectric projects on jurisdictional waters and/or federal land. The transmission corridor crosses 7.23 acres of federal lands (Jefferson National Forest). Appalachian understands these lands to be held in easement as the corridor pre-dates the Jefferson National Forest.

The Project underwent relicensing in the early 1990s, including conversion to run-of-river operations and incorporating additional protection, mitigation, and enhancement (PM&E) measures. The current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5. In accordance with FERC's regulations at 18 CFR §16.9(b), Appalachian must file its Final License Application (FLA) with FERC no later than February 28, 2022.

Appalachian is applying for a 50-year license for the Project. Appalachian believes that the level of investment in terms of plant modernization and environmental measures proposed in the FLA will support this requested license term.

Summary of Byllesby-Buck Hydroelectric Project

The Project consists of two hydroelectric developments. The Byllesby Development (Byllesby) is located about nine miles north of the city of Galax, Virginia, on the New River. The Buck Development (Buck) is located about 3 miles downstream from the Byllesby dam. Each development consists of a reservoir, concrete gravity dam and spillway, and powerhouse, and the Project also includes a control house and switchyard located at the Byllesby Development and two 2-mile long 13.2-kV overhead transmission lines connecting the two developments. The Project has been operated by Appalachian over the previous license term in a run-of-river mode, utilizing upper New

River inflows to provide up to 30.1 megawatts (MW) of renewable capacity and average annual energy generation of 92,891 megawatt hours (MWh).

Agency Consultation and Relicensing Process

Appalachian followed FERC's ILP in support of preparing this application for new license. Appalachian filed a Pre-Application Document (PAD) and associated Notice of Intent (NOI) with the Commission on January 7, 2019, to initiate the ILP. The PAD provided a description of the Projects and summarized existing, relevant, and reasonably available information to assist resource agencies, federally recognized Indian tribes, non-governmental organizations (NGOs) and other interested parties (collectively, "stakeholders") in identifying issues, determining information needs, preparing study requests, and analyzing the license application.

The Commission issued Scoping Document 1 (SD1) for the Project on March 8, 2019. As provided in 18 CFR §5.8(a) and §5.18(b), the Commission issued a notice of commencement of the relicensing proceeding concomitant with SD1. On April 10 and 11, 2019, the Commission held public scoping meetings and a site visit pursuant to 18 CFR §5.8(d). During these meetings, FERC staff presented information regarding the ILP and details regarding the study scoping process and how to request a relicensing study, including the Commission's study criteria. In addition, FERC staff solicited comments regarding the scope of issues and analyses for the Environmental Assessment. Resource agencies, Indian Tribes, NGOs, and other interested parties were afforded a 60-day period to request studies and provide comments on the PAD and SD1.

In accordance with ILP regulations, comments on the PAD and SD1 and study requests were due to FERC by May 7, 2019. Stakeholders filed letters with the Commission providing general comments, comments regarding the PAD and SD1, and/or study requests. Twenty-two formal study requests and/or comments were received during the comment period from the following stakeholders;

- Cherokee Nation
- Delaware Nation
- National Park Service
- New River Conservancy
- U.S. Fish and Wildlife Service (USFWS)
- Virginia Department of Conservation and Recreation (VDCR), Division of Planning and Recreation Resources and Division of Natural Heritage
- Virginia Department of Environmental Quality (VDEQ)

- Virginia Department of Wildlife Resources (VDWR) (formerly the Virginia Department of Game and Inland Fisheries [VDGIF])
- Virginia Department of Health (VDH)
- Virginia Polytechnic Institute and State University (Virginia Tech)

FERC issued Scoping Document 2 (SD2) on June 21, 2019, and, in accordance with 18 CFR §5.11, Appalachian developed a Proposed Study Plan (PSP) for the Project that was filed with the Commission and made available to stakeholders on June 21, 2019. The PSP described Appalachian's proposed approaches for conducting studies and addressed agency and stakeholder study requests. Pursuant to 18 CFR §5.11(e), Appalachian held a PSP Meeting on July 18, 2019, for the purpose of clarifying the PSP, explaining initial information gathering needs, and addressing outstanding issues associated with the PSP. Appalachian received timely formal comments on the PSP from Commission staff, the USFWS, and VDGIF. Virginia Tech's College of Natural Resources and Environment filed multiple study requests on March 15, 2019.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project, which incorporated comments and study requests considered in developing the PSP, the Commission's June 21, 2019 SD2 and comments on the PSP, and it was filed with the Commission and made available to stakeholders on October 18, 2019. On November 18, 2019 FERC issued the Study Plan Determination (SPD). On December 18, 2019, Appalachian filed a request for rehearing of the SPD. The SPD was subsequently modified by FERC by an Order on Rehearing dated February 20, 2020. The modified SPD required eight studies to be performed in support of issuing a new license for the Project, as listed below:

1. Bypass Reach Flow and Aquatic Habitat Study
2. Water Quality Study
3. Aquatic Resources Study
4. Wetlands, Riparian, and Littoral Habitat Characterization Study
5. Terrestrial Resources Study
6. Shoreline Stability Assessment Study
7. Recreation Study
8. Cultural Resources Study

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 18, 2021.

On December 23, 2020, FERC issued Scoping Document 3 (SD3) for the Project, to account for updates about Commission's staff intent to conduct their National Environmental Policy Act (NEPA) review in accordance with the Council on Environmental Quality's (CEQ) updated NEPA regulations at 40 CFR Part 1500-1518.

Appalachian filed the ISR on January 18, 2021, conducted a virtual ISR Meeting on January 28, 2021, and filed the ISR Meeting summary with the Commission on February 12, 2021. Written comments in response to Appalachian's filing of the ISR meeting summary were filed by USFWS, VDWR, and FERC staff. Appalachian filed a response to comments on the ISR on April 13, 2021. Because no substantive study modifications were requested in response to the ISR, FERC did not in turn provide a Determination on Requests for Study Modifications.

Throughout the study phase of the ILP (i.e., July 2020 through the USR), either by separate filing or in conjunction with the filings described above, Appalachian has provided FERC and relicensing participants with quarterly ILP study progress reports describing study activities completed by Appalachian, updates to the study schedule, and variances from the schedule or methods of the RSP.

In addition to the formal consultation activities describe above and as represented in Appendix I of Volume II of this FLA, Appalachian conducted consultation with specific stakeholders in support of the Cultural Resources Study, informal consultation with stakeholders in association with study activities, and also convened and participated in additional meetings with relicensing participants throughout the pre-filing consultation period, including:

- June 29, 2020: ILP Study Schedule Update to Agencies (Virtual Meeting) (VDWR, VDEQ, USFWS)
- August 28, 2020: Discussion of Byllesby-Buck Bypass Flow and Bypass Reach Study flow test scenarios (Virtual Meeting) (VDWR, USFWS, and VDEQ)
- October 23, 2020: Recreation Study Update (Virtual Meeting) (VDWR, VDCR-New River Trail State Park, USFWS, Carroll County, New River Conservancy)
- October 28, 2020: Byllesby-Buck Recreation Site Stakeholder Visit (VDWR, Carroll County, Land Planning Design Associates [LPDA], VDCR-New River Trail State Park)
- March 24, 2021: Recreation Stakeholder Meeting and Site Visit to Loafer's Rest recreational facility (VDWR)
- June 29, 2021: Potential Recreation Improvements Discussion with DWR (Virtual Meeting)

On October 1, 2021, Appalachian filed the Draft License Application (DLA) with the Commission and distributed notice of these filings to the Projects' mailing list. Comments on the DLA were filed by FERC staff (December 20, 2021), VDWR (December 22, 2021), and USFWS (December 30, 2021).

Studies were completed in 2021 and the USR was filed with the FERC on November 17, 2021. The USR meeting was held on December 1, 2021 and the meeting summary was filed on December 16, 2021. The following parties provided written comments in response to Appalachian's filing of the USR meeting summary: FERC staff (January 18, 2022), USFWS (January 18, 2022), and VDWR (January 18, 2022). On February 14, 2022, Appalachian filed with FERC a response to comments on the USR and a request for extension of time to file revised study reports (Bypass Reach Flow and Aquatic Habitat Study Report and Aquatic Resources Study Report), given the additional time and effort needed to address comments received on the USR. FERC filed a letter on February 17, 2022 requesting Appalachian include the proposed schedule with the FLA. Appalachian will file the revised study reports (Bypass Reach Flow and Aquatic Habitat Study Report and Aquatic Resources Study Report) on or before April 14, 2022.

Additional consultation conducted by Appalachian in support of preparation of this FLA included the following:

- January 26, 2022 distribution of the draft Recreation Management Plan to recreation stakeholders (VDWR, USFWS, VDCR, VDEQ, Carroll County, Town of Wytheville, and New River Conservancy) for a 30-day review period.
- Informal email and telephone communications (January-February 2022) with VDWR regarding fishery (walleye body depth) data and documentation of past stranding incidents in the Buck bypass reach, as well as the potential for occurrence of Eastern hellbender in each bypass reach.
- Virtual (WebEx) meetings with representatives from VDWR, USFWS, and VDEQ on February 1, 2022 and February 16, 2022 to discuss comments received in response to the USR and DLA.

Appalachian has reviewed and considered comments received on both the DLA and USR as evidenced through further development of the Licensee's measures proposed in this FLA and summarized in Table ES-1 and Table ES-2.

Table ES-1. Resolution of Comments on Byllesby-Buck Hydroelectric Project Draft License Application.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
1	USFWS	The Service recommends that Appalachian prioritize excess flow releases through Obermeyer gates near the right descending bank in order to prioritize release of excess flow into the thalweg portion of the bypass reach. This would mimic natural flow conditions and reduce stranding potential in adjacent areas. As an alternative, the Service recommends consideration of an increase in the minimum flow to the bypass reach that will maintain pool connectivity.	Appalachian does not propose to provide a minimum bypass flow at the Byllesby Development. See Exhibit E.9.3 for additional discussion.
2	USFWS	The Service recommends that Appalachian consider replacing flashboard gates near the left descending bank of the Buck bypass reach with Obermeyer gates in order to allow Appalachian to prioritize excess flow releases into the thalweg portion of the bypass reach. This would mimic natural flow conditions and reduce stranding potential in adjacent areas. As an alternative, the Service recommends consideration of an increase in the minimum flow to the bypass reach that will maintain pool connectivity.	For the reasons described in Section E.9.3, Appalachian does not believe that prioritizing flood releases to the sections of the spillway near the left descending bank to be cost-effective or desirable for Project operations during high flows. Prioritizing flood releases to the left descending bank could increase incidents of stranding, given that it is not feasible to provide a minimum flow release for an extended period of time following flood operations over an Obermeyer gate.
3	USFWS	This bypass reach appears to be significantly longer than 475 feet. The distance downstream from the base of the spillway to the downstream end of the island separating the tailrace channel from the bypass reach is approximately 590 feet (measured in both Google Earth Pro and ArcMap), and it appears that mixing of the powerhouse discharge and the bypass reach flow during periods of low inflow (e.g., leakage flow only) does not occur until approximately 800 feet downstream from the spillway. For calibration purposes, the Service measured other features such as the Byllesby spillway, and we found our measurements of such features to be consistent with the Project Description. The only significant inconsistency we found was between our measurement of the Byllesby bypass reach and the description of this feature in this and other sections of the DLA.	Length of the Byllesby bypass reach has been updated from 475 ft to 590 ft in Exhibit A, Exhibit E, and in the revised Updated Study Report.
4	USFWS	The DLA states that the new Kaplan turbines would each have 6 runner blades. This does not agree with information provided during the December 1, 2021 USR meeting, which described the proposed new turbines as having 5 runner blades. The Service pointed out this discrepancy during the meeting, and Appalachian stated that this would be corrected in the FLA.	Descriptions of turbines have been updated from 6 runner blades to 5 runner blades in Section A.4.2.2.
5	USFWS	The Service recommends that Appalachian work with the Service to plan and design a safer alternative downstream route of passage. The Service does not recognize passage through the turbine intakes as an acceptable downstream route for fish (USFWS 2019).	The findings of Appalachian's relicensing studies and the lack of migratory species in this section of the New River do not suggest that additional measures or Project modifications to provide alternative route of downstream fish passage are required.
6	USFWS	As in the previous section, the provided turbine specifications do not completely agree with those provided during the USR meeting (discrepancy regarding number of blades on each turbine). These proposed new turbines will have somewhat slower rotation speeds (156.52 rpm) and will be safer than the Francis turbines they are replacing. However, considering the rotation speed, the number of blades, and the results of the Turbine Blade Strike Analysis, it is the Service's opinion that these turbines do not represent the best available technology for avoiding unacceptable levels of injury or mortality to fish passing through the powerhouse.	See responses to Comments 4 above and 12 below.
7	USFWS	The Service recommends as a Protection, Mitigation and Enhancement (P, M, & E) measure, appropriate time of year restrictions for any tree cutting associated with transmission right of way (ROW) maintenance, to avoid adverse effects to federally listed bats, as well as to migratory birds during the nesting season. Most of the approximate 2-mile-long right of way occurs through suitable summer (forest) roosting habitat for Indiana bat (Myotis sodalis) and northern long-eared bat (Myotis septentrionalis). Further explanation to the current regulations for northern long ear bat can be found at the link below. The Service advises maintaining coordination as the project progresses. https://www.fws.gov/midwest/endangered/mammals/nleb/FAQsFinal4dRuleNLEB.html	As noted in Section E.12.3, over the term of the new license, Appalachian proposes to consult with USFWS and VDWR prior to the removal of forested habitat that may be used by protected bat species for summer roosting.
8	USFWS	Table B.1.1. in the DLA presents hydraulic capacity of the turbines related to hydrologic inputs to the powerhouse to depict the percent of time in average, dry and wet years that releases of water will occur on an annual and monthly basis into the Byllebsy bypass and Buck bypass reaches. Using non-exceedance data is a flipped depiction of how the Service would prefer to see the data presented. In the FLA, the table should present exceedance probability such that the dry year annual release probability into the bypass reaches would be 1.9 percent for Buck and 3.0 percent for Byllesby, and for the months of March, April, May, June, September, October, November and December, 0 percent release would occur for Buck, and 0 percent release for Byllesby in March, April, May, June, September, October and December. Table B.1.1. Note also states a "30-year" record. Use of 1996-2000 gage data is a 25-year record, to correct for the FLA, with the addition of the gage name (Ivanhoe VA) as well as the given number. As the previous page B-2 states in the DLA, "Gate openings are planned and based on monitoring of the USGS gage at Galax, VA and Byllesby and Buck forebay elevations," a clarification in the FLA of when Galax gage data are used and when Ivanhoe gage data are used would be helpful.	Table B.1.1 was updated to show exceedance rather than non-exceedance and a discussion of gage use (Galax vs. Ivanhoe USGS gages) was included in Section B.1.2.
9	USFWS	The DLA presents a 25-year period of record for hydrologic analysis. While it is appropriate to use the more modern record of 1996 – 2020, the	Comment noted by Licensee.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		Service's Design Manual for Fish Passage recommends a 30-year period of record. We understand that the New River at Ivanhoe, VA gage station (# 03165500) discontinuity of record prior to 1996 limits this available record.	
10	USFWS	Within the flow figure depiction of annual and monthly exceedance flows, the use of a scale from 0 cubic feet per second (cfs) to 40,000 cfs is inappropriately large for meaningful interpretation of the data. The results are flattened curves in the 10 percent exceedance to 99.9 percent exceedance which fail to provide the information needed for analysis. The FLA should depict hydrologic data so that magnitude, seasonality and duration can be assessed for a variety of parameters to analyze inflows and riverine ecological patterns. The Nature Conservancy's Indicators of Hydrologic Alteration (IHA) method provides a number of parameters to consider for turbine hydraulic capacity flows and the low flow portion of the hydrograph which are of interest to us. The project's run of river operation without additional storage capacity does not alter the high flow hydrograph as a project with storage would.	A new set of flow duration figures is provided in Appendix A with requested reduced (truncated) scale.
11	USFWS	The Service supports discussion on the continuation of ramping rates as currently required under License Article 406, and optimization of these rates for the spring spawning season of Walleye (Sander vitreus), among other resources.	Based on Appalachian's evaluations, and as stated in Section E.9.3, Appalachian proposes a modification to the existing ramping rate requirements for the Buck Development to add a 0.5 ft gate opening hold period to the existing requirements, but shorten the hold periods to two hours each (instead of three hours). Stepping down from a 0.5 ft gate opening to a closed gate position would result in a smaller incremental change in water surface elevations along the main flow pathway in the upper bypass reach ranging from 1.0 – 1.5 ft versus the current 1.5 – 2.0 ft when going from a 1 ft gate opening to a closed position. This modification would result in a more gradual lowering of depths in the upper bypass reach to further minimize the potential for fish stranding, particularly in pool areas along the main flow pathway as well as the side channel area along the upper left descending bank of the bypass reach.
12	USFWS	The Service recommends that the Applicant consider more fish-friendly turbines (e.g., Natel Restoration Turbine; Voith) to replace Byllesby Units 1, 2 and 4, and Buck Units 1 and 3. Although the proposed [the proposed new Mavel KV2650K5 Kaplan turbines, with 5 blades each, and a rotation speed of 189.47 rotations per minute (rpm)] turbines would be less hazardous than the Francis turbines they will replace, they do not appear to be the best technology available for preventing a significant level of injuries and mortality to fish that pass through the powerhouses, based on the results of the Turbine Blade Strike Analyses conducted in support of relicensing. The Service would be happy to discuss this issue with the Applicant. Aside from the above recommendation, any additional recommendations will be provided in our comments on the FLA because of the number of relicensing studies that were not yet completed or reported on as of the filing of the DLA.	As now noted in Section E.9.3, Appalachian does not propose to modify the upgrade proposal for the Project to utilize a different turbine technology. The proposed turbines would improve prevention of significant injuries and mortality of entrained fish and represent what Appalachian believes to be the optimal design for the Project for balancing energy generation and cost.
13	USFWS	Table E.8-4. Numeric Water Quality Criteria for Class IV Waters: The Service recognizes that the Project is not required to meet water quality criteria beyond those presented in this table. However, we note for the record and for future reference that the dissolved oxygen (DO) criteria are not fully supportive of optimal growth conditions for fish. According to the 1986 EPA water quality criteria, DO effects in non-salmonid(warm) waters for early life stage warm-water fishes are no production impairment at 6.5 mg/L, slight production impairment at 5.5 mg/L, and moderate production impairment at 5 mg/L. For other life stages, there is no production impairment at 6 mg/L, and slight production impairment at 5 mg/L. A literature review by Chamberlain et al. (1980) found that largemouth bass (Micropterus salmoides) experienced reduced larval growth at 6 mg/L (temperature: 20-23 degrees C), and juvenile swimming speed was reduced at DO concentrations of < 5.0-6.0 mg/L (temperature = 25 degrees C). Carlson and Siefert (1974) concluded that DO concentrations up to 6.3 mg/L reduced the growth of early stages of the largemouth bass by 10 to 20 percent. Stewart et al. (1967) observed reduced growth of juvenile largemouth bass at 5.9 mg/L and lower concentrations, with significant growth reductions at concentrations below 5.5 mg/L. In general, prolonged exposure to 4 mg/L causes acute mortality in many invertebrates and non-salmonid fish embryos (Gray et al. 2002). Severe production impairment of early-life-stage non-salmonid species occurs when oxygen falls below 4.5 mg/L (EPA 1986). The Habitat Suitability Index Model for largemouth bass considers a DO concentration of 5-8 mg/L as providing a suitability of 80 percent during midsummer within pools or littoral areas, and a concentration of 8 mg/L as being optimal (suitability rating of 100 percent) (Stuber et al. 1982). Optimal DO concentration for walleye spawning and embryo development is > 6.5 mg/L (McMahon et al. 1984).	Comment noted by Licensee. Appalachian expects that FERC staff will use this additional information in support of their environmental analysis as they see fit.
14	USFWS	As this study was not completed at the time of the filing of the DLA, the Service will provide its comments in response to the USR and FLA when it is filed.	Comment noted by Licensee.
15	USFWS	Because the DLA presents only preliminary results from this study, the Service will reserve the bulk of its comments on this study until we provide our comments on the USR and the FLA. However, we note that the Turbine Blade Strike Analysis (TBSA) modeling conducted as a part of this study used a tail length of only 13.5 inches for walleye, apparently based on fisheries sampling conducted in support of relicensing. Walleye lengths of 20-22 inches or greater are known in the New River (J. Copeland, personal communication, 12/22/2021). It is also important to note that walleye do not	Based on body length to depth conversions, a Walleye of 18.5 inches is the maximum size fish that would be susceptible to entrainment at the intake structure, where it would subsequently be susceptible to blade strike. However, based on research by Peake et al. (2000), Walleye with a fork length of 13.78 inches exhibited a burst or

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		move upstream only. A 1992-1994 discharge netting study at the Townsend Project on the Beaver River (Ohio River tributary) in Pennsylvania collected walleye moving downstream through the powerhouse during all months of the year except for June, and captured walleye tail lengths ranged up to 18-19 inches (RMC 1994). In addition, on page E-62 of the DLA, there is information regarding surveys of the upper New River from 2004 to 2014 in which collected walleye ranged in length from 13 to 29 inches, with an average of 17 inches. Furthermore, the relicensing study represents only a snapshot in time, and fish tail lengths recorded during the study may not be representative of maximum tail lengths attained by key species such as walleye at any given time during the next license term, nor could the relicensing surveys be expected to capture 100 percent of individuals present in the project impoundment such that measured tail lengths of captured fish would be representative of the full range of tail lengths for the target species. It is standard practice for a comprehensive desktop entrainment and impingement study to be conducted that includes estimates of blade strike mortality to estimate mortality rates for the typical maximum tail length of a target species. Therefore, the Service requests that additional Turbine Blade Strike Analysis modeling be conducted for walleye up to a maximum tail length of 29 inches and a standard deviation of 1.5 inches. The requested information is needed in order to estimate survival rates for the largest walleye that may pass through Project turbines.	startle swim speed of 7.2 fps which is significantly higher than approach velocity at the intake structure. Thus, it is likely that most Walleye greater than 13.5 inches would be able to avoid approach velocities and entrainment at the intake structure. Walleye 18.5 inches and larger would be able to swim away from the approach velocities at the intake structure; however, the turbine blade strike analysis model was re-run for Walleye for the existing and proposed conditions using 18.5 inch maximum length and standard deviation of 1.5 inches. Appalachian will take under consideration the balance of the USFWS comment in the revised Aquatic Study Report to be submitted as supplemental information by April 14, 2022.
16	USFWS	The Service does not agree with the DLA's conclusion the bypass reaches do not contain suitable habitat for Eastern hellbender (Cryptobranchus alleganiensis alleganiensis). These statements should be re-examined in the FLA. The Eastern hellbender does not require woody debris or logs, and is often found using crevices in boulder-dominated and bedrock-dominated habitats which are prevalent in the Project bypass reaches. An E. hellbender individual was found in 2018 above the dam of the nearby Fries Hydroelectric Project, as the DLA notes. The FLA would benefit from information found within the E. Hellbender Species Status Assessment Report, final version 1.1 (USFWS, 2018).	Additional text was added in Exhibit E characterizing habitat requirements of Eastern hellbender. The conclusion that hellbender are unlikely to occur in the bypass reaches at the Project is supported by informal consultation with VDWR that Appalachian conducted in support of preparation of this FLA.
17	USFWS	Because the Bypass Reach Flow and Aquatic Habitat Study results have not been finalized as of the filing of the DLA, the Service will provide its comments and recommendations regarding any need for higher minimum flows to the bypass reaches and/or continuation of ramping rates after a more complete review of the results of that study.	Comment noted by Licensee. Appalachian's proposed revise ramping procedure is described in response to Comment 11 above.
18	USFWS	The DLA states that, "For the protection of mussels, Appalachian will continue to consult with USFWS and VDWR in advance of reservoir drawdowns..." The Service believes additional P,M,& E measures should be proposed in the FLA. The final Species Status Assessment Report for Green Floater and listing determination will occur sometime in early 2022. This information could help shape additional conservation measures needed for the species. Fish host species required for the species to successfully reproduce should be considered and protected, especially with new research on possible host fish for green floater and differing reproductive strategies. Fish hosts for the state listed mussels Pistolgrip (Tritogonia verrucosa) and Tennessee heelsplitter (Lasmigona holstonia) should also be considered for focus and protection measures. Minimization of turbine impacts to fish hosts should be included in the FLA.	No additional protection, minimization, or mitigation efforts are proposed by Appalachian for the protection of fishery and aquatic resources. Results of studies conducted for the license application indicate that the New River within the Project Boundary continues to support a balanced and indigenous aquatic biological community characterized by a diversity of game and non-game fishes, and the presence of an abundant and diverse benthic macroinvertebrate community, including mussels and crayfish. Findings of the desktop entrainment study (to be filed with the revised Aquatic Study Report as supplemental information by April 14, 2022) concur with historical entrainment results in that effects to the fish community in the Project vicinity are expected to be minimal. Most larval fish and eggs would not be excluded by the intake trashracks at Byllesby and Buck intake structures; however, velocities in front of the intakes are comparable to normal flow conditions of the New River and would therefore likely be navigable by most juvenile and adult fish in the area. Entrainment of early life stage fishes (eggs and larvae) is likely minimal given the life history characteristics of species in the vicinity of the Project. Susceptibility to entrainment is variable depending on species and time period, however most target species and species groups have low entrainment potential for most of the year. Further, the low head design coupled with the spillway apron design indicate that fish that do pass through the turbines or over the spillway would exhibit relatively high survival. As such, no additional PM&E measures are needed to protect fish species identified as potential mussel glochidial hosts.
19	USFWS	The Service will be recommending a Time of Year Restriction (TOYR) for any tree-cutting associated with transmission line ROW maintenance that may be conducted during the next license term, in order to protect roosting Indiana bats and northern long-eared bat.	See response to Comment 7 above.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
20	USFWS	The DLA does not note that the Service initiated a 5-year review under the Endangered Species Act for the riverine plant, Virginia spiraea (Spiraea virginiana) on September 4, 2019. On final publication of the review, the FLA should consider these data along with information from the USR in its discussion of the species and potential protection, mitigation and enhancement measures.	Language has been added to Section E.11.13 acknowledging the Service's ongoing 5-year review of Virginia spiraea.
21	FERC	An SDR is a standard requirement for an FLA in accordance with sections 4.51(g) and 4.41(g)(3) of the Commission's regulations.	A Supporting Design Report (SDR) has been developed and is included in Volume IV of the FLA (CEII).
22	FERC	Sections 5.17(e) and 4.38(b)(2)(vi) of the Commission's regulations require that every application for a license for a project with a capacity of 80 megawatts or less must include in its application copies of statements of whether it is seeking benefits under section 210 of the Public Utilities Regulatory Policies Act of 1978 (PURPA). The draft license application (DLA) does not indicate whether Appalachian is seeking PURPA benefits. Therefore, in the final license application (FLA), please indicate if benefits are being sought under 210 of PURPA; if so, provide the necessary documentation for doing so in accordance with section 4.38(b)(2)(vi) of the Commission's regulations.	Appalachian will not be seeking benefits under Section 210 of the Public Utility Regulatory Policies Act (PURPA) of 1978 for qualifying hydroelectric small power production facilities in §292.203 of this chapter. This has been added to Section D.9.
23	FERC	Exhibit A contains several inconsistencies regarding the rated capacities of the existing and proposed turbine-generator units at each development. For the Byllesby Development, table A.4-1 reports the rated capacity of each existing generator (units 1 through 4) as 5,400 kilowatts (kW), but table A.4-5 lists the existing capacities of each generator as 5,440 kW. Also, table A.4-2 indicates the ratings of the proposed (new) generators at Byllesby (units 1, 2, and 4) as 5,296.5 kW, but table A.4-6 lists the rated capacities for the new generators as 5,450 kW each. Further, the generator capacity of unit 3 at Byllesby (which is not proposed to be replaced) is listed as 5,440 kW in table A.4-6, but 5,400 kW in tables A.4-1 and A.4-2. For the Buck Development, the turbine capacity for the existing unit 2 (which is not proposed to be replaced) is reported as 3,360 kW in table A.4-3, but 3,335 kW in table A.4-6. Also, the rated capacities for the new generators proposed to be installed at Buck (units 1 and 3) are reported as 3,690 kW in table A.4-4, but 3,770 kW in table A.4. In the FLA, please correct these inconsistencies and update all tables and text in the application to reflect the correct rated capacities of all existing and proposed turbines and generators at the project, as this information will allow Commission staff to determine the authorized installed capacity of the project as defined in section 11.1(i) of the Commission's regulations.	Values and inconsistencies have been corrected throughout the FLA, including the sections in Exhibit A referenced in Commission staff's comment.
24	FERC	Page B-20 of Exhibit B states that power generated at the project is to be utilized by Appalachian's 'internal customers.' It is unclear who these internal customers are. Therefore, in the FLA, please identify, and describe in further detail, Appalachian's internal customers.	Revised language to clarify in Section B.3.
25	FERC	Page B-11 of Exhibit B states that spillage into the bypassed reach is more common at the Buck Development than at the Byllesby Development due to the lower maximum hydraulic capacity of Buck—3,540 cubic feet per second (cfs)—compared to Byllesby (5,868 cfs). However, table B.1-1, which reports spillage frequencies, indicates the opposite pattern is true and that spillage is more common at Byllesby than at Buck. Therefore, in the FLA, please correct this discrepancy regarding spillage frequencies at the two developments.	This discrepancy has been corrected in text (B.2.3) and the updated values are provided in Table B.1-1.
26	FERC	Pages B-4 through B-6 of Exhibit B state that the project's flashboards are manually released only after all Tainter and Obermeyer gates are fully open and impoundment levels continue to rise. In the FLA, please specify the flows at which manual tripping of the flashboards commences at each development.	Approximate flows at which flashboards are manually tripped have been added to text.
27	FERC	Section B.2.5 of Exhibit B provides the maximum hydraulic capacities of each development under both existing and proposed conditions (i.e., if the new turbine-generator units were to be installed), but there is no indication of the minimum hydraulic capacities of each development under the proposed operating conditions, as required by section 4.51(e)(2)(iii) of the Commission's regulations. Therefore, in the FLA please specify the minimum hydraulic capacity of each development, as well as the minimum hydraulic capacities of each proposed turbine unit if the minimum hydraulic capacities are expected to differ among the new turbine units proposed to be installed at each development.	The requested additional information has been added to Section B.2.5.
28	FERC	Page B-11 of Exhibit B states the monthly flow duration curves presented in the DLA are based on pro-rated flows from a U.S. Geological Survey (USGS) gage (No. 03165500) located near Ivanhoe, Virginia, downstream of the project. However, page E-37 of Exhibit E states the monthly flow duration curves are based on pro-rated flows from a USGS gage (No. 03164000) located upstream of the project, near Galax, Virginia. Please clarify this discrepancy in the FLA.	All table flows are calculated using Ivanhoe gage; text has been updated in Exhibit E.
29	FERC	Several of the monthly flow duration curves for the Byllesby and Buck developments are mis-labeled with the incorrect month; specifically, figures B.5-17, B.5-18,B.5-19, B.5-20, and B.5-40. In the FLA, please provide the correct captions for these figures.	Figure captions have been re-labeled.
30	FERC	Section 4.51(e)(2)(iii) of the Commission's regulations requires applicants that are applying for a new license, and are not a municipality or state, to provide an estimate of the amount which would be payable if the project were to be taken over pursuant to section 14 of the Federal Power Act upon expiration of the license in effect [see U.S.C. 807], including severance damages. No estimate of severance damages was provided in the DLA; therefore, please provide this information in the FLA.	This value is now included in Exhibit D.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
31	FERC	Page E-16 of Exhibit E states that by letter dated September 1, 2017, the Virginia Department of Environmental Quality's (Virginia DEQ's) Office of Environmental Impact Review confirmed that Carroll County is not located within Virginia's coastal management area. However, no copy of this letter is provided in the Consultation Summary. Therefore, please include a copy of this letter in the Consultation Summary filed with the FLA.	A copy of the referenced letter is included in this FLA in Volume II, Appendix I.
32	FERC	Section E.9.2.2.5 of Exhibit E discusses the eastern hellbender and states that although the species is presumed to occur within the project boundary, the bypassed reaches do not contain suitable habitat (woody debris and logs) and therefore no effect from project operations is anticipated. However, the eastern hellbender also utilizes rocks, boulders, and cobbles as key habitat features and the Bypass Reach Flow and Aquatic Habitat Study indicated the presence of such features (as well as some degree of woody debris) in both reaches. Therefore, in the FLA, please explain how the results from the Bypass Reach Flow and Aquatic Habitat Study—indicating potentially suitable habitat in the bypassed reaches—bear on the determination in the DLA that the bypassed reaches do not contain suitable eastern hellbender habitat and that project effects are not anticipated.	Exhibit E (E.9.2.2.5) was revised to clarify that existing substrate it is not suitable habitat associated with clean, swift, well-oxygenated water. The conclusion that hellbender are unlikely to occur in the bypass reaches at the Project is supported by informal consultation with VDWR that Appalachian conducted in support of preparation of this FLA
33	FERC	Section E.11.1.2.3 of Exhibit E states that one eastern hellbender was documented at the Fries Project in 2018. However, the Environmental Assessment issued for the Fries Project in December 2020 notes that two eastern hellbenders were documented within the Fries project boundary in 2018; one upstream of the dam and one downstream. In the FLA, please update section E.11.1.2.3 of Exhibit E to correctly reflect those findings. Additionally, section 11.1.2.3 references the most recent records of eastern hellbender in the 'mainstem of the upper New River' as being from 2002 and 2014. Please define the bounds of the mainstem upper New River and update the year of the last recorded capture or observation to 2018 if the Fries Project falls within those bounds.	Updated text in E.11.1.2.3 to reflect the 2018 findings from the Special Status Assessment Report as suggested and provided footnote defining Upper New River.
34	FERC	Section E.10.1.2 of Exhibit E states that 9.17 total acres of wetland habitat are present within the project boundary based on data from the National Wetlands Inventory. However, results from the Wetlands, Riparian, and Littoral Habitat Study presented in the Updated Study Report (USR) indicated that more than 90 total acres of wetlands are present in the project area. In the FLA, please provide updated wetland acreages that include the new totals from the USR.	Exhibit E of the FLA has been updated to reflect wetland acres identified through the Terrestrial Resources field study.
35	FERC	Section E.11.1.1 of Exhibit E states that a review of federally listed species was conducted using the U.S. Fish and Wildlife Service's Information for Planning and Consultation (IPaC) tool on December 18, 2018. Because such reviews need to be verified after 90 days due to the potential listing of new threatened, endangered, or candidate species (e.g., Monarch Butterfly), please provide an updated IPaC review in the FLA.	An updated USFWS IPaC report was run and the monarch butterfly was included in Exhibit E of the FLA and the Terrestrial Resources Study report.
36	FERC	Section E.11.1.2.3 of Exhibit E discusses the bog turtle, a federally threatened species, and uses findings from a study by Carey et al. (2017) at the Fries Hydroelectric Project—located approximately 5.3 river-miles upstream of the Byllesby-Buck Project— to conclude that this species is unlikely to occur in the vicinity of the Byllesby-Buck Project. In the FLA, please explain why the Carey et al. (2017) study is sufficient for determining that the bog turtle is unlikely to occur at the Byllesby-Buck Project.	Language has been updated in Exhibit E of the FLA to indicate that lack of habitat/presence for the bog turtle is based on recent surveys and clarified that the species is not included on a recent IPaC search report. Additionally, species / habitat surveys for the bog turtle were not required by the FERC-approved study plan.
37	FERC	Section E.13.3 of Exhibit E states that recreation facility enhancements are anticipated at the Virginia Department of Wildlife Resources' Loafers Rest recreation area that is located on the western bank of the New River directly adjacent to the northern (downstream) limit of the project boundary. However, there is little discussion about the extent of such enhancements and how they could impact existing terrestrial and wetland resources, or how construction, maintenance, and visitor use could affect wildlife and protected species that may occur within or adjacent to the proposed facility. Therefore, in the FLA, please include a discussion of the potential effects, if any, of these proposed enhancements on terrestrial and wetland resources, including any rare, threatened, or endangered species.	Appalachian has not conducted field assessments of the area proposed to be developed as a Non-Project recreation facility. The area is located outside of the Project Boundary. Appalachian expects to complete additional field survey (including wetlands and sensitive species) in consultation with VDWR and USFWS in association with additional state and/or federal permits that would be required for construction of the proposed facilities in the new license term.
38	FERC	Please include, in the FLA, a figure indicating the locations where trail cameras were installed during the Recreation Study.	The locations of the trail camera monitoring locations are depicted on Figure E.13.1.
39	FERC	Page E-137 of Exhibit E refers to the New River Canoe Launch as the "Byllesby portage put-in." In the FLA, please use consistent names throughout the document when referring to facilities.	Edits were made throughout the reference section for consistency.
40	FERC	Figure E.13-1 indicates the boundary of the Recreation Study area but does not include the project boundary. In the FLA, please also denote the project boundary on this figure.	Figure E.13-1 has been modified to include the Project Boundary.
41	FERC	In the FLA, please include a figure depicting land ownership parcels within the project area and also indicate the project boundary so that staff can clearly understand how existing and proposed recreation facilities in the project vicinity correspond to property owned by other entities.	Figure E.13-2 has been modified to include land ownership parcels.
42	FERC	Section E.14.2.1.2 of Exhibit E lists the three above-ground resources within the project area that are eligible for listing in the National Register of Historic Places, including the: (1) Buck Hydroelectric Facility (017-0022), (2) Byllesby Dam (017-5154),and (3) Norfolk and Western Railway Cripple Creek Extension (077-5068). However, in table E.14-1 the resource numbered 017-5154 is listed as the "Byllesby Hydroelectric Facility" and not the "Byllesby Dam." In the FLA, please use consistent references for each resource.	Resource No. 017-5154 was initially recorded under the name "Byllesby Dam," but is referred to now as the Byllesby Hydroelectric Facility to reflect the inclusion of resources beyond just the dam (e.g., the powerhouse and spillway). Therefore, the name Byllesby Hydroelectric Facility is used throughout the remainder of the Cultural Resources Report for Resource No. 017-5154, except when discussing prior research where the original name is kept. This explanation has also been clarified in the

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
			Cultural Resources Report.
43	FERC	Page G-2 of Exhibit G states there are no federal lands within the proposed project boundary. However, based on Sheets 1 and 3 of Exhibit G and Figure E.2-2 of Exhibit E, the nearly 2-mile-long transmission line corridor that Appalachian proposes to add to the existing project boundary—and spans from the Buck powerhouse to the Byllesby switchyard/control house—appears to cross the Jefferson National Forest. In the FLA, please clarify whether the proposed transmission corridor represents an inholding1 or is located on federal lands. If the transmission line corridor is located on federal lands, please update the Exhibit G filed with the FLA, accordingly, by providing the information specified in section 4.41(h)(3) of the Commission's regulations.	The transmission corridor crosses 7.23 acres of federal lands (Jefferson National Forest). Appalachian understands these lands to be held in easement as the corridor pre-dates the Jefferson National Forest. Exhibit G has been updated to include this designation.
44	FERC	Section 4.51(h) of the Commission's regulations requires, in part, that an application includes an Exhibit G with a map or series of maps that complies with section 4.41(h) of the Commission's regulations. Section 4.41(h) requires an applicant to provide the project boundary data in a geo-referenced electronic format. However, no project boundary data in a geo-referenced electronic format are provided in the DLA. Therefore, please provide this information in the FLA. In addition, each map and drawing should conform to section 4.39 of the Commission's regulations.	Exhibit G (Project Boundary maps) are provided in Exhibit G of the FLA and also as electronic files.
45	FERC	Section 4.39(a) of the Commission's regulations requires that Exhibit G maps and drawings be stamped by a registered land surveyor. The Exhibit G maps and drawings provided in the DLA lack a registered land surveyor's stamp. Therefore, all Exhibit G maps and drawings in the FLA should contain a stamp from a registered land surveyor.	Exhibit G maps have been stamped by a licensed surveyor.
46	VDWR	Section E.9.2.2.5 of Exhibit E includes a section discussing Eastern Hellbender and the lack of availability of suitable woody debris habitat in the bypass reaches, leading to a conclusion that 'no effect of Project operations on this species is anticipated'. The Bypass Reach Flow and Aquatic Habitat Study indicates that suitable habitat for this species is found in the bypass reaches, including rock, boulder, cobble, and some woody debris, so further analysis of this conclusion needs to be provided in the FLA.	Exhibit E (E.9.2.2.5) was revised to clarify that existing substrate it is not suitable habitat associated with clean, swift, well-oxygenated water. The conclusion that hellbender are unlikely to occur in the bypass reaches at the Project is supported by informal consultation with VDWR that Appalachian conducted in support of preparation of this FLA.
47	VDWR	Section E.9.3 of Exhibit E discusses PME measures including discussion of the existing ramping rate requirements for the Buck Bypass Reach. We support additional discussion of ramping rate requirements with particular emphasis on impacts during the spring Walleye spawning season.	See response to Comment 11 above.
48	VDWR	Section E.10.3. discusses PME measures related to wetland, riparian, and littoral habitats at the Project, including a discussion of suspending the Wildlife Management Plan in place under the current license. Results of the Wetland, Riparian, and Littoral Habitat Study should be used to develop a Wildlife Management Plan that examines enhancing Project wetlands for specific wildlife species, including ways to enhance some of the more significant wetlands for waterfowl use. Maintaining wetland resources at the Project to benefit waterfowl and waterfowl hunters will also provide additional recreational enhancement. DWR staff are available to discuss the development of a Wetland Management Plan	As now stated in this section of Exhibit E, Appalachian acknowledges that the wetland areas in the Project Boundary are important wildlife resources for waterfowl and fish and aquatic communities. Appalachian's ownership and control of lands in the Project Boundary, and the run-of-river operation of the Project, provide important protections for wetland, riparian, and littoral habitat within the Project Boundary. The results of the relicensing study do not support a conclusion that the Project operations are adversely affecting wetland, riparian, and littoral habitat at the Project to support PM&E measures for more active management by Appalachian of these resources.
49	VDWR	Section 13.3 discusses a forthcoming Recreation Management Plan, including potential improvements to signage within the Project boundary, upgrades to the Byllesby Boat Launch, improvements to the Buck portage put-in, and the construction of new facilities at the Loafer's Rest Area, leased by APCo to the VDWR. Our Department staff will participate in the development of this plan. Further collaboration of the Recreation Management Plan is advisable prior to filing the FLA.	Appalachian distributed a draft Recreation Management Plan to recreation stakeholders for review on January 26, 2022. As of the preparation of this FLA, consultation about the Recreation Management Plan is ongoing. Appalachian expects to finalize the Recreation Management Plan in consultation with recreation stakeholders and for FERC approval prior to or shortly following the new license issuance. Additional design details for specific improvements will be developed according to the procedures and schedules established by the Recreation Management Plan.

Table ES-2. Resolution of Comments on Byllesby-Buck Hydroelectric Project Updated Study Report.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
1	FERC	Continuously recorded (15-minute) water temperature and dissolved oxygen (DO) data from each monitoring location during the 2020 and 2021 water quality monitoring seasons are presented graphically in Attachments 1 and 2 of the Water Quality Study Report filed with the USR. While these plots are useful in discerning general trends and differences in water quality parameters among the various monitoring locations, it is difficult to ascertain from these graphs the number of days that temperature and DO values were inconsistent with state water quality standards or to quantify the degree of stratification in the project's impoundments. Therefore, to assist staff's analysis of project effects on water quality, please provide a series of tables, or a spreadsheet file, that reports for each day of the 2020 and 2021 monitoring seasons, the daily minimum, maximum, and average water temperatures and DO values at each continuous water quality monitoring site, including each monitoring depth in the Byllesby and Buck impoundments. Please provide all water temperature data in degrees Fahrenheit and all DO data in units of milligrams per liter (mg/L).	Tables or a spreadsheet file that includes the daily minimum, maximum, and average water temperatures and DO values at each of the continuous water quality monitoring sites for the 2020 and 2021 monitoring seasons are provided in the revised Water Quality Study report (Volume II, Appendix B). All temperature data is now provided in degrees Fahrenheit and all DO data will be provided in milligrams per liter.
2	FERC	Figure 8.1 of Attachment 8 of the Water Quality Study Report does not indicate the timing of drag rake operations at each development (Byllesby and Buck), as is shown by vertical reference lines on a similar figure in the report (figure 8.2). Therefore, please add reference lines to figure 8.1 to indicate the timing of drag rake operations at each development.	Figure 8.1 in the Water Quality Study report has been updated to indicate the timing of drag rake operations at each development. The revised Water Quality Study report is included as Volume II, Appendix B.
3	FERC	As indicated at both the USR and Initial Study Report (ISR) meetings, the potential stranding of walleye in the Buck bypassed reach during spill events in the spring spawning season is a concern. While a two-dimensional (2-D) hydraulic model was developed to simulate water depths and flow patterns in the Buck bypassed reach under the currently required ramping rate,2 the USR contains no information on the body depths of walleye. Therefore, to aid staff in their interpretation of the additional modeling scenario requested below in item 4, please provide body depth data for the size range of walleye that would be expected to occur in this portion of the New River during the spring spawning season. This information will help staff determine whether the existing ramping rate provides adequate escape routes (of sufficient water depth) for any walleye that may be attracted to intermittent spill flows and enter the Buck bypassed reach during the spring spawning season. Please consult with the Virginia Department of Wildlife Resources (DWR) to determine if body depth data are available for the New River strain of walleye; if such data are not available, data from nearby river systems may be used; in either case, please specify the sample sizes for all provided body depth data. Lastly, please file copies of any stranding reports or incidents (for walleye or other species) that Virginia DWR may have in its possession or be aware of, as this could provide information on the potential stranding locations in the Buck bypassed reach as well as the sizes of stranded fish.	Appalachian is consulting with the VDWR to determine if body depth data are available for the New River strain of Walleye, or data from nearby river systems if unavailable for New River strain. Appalachian will file this information with FERC, if received in time, as supplemental information after the FLA as part of the revised Aquatic Resources Study Report.
4	FERC	The approved study plan states that model simulations will be performed to evaluate flow releases from various spillway gates and spill configurations [emphasis added] to determine flow patterns and hydraulic connectivity at downstream locations of interest. However, the 2-D hydraulic model developed for the Buck Development was only used to evaluate flow patterns under a single spill configuration, that of the existing ramping rate, whereby down-ramping flows are released into the bypassed reach through Tainter Gate 1. Therefore, to help inform an analysis of the optimal spillway gate through which down-ramping flows should be released to minimize the stranding risk of walleye in the Buck bypassed reach and to ensure the study is completed in accordance with the approved study plan, please perform a modeling scenario that simulates water depths and velocities in the Buck bypassed reach under the currently required ramping rate but releases down-ramping flows through Obermeyer Gate 10 instead of Tainter Gate 1. (Obermeyer Gate 10 is the gate closest to the area of concern for walleye stranding; whereas Tainter Gate 1 is the most distant gate from this area of concern (see figure 4-2 of the Bypassed Reach Flow and Aquatic Habitat Study Report). If the currently required ramping rate (i.e., down-ramping flows of the same magnitude and duration as are currently released through Tainter Gate 1) cannot be achieved with the Obermeyer gates, please explain why, and use the Tainter gate nearest the stranding area of concern (i.e., the southeastern portion of the bypassed reach immediately downstream of the spillway) as the release location for down-ramping flows.	Appalachian has included additional summary information comparing releases from Buck Tainter Gate 1 and Buck Obermeyer Gates in Exhibit E. Additional figures and analysis will be included, if and as appropriate, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
5	FERC	Model output should include, at a minimum, depth and velocity heat maps for each of four modeled flows: (1) leakage; and flows equivalent to Tainter Gate openings of (2) 0.5 foot (~210 cfs), (3) 1.0 foot (~354 cfs), and (4) 2.0 feet (~714 cfs). The depth and velocity heat maps should be similar to figures 4-12 through 4-19 of the Buck Bypassed Reach Integrated Catchment Model (ICM) Development Report. In addition, for both release locations (Tainter Gate 1 and Obermeyer Gate 10 or the nearest feasible gate), please use the body depth information requested in item 3 above, to generate a new series of figures that are similar to the heat maps but instead show only those portions of the bypassed reach that have sufficient water depths (based on body size data) for walleye to swim through. Such maps should be generated for the both the smallest- and largest-sized walleye expected in the bypassed reach (based on consultation with Virginia DWR as described above) for each combination of release location (i.e., Tainter Gate 1 vs. Obermeyer Gate 10) and modeled flow (leakage, ~210 cfs, ~354 cfs, and ~714 cfs). This information will allow staff to assess if there are any differences in stranding risk and flow patterns (i.e., escape paths and connectivity in the bypassed reach) between these two different release locations for down-ramping flows.	Appalachian will conduct additional analyses per FERC's previous comment and provide new figures in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
6	FERC	The current license does not specify where the required 360-cfs minimum flow must be released at each development. Appalachian currently provides this minimum flow via generation (i.e., as part of the flow through each powerhouse) and monitors compliance with the required minimum flow using flow data from a United States Geological Survey gage (No. 01365500) located about 2.5 river miles downstream of the Buck	Appalachian will use the 2-D hydraulic models that were developed for Byllesby and Buck to simulate habitat conditions in each bypass reach as requested. This information are summarized in Exhibit E of the FLA and will be supported by

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		Development. The approved study plan states that the 2-D hydraulic models developed for Byllesby and Buck will be used to evaluate the relationship between minimum flow releases to the tailwater areas versus the bypassed reaches with respect to aquatic (fish) habitat. There was also discussion at the USR Meeting as to how the hydraulic connectivity of side channels, which can serve as important aquatic habitat for fish and freshwater mussels due to their relatively unique substrate composition (i.e., predominantly gravel and cobble vs. bedrock), may vary depending on the release location (powerhouse vs. bypassed reach) of the currently required 360-cfs minimum flow. However, the currently required minimum flow at each development (360 cfs) was not explicitly included (modeled) as a test flow; the only flows evaluated were those used to develop and calibrate the models. Therefore, to allow staff to assess the potential benefits of releasing the currently required 360-cfs minimum flow into the bypassed reaches, rather than through the powerhouses, please use the 2-D hydraulic models that were developed for Byllesby and Buck to simulate habitat conditions (i.e., water depths and velocities) in each bypassed reach (Byllesby and Buck) under both existing project operation (i.e., whereby the minimum flow is included as part of the generation flows through each powerhouse) and a potential future operational scenario whereby a continuous 360-cfs minimum flow is released into each bypassed reach via Tainter Gate 1 at Buck and Tainter Gate 6 at Byllesby. This information would aid in minimum flow evaluations (e.g., the release location of minimum flows at each development) and ensure the study is completed in accordance with the approved study plan.	information to be included in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
7	FERC	Habitat conditions should be evaluated across a range of inflow conditions, including low-, mid-, and high-inflows; for example, the 90% exceedance, 50% exceedance (median), and 10% exceedance inflows, respectively. Also, the powerhouses should be 'operating' during the model simulations, with the amount of flow being passed through each powerhouse dependent on the particular combination of minimum flow release location (spillway vs. powerhouse) and inflow (low-, mid-, and high-) being modeled. In addition to depth and velocity heat maps for each combination of release location by inflow, model outputs should include habitat suitability maps (similar to the figures provided in Attachment 3 of the Bypassed Reach Flow and Aquatic Habitat Study Report) and also tabulate, for each release location by inflow combination, the weighted usable area (WUAs) for the species (all life stages of walleye) and guilds specified in Table 5-3 of the Bypassed Reach Flow and Aquatic Habitat Study Report.	Appalachian will provide model results for a range of inflow conditions as requested, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
8	FERC	The Buck Bypassed Reach ICM Model Development Report contains depth and velocity heat maps for each of the test flows used to calibrate the model (i.e., leakage, 210 cfs, 354 cfs, and 714 cfs). However, no such heat maps are provided for the Byllesby Development. Therefore, please provide, in your filing, the depth and velocity heat maps for each of the four test flows (leakage, 88 cfs, 158 cfs, and 194 cfs) that were used to develop the 2-D hydraulic model for the Byllesby Development. On each heat map, please indicate the magnitude of flows that were being released (spilled) into the bypassed reach and passed through the powerhouse, similar to figures 4-12 through 4-19 of the Buck Bypassed Reach ICM Model Development Report.	Appalachian will revise the Bypass Flow and Aquatic Habitat Study report to include the depth and velocity heat maps for each of the four test flows. Additionally, each heat mapwill be updated to indicate the magnitude of flows that were being released (spilled) into the bypass reach and passed through the powerhouse. The revised Bypass Flow and Aquatic Habitat Study report will be filed with FERC as supplemental information after the FLA.
9	FERC	At the USR Meeting, Appalachian indicated that its current practice to ensure run-of-river operation during a powerhouse outage or complete station trip at either development is to immediately open spillway gates to ensure that total outflow from the project continues to approximate inflows. Please describe how it is possible for the spillway gates at each development to be operated during station outages (e.g., via backup generators, etc.). Also, please describe the maximum amount of inflow that can be passed through each powerhouse when all of its turbine units are non-operational (e.g., during complete station outages or unit trips); and describe whether it is possible to release the currently required 360-cfs minimum flow through the powerhouses during such non-operational periods.	Appalachian has provide additional description of Project operation of spillway gates during an outage in Section A.3.2.
10	FERC	Page 7 of the Buck Bypassed Reach ICM Development Report states that additional bathymetry data for two pools on the southeast side of the Buck bypassed reach (see figure 2-3 of Attachment 1 of the report) may need to be collected and incorporated into the 2-D hydraulic model for the Buck Development. However, no additional bathymetry data appears to have been collected for this area, nor does there appear to be any plans for additional field work based on Appalachian's comments at the USR meeting. Therefore, please explain why additional bathymetry data was not collected for this area—which is the main stranding area of concern for walleye—and describe why the existing bathymetry data from this area is sufficient for modeling purposes.	Appalachian will address this comment in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA. No additional field data collection is planned or believed by Appalachian to be needed for the purposes of this study.
11	FERC	Based on figure 3-1 of the Buck Bypassed Reach ICM Development Report, there appears to be a small tributary that enters the bypassed reach along its southern shoreline, approximately mid-way down the reach. Please describe if, and how, inflow from this tributary was accounted for in your calculations of the amount of leakage flow through each of the spillway gates at the Buck Development (Table 2-2). Also, please confirm that the standing pools of water located upstream of this tributary (along the southeastern bank of the bypassed reach, immediately below the spillway) are maintained by leakage through the flashboard bays farthest away from the powerhouse (i.e., bays 15-22).	Appalachian will revise the Bypass Flow and Aquatic Habitat Study report to provide additional details regarding the small tributary entering the bypass reach and the standing pools located upstream of the tributary. The revised Bypass Flow and Aquatic Habitat Study report will be filed with FERC as supplemental information after the FLA.
12	FERC	The colors in the legend for figure 6-8 of the Bypassed Reach Flow and Aquatic Habitat Study Report do not match, or correspond to, the colors used in the graphic of this figure. Also, in figure 6-9 (of the same report), the colors on the plot are very difficult to distinguish from one another. Therefore, please provide updated figures for figures 6-8 and 6-9 that contain appropriately labeled legends and sufficient color distinctions to allow readers to	Appalachian will update the figures included in the Bypass Flow and Aquatic Habitat Study report and has carried the changes over into Exhibit E of the FLA, to the extent updates were made prior to the FLA filing. The revised Bypass Flow and Aquatic

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		distinguish the various water level logger locations more easily.	Habitat Study report will be filed with FERC as supplemental information after the FLA.
13	FERC	During the USR meeting, Commission staff asked if any observations of eastern hellbender, formal or incidental, had been made during the study period or any of the individual studies conducted therein. However, the Meeting Summary did not include this question or any response from the applicant. Therefore, please address this question in the license application.	No hellbenders were observed or reported during execution of the relicensing studies. Appalachian has addressed FERC's question regarding whether any observations of eastern hellbender had been made during the study period or any of the other relicensing studies Exhibit E.
14	FERC	Page 7 of the Meeting Summary includes a question and comments about wetland acreages associated with the Wetlands, Riparian, and Littoral Habitat Study. In particular, the summary states that the "NWI estimated 9 acres of wetlands and the field verification estimated 12 acres of wetlands." Given that the NWI estimated 9 acres and the Wetlands, Riparian, and Littoral Habitat Study reported a total of 95.43 field-verified wetland acres, it is unclear what the 'estimated 12 acres' refers to specifically. Therefore, please explain and clarify the difference between field verifications that estimated 12 acres of wetlands versus those that estimated 95.43 acres of wetlands.	Appalachian has revised the Wetland, Riparian, and Littoral Habitat Study report to clarify the estimated wetland acreages (Volume II, Appendix E). Additionally, as applicable, wetland descriptions in Exhibit E now reflect this updated information.
15	FERC	The Consulting Party Distribution List in the Cultural Resources Study Report only contains three Tribes as having received the report. However, page 4 of the Distribution List of the draft license application (DLA) includes additional Tribes. Moving forward, please ensure that all Tribes who are included on the Distribution List of the DLA receive a copy of all study reports related to cultural resources, including the Cultural Resources Study Report filed with the Commission on September 13, 2021.	Tribes that did not respond to the initial and follow up consultation were excluded by Appalachian's cultural resources consultant from subsequent distribution as the lack of response implied they had no interest in the undertaking. Appalachian has retained the Tribes listed for the DLA distribution on the distribution of the FLA.
16	USFWS	The Byllesby bypass reach appears to be significantly longer than 475 feet. The distance downstream from the base of the spillway to the downstream end of the island separating the tailrace channel from the bypass reach is approximately 590 feet (measured in both Google Earth Pro and ArcMap), and it appears that mixing of the powerhouse discharge and the bypass reach flow during periods of low inflow (e.g., Leakage Flow only) does not occur until approximately 800 feet downstream from the spillway. Further supporting this is the mesohabitat mapping which shows run habitat on the powerhouse discharge side meeting riffle habitat on the bypass reach side, at the downstream end of the island separating the two. The riverbed elevation would typically be expected to be higher in a riffle than in an adjacent run. For calibration purposes, the Service measured other features such as the Byllesby spillway, and we found our measurements of such features to be consistent with the Project Description. The Project Description should be updated to reflect an accurate description of the Byllesby bypass reach.	The Project description has been updated in the FLA (Exhibits A and E) and, as necessary, in all revised study reports to accurately reflect the Byllesby bypass reach.
17	USFWS	The explanation of the assessment of cover types does not explain how the desktop habitat designation was verified in the field. Section 6.3.2. mentions that field investigation (as necessary) was done in September 2020. How much of the area was field verified? How do the LiDAR categories designated for cover (1-18 in Table 5-1) match to the narrative description in the original Habitat Suitability Criteria narratives?	Appalachian will include additional information to respond to the USFWS's comment in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
18	USFWS	The Service questions the prioritization of Byllesby Tainter Gate #6 as the first gate operated for releases into the bypass reach. Although this gate is near the center of the spillway structure, the downstream thalweg appears to be closer to the right descending bank (RDB). Releasing flows through Obermeyer gates closer to the RDB would better mimic natural conditions where low flows are mostly confined to the thalweg. This approach may also reduce fish stranding potential by avoiding short-duration wetting of adjacent, higher-elevation portions of the bypass reach. Obermeyer gate #11 or #12 should be considered as the primary gate for flow releases to this bypass reach. We also question the use of Buck Tainter Gate #1 as the first gate opened to release flows into the Buck bypass reach. The downstream thalweg appears to mostly follow the left descending bank (LDB), as would be expected (i.e., the thalweg typically follows the outside of a channel bend). However, the section of the spillway near the LDB is a flashboard section which does not allow for automated flow releases. Therefore, the Service recommends consideration of Obermeyer Gate #10 for flow releases to the Byllesby spillway. We recognize that under current operations, incremental Tainter gate settings are utilized for providing the ramping flows. The Service requests further analysis and discussion of this issue.	See response to Comment 4 above.
19	USFWS	This section lists the source documents for the numerical HSI curves used for each life stage, but does not indicate if those curves were developed from research immediately prior to the source documents publication of 2010, 2007, and 2008, or if they used prior published curves from earlier decades. How does research in the current decade after 2010 corroborate or contrast with the knowledge that went into earlier HIS curve development? Please provide the narrative of original HSI sources and their reference data sources. Attachment 2 only has numeric values of the HSI curves.	Appalachian will include additional information to respond to the USFWS's comment in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
20	USFWS	As the Service discussed in the USR joint agency meeting on December 1, 2021, we would like to understand how the Habitat Characteristic Classification designations equate to our understanding of riverine habitat. Instream Cover and Overhead Vegetation are not necessarily mutually exclusive categories, as the Tables 6-1 and 6-2 sum their percentages, with No Cover, to one hundred. Please provide the specific definitions for each category used from the model, and how they were assessed.	Appalachian will provide clarification or definitions for each category used from the model and provide an explanation of how they were assessed in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
21	USFWS	The Service mostly agrees that there is little to no potential habitat under any flow scenario in the Byllesby bypass reach for the Deep-Fast Guild; however, there is a slight increase in habitat suitability for both the coarse substrate-associated representative (adult shorthead redhorse, Moxostoma macrolepidotum) and the fine substrate-associated guild representative (adult silver redhorse, Moxostoma anisurum) across all flows above leakage. However, no optimal habitat is gained, and the quantity of habitat gained is minimal.	Comment acknowledged. No changes are required to Exhibit E or the Bypass Flow and Aquatic Habitat Study report.
22	USFWS	The Service also considered negative tradeoffs (e.g., loss of habitat or reduction in habitat suitability for a particular guild or life stage with increased flows to the bypass reach). The greatest gains in habitat with the fewest negative tradeoffs appear to be associated with the Low Flow release (88 cfs). In addition, the Byllesby bypass reach wetted area had a relative increase the most from Leakage Flow to Low Flow (by 1 acre), compared to the wetted area increases corresponding with the Mid Flow (0.3-acre increase) and High Flow (0.1-acre increase). Although, absolute total increase in wetted area could increase primary productivity instream and macroinvertebrate prey habitat. When considering these tradeoffs, one should also consider what percentage of the mean inflow each bypass reach flow represents. The Leakage Flow represents less than 0.5 percent of the annual mean inflow, whereas a minimum flow release of 88 cfs represents 3.9 percent of the annual mean flow. In order to prioritize spawning habitat for the endemic bigmouth chub and habitat for all life stages of the New River shiner, the Service will be recommending an increase in the minimum flow, to 88 cfs, to the Byllesby bypass reach. A minimum flow of 88 cfs represents only 3.9 percent of the annual mean in-flow to the Project.	Appalachian has included summary information to support evaluation of the USFWS's preliminary recommendation in Exhibit E of the FLA. Additional analysis may be included, if and as appropriate, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
23	USFWS	For the walleye adult life stage, the Service agrees that the results indicate little to no suitable habitat under any of the target flow scenarios. There is little difference between flows; increasing flow releases result in increases in marginal habitat quantity, but there is no obvious increase in habitat suitability with increasing flow. For walleye fry, there are tradeoffs, and we do not completely agree with the Applicant's interpretation of the results. Optimal habitat at the lower end of the Buck bypass reach becomes unsuitable above leakage flow, but a Mid Flow (354 cfs) release appears to provide the greatest increase in dispersed suitable and optimal habitat patches. We agree that the largest patch of optimal habitat is seen at Leakage Flow, at the lower end of the bypass reach, but the Mid Flow release clearly provides more optimal habitat than does the Low Flow release, based on the study results. For the walleye juvenile life stage, there were no significant improvements at any flow, except for some marginal habitat increase at the 354 cfs Mid Flow and the small amount of increased potential habitat described in the USR. For the walleye spawning stage, the Service does not completely agree with the Applicant's interpretation of the model results. Walleye spawning habitat suitability clearly improves with increasing flows to the Buck bypass reach, with the most suitable habitat provided under the High Flow release scenario (714 cfs). The reduction in habitat suitability downstream of the bypass reach and just downstream of the tailrace channel is related to the reduced powerhouse discharge on Day 4, compared to that of Day 3, and is not directly related to the increased flow to the bypass reach. Indirectly, a minimum flow of 714 cfs to the bypass reach would reduce the number of days that the powerhouse can generate at the Day 3 level. However, under the Day 3 scenario, the combined HSI score just downstream of the tailrace channel appears to be around 0.75 (i.e., sub-optimal), so this decline in suitability under the Day 4 scenario is an acceptable tradeoff for the increase in optimal and suitable habitat in the Buck bypass reach under the Day 4 scenario.	Appalachian has included summary information to support evaluation of the USFWS's comment in Exhibit E of the FLA. Additional analysis may be included, if and as appropriate, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
24	USFWS	The High Flow 714 cfs release resulted in the greatest overall improvement in habitat suitability when considering all species and guilds together, and the Mid Flow release was a close second, based on the model results. However, tradeoffs in reduced habitat downstream of the tailrace should also be considered. Leakage flow represents only 0.75 percent of the mean annual inflow to the Buck development, while the 210.7 cfs Low Flow release represents 9.3 percent of the mean annual inflow, the 354 cfs Mid Flow release represents 15.6 percent of the mean annual inflow, and the 714 cfs High Flow release represents 31.4 percent of the mean annual inflow. Considering all of the above, the Service will be recommending an increase in the minimum flow to the Buck bypass reach, to 354 cfs.	Appalachian has included summary information to support evaluation of the USFWS's preliminary recommendation in Exhibit E of the FLA. Additional analysis may be included, if and as appropriate, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
25	USFWS	While the Service does not disagree with the USR's conclusions regarding the habitat benefits of maintaining run-of-river operations through the Byllesby powerhouse, we believe that the Low Flow release (88 cfs) to the Byllesby bypass reach provides enough habitat benefits to justify the tradeoff in slightly reduced powerhouse generation flows to the tailrace, cross-over channel and side channel. We also question whether negative effects of reduced powerhouse generation were sufficiently tested, considering the limited range of modeled generation flows (from 1,144 cfs to 1,555 cfs) and the fact that the highest generation flow did not correspond with the lowest bypass reach flow release, nor did the lowest generation flow correspond with the highest bypass reach flow release, under the various test scenarios. We understand that this aspect of the study was dictated by Project inflow, and was not within the Applicant's control, but a true test of these tradeoffs would require a greater range of generation flows (Byllesby powerhouse hydraulic capacity is more than 3x the highest generation flow in the study), and	Appalachian has included summary information to support evaluation of the USFWS's comment in Exhibit E of the FLA. Additional analysis may be included, if and as appropriate, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		incrementally increasing bypass reach flows tested against incrementally decreasing powerhouse generation flows. The Day 2 flow to the Byllesby bypass reach (88 cfs; recommended by the Service) corresponded with the highest powerhouse discharge flow to the tailrace, cross-over channel and side channel, such that the study did not evaluate a corresponding decrease in flow to these other Project features. The goal of systematically evaluating and balancing the needs and priorities of the various flow-related resources (as stated in Section 5, Methodology, Page 9 of the USR) was not completely met by this study, because there was no true evaluation of balancing of flow distribution. Negative tradeoffs proportional to the bypass reach flow releases were not sufficiently tested. Therefore, the Service focused its evaluation of study results primarily on the effects of the different test flows released to the bypass reaches. In addition, a finding of the study (Page 31) was that bypass flow releases did not influence water surface elevations in the tailrace, cross-over channel, or side channel areas.	
26	USFWS	The Service does not agree with the statement in the last paragraph of this section that, from an aquatic habitat perspective, it likely makes no substantial difference which gate is used to release the minimum downstream flow requirement. The thalweg is near the eastern bank (RDB), and the minimum flow should be released through the gate that is most directly aligned with the thalweg.	Appalachian has included summary information to support evaluation of the USFWS's comment in Exhibit E of the FLA. Additional analysis may be included, if and as appropriate, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
27	USFWS	The Service does not completely agree with the stated conclusions in this section. Model results indicated a significant increase in habitat suitability for the generic shallow-slow guild with coarse substrate (represented by the spawning life stage of the redbreast sunfish) in the lower Byllesby bypass reach, especially in the thalweg, under the Low Flow release scenario (88 cfs). In addition, although the Service had sufficient opportunity to influence the list of species to be evaluated, a thorough evaluation of all possible benefits to aquatic organisms would be well beyond the practicable scope of the study, and existing research (e.g. TNC Indicators of Hydrologic Alteration) supports a minimum flow to the Byllesby bypass reach that is greater than 0.5 percent of the annual mean inflow to the Project (current minimum flow provided through leakage). The Service does not agree with the conclusions in this section.	Appalachian has included summary information to support evaluation of the USFWS's comment in Exhibit E of the FLA. Additional analysis may be included, if and as appropriate, in the revised Bypass Flow and Aquatic Habitat Study report, to be filed with FERC as supplemental information after the FLA.
28	USFWS	The Service notes the utility this study shows in field verification of data, especially for jurisdictional wetlands, as documented wetlands increased greatly over desktop analysis projections. Nearly 78 acres of palustrine emergent, scrub shrub and forested wetlands are important wildlife resources for waterfowl and fish and aquatic communities. The Service supports continued consultation with the Virginia Department of Wildlife Resources staff in developing the Wetland Management Plan. As we noted in the USR Meeting, impacts to wetland resources, even temporary drawdown impacts for months of maintenance or other factors, should be documented. Persistence of wetland vegetation is only one component of wetland habitat, and the seasonal presence or lack of hydrology must be factored into consideration.	Comment noted and has been taken into consideration in Appalachian's preparation of Exhibit E.
29	USFWS	Water quality data and velocity data were collected at sampling sites which included the bypass reaches. What were the flows (cfs) to the bypass during the surveys? The Service did not see this information in the USR. If this information was not documented at the time of the surveys, it should be possible to look back to the dates and times of the surveys and provide this information.	Appalachian has provided the flows (cfs) in the bypass reaches at the times when water quality and velocity data were collected in relevant sections of Exhibit E. This information will be supplemented or also included in the revised Aquatic Resources Study report to be filed as supplemental information after the FLA.
30	USFWS	A spillway and bypass passage survival rate of 97 percent was assumed based on the average of 136 survival tests conducted with juvenile salmonids on the Columbia River (Amaral et al. 2013). How does the spillway from the cited study compare to the Project spillways with regards to the drop in elevation from the downstream end of the spillway apron to the riverbed and plunge pool depth below the dam apron? There appears to be a drop in elevation from the Byllesby spillway apron to the riverbed below, with little to no plunge pool below most of the spillway gates. The Service requests additional information to support the assumption of 97 percent survival of fish passing via the spillways.	Appalachian will revise the Aquatic Resources Study report to address the USFWS's comment. The revised Aquatic Resources Study report to be filed as supplemental information after the FLA.
31	USFWS	Were the submerged heights of the intake structures used to calculate velocities, or were the total heights (including non-submerged sections) of the intake structures used in the calculations? If non-submerged sections of the intake dimensions were used in the calculations, then the resulting calculated velocities will be underestimates. The Service has previously requested design plans of the intake structures, and water surface elevations. Without that detailed information, we cannot verify that the applicant's velocity calculations were performed according to the parameters the Service uses for calculations. Drawings presented in Appendix I, Additional Intake Drawings are insufficient.	See response to Comment 30 above.
32	USFWS	This section states that burst swim speed data were compiled from the literature, however if data for a specific species or group was not directly available, it was calculated as 2x the critical swim speed based on Bell (1991). Bell (1991) does not define "critical" swim speed. The three swim speeds defined by Bell (1991) are cruising, sustained, and darting. To which of these does "critical swim speed" equate?	See response to Comment 30 above.
33	USFWS	The Service previously provided our December 30, 2021 Draft License Application (DLA) comments regarding the tail length used for walleye in the Turbine Blade Strike Analysis (TBSA). In those comments, we noted that walleye up to 29 inches in tail length have been collected from the New	See response to Comment 30 above.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		River and stating, therefore, that this should be the maximum length used in the TBSA, as opposed to the upper limit of 13.5 which was used in this study, based on the 2020-2021 surveys. However, we did not take into account the clear bar spacing on the trash racks, and the body width to length scaling factor for walleye. Based on the scaling factor, this study determined that walleye with a tail length of 18.5 inches or greater will be excluded from the Project intakes. Therefore, we revise our previous request in our DLA comments, to conduct additional TBSA modeling for walleye, using 18 inches as the tail length upper limit for this species.	
34	USFWS	Table 5-11 indicates low monthly entrainment potential for walleye in all months except for June and July. However, we note that a 1992-1994 discharge netting study at the Townsend Project on the Beaver River (Ohio River tributary) in Pennsylvania collected walleye moving downstream through the powerhouse during all months of the year except for June (RMC 1994).	See response to Comment 30 above.
35	USFWS	5.2.3.3 Turbine Blade Strike Analysis, page 5-24, second paragraph, last sentence. This sentence refers to Table 5-6 which summarizes body length to width ratios and minimum length of at which fish species would be excluded by the trash racks. The minimum size of exclusion for larger bodied species of 14.5 to 18 inches does not completely agree with the table (upper end of range is 18.5 inches in the table).	See response to Comment 30 above.
36	USFWS	The Service previously provided DLA comments pertaining to the maximum tail length used for walleye in the TBSA modeling, stating that walleye up to 29 inches have been collected from the New River. The maximum length used in the TBSA modeling was only 13.5 inches, based on specimens collected during the 2020-2021 surveys. The minimum length for this species that would be excluded from the powerhouses, based on the clear bar spacing of the trash racks, would be 18.5 inches. Therefore, the Service requests that additional TBSA modeling be conducted for walleye up to a maximum tail length of 18 inches, and that this table be revised to reflect the updated survival rates based on the additional modeling.	See response to Comment 30 above.
37	USFWS	Were the submerged heights of the intake structures used to calculate velocities, or were the total heights (including non-submerged sections) of the intake structures used in the calculations? If non-submerged sections of the intake dimensions were used in the calculations, then the resulting calculated velocities will be underestimates. The Service has previously requested design plans of the intake structures, and water surface elevations. Without that detailed information, we cannot verify that the applicant's velocity calculations were performed according to the parameters we use.	The Aquatic Resources Study report will be revised to address the USFWS's comment. The revised study report will be filed with FERC as supplemental information after the FLA. Appalachian notes that while additional historical design drawings for the Byllesby Development have been located and will be included, Appalachian has not been able to locate this design information in a different format.
38	VDWR	Results of the Wetland, Riparian, and Littoral Habitat Study could inform development of a Wildlife Management Plan to enhance Project wetlands for specific wildlife species, including ways to enhance some of the more significant wetlands for waterfowl use. Maintaining wetland resources at the Project to benefit waterfowl and waterfowl hunters would also provide additional recreation enhancement not outlined in the Recreation Study. Department of Wildlife Resources staff are available to discuss the development of a Wetlands Management Plan.	Comment noted and has been taken into consideration in Appalachian's preparation of the FLA.
39	VDWR	We support the comments of our partner agency, the U.S. Fish and Wildlife Service, regarding the Bypass Reach Flow and Aquatic Habitat Study, particularly with regard to reducing fish stranding, but also in terms of the actual length of the Byllesby bypass reach, instream flow modeling and instream flow needs, and native fish species benefited by the guilds examined. We emphasize the following points regarding how this study was conducted that are important to appropriate management of these formerly riverine habitats.	Comment acknowledged. No changes are proposed to the Bypass Flow and Aquatic Habitat Study report.
40	VDWR	During this Study, as reported in the USR Meeting Summary, the DLA, and the USR, bypass flow to the Byllesby bypass reach was provided through Tainter Gate #6. A primary discharge from this gate, located near the center of the Byllesby Dam spillway, may have hindered the results of this study in the Byllesby bypass reach, since the location of this release point ignores the location of the thalweg on the right descending bank. As a result, the evaluation of bypass reach flows for this portion of the Project may not fully demonstrate how bypass reach flows can improve downstream connectivity and reduce potential stranding in the bypass reach.	See response to Comment 4 above.
41	VDWR	During this Study, as reported in the USR Meeting Summary, the DLA, and the USR, bypass flow to the Buck bypass reach was provided through Tainter Gate #1. A primary discharge from this gate, located near the right descending bank of the Buck Dam spillway, may have hindered the results of this study in the Buck bypass reach, since the location of this release point ignores the location of the thalweg on the left descending bank. As a result, the evaluation of bypass reach flows for this portion of the Project may not fully demonstrate how bypass reach flows can improve downstream connectivity and reduce potential stranding in the bypass reach. As stated in our comments to date, we have a continuing concern about Walleye stranding in the Buck bypass reach, particularly during the spring Walleye spawning season when the Buck bypass is more frequently activated than at other times of the year.	See response to Comment 4 above.
42	VDWR	We agree with the U.S. Fish and Wildlife Service's evaluation of the interpretation of Buck bypass reach model results for the Walleye spawning stage when they state that the most suitable habitat is provided under the highest flow release scenario (714 cfs). Walleye spawning requires attractant flows and suitable spawning substrate. Creating suitable spawning conditions for the New River strain Walleye strain is a high priority for our agency, as outlined in our New River Walleye Management Plan, filed as a management plan under this Project. The Buck bypass reach was formerly fully functioning riverine habitat that provided Walleye spawning habitat, so its potential importance to the New River Walleye population should be an	Comment noted and has been taken into consideration in Appalachian's preparation of the FLA.

Comment Number	Agency	Comment	Resolution of Comment in Final License Application
		important consideration in managing bypass reach flows.	
43	VDWR	We support the comments of our partner agency, the U.S. Fish and Wildlife Service, particularly with regard to turbine blade strike and spillway survival assessment and intake velocity measurements. In addition, we emphasize the following point regarding this study: With a total of only nine Walleye collected during the Aquatic Resources Study, using the mean total length of Walleye collected (13.5 inches, Standard Deviation of 1.5 inches) for the Impingement and Entrainment Study did not capture a realistic size distribution of Walleye using the Byllesby Buck Project Area. As a result, we support the U.S. Fish and Wildlife Service recommendation to perform additional Turbine Blade Strike Analysis for Walleye up to a maximum total length of 18 inches, based on the minimum size Walleye excluded from the intake of 18.5 inches total length, since the 2.25-inch clear bar spacing on the trash racks excludes Walleye of that length and larger.	The Aquatic Resources Study report will be revised to address the VDWR's comment. The revised study report will be filed with FERC as supplemental information after the FLA.
44	VDWR	The Recreation Study was completed to our satisfaction, with the exception of documenting use of the Buck tailrace area, where use was discouraged by the presence of No Trespassing signs in close proximity to the dam, resulting in capturing virtually no human activity on cameras installed to assess use. As stated in our comments on the DLA, we support a collaborative approach to developing a Recreation Management Plan, including potential improvements to signage within the Project boundary, upgrades to the Byllesby Boat Launch, improvements to the Buck postage put-in, and the construction of new facilities at the Loafer's Rest Area, leased by Appalachian Power Company to the Virginia Department of Wildlife Resources. Our Department staff will participate in the development of this plan. Further collaboration on the Recreation Management Plan is advisable prior to filing the FLA.	Comment acknowledged. No changes were made to the Recreation Study report.

This page intentionally left blank.

Summary of Proposed Action and Enhancement Measures

The Project operates in a run-of-river mode under all flow conditions and Appalachian proposes to continue operating the Project as presently licensed. Under normal operating conditions, Appalachian operates the Project to use available flows for powerhouse generation, maintaining the elevation (EL.) of the Byllesby reservoir between EL. 2,078.2 feet (ft) and 2,079.2 ft and the Buck reservoir between EL. 2,002.4 ft and 2,003.4 ft. Appalachian is also presently required to release a minimum flow of 360 cubic feet per second (cfs) or inflow to the Project, whichever is less, downstream of the Project powerhouses.

During the new license term, Appalachian proposes to modernize the Byllesby and Buck developments to include replacement of Byllesby Units 1, 2 and 4 and Buck Units 1 and 3. All but one (Buck Unit 2) of the seven turbine-generator units installed at the Project are the original major components of the Project as constructed in 1912. Many of the major electrical and mechanical and supporting systems and components of the Project developments are nearing the end of their useful service life, when compared to industry-recognized standards. The existing vertical Francis units would be replaced by fixed blade Kaplan units. Unit upgrade activities would be confined to within the powerhouse, and there would be minimal changes to operating parameters for the Project. Following completion of the upgrades, the authorized installed capacities for the Byllesby and Buck developments will be 20,389.5 kW and 9,435 kW, respectively, with maximum hydraulic capacities of 5,868 cfs and 3,540 cfs, respectively. Due to efficiencies of the Kaplan units and modern components, the upgrades are expected to increase average annual generation at the Project by approximately 25,927 MWh.

Appalachian also proposes to implement the following additional enhancement measures under the new license term:

- Continue to operate the Project in a run-of-river mode, maintaining the Byllesby reservoir between EL. 2,078.2 ft and 2,079.2 ft and the Buck reservoir between EL. 2,002.4 ft and 2,003.4 ft.

- Continue funding of the USGS New River at Galax and Ivanhoe gages.

- Continue to provide a minimum flow of 360 cfs, or inflow through the Project, whichever is less, to the New River downstream of each powerhouse.

- Implement a modified ramping rate for spillway gate operations at the Buck development; whereby, following periods of spill when a spillway gate has been opened 2 ft or more, water will continue to be released into the bypass reach through a 2-ft-gate opening for at least 2 hours, then the gate opening will be reduced to 1.0 ft for 2 hours and then to 0.5 ft for 2 hours before closing.

- Develop and implement a Bypass Reach Aquatic Resources Protection Plan in consultation with USFWS and VDWR and for FERC approval. The Bypass Reach Aquatic Resources Protection Plan will include provisions for the spillway gate and ramping rate procedures, measures to identify and address (through visual inspection and relocation, if appropriate) isolated incidents of fish stranding in isolated pools along the left descending bank in the Buck bypass reach, and measures to reduce impacts of scheduled powerhouse outages.

- Conduct Project maintenance and new license implementation activities, as applicable, in accordance the USFWS's prevailing eagle management guidance and regulations.

- Finalize and implement the Recreation Management Plan in consultation with Project stakeholders, including provisions for improvements to existing Project facilities (Byllesby Boat Launch, Byllesby Dam Fishing Access, Byllesby Canoe Portage (Take-Out), New River Canoe Launch (Put-In), and Buck Canoe Portage (Take-Out and Put-In) as well as construction of the Non-Project Loafer's Rest Area and Fishing Trail.

- Finalize in consultation with consulting parties (Tribes, SHPO, and FERC) the draft Historic Properties Management Plan.

Application Road Map

This Final License Application consists of five volumes.

Volume I of V (Public)

- **Table of Contents**
- **Executive Summary**
- **Initial Statement and Additional Information Required by 18 CFR §4.32**
- **Exhibit A – Project Description**
- **Exhibit B – Project Operations and Resource Utilization**
    - **Appendix A – Flow Duration Curves**

- **Exhibit C – Construction History and Proposed Construction Schedule**
- **Exhibit D – Costs and Financing**

Volume II of V (Public)

- **Exhibit E –** Includes the Environmental Report (Part 1) and all study reports as appendices (Part 2). Volume II also includes the draft Recreation Management Plan (Part 3), and documentation of consultation undertaken during this relicensing as appendices (Part 4).
    - **Appendix A – Bypass Reach Flow and Aquatic Habitat Study *(will be provided as supplemental information within 45-day of license filing)***
    - **Appendix B – Water Quality**
    - **Appendix C – Aquatic Resources Study *(will be provided as supplemental information within 45-day of license filing)***
    - **Appendix D – Terrestrial Resources**
    - **Appendix E – Wetlands, Riparian, and Littoral Habitat Study**
    - **Appendix F – Shoreline Stability Study**
    - **Appendix G – Recreation Study**
    - **Appendix H – Recreation Management Plan**
    - **Appendix I – Consultation**

Volume III of V (Public)

- **Exhibit F – List of General Design Drawings:** Includes the list of design drawings filed as Critical Energy/Electric Infrastructure Information (CEII) in accordance with 18 CFR §388.112. The Design Drawings are included in Volume IV (CEII). A Supporting Design Report has been developed and is also included in Volume IV (CEII).
- **Exhibit G – Project Boundary Maps:** Includes map showing the Project Boundary for the Byllesby-Buck Project. (*Electronic Project Boundary files also included.*)
- **Exhibit H – Ability to Operate:** Describes the commitment and responsibility of Appalachian as a Licensee to continue to operate and maintain the Project and the needs and costs for power from the Project or alternate sources.

Volume IV of V (CEII)

- **Exhibit F – General Design Drawings and Supporting Design Report**
- **Exhibit H – Single-line Diagram**

Volume V of V (Controlled Unclassified Information/Privileged [CUI/PRIV])

- **Cultural Resources Study Report**
- **Draft Historic Properties Management Plan**

FINAL LICENSE APPLICATION

BYLLESBY-BUCK HYDROELECTRIC PROJECT

(FERC NO. 2514)

Initial Statement (18 CFR §4.51(a))

This page intentionally left blank.

BEFORE THE UNITED STATES OF AMERICA FEDERAL ENERGY REGULATORY COMMISSION

BYLLESBY-BUCK HYDROELECTRIC PROJECT (FERC NO. 2514)

APPLICATION FOR A NEW LICENSE FOR A MAJOR WATER POWER PROJECT – GREATER THAN 5 MEGAWATTS

(1) Appalachian Power Company (Appalachian or Licensee or Applicant), a unit of American Electric Power (AEP) applies to the Federal Energy Regulatory Commission (FERC or Commission) for a new license for the Byllesby-Buck Hydroelectric Project (Project) (FERC Project No. 2514). The current license for the Project was issued on March 25, 1994 and expires on February 29, 2024.

(2) The location of the Project is:

State or territory:	Virginia
County:	Carroll
Township or nearby town:	City of Galax
Stream or other body of water:	New River

(3) The exact name, address and telephone number of the applicant are:

Appalachian Power Company
Stephen A. Dolan
Plant Manager Hydro and Ceredo
American Electric Power Service Corporation
40 Franklin Road SW
Roanoke, Virginia 24011

(4) The exact name, address and telephone number of each person authorized to act as agent for the applicant in this application are:

Ms. Elizabeth B. Parcell
Process Supervisor
American Electric Power Service Corporation
40 Franklin Road SW
Roanoke, VA 24011
(540) 985-2441
ebparcell@aep.com

Mr. Jonathan Magalski
Environmental Supervisor, Renewables
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215
(614) 716-2240

jmmagalski@aep.com

(5) The applicant is a domestic corporation and is not claiming preference under Section 7(a) of the Federal Power Act. See 16 U.S.C. 796.

(6) The statutory or regulatory requirements of the state in which the Project is located that affect the Project as proposed with respect to bed and banks and the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and in any other business necessary to accomplish the purposes of the license under the Federal Power Act are: Water rights involved are merely the riparian rights appurtenant, under Virginia law, to the various lands needed for dam site, flowage and tailrace purposes.

The Project was constructed and being utilized prior to 1928, the effective date of the (Virginia) Water Power Act and thus was exempted from the requirement that a license be obtained under the Act. Under said Act (Section 3581(13) of Michie Code 1942), all persons, firms, associations, or corporations who constructed and were utilizing their water power developments prior to 1928, and their lessees, successors and assigns, have, as to such developments and any reconstructions or enlargements thereof, all of the rights and powers conferred by the Act to the same extent as if they were licensees under the Act except that they do not have the power of eminent domain thereunder. By Section 62-88 of Chapter 5 of Title 62 of the Code of Virginia, the provisions of Section 3581(13) of Michie Code 1942 were continued in effect. Appalachian is incorporated under the laws of the Commonwealth of Virginia and qualified to do business as a public utility in Virginia.

The applicant will apply for the Section 401 Water Quality Certification per 18 Code of Federal Regulations (CFR) § 5.23(b). Under Section 401 of the Clean Water Act (CWA) (33 USC § 1251 et seq.), a federal agency may not issue a license or permit to conduct any activity that may result in any discharge into waters of the United States unless the state or authorized tribe where the discharge would originate either issues a Section 401 Water Quality Certification finding compliance with existing water quality requirements or waives the certification requirement. In the Commonwealth of Virginia, under § 62.1-44.15 of the Code of Virginia, the Virginia Department of Environmental Quality (VDEQ) provides Section 401 Water Quality Certification through the Virginia Water Protection (VWP) Program, as authorized by the State Water Control Law and as described in the VWP Permit Regulation. Appalachian is preparing a joint permit application for a VWP permit and surface water withdrawal for the continued operation of the Project in parallel with the FERC licensing process and intends, to the greatest extent possible, to use licensing documents including but not limited to study reports and the license application exhibits to satisfy this parallel regulatory process. Requirements for a VWP permit are described in 9 Virginia Administrative Cody (VAC) 25-210-80 and 9VAC25-210-340.

(7) Brief Project Description: Appalachian is the owner and operator of the two-development (Byllesby and Buck developments) Project located on the upper New River in Carroll County, Virginia. The Byllesby development is located about 9 miles north of the City of Galax, and the Buck development is located approximately three river miles downstream

of Byllesby. The Project was constructed in 1912 and has been operated by Appalachian for hydroelectric power generation since 1926. Today the Project is operated by Appalachian in a run-of-river manner, utilizing upper New River inflows to provide up to 30.1 megawatts (MW) of renewable capacity.

Presently licensed[1] project works are as follows:

The Byllesby Development consists of: (1) a 64-foot-high, 528-foot-long concrete dam and main spillway section topped with four sections of 9-foot-high flashboards, five sections of 9-foot-high inflatable Obermeyer crest gates, and six bays of 10-foot-high Tainter gates; (2) an auxiliary spillway including six sections of 9-foot-high flashboards; (3) a 239-acre impoundment with a gross storage capacity of 2,000 acre-feet; (4) a powerhouse containing four generating units with a total authorized installed capacity of 21.6 megawatts (MW); and (5) appurtenant facilities.

The Buck Development consists of: (1) a 42-foot-high, 353-foot-long concrete dam; (2) a 1,005-foot-long, 19-foot-high spillway section topped with 20 sections of 9-foot-highflashboards, four sections of 9-foot-high inflatable Obermeyer crest gates, and six bays of 10-foot-high Tainter gates; (3) a 66-acre impoundment with a gross storage capacity of 661 acre-feet; (4) a powerhouse containing three generating units with a total authorized installed capacity of 8.5 MW; and (5) appurtenant facilities.

Additional existing facilities expected to be included as project works in the new license, as further explained in the exhibits that follow, include the following: (1) the Byllesby control house and switchyard, and (2) two 2-mile long overhead 13.2-kilovot (kV) transmission lines extending from the Buck powerhouse to the Byllesby control house.

(8) The Project Boundary for the transmission corridor, which under the existing license is a licensed Project feature but not included in the Project Boundary, encompasses 7.23 acres of federal lands (Jefferson National Forest).

(9) The Project is an existing constructed project.

[1] Authorized installed capacity values listed here are as presently licensed. Revisions to the existing authorized installed capacity values for the Project are described in Exhibit A.

Additional Information Required by 18 CFR § 4.32(a)(2)

(1) Identify every person, citizen, association of citizens, domestic corporation, municipality, or state Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate, or maintain the project:

Appalachian presently holds and will continue to hold the proprietary rights necessary to operate and maintain the Project.

(2) Identify (providing names and addresses):

i. Every county in which any part of the project, and any Federal facilities that would be used by the project would be located:

Name	Address
Carroll County, Virginia	Administrator Carroll County P.O. Box 515 Hillsville, VA 24343

ii. The names and addresses of every city, town or similar local political subdivision in which any part of the Project, and any Federal facilities that would be used by the Project, are located or that has a population of 5,000 or more people and is located within fifteen (15) miles of the project dam are as follows:

Name	Address
City of Galax, Virginia	Mayor City of Galax Galax, Virginia 24333
City of Pulaski, Virginia	Mayor City of Pulaski P.O. Box 660 Pulaski, Virginia 24330
Town of Fries, Virginia	Manager Town of Fries P.O. Box 452 Fries, Virginia 24330
Town of Hillsville, Virginia	Manager Town of Hillsville P.O. Box 545 Hillsville, Virginia 24343
Town of Wytheville, Virginia	Manager Town of Wytheville P.O. Box 533 Wytheville, Virginia 24382
Pulaski County, Virginia	Administrator

Name	Address
	Pulaski County 143 Third Street Pulaski, Virginia 24301
Grayson County, Virginia	Administrator Grayson County P.O. Box 217 Independence, Virginia 24348
Wythe County, Virginia	Administrator Wythe County 108 County Office Building 275 South Fourth Street Wytheville, Virginia 24382

There are no Federal facilities associated with the Project.

iii. Every irrigation district, drainage district, or similar special purpose political subdivision:

A. In which any part of the project, and any Federal facilities that would be used by the project, would be located, or (B) That owns, operates, maintains, or uses any project facilities or any Federal facilities that would be used by the project:

There are no irrigation or drainage districts, or similar special purpose political subdivisions associated with or in the general area of the Project. There are no federal facilities associated with the Project.

iv. Every other political subdivision in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

There are no other political subdivisions in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

v. All Indian tribes that may be affected by the Project:

Tribe	Address
Catawba Indian Nation	Wenonah Haire Tribal Historic Preservation Officer Catawba Indian Nation 1536 Tom Steven Rd. Rock Hill, SC 29730
Delaware Nation	Erin Paden Director of Historic Preservation Delaware Nation PO Box 825 Anadarko, OK 73005
Pamunkey Indian Tribe	Terry Clouthier Cultural Resources Director Pamunkey Indian Tribe 1054 Pocahontas Trail King William, VA 23086

VERIFICATION

This application is executed in the

State of: Virginia

County of: Roanoke

Stephen A. Dolan
Plant Manager Hydro and Ceredo
American Electric Power Service Corporation
40 Franklin Road SW
Roanoke, Virginia 24011

The undersigned being duly sworn, deposes and says that the contents of this application are true to the best of his knowledge or belief. The undersigned applicant has signed this application this 23 day of February, 2022.

Stephen A. Dolan

Subscribed and sworn to before me, a Notary Public of the Commonwealth of Virginia, this 23rd day of February, 2022.

Notary Public

ANNA ELISE PAINTER
NOTARY PUBLIC
REG. #7796940
MY COMMISSION EXPIRES
04/30/2022
COMMONWEALTH OF VIRGINIA

FINAL LICENSE APPLICATION

BYLLESBY-BUCK HYDROELECTRIC PROJECT

(FERC NO. 2514)

EXHIBIT A

PROJECT DESCRIPTION

This page intentionally left blank.

Exhibit A - Project Description (18 CFR §4.51(b))

A.1 Project Overview and Location

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the two-development Byllesby-Buck Hydroelectric Project (Project) (Federal Energy Regulatory Commission [FERC or Commission] Project No. 2514), located on the upper New River in Carroll County, Virginia.

The Byllesby Development (Byllesby) is located about nine miles north of the city of Galax, Virginia, on the New River. The primary facilities, including the powerhouse and spillway, are located within the Austinville, Virginia Quadrangle at approximately N. 36 deg., 47 min., 9 sec. and W. 80 deg., 56 min., 1 sec. The Buck Development (Buck) is located about 3 miles downstream from the Byllesby Dam. The primary facilities are located within the Austinville, Virginia Quadrangle at approximately N. 36 deg., 48 min., 20 sec. and W. 80 deg., 56 min., 4 sec.

Each development consists of a reservoir, concrete gravity dam and spillway, and powerhouse, and the Project also includes a control house and switchyard located at the Byllesby Development and two 2-mile-long 13.2-kilovolt (kV) overhead transmission lines connecting the two developments.

The Project is operated by Appalachian in a run-of-river manner, utilizing upper New River inflows to provide up to 30.1 megawatts (MW) of renewable capacity. Figure A.1-1 provides an overview of the Project setting and the FERC Project Boundary and Figure A.1-2 shows the location of the Project within the New River Basin.

All but one of the seven turbine-generator units installed at the Project are the original major components of the Project as constructed in 1912. Many of the major electrical and mechanical and supporting systems and components of the Project developments are nearing the end of their useful service life, when compared to industry-recognized standards. As described Section A.4 Appalachian proposes to modernize the Byllesby and Buck developments during the new license term to include replacement of Byllesby Units 1, 2, and 4 and Buck Units 1 and 3.

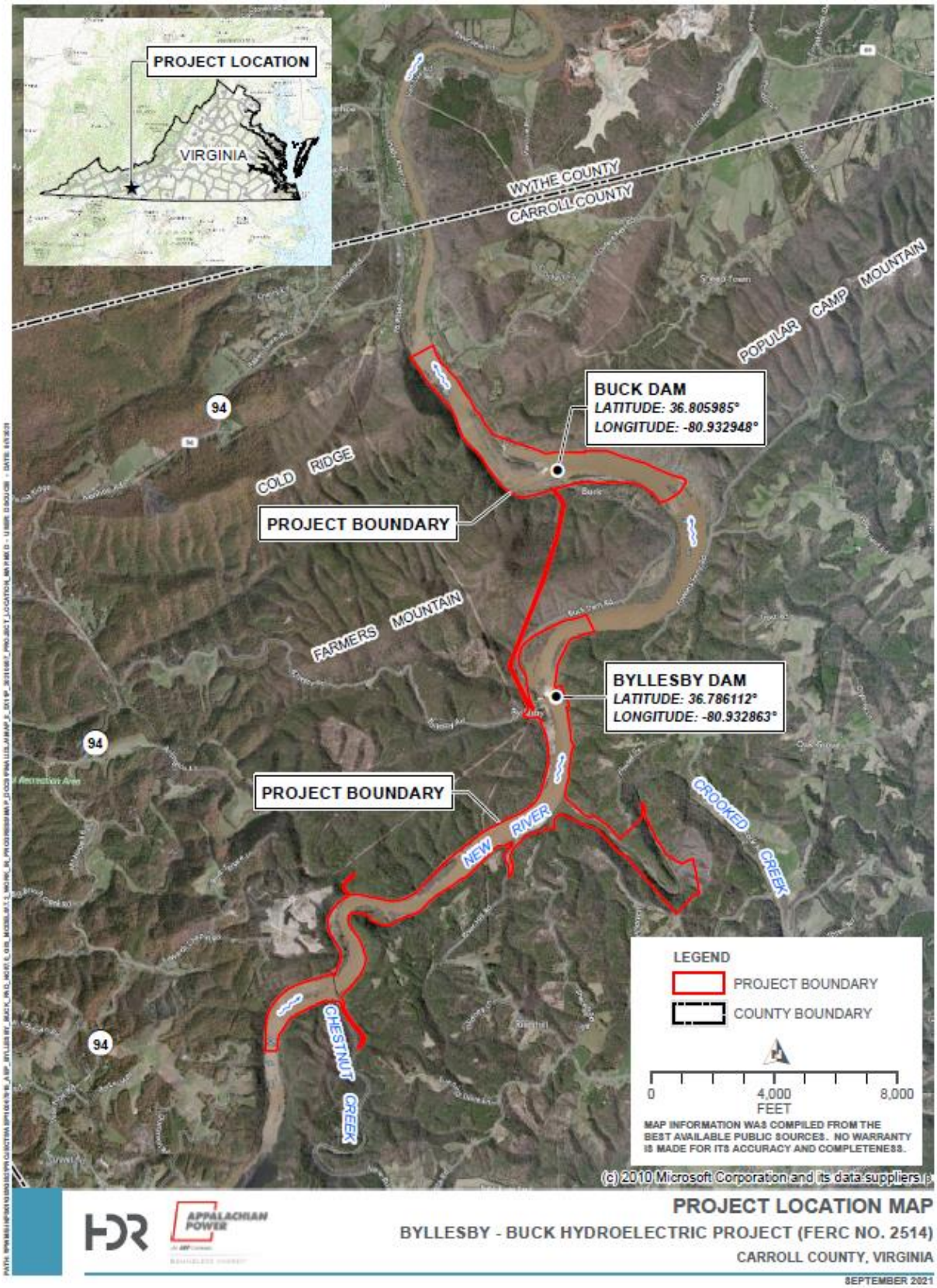


Figure A.1-1. Project Location Map

Figure A.1-2. Project Location on New River

A.2 Project Description

The Project was constructed in 1912 and has been operated by Appalachian for hydroelectric power generation since 1926.

The Byllesby Development consists of (1) a 64-foot [ft]-high, 528-ft-long concrete dam, sluice gate, and main spillway section topped with four sections of 9-ft-high flashboards, five sections of 9-ft-high inflatable Obermeyer crest gates, and six bays of 10-ft-high Tainter gates; (2) an auxiliary spillway including six sections of 9-ft-high flashboards; (3) a 239-acre reservoir with a gross storage capacity of approximately 2,000 acre-ft; (4) a powerhouse containing four generating units with a total authorized installed capacity of 18 MW; (5) a control house and switchyard; and (6) appurtenant facilities.

The Buck Development consists of (1) a 42-ft-high, 353-ft-long concrete dam and sluice gate; (2) a 1,005-ft-long, 19-ft-high spillway section topped with 20 sections of 9-ft-high flashboards, four sections of 9-ft-high inflatable Obermeyer crest gates, and six bays of 10-ft-high Tainter gates; (3) a 66-acre impoundment with a gross storage capacity of approximately 661 acre-ft; (4) a powerhouse containing three generating units with a total installed capacity of 8.087 MW; (5) a two 2-mile long overhead 13.2-kV transmission lines extending from the Buck powerhouse to the Byllesby control house; and (6) appurtenant facilities (FERC 2017).

Each development recently underwent modification as approved by an order amending license issued by FERC on May 18, 2017 to replace several sections of existing wooden flashboards with inflatable Obermeyer pneumatic crest gates. The Obermeyer crest gates facilitate smoothing Project operations by reducing reservoir water level fluctuations and instances of inadvertent flow to the bypass reaches and reducing the frequency of maintenance drawdowns associated with wooden flashboard failure and replacement.

The facilities and structures listed above are described in the sections that follow, are depicted on Figure A.2-1 and Figure A.2-2, and are also shown on the project drawings included in Exhibit F (filed as Critical Energy/Electric Infrastructure Information [CEII] in accordance with 18 CFR §388.112) of this Final License Application (FLA).

.

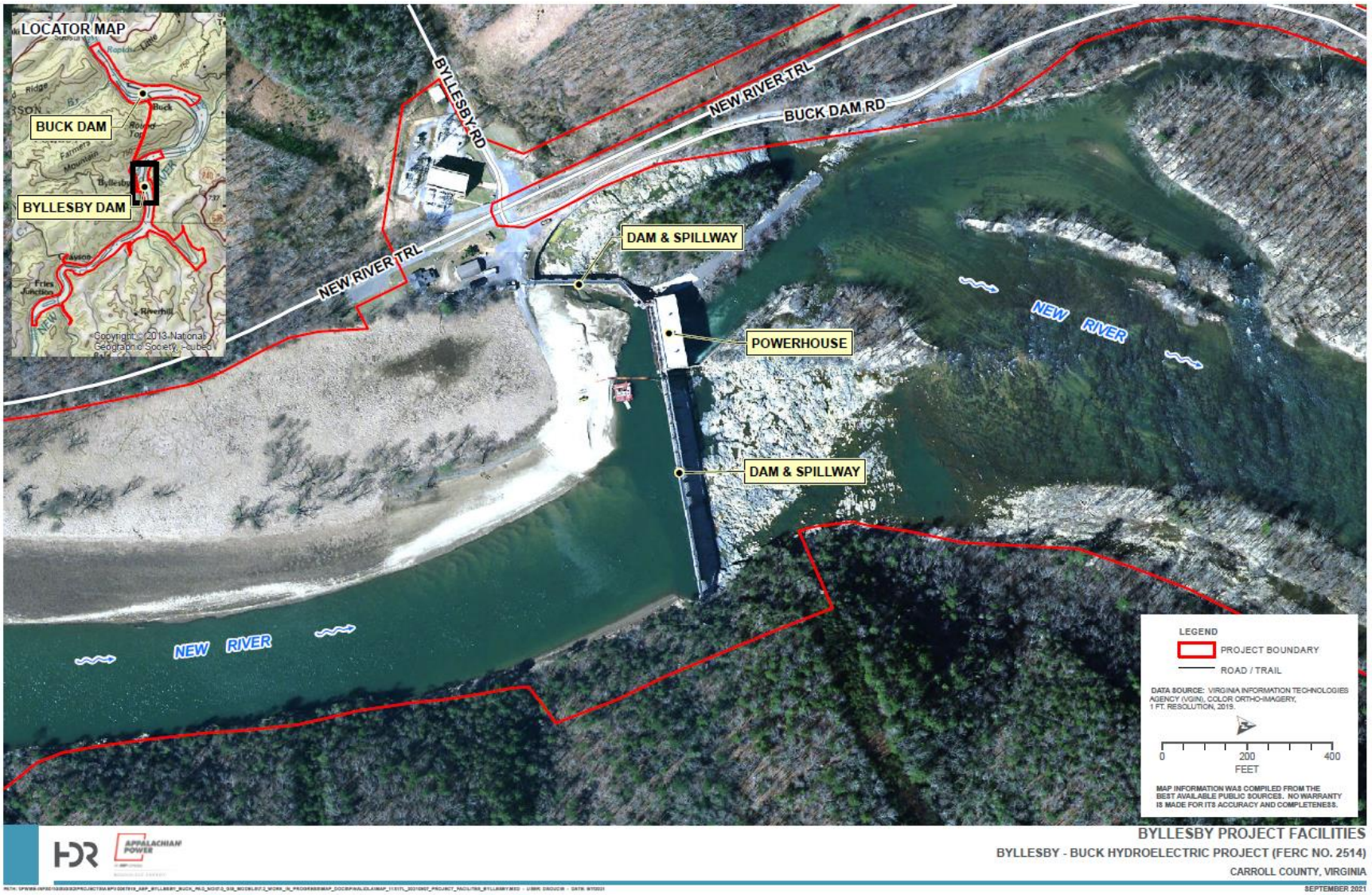


Figure A.2-1. Existing Project Facilities – Byllesby Development

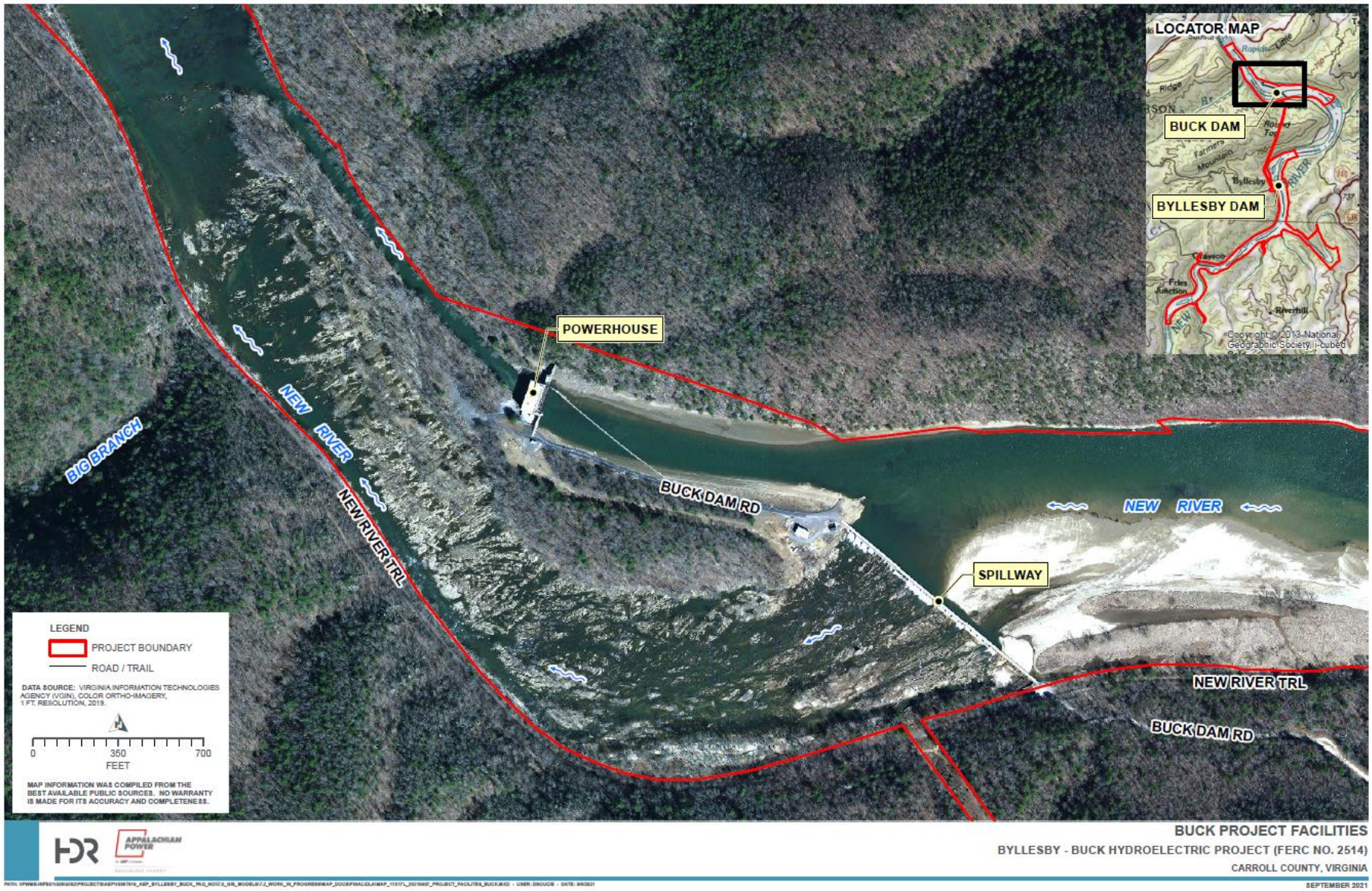


Figure A.2-2. Existing Project Facilities – Buck Development

A.3 Existing Project Facilities

A.3.1 Reservoirs

A.3.1.1 Byllesby Development

The Byllesby Development is operated year-round in a run-of-river mode under all flow conditions. Under normal operating conditions, Appalachian operates Byllesby to maintain the headwater between EL. 2,079.2 and 2,078.2 ft[2]. Byllesby has little storage capacity or ability to regulate river flow; inflow is either used for generation or passed through the spillway.

The normal maximum surface area of the reservoir formed by the Byllesby dam is 239 acres at a normal maximum surface EL. 2079.2 ft. The corresponding gross storage capacity of the Byllesby reservoir is approximately 2,000 acre-ft, and the usable storage capacity in the upper 5.2 ft of the pool is approximately 1,153 acre-ft. Table A.3-1 contains Byllesby Development reservoir data. A reservoir storage capacity curve is included in Exhibit B.

Table A.3-1. Byllesby Development Reservoir Data

Drainage area	1,310 square miles
Shoreline length	16.8 miles
Typical surface area	239 acres
Maximum Depth	35 ft
Permanent crest of dam elevation	2,071 ft NGVD
Typical normal surface water elevation	2079.2 ft NGVD
Operations	Run-of-river
Gross Storage capacity	2,000 acre-ft

A.3.1.2 Buck Development

The Buck Development is operated year-round in a run-of-river mode under all flow conditions. Under normal operating conditions, Appalachian operates Buck to maintain the headwater between EL. 2,003.4 and 2,002.4 ft. Buck has little storage capacity or ability to regulate river flow; inflow is either used for generation or passed through the spillway. Because the Buck Development is only approximately three miles downstream from the Byllesby Development, the operation of the two

[2] All elevations are referenced to national Geodetic Vertical Datum of 1929 (NGVD)

developments is closely coordinated, with Buck Development operations dependent on flows through the Byllesby Development.

The Buck reservoir has a surface area of approximately 66 acres at a normal maximum pool EL. 2,003.4 ft.). The corresponding gross storage capacity of the Buck reservoir is approximately 661 acre-ft, and the usable storage capacity in the upper 8.4 ft of the pool is approximately 579 acre-ft. Table A.3-2 contains Buck Development reservoir data. A reservoir storage capacity curve is included in Exhibit B.

Table A.3-2. Buck Development Impoundment Data

Drainage area	1,320 square miles
Shoreline length	5.8 miles
Typical surface area	66 acres
Maximum Depth	20 ft
Permanent crest of dam elevation	1995 ft NGVD
Typical normal surface water elevation	2003.4 ft NGVD
Operations	Run-of-river
Gross Storage capacity	661 acre-ft

A.3.2 Spillway and Dam

A.3.2.1 Byllesby Development

Water-impounding or controlling structures at the Byllesby Development include a main dam/spillway topped with Tainter gates, inflatable Obermeyer crest gates, and flashboard sections; a trash sluice gate; a powerhouse; and an auxiliary (or emergency) spillway surmounted by flashboards. The main spillway extends across the New River perpendicular to the flow. The spillway is a solid, concrete, gravity-type structure approximately 528 ft long by 44 ft high from toe to crest. The crest of the spillway is at elevation 2071 ft. Topping the main spillway, beginning at the western end, are six radial Tainter gates (Bays 1 – 6), three wooden flashboard sections (Bays 7 – 9), five inflatable Obermeyer crest gates (Bays 10 – 14)[3], and one additional wooden flashboard section (Bay 15). The spillway gate configuration is shown on Figure A.3-1.

[3] The first Obermeyer gate was installed in 1998 to replace the flashboards in Bay 14. Two additional bays of Obermeyer gates were installed in 2016 (Bays 12 and 13) and 2018 (Bays 10 and 11).

Each bay is supported by reinforced-concrete piers and is approximately 31 ft, 4 inches wide. The gates and flashboards have a total height of approximately 9 ft. The Tainter gates consist of a steel gate with a radius of 11 ft, 3 inches supported by reinforced-concrete piers. Each gate rotates on a pin. Each Obermeyer gate is also approximately 31 ft, 4 inches wide. The Tainter gates and are opened and closed by means of a hoist powered by an electric motor, and the Obermeyer gates are operated with air compressors installed inside the powerhouse that provide for redundant inflation of the air bladders via stainless steel piping that conveys the compressed air from the receiver tank to the Obermeyer control enclosure. The Tainter gates and Obermeyer gates can be remotely monitored and operated from AEP's 24-hour Columbus Operations Center (COC) in Columbus, Ohio. A propane-powered auxiliary generator is available to support spillway gate operation in case of an electrical outage. A steel-grated foot bridge supported by steel beams on the concrete piers runs the length of the main spillway.

The auxiliary spillway is located upstream and to the west of the powerhouse and to the west of the main spillway. The auxiliary spillway is connected to the powerhouse by an angled 77-ft-long non-overflow bulkhead (or "wingwall") with a crest elevation of 2,085.0 ft and a structural height that varies from 24 ft to 43 ft. The auxiliary spillway is a concrete structure approximately 198 ft long and 6.5 ft high from toe to crest. It is topped by six spans of flashboards approximately 9 ft high. Reinforced-concrete piers support the flashboard sections and an access bridge. The existing access bridge is of metal grating grouted with concrete atop steel beams. The auxiliary spillway discharges into a 600-ft-long channel, excavated from rock, which curves around and empties into the New River further downstream.

The spillway capacity curve for the Byllesby Development is provided in Exhibit B.

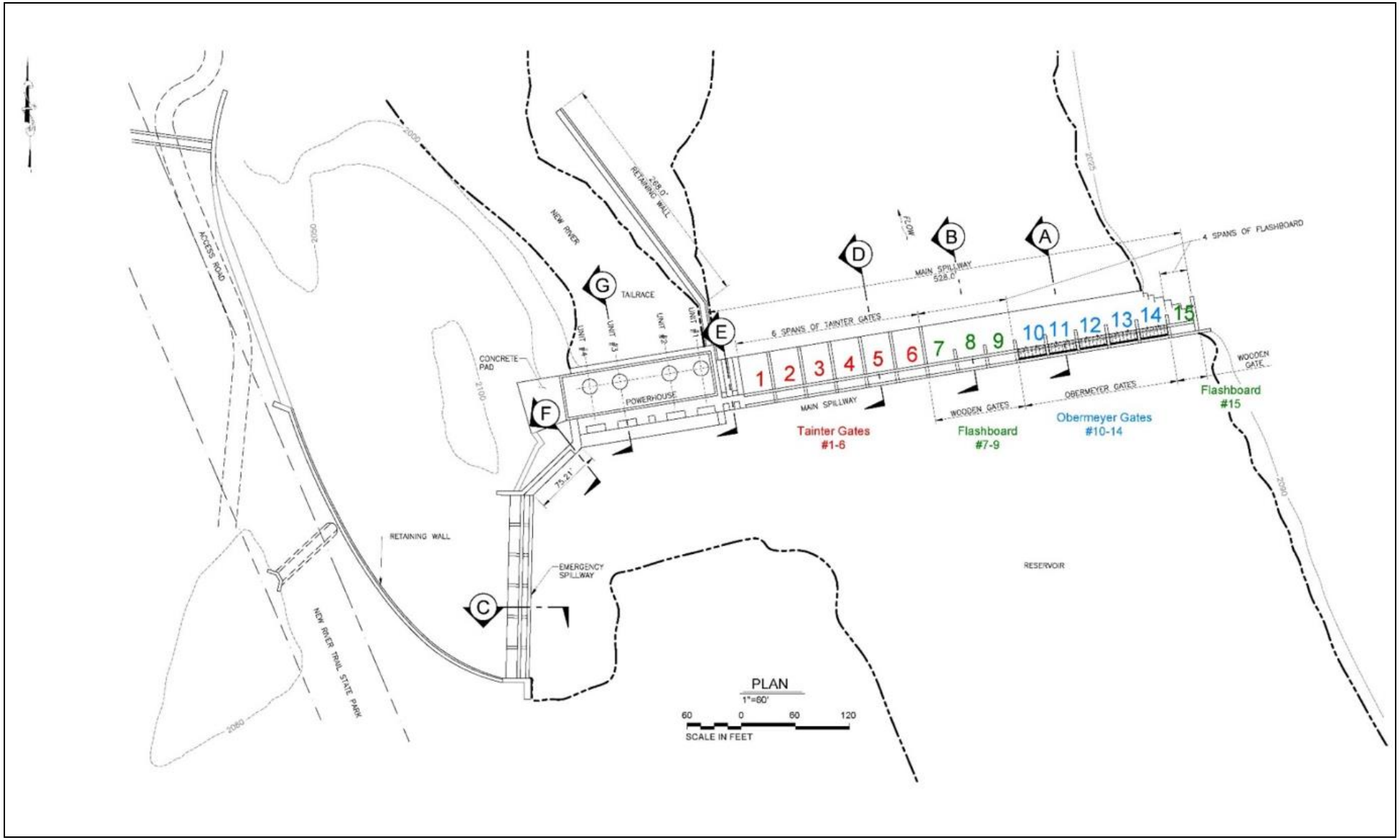


Figure A.3-1. Byllesby Dam Spillway Gates

A.3.2.2 Buck Development

Water-impounding or controlling structures at the Buck Development consist of spillway and main dam sections separated by Mountain (or Buck) Island that is bedrock controlled. The spillway section is located on the south side of the island. From left to right, the spillway section consists of 18 stanchion type flashboard bays, four Obermeyer gate bays, six Tainter gate bays and two additional flashboard bays. To the right of the spillway and approximately 1,300 ft downstream, and on the opposite side of Mountain Island, the 352-ft-long by 44-ft-high main dam consists of a left non-overflow (South Bulkhead) section, powerhouse with integral intake, a trash sluice with a vertical slide gate, and right non-overflow (North Bulkhead) section. The normal headwater at both sections ranges from EL. 2,002.41 ft to 2,003.4 ft. The normal tailwater at the spillway and main dam sections is EL. 1,980.0 ft and 1,962.7 ft, respectively.

The spillway, similar to the Byllesby spillway, is a solid, concrete, gravity-type structure approximately 1,005 ft long by 19 ft high from base to crest. The crest of the spillway is at EL. 1,995 ft. The spillway is flanked at both contacts by non-overflow wingwalls. The spillway is topped with a bridge, constructed of recast, pre-stressed concrete beams, supported atop the spillway gate piers.

Topping the spillway, beginning at the northwestern end, are two wooden flashboard sections supported by reinforced-concrete piers, with widths of 31 ft, 10 inches and 32 ft, 10 inches, respectively, and a height of approximately 9 ft. Adjacent to the flashboard sections are six radial Tainter gate bays (Gates 1 – 6). The spillway gate configuration is shown on Figure A.3-2.

Each Tainter gate bay is approximately 31 ft, 4 inches wide and contains a steel gate of radius 11 ft, 3 inches supported by reinforced-concrete piers. The gates rotate on a pin and are opened and closed by means of a hoist powered by an electric motor. Adjacent to the Tainter gates are four inflatable Obermeyer crest gates (Gates 7 – 10), with each Obermeyer gate measuring 9.2-ft-high by 31.3-ft-wide. The Obermeyer gates are operated with air compressors that provide for redundant inflation of the air bladders. Due to the distance of the spillway from the powerhouse, during installation of the first two Obermeyer gates in 2017, two new air compressors were installed in a newly constructed building adjacent to the spillway, with new stainless steel piping installed to convey the compressed air from the receiver tank to the Obermeyer control enclosure. Both the Tainter gates and Obermeyer gates can be remotely monitored and operated from AEP's 24-hour control COC. A propane-fueled auxiliary generator is available to support spillway gate operation in case of an electrical outrage.

The spillway capacity curve for the Buck Development is provided in Exhibit B.

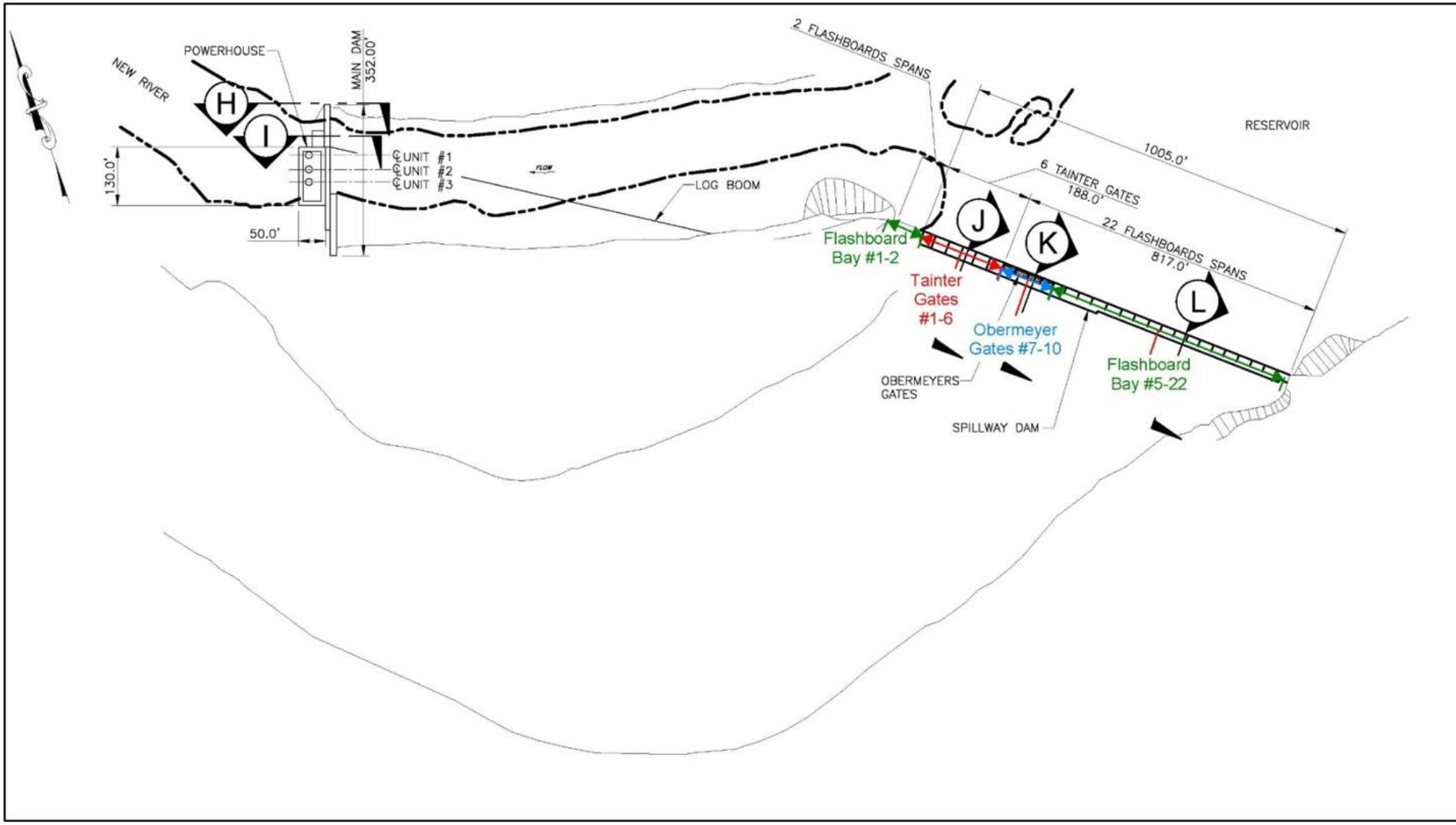


Figure A.3-2. Buck Dam Spillway Gates

A.3.3 Low-Level Outlets and Sluice Gates

A.3.3.1 Byllesby Development

The sluice gate section is a 24-ft-long mass concrete gravity structure located between the powerhouse and main spillway sections and founded directly on bedrock. In 1993, two post-tensioned rock anchors were installed through the downstream face at approximate EL. 2,073.5 and 2,077.2 ft, respectively. The crest of the sluice gate section is at EL. 2,085.0 ft corresponding to a structural height of 63.0 ft. When the Project was originally constructed in 1912, two mud sluice gates were installed between the Byllesby powerhouse and the main spillway. These mud gates have since been taken out of service and concreted in. A steel plate vertical drop gate approximately 6-ft-10 ¼-inch wide by 5-ft high has since been installed in the slots of the western-most mud sluice. This gate is manually lowered and raised by an electric motor-powered hoist.

A.3.3.2 Buck Development

A 36-foot-long sluice gate section is located between the powerhouse and the right non-overflow section. The sluice gate section is constructed of mass concrete socketed into bedrock at and bearing at approximate EL. 1,965.0 ft. In 1993, three vertical post-tensioned rock anchors were installed through the crest at EL. 2,007 ft. The crest of the sluice section is at elevation 2,007.0 ft corresponding to a structural height of 42.0 ft. As for Byllesby, during original Project construction in 1912, two mud sluices and a vertical lift gate were installed in the main dam, immediately adjacent to the north end of the powerhouse. The mud sluices were reportedly abandoned with concrete in-fill in 1930. The sluice gate section also includes a 6-ft-wide by 14-ft-high vertical slide gate, which is manually operated as required to pass flotsam and debris through the sluice.

A.3.4 Forebay and Intake

A.3.4.1 Byllesby Development

The intake section, located immediately upstream of the powerhouse, consists of four inlet bays. Each bay has a 14.5-ft-high by 23-ft-wide headgate, which is used during maintenance periods. A 3-ft-wide, reinforced-concrete pier is set vertically in the middle of each inlet bay to support the headgate. Each headgate is closed and opened by a gear and screw lift shaft assembly powered by an electric motor. Each bay admits water to a concrete volute casing, which channels flow to a vertical-shaft Francis hydraulic turbine direct-connected to a generator on the upper level. Flow through the four turbines passes to concrete draft tubes and into the New River.

The intake section at Byllesby is faced with an intake screen approximately 143 ft wide and consisting of 3/8-inch by 3-1/2-inch steel bars. The bars are 47 ft, 6-3/8 inches long and are inclined

toward the powerhouse at approximately 15 degrees to the vertical. The bars are spaced 2-21/32 inches center-to-center and have a cleared space of 2-9/32 inches.

A logboom consisting of interconnected floating platforms diverts large objects carried by the current away from the powerhouse intakes. The logboom, which is approximately 140 ft long, is anchored on land at one end and adjacent to the vertical drop trash sluice gate on the other end.

A.3.4.2 Buck Development

The Buck intake section, which is immediately upstream of the powerhouse, is of concrete construction and consists of three inlet bays. Each bay has a 14.5-ft-high by 23-ft-wide headgate which is used during maintenance periods. A 3-ft-wide, reinforced-concrete pier is set vertically in the middle of each inlet bay to support the headgate. Each gate is operated by a gear and threaded lift shaft assembly powered by an electric motor. The bays admit water to a concrete volute casing, which channels flow to a vertical-shaft Francis hydraulic turbine, direct-connected to a generator on the upper level. Flow through the three turbines passes to concrete draft tubes and into the New River.

The intake section at Buck is faced with an intake screen approximately 104 ft wide and consisting of 3/8-inch by 3-1/2-inch steel bars. The screen is 39 ft, 2-1/16 inches high and is inclined toward the powerhouse at approximately 15 degrees to the vertical. The bars are spaced 2-21/32 inches center-to-center and have a cleared space of 2-9/32 inches.

A logboom consisting of interconnected floating platforms diverts large objects carried by the current away from the powerhouse intakes. The logboom is anchored at one end to the north shore of Mountain Island, approximately 580 ft upstream of the main dam. The logboom spans approximately 620 ft and anchors at the other end, adjacent to the vertical lift trash sluice gate.

A.3.5 Bypass Reach

A.3.5.1 Byllesby Development

The Byllesby Development includes a 590-ft-long bypass reach consisting primarily of exposed bedrock and rock outcroppings. This reach normally receives only leakage flow, unless flows are being spilled at the dam or the flashboards are breached.

A.3.5.2 Buck Development

The Buck Development has a 4,100-ft-long, steep bypass reach consisting of exposed bedrock. This reach normally receives only leakage flow, unless flows are being spilled at the dam or the flashboards are breached.

A.3.6 Powerhouse

A.3.6.1 Byllesby Development

The Byllesby powerhouse is located to the west of the main spillway. The powerhouse is a 151-ft-long reinforced concrete water retaining structure with a 170-ft-long steel frame and brick superstructure. Four generators and their respective governors and exciters, pumps, a gantry crane and miscellaneous accessory equipment necessary for operation are housed in the upper level of the powerhouse. The powerhouse is supported directly on bedrock. The intake invert is at EL. 2,040.0 ft and the deck is at EL. 2,085.0 ft. The upstream substructure wall is integral with both the left non-overflow structure to the left and sluice gate section to the right. There are no means for passing flows through the powerhouse other than through the turbines. The vertical drop sluice gate, located between the powerhouse and main spillway sections, provides the closest spill location, but this release is to the spillway tailwater and not the powerhouse tailrace.

A.3.6.2 Buck Development

The powerhouse, located at the main dam, includes a 116-ft-long reinforced concrete water retaining substructure with a 132-ft-long steel frame and brick superstructure. The powerhouse has two levels. Three generators, and their respective governors and exciters, switchboards, switching equipment, pumps, a gantry crane and miscellaneous accessory equipment necessary for project operation are housed in the upper level of the powerhouse. The powerhouse is supported directly on bedrock at approximate EL. 1,964 ft. The intake invert is at EL. 1,969 ft and upstream intake deck slab is at EL. 2,007.0 ft. The substructure walls are integral with the left non-overflow section and sluice gate section to the right. There are no means for passing flows through the powerhouse other than through the turbines. Flows to the Buck tailrace can be provided via the vertical slide gate located in the sluice section located between the powerhouse and the right non-overflow section.

A.4 Existing and Proposed Turbines and Generators

A.4.1 Authorized Installed Capacity - Existing

The Project's installed capacity is presently considered by FERC to be 30.1 MW, representing 21.6 MW at Byllesby and 8.5 MW at Buck (Appalachian 2019). These values are based on the capacities

of the generators, which was the basis for installed capacity at the time of the last relicensing. Based on the installed nameplate ratings and the method now used by FERC to calculate authorized installed capacity (18 CFR §11.1(i)), the existing installed capacities for the Byllesby and Buck developments, should be considered 18 MW and 8.087 MW, respectively, for a total authorized installed capacity of 26.087 MW. A summary of existing and proposed, as described and proposed below, authorized installed capacities for both developments is provided at the end of this section in Table A.4-5.

A.4.2 Byllesby Development

A.4.2.1 Existing Equipment

The powerhouse contains four, vertical Francis-type turbine generator units (Nos. 1 through 4 from right to left) under a normal gross head of 56.4 ft, each direct-connected to a generator on the upper level. The turbine units were manufactured by I.P. Morris Company in 1912 and contain 16 buckets per runner. The edge-to-edge diameter of the runners is 8-ft 9-inches measured at the bottom of the runner, inside the band. There are 20 cast iron wicket gates at each hydraulic turbine with heights of 2-ft 11-inches to 15/16-inches each. The wicket gates are placed in a circular pattern at a radial dimension of 4-ft 11-inches from the centerline of the turbine shaft to the pivot point of each gate. By adjusting the openings between the wicket gates, flow to the turbine is controlled. Outside of the wicket gates are ten stay vanes arranged in a circular pattern at a radial distance of 7 ft from the centerline of the turbine shaft to the leading edge of the stay vane. The stay vanes are stationary and are used to control the direction of flow and to support the structure overhead.

Maximum flow of 1,360 cubic ft per second (cfs) through each unit (total capacity of 5,440 cfs) is discharged through four draft tubes into a 300-ft-long tailrace defined by the bedrock outcrop (island) on the left and a concrete training wall on the right. The right training wall separates the powerhouse discharge from the main spillway. In 1993, 12 vertical post-tensioned rock anchors (P-1 through P-12) were installed through the piers on the upstream side of the intake deck at elevation 2,085.0 ft.

Each Byllesby turbine is rated at 6,000 horsepower (hp) at a 49 ft design head and has a rated speed of 116 rotations per minute (rpm). Based on design curves, one unit can pass 1,467 cfs at 5,265 kilowatt (kW) turbine-generator output and a 56 ft net head.

The four AC generators, located in the upper level of the Byllesby powerhouse, are identical and were manufactured by the General Electric Company. These generators have been in service since 1912. They are rated at 5,400 kW at 90 percent power factor, 3 phase (PH), 60 cycles and 13,200 volts (V). Each 62 pole generator has a rotor speed of 116 rpm at 60 Hertz (Hz).

Each generator has an inside diameter of 13-ft 4-inch and contains 93 coils. Each coil slot is 42 and 1/8 inches high by 1.45 inches wide by 2.93 inches deep. Pertinent turbine and generator data for Byllesby is included in Table A.4-1.

Table A.4-1. Byllesby Development Turbine and Generator Data - Existing

Turbines	
Number of Units	4
Type	Vertical Francis, I.P. Morris Co.
Design Head	49 ft
Rated Capacity	6,000 hp / 4,500 kW (each unit)
Minimum Discharge	325 cfs (per unit)
Maximum Discharge	1,467 cfs (per unit)
Operating Speed	116 rpm
Generators	
Type	Vertical configuration, General Electric Co.
Rated Capacity	5,400 kW (per unit)
Power Factor	0.9
Phase	3 PH (per unit)
Voltage	13,200 V (per unit)
Frequency	60 Hz (per unit)
Synchronous Speed	116 rpm (per unit)

A.4.2.2 Proposed Upgrade

All of the turbine-generator units at the Byllesby Development are the original major components of the Project as constructed in 1912. Unit 4 is presently off-line and has been deemed by Appalachian to be non-repairable. Many of the major electrical and mechanical and supporting systems and components at Byllesby are nearing the end of their useful service life, when compared to industry-recognized standards. Appalachian proposes to modernize the Byllesby Development during the new license term to include replacement of Byllesby Units 1, 2, and 4. Byllesby Unit 3 would remain as-is and, following completion of the upgrades, would be operated in a last-on/first-off sequence.

Appalachian proposes to replace each existing vertical Francis turbine with a vertical Kaplan turbine. The most efficient point (MEP) operation setting for each new unit at the design head of 54 ft is

91.69 turbine efficiency, representing a unit discharge of approximately 1,348 cfs. The new Kaplan turbines would each have 5 runner blades, 16 wicket gates, and a runner diameter of 8.7 ft.

Each turbine upgrade will include:

- Mavel KV2650K5 Kaplan turbine including stay ring, operating ring, wicket gate mechanism, upper distributor ring, and wicket gates;
- Hydraulic Power Unit (HPU) with accumulator tank for control of the wicket gates, blades, and brake;
- Wicket gate, blade, and brake servomotors;
- Sensors for control and monitoring of the turbine;
- Steel portion of a replacement section of the draft tube;
- Civil work as needed to facilitate installation; and
- Controls, cabling, switchgear, and other electrical work.

Appalachian is also presently proposing to replace each generator. The highest efficiency point of the new generators would be approximately 96.9 percent at 100 percent load.

Proposed upgraded turbine and generator parameters for the Byllesby Development are presented in Table A.4-2.

Table A.4-2. Byllesby Development Turbine and Generator Data – Proposed (Upgrades to Units 1, 2, and 4)

Turbines	
Number of Units	4
Type	**Units 1, 2, and 4:** Vertical Kaplan, Mavel **Unit 3:** Vertical Francis, I.P. Morris Co.
Design Head	**Units 1, 2, and 4:** 56 ft **Unit 3:** 49 ft
Rated Capacity	**Units 1, 2, and 4:** 7,371 hp / 5,528 kW (per unit) **Unit 3:** 6,000 hp / 4,500 kW
Minimum Discharge	**Units 1, 2, and 4:** 350 cfs (per unit) **Unit 3:** 325 cfs
Maximum Discharge	**Units 1, 2, and 4:** 1,348 cfs (per unit) **Unit 3:** 1,467 cfs
Operating Speed	**Units 1, 2, and 4:** 189.47 rpm **Unit 3:** 116 rpm
Generators	
Type	**Units 1, 2, and 4:** Vertical configuration, Mavel **Unit 3:** Vertical configuration, General Electric Co.
Rated Capacity	**Units 1, 2, and 4:** 5,885 kVA / 5,296.5 kW (per unit) **Unit 3:** 5,400 kW (per unit)
Power Factor	0.9
Phase	3 PH (per unit)
Voltage	13,200 V (per unit)
Frequency	60 Hz (per unit)
Synchronous Speed	**Units 1, 2, and 4:** 189.47 rpm (per unit) **Unit 3:** 116 rpm

A.4.3 Buck Development

A.4.3.1 Existing Equipment

Within the substructure of the Buck powerhouse are housed three vertical-shaft Francis hydraulic turbines, each direct-connected to a generator on the upper level. The three turbine units at Buck were manufactured by I.P. Morris Company in 1912. Unit 2 was refurbished in 2006 with an in-kind American Hydro runner replacement. The dimensions and configuration of each turbine's runner, wicket gates and stay vanes are identical to those of the Byllesby turbine units. Maximum flow of

1,180 cfs through each unit (total capacity of 3,540 cfs) is discharged through three draft tubes into the tailrace channel that was excavated into bedrock. Based on design curves, one unit can pass 1,180 cfs at 3,158 kW turbine-generator output and a 40 ft net head. In 1993, seven vertical post-tensioned rock anchors were installed through the concrete piers on the upstream side of the intake deck at elevation 2,007 ft. Each of the three turbines at Buck is rated at 3,500 hp at a 34 ft design head and has a rated speed of 97 rpm.

The three AC generators, located in the upper level of the Buck Powerhouse, are identical and were manufactured by the General Electric Company. These generators have been in service since 1912. They are rated at 2,835 kW at 90 percent power factor, 3 PH, 60 cycles and 13,200 V. Each 74 pole generator has a rotor speed of 97 rpm at 60 Hz.

Each generator stator has an inside diameter of 15-ft 10-inches and contains 222 coils. Each coil slot is 23 and 7/8 inches high by 1.312 inches wide by 3.75 inches deep. The Buck development has a total installed capacity of 8.087 MW. The turbines discharge into a tailrace channel that is approximately 1,700 ft long and 70 ft wide. The depth of the channel is fairly uniform downstream of the immediate vicinity of the powerhouse, averaging 6.5 to 10 ft at a point 160 ft downstream of the powerhouse. Pertinent turbine and generator data for the Buck Development is included in Table A.4-3.

Table A.4-3. Buck Development Turbine and Generator Data - Existing

Turbines	
Number of Units	3
Type	**Units 1 and 3:** Vertical Francis, I.P. Morris Co. **Unit 2:** American Hydro
Design Head	34 ft
Rated Capacity	**Units 1 and 3**: 3,500 hp / 2,626 kW **Unit 2:** 4,480 hp / 3,360 kW
Minimum Discharge	275 cfs (per unit)
Maximum Discharge	1,180 cfs (per unit)
Operating Speed	97 rpm
Generators	
Type	Vertical configuration, General Electric Co.
Rated Capacity	2,835 kW (per unit)
Power Factor	0.9
Phase	3 PH (per unit)
Voltage	13,200 V (per unit)
Frequency	60 Hz (per unit)
Synchronous Speed	97 rpm (per unit)

A.4.3.2 Proposed Upgrade

Two of three turbine-generator units at the Buck Development are the original major components of the Project as constructed in 1912. Many of the major electrical and mechanical and supporting systems and components at Buck are nearing the end of their useful service life, when compared to industry-recognized standards. Appalachian proposes to modernize the Buck Development during the new license term to include replacement of Buck Units 1 and 3.

Appalachian proposes to replace two of the existing vertical Francis turbine with vertical Kaplan turbines. The MEP operation setting for each new unit at a design head of 42.4 ft is 91.59 turbine efficiency, representing a unit discharge of approximately 930 cfs. The new Kaplan turbines would each have 5 runner blades, 16 wicket gates, a runner diameter of 8.7 ft, and a runner setting of 1,981.89 ft.

Each turbine upgrade will include:

- Mavel KV2650K5 Kaplan turbine including stay ring, operating ring, wicket gate mechanism, upper distributor ring, and wicket gates;

- HPU with accumulator tank for control of the wicket gates, blades, and brake;
- Wicket gate, blade, and brake servomotors;
- Sensors for control and monitoring of the turbine;
- Steel portion of a replacement section of the draft tube;
- Civil work as needed to facilitate installation; and
- Controls, cabling, switchgear, and other electrical work.

Appalachian is also presently proposing to replace each generator. The highest efficiency point of the new generators would be approximately 96.9 percent at 100 percent load.

Proposed upgraded turbine and generator parameters for the Buck Development are presented in Table A.4-4.

Table A.4-4. Buck Development Turbine and Generator Data – Proposed (Upgrades to Units 1 and 3)

Turbines	
Number of Units	3
Type	**Units 1 and 3:** Vertical Kaplan, Mavel **Unit 2:** Vertical Francis, American Hydro
Design Head	**Units 1 and 3:** 42.4 ft **Unit 2:** 34 ft
Rated Capacity	**Units 1 and 3**: 4,400 hp / 3,300 kW (per unit) **Unit 2:** 4,480 hp / 3,360 kW
Minimum Discharge	**Units 1 and 3:** 300 cfs (per unit) **Unit 2:** 275 cfs
Maximum Discharge	**Units 1 and 3:** 1,195 cfs (per unit) **Unit 2:** 1,180 cfs
Operating Speed	**Units 1 and 3:** 156.52 rpm **Unit 2:** 97 rpm
Generators	
Type	**Units 1 and 3:** Vertical configuration, Mavel **Unit 2:** Vertical configuration, General Electric Co.
Rated Capacity	**Units 1 and 3:** 4,100 kVA / 3,690 kW (per unit) **Unit 2:** 2,835 kW
Power Factor	0.9
Phase	3 PH (per unit)
Voltage	13,200 V (per unit)
Frequency	60 Hz (per unit)
Synchronous Speed	**Units 1 and 3:** 156.52 rpm **Unit 2:** 97 rpm

A.4.4 Authorized Installed Capacity - Proposed

Table A.4-5 presents a comparison of the existing and proposed authorized installed capacities for the existing and proposed units. Based on the installed nameplate ratings and the method used by FERC to calculate authorized installed capacity (18 CFR §11.1(i)), with the proposed upgrades, the authorized installed capacities for the Byllesby and Buck developments will be 20.3895 MW and 9.435 MW, respectively, for a total authorized installed capacity of 29.8245 MW.

Table A.4-5. Existing and Proposed Unit Comparison

Development	Unit	Existing Units				Proposed Units			
		Turbine Rating (kW)	Maximum Turbine Discharge (cfs)	Generator Rating (kW)	Authorized Installed Capacity (kW)	Turbine Rating (kW)	Maximum Turbine Discharge (cfs)	Generator Rating (kW)	Authorized Installed Capacity (kW)
Byllesby	1	4,500.0	1,467.0	5,400.0	4,500.0	5,528.0	1,348.0	5,296.5	5,296.5
	2	4,500.0	1,467.0	5,400.0	4,500.0	5,528.0	1,348.0	5,296.5	5,296.5
	3	4,500.0	1,467.0	5,400.0	4,500.0	4,500.0	1,467.0	5,400.0	4,500.0
	4	4,500.0	1,467.0	5,400.0	4,500.0	5,528.0	1,348.0	5,296.5	5,296.5
	Total	**18,000.0**	**5,868.0**	**21,600.0**	**18,000.0**	**21,084.0**	**5,511.0**	**21,289.5**	**20,389.5**
Buck	1	2,626.0	1,180.0	2,835.0	2,626.0	3,300.0	1,195.0	3,690.0	3,300.0
	2	3,360.0	1,180.0	2,835.0	2,835.0	3,360.0	1,180.0	2,835.0	2,835.0
	3	2,626.0	1,180.0	2,835.0	2,626.0	3,300.0	1,195.0	3,690.0	3,300.0
	Total	**8,612.0**	**3,540.0**	**8,505.0**	**8,087.0**	**9,960.0**	**3,570.0**	**10,215.0**	**9,435.0**
				Total	**26,087**			**Total**	**29,824.5**

A.5 Transmission

Project power connects to AEP's 69 kV distribution system at the single generator step-up transformer (GSU) located within the Byllesby switchyard (also known as the Byllesby 69 kV substation). The GSU is connected to the single 13.2 kV bus located within the Byllesby control house. Generator leads for each of the four Byllesby units are connected to this 13.2 kV bus. Generator leads for the three Buck units are connected to a common 13.2 kV bus within the Buck powerhouse, which is in turn connected to the two approximately 2-mile-long overhead 13.2 kV lines (Byllesby Buck #1 and Byllesby Buck #2) that cross the New River near the Buck spillway and extend to the Byllesby control house, where they connect to the 13.2 kV bus within. The GSU steps up the 13.2 kV generator voltage to 69 kV to match the voltage on the electrical distribution system.

Since constructed in 1911-1912, the Byllesby and Buck developments have been connected to a single transformer station located at the large "control house" building near the Byllesby powerhouse. The control house is located southwest of the Byllesby auxiliary spillway and several hundred feet back from the river. It is a two-level, rectangular, steel-framed, brick-walled building, surrounded by transformers and other appurtenant equipment. The building's interior contains offices, a maintenance area, and control rooms.

Primary transmission lines at the Project are limited to two approximately 2-mile long overhead 13.2-kV transmission lines (Byllesby Buck #1 and Byllesby Buck #2), which extend from the 13.2 kV bus within the Buck powerhouse to the 13.2 kV bus within the Byllesby control house.

Primary transmission lines at the Project are limited to the two 13.2-kV transmission lines (Byllesby Buck #1 and Byllesby Buck #2), which extend from the 13.2 kV bus within the Buck powerhouse to the 13.2 kV bus within the Byllesby control house.

Appurtenant mechanical, electrical, and transmission equipment required for efficient operation of the Byllesby powerhouse includes 13.2-kV generator leads to a 13.2-kV bus, the 13.2-kV bus, a 13.2-kV line from the bus to a 13.2/69 kV transformer, the 13.2/69 kV transformer, and the 69-kV connection from the transformer to the 69-kV transformer bus. Appurtenant mechanical and electrical equipment required for efficient operation of the Buck powerhouse includes 13.2-kV generator leads to a 13.2-kV bus, the common 13.2-kV bus, and 13.2-kV lines from the bus to the 13.2-kV Byllesby/Ivanhoe lines.

Specifications of additional mechanical and electrical equipment appurtenant to the Byllesby/Buck Hydroelectric Project are included in Table A.5-1 and Table A.5-2. The Project's single-line electrical diagram is included in Volume V of this draft license application (filed as CEII).

Table A.5-1. Appurtenant Mechanical, Electrical, and Transmission Equipment – Byllesby Development

Equipment		Manufacturer	Description
1)	Exciters	Allis-Chalmers Mfg. Co.	4-Type G Statex, Solid State, 75, kW, 250 V DC, 300 AMP
2)	Automatic Circuit Breaker	General Electric Company	Type C, Form K. 2,000 amps, 250 V
3)	Powerhouse Gantry Crane	Alliance	57/5 Tom capacity
4)	Actuators	Woodward Governor Co.	Type A
5)	Trash Rakes	Northfork Electric	Dragrake operated by system of motorized cable hoists that move a raking beam in a cyclical motion
6)	Motor Hoist & Controls	Harnischfeger Corporation	Gear and screw lift shaft assembly
7)	and other mechanical and electrical equipment required for efficient operation of the Project, including the following transmission equipment:		
	a)	The 13.2 kV generator leads to the 13.2 kV bus;	
	b)	The 13.2 kV bus (located within the Byllesby control house);	
	c)	The 13.2 kV line from the bus to the 13.2/69 kV transformer;	
	d)	The 13.2/69 kV transformer (located within the switchyard adjacent to the Byllesby control house);	
	e)	The 69 kV connection from the transformer to the 69 kV transformer bus (located within the switchyard adjacent to the Byllesby control house).	

Table A.5-2. Appurtenant Mechanical, Electrical, and Transmission Equipment – Buck Development

Equipment		Manufacturer	Description
1)	Motor Generator Exciter	Westinghouse Electric	1 – Type SK. DC Gen. 150 kW, 250 V, 600 amps, 1,180 rpm speed, shunt wound, style 6G6959
2)	Powerhouse Gantry Crane	Alliance	44/5 Ton Capacity
3)	Actuators	Woodward Governor Co.	Type A
4)	Trash Rake	Northfork Electric	Dragrake operated by system of motorized cable hoists that move a raking beam in a cyclical motion

Equipment			Manufacturer	Description
5)	Motor Hoist & Controls		Harnischfeger Corp.	Gear and threaded lift shaft assembly
6)	and other mechanical and electrical equipment required for efficient operation of the Project, including the following transmission equipment:			
	a)	The 13.2 kV generator leads to the 13.2 kV bus;		
	b)	The common 13.2 kV bus (located within the Buck powerhouse);		
	c)	The 13.2 kV line from the bus to the 13.2 kV Byllesby-Buck #1 and #2 transmission lines.		

A.6 Lands of the United States

The transmission corridor crosses 7.23 acres of federal lands (Jefferson National Forest). Appalachian understands these lands to be held in easement as the corridor pre-dates the Jefferson National Forest.

Most the land to the west of the Project is owned by the U.S. Forest Service and consists of the George Washington and Jefferson National Forest. The Mount Rogers National Recreation Area, a unit within the Jefferson National Forest and created in 1966, borders the Project to the west. These lands include approximately 100 acres of former Project lands that were transferred by Appalachian to the U.S. Forest Service in 1984, and subsequently removed from the Project Boundary, as authorized by FERC order dated December 18, 1984.

This page intentionally left blank.

FINAL LICENSE APPLICATION

BYLLESBY-BUCK HYDROELECTRIC PROJECT

(FERC NO. 2514)

EXHIBIT B

PROJECT OPERATION AND RESOURCE UTILIZATION

This page intentionally left blank.

Exhibit B - Project Operation and Resource Utilization (18 CFR §4.51(c))

B.1 Description of Plant Operations

B.1.1 Drainage Basin Description

The Byllesby and Buck developments (collectively the Project) are situated in the upper New River Basin (Hydrologic Unit Code 0505001) which extends from the Bluestone Dam near Hinton, West Virginia, to the headwaters of the New River's north and south forks in northwestern North Carolina near Blowing Rock. The New River originates in the mountainous northwest corner of North Carolina at approximate EL. 3,700 ft and extends northward into Virginia and eventually empties into the Ohio River in West Virginia. The Byllesby Development is approximately 3 miles upstream of the Buck Development. The drainage area is 1,310 square miles for Byllesby and 1,320 square miles for Buck.

The New River originates in North Carolina at the confluence of the North Fork New River and the South Fork New River. It then flows northward for 320 miles through Virginia before entering West Virginia and flowing to the confluence of the Gauley River forming the Kanawha River, a tributary to the Ohio River. The New River flows through valleys ranging in width from 200 to 1,000 ft and has banks with precipitous bluffs and steep side slopes; steep gradients throughout much of the upper basin result in increased overland runoff and high flow velocities.

B.1.2 Project Operation

During the term of a new FERC license, Appalachian proposes to continue operating the Byllesby-Buck Hydroelectric Project in a run-of-river mode with a 1-ft normal reservoir operating band at each development. There are no proposed changes to mode of operation.

The Project operates in a run-of-river mode under all flow conditions. Because the Buck Development is approximately three miles downstream from the Byllesby Development, operations of the two developments are closely coordinated and operations at Buck are dependent on flows through Byllesby. Under normal operating conditions, Appalachian operates the Project to use available flows for powerhouse generation, maintaining the elevation of the Byllesby reservoir between EL. 2,078.2 ft and 2,079.2 ft and the Buck reservoir between EL. 2,002.4 ft and 2,003.4 ft.

Appalachian is also required to release a minimum flow of 360 cfs or inflow to the Project, whichever is less, downstream of the Project powerhouses.

Under normal operating conditions, the minimum flow requirements and normal headwater elevation is maintained by passing flow through the turbine generating units. The unit operations are monitored and controlled either locally from the plant's computer or remotely from AEP's COC in Columbus, Ohio. Tainter gate and Obermeyer gate operation at both Byllesby and Buck are also remotely controlled from AEP's COC. Operators are stationed at the control center twenty-four hours per day, seven days per week. Plant personnel are typically present at the Project during normal working hours Monday through Thursday to perform routine maintenance. The plant is staffed four days a week (typically Monday through Thursday), 10 hours a day during normal operating conditions.

As further described in the section below, when inflow to either development exceeds the discharge capacity of the powerhouse (5,868 cfs for Byllesby and 3,540 cfs for Buck), the Tainter gates and/or Obermeyer gates are opened to pass the excess flow. Gate openings are planned and based on monitoring of the U.S. Geological Survey (USGS) gage 0316400, New River near at Galax, VA and Byllesby and Buck forebay elevations. Note AEP uses the Galax USGS gage to inform real-time operations, but USGS gage 03165500 New River at Ivanhoe provides a more complete history of flow conditions at the Project. If inflows exceed the capacity of the Tainter and Obermeyer gates, the wooden flashboards are manually released. The wooden flashboards must then be subsequently re-installed during a period when the reservoir is drawn down to the spillway crest elevation.

Ramping rates are required under Article 406 of the license for the protection of fish resources downstream of the Buck spillway. The gradual reduction of flow allows fish to progressively leave the area, versus possible stranding at sudden flow discontinuation. Following periods of spill from the Buck spillway when a spillway gate has been opened 2 ft or more, Appalachian is required to discharge flows through a 2-ft gate opening for at least three hours. Appalachian is then required to reduce the opening to 1 ft for at least an additional 3 hours, after which Appalachian may close the gate.

The frequency of spills to the bypass reaches during the period of record (POR), as well as dry and wet years, is presented in Table B.1-1. The values in the table below indicate the percentage of time in a given period where Project flows exceeded the hydraulic capacity of the powerhouse, which is the same as the percentage of time where there would have been spills to the bypass reach.

Table B.1-1. Exceedance Probability of Discharge to the Bypass Reaches at Byllesby and Buck Dams

	Buck (3,540 cfs)			Byllesby (5,868 cfs)		
	1996-2020	2008	2020	1996-2020	2008	2020
Annual	15.5%	6.0%	39.6%	10.8%	3.8%	28.4%
Jan	20.5%	0.0%	25.8%	14.7%	0.0%	19.4%
Feb	22.0%	0.0%	65.5%	15.8%	0.0%	44.8%
Mar	25.3%	22.6%	29.0%	16.4%	12.9%	19.4%
Apr	27.1%	3.3%	63.3%	18.1%	0.0%	36.7%
May	21.7%	0.0%	74.2%	14.7%	0.0%	64.5%
Jun	14.1%	0.0%	73.3%	10.0%	0.0%	50.0%
Jul	5.9%	0.0%	0.0%	5.3%	0.0%	0.0%
Aug	8.0%	32.3%	22.6%	5.8%	29.0%	19.4%
Sep	6.8%	6.7%	26.7%	5.3%	0.0%	20.0%
Oct	7.7%	0.0%	29.0%	5.4%	0.0%	22.6%
Nov	10.9%	0.0%	40.0%	7.6%	0.0%	30.0%
Dec	16.3%	6.5%	29.0%	11.0%	3.2%	16.1%

Note: 2008 was the driest average year of the 25-year record. 2020 was the wettest average year of the 25-year record. Data based on operational model and prorated hydrology data from USGS 03165500.

B.1.3 Flood Operations

B.1.3.1 Byllesby

When flows exceed the hydraulic capacity of the units during normal high-water events (approximately 5,868 cfs), the Tainter gates are opened in sequence from right to left towards the powerhouse. Tainter Gate No. 6 is opened first using a dedicated electric hoist and primary power provided through the powerhouse. When Tainter Gate No. 6 reaches the full-open position, the Obermeyer gates are opened. The Obermeyer gates are opened sequentially from right to left beginning with Bay No. 14, furthest from the powerhouse. (As flows recede, the gates are closed in reverse order of opening.) Tainter Gate No. 5 is used to manage river flows while the Obermeyer gates are being opened. The Tainter gates and Obermeyer gates are automated and can be remotely operated from the COC or manually on-site. The sluice gate is operated locally as needed to pass debris. The Obermeyer gates can also be used to sluice debris, as needed. The plant is staffed 24 hours per day, 7 days per week during unusual (i.e., flood) conditions when all the gates are in full-open position.

In advance of a forecast of two or more inches of rain, AEP may determine that a reservoir drawdown below EL. 2,078.2 ft is needed. Mutual agreement is also required for drawdown below EL. 2,078.2 ft.

During flood-stage flows, all generating units at the powerhouse may be shut down due to the loss of operating head. As the reservoir continues to rise, and with all gates in the full-open position, the main dam flashboards are manually released as required to maintain the reservoir at or below EL. 2,081.5 ft. Flashboards are manually tripped at approximately 43,102 cfs. The Byllesby auxiliary spillway is operated after all Tainter and Obermeyer gates have been opened and all wooden flashboard sections have been released, typically at flows in excess of 46,690 cfs. Each flashboard stanchion is released by striking a release pin with a hand-held steel bar, shearing a nail through the pin, allowing the stanchion to drop. The release is accessed via a sleeve through the spillway bridge deck. The flashboard release sequence varies with flashboard sections with old or deteriorated timber members being released first. The flashboards are released only after all six Tainter gates and five Obermeyer gates are fully opened and the reservoir level continues to rise. The Water Filtration Plants at Ivanhoe and Allisonia are notified before releasing flashboards. Prior to releasing the auxiliary spillway flashboards, the Emergency Action Plan (EAP) for the Project is activated.

During extreme flood conditions, once all the flashboards are released, the powerhouse unit head gates are closed, the powerhouse is de-energized and abandoned in preparation of dam overtopping. The powerhouse bulkhead door is closed to minimize flooding of the powerhouse.

The non-overflow (angled bulkhead) section begins to overtop at reservoir EL. 2,085.0 ft rendering the powerhouse and main spillway inaccessible. The spillway walkway and left abutment area are overtopped at reservoir EL. 2,087.5 ft, and flows proceed downstream to the Buck Development. The powerhouse generator floor at EL. 2,048.0 ft would be flooded by high tailwater when flows reached 192,000 cfs, based on tailwater rating curves.

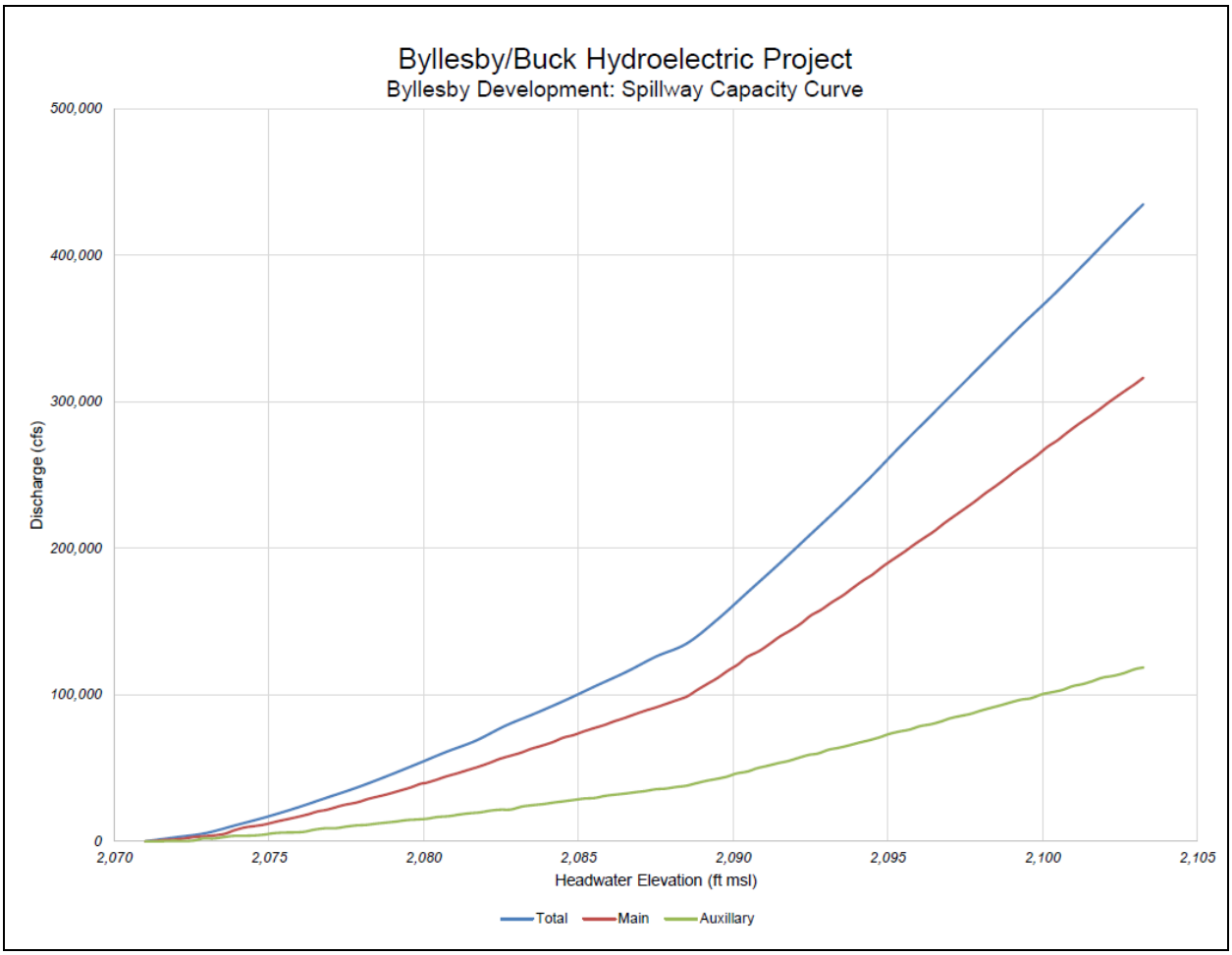


Figure B.1-1. Byllesby Spillway Capacity Curve

B.1.3.2 Buck

During high flows that exceed the hydraulic capacity of the generating units (approximately 3,540 cfs), the Tainter gates are opened in the following sequence: 1, 2, 3, 4, 5, and 6 using a dedicated electric hoist and primary power provided through the powerhouse. The four Obermeyer gates are then operated sequentially 7 through 10 to maintain the reservoir at EL. 2,003.4 ft. (As flows recede, the gates are closed in reverse order of opening.) The plant is staffed 24 hours per day, 7 days per week during unusual (i.e., flood) conditions when all the gates are in full-open position. The Tainter gates and Obermeyer gates are automated and can be remotely operated from the COC or manually on-site. The Obermeyer gates can be used to sluice debris, as needed. The plant is staffed 24 hours per day, 7 days per week during unusual (i.e., flood) conditions when all the gates are in full-open position.

In advance of a forecast of two or more inches of rain, AEP may determine that a reservoir drawdown below EL. 2,002.4 ft is needed. Agency approval is also required for drawdown below elevation 2,002.4 ft.

As the reservoir continues to rise, and with all gates in the full-open position, the flashboards are manually released as required to maintain the reservoir at or below EL. 2,005.5 ft. Flashboards are manually tripped at approximately 34,872 cfs. Each flashboard stanchion is released by striking a release pin with a hand-held steel bar, shearing a nail through the pin, allowing the stanchion to drop. The release is accessed via a sleeve through the spillway bridge deck. The flashboard release sequence varies with flashboard sections with old or deteriorated timber members being released first. The flashboards are released only after all six Tainter gates and four Obermeyer gates are fully opened, and the reservoir level continues to rise. The Water Filtration Plants at Ivanhoe and Allisonia are notified before releasing flashboards. The plant is staffed 24 hours per day, 7 days per week during unusual (i.e., flood) conditions when all the gates are in the full-open position.

During extreme floods, once all the flashboards are released, the powerhouse unit head gates are closed, the powerhouse is de-energized, bulkhead doors closed, and all staff would move upland in preparation of dam overtopping. The powerhouse bulkhead door is closed to minimize flooding of the powerhouse. Prior to leaving the powerhouse, downstream communication is given in accordance with the EAP for the Project.

The main dam non-overflow sections and the spillway abutment at Mountain Island and wingwall sections begin to overtop at reservoir EL. 2,007.0 ft rendering the powerhouse, non-overflow sections and spillway bridge inaccessible. The spillway deck and left abutment are overtopped at reservoir EL. 2,010.0 ft. The powerhouse generator floor at EL. 1986.5 ft would be flooded by high tailwater when flows reached 175,000 cfs, based on tailwater rating curves.

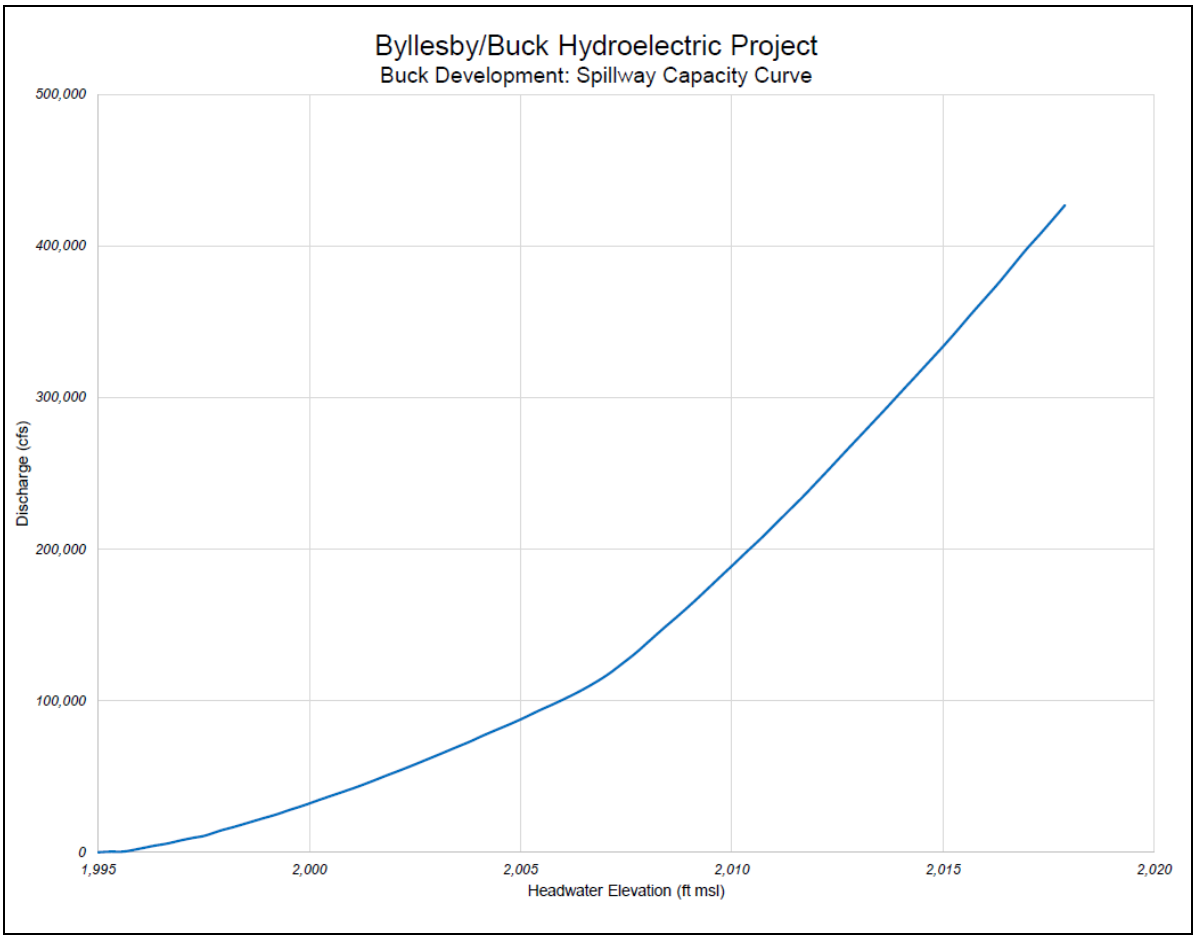


Figure B.1-2. Buck Spillway Capacity Curve

B.1.4 Plant Factor

The annual plant factor is the ratio of estimated average annual generation from the plant (in megawatt hours per year [MWh/yr]) to the energy that the plant might produce if it operated at full capacity for one year. Based on historical generation results, the plant factors at Byllesby and Buck are 34.2 percent and 55.3 percent, respectively. Following completion of the unit upgrades proposed by Appalachian, the plant factors are estimated to be 38.65 percent for Byllesby and 52.93 percent for Buck.

B.2 Estimated Energy Production and Dependable Capacity of the Project

B.2.1 Generation

Average annual historical generation at Byllesby and Buck over the past 50 years (approximately) is 53,913 MWh and 39,197 MWh, respectively. With the turbine-generator upgrades proposed by

Appalachian for the new license term (Byllesby Units 1, 2, and 4 and Buck Units 1 and 3), average annual generation at the Byllesby and Buck developments is expected to increase to 70,600 and 48,220 MWh, respectively. Without the unit replacements, generation production and plant factors will degrade, and the probability of equipment failure will increase.

The Project operates in a run-of-river mode, and inflows to the Project are controlled by upstream flows. The Project experiences significant seasonal and annual variations in generation due to its run-of-river operation and seasonal precipitation events. Table B.2-1 provides a summary of monthly and annual generation in gross MWh for the past 5 years (2016 to 2020) for Byllesby and Table B.2-2 provides the same information for the Buck. This data also reflects the effects of plant and unit outages. Table B.2-3 provides a summary of monthly and annual average flows through the Byllesby-Buck Project (based on Byllesby outflows) in cfs for this same period from the USGS 03165500 New River at Ivanhoe, VA stream gage and prorating by drainage area.

Table B.2-1. Byllesby Monthly and Annual Generation (MWh) (2016-2020)

Period	2016	2017	2018	2019	2020	Monthly Average
January	6,757	4,318	2,902	6,496	5,526	5,200
February	3,976	2,369	6,383	5,198	4,476	4,480
March	7,270	3,183	3,692	6,752	6,775	5,534
April	4,324	5,561	4,850	8,098	5,304	5,627
May	5,649	8,778	6,103	7,164	5,096	6,558
June	3,215	5,275	5,299	7,372	5,292	5,291
July	1,822	2,941	2,783	5,834	4,887	3,654
August	2,662	2,771	3,840	4,049	5,083	3,681
September	1,129	2,731	2,247	2,113	4,492	2,542
October	1,400	3,919	4,188	3,778	4,163	3,489
November	1,046	3,882	5,754	4,327	2,565	3,515
December	2,849	2,609	5,373	5,251	2,712	3,759
Total	42,099	48,337	53,416	66,430	56,370	53,330

Table B.2-2. Buck Monthly and Annual Generation (MWh) (2016-2020)

Period	2016	2017	2018	2019	2020	Monthly Average
January	5,366	3,597	2,255	1,482	5,391	3,618
February	4,563	1,883	3,584	1,362	5,784	3,435

Period	2016	2017	2018	2019	2020	Monthly Average
March	5,941	2,298	1,595	3,759	5,449	3,808
April	3,937	4,668	3,773	4,057	4,847	4,256
May	4,394	6,445	4,962	3,887	5,006	4,939
June	2,986	4,138	3,532	3,992	3,048	3,539
July	2,113	2,203	1,852	3,341	3,064	2,515
August	2,609	2,191	3,896	2,105	4,503	3,061
September	583	2,028	3,660	1,119	3,875	2,253
October	1,170	3,062	2,438	2,152	3,872	2,539
November	1,056	2,588	3,444	1,981	4,366	2,687
December	2,261	1,629	2,385	2,851	5,072	2,839
Total	36,980	36,729	37,376	32,088	54,277	39,490

Table B.2-3. Monthly and Annual Average Project Outflows (cfs) (2016-2020)

Period	2016	2017	2018	2019	2020	Monthly Average
January	3,106	2,162	1,986	5,129	3,477	3,172
February	5,450	1,229	3,207	6,559	5,579	4,405
March	2,943	1,312	2,727	3,929	3,586	2,900
April	1,974	4,114	4,802	4,816	4,956	4,132
May	2,359	5,315	5,148	3,006	8,714	4,908
June	1,826	2,287	2,932	4,599	4,130	3,155
July	1,146	1,304	1,602	2,402	2,364	1,764
August	1,438	1,160	2,342	1,619	3,472	2,006
September	773	1,182	4,783	970	3,068	2,155
October	945	2,456	5,337	1,701	3,648	2,817
November	751	1,638	3,807	2,052	4,806	2,611
December	1,044	1,145	7,017	2,826	3,378	3,082
Average	**1,980**	**2,109**	**3,807**	**3,301**	**4,265**	**3,092**

B.2.2 Dependable Generating Capacity

The estimated winter season dependable capacity for the Byllesby Development is 8 MW, while the estimated summer season dependable capacity is 5 MW. The estimated winter season dependable capacity for the Buck Development is 5 MW, while the estimated summer season dependable capacity is 3 MW. These estimates are based on the monthly project flow duration curves for the months of January (winter season) and August (summer season) and manufacturer's data relative to equipment performance. Flow duration curves for January and August were chosen because peak demands for energy on the AEP system typically occur during these months.

B.2.3 Flows

Monthly flow data from the USGS 03165500 New River at Ivanhoe, VA flow gaging station is provided in Table B.2-4. This gage is located approximately 2.8 miles downstream of the Buck Development and reports daily average flow data starting in October 1929 through present, with a data gap from September 1978 to January 1996, providing a discontinuous 74-year POR. Monthly mean flow data, along with the 25th and 75th percentile flow data[4] is provided from January 1996 through December 2020 (a 25-year POR[5]) to put recent historic river flows in perspective with Byllesby and Buck maximum hydraulic capacities and current minimum downstream flow release requirements. For example, mean monthly flows recorded at the USGS 03165500 New River at Ivanhoe, VA gage are less than the hydraulic capacities of both the Byllesby and Buck developments. And while the monthly 75th percentile flows are less than the Byllesby powerhouse capacity, they exceed the smaller Buck powerhouse capacity. As a result, flow releases into the Buck bypass reach are more common than into the Byllesby bypass reach.

Table B.2-4 New River Flow Data (USGS Ivanhoe Gage), 1996 through 2020

Month	Flow (cfs)			
	Average	Minimum	Median	Maximum
January	2,553	393	2,090	32,701
February	2,869	582	2,350	26,588

[4] A percentile is a value on a scale of one hundred that indicates the percent of a distribution that is equal to or below it. A flow percentile greater than 75 is considered to be wetter than normal; a flow percentile between 25 and 75 is considered normal; and a flow percentile less than 25 is considered to be drier than normal.

[5] The January 1996 – December 2020 POR is reflective of current land use and water use practices and uses more modern data collection and recording methods compared to the 1929 – 1978 POR. The more recent POR also contains a number of dry and wet periods that are sufficient for purposes of evaluating flow regimes relevant to the bypass reach flow and aquatic habitat study goals and objectives.

Month	Flow (cfs)			
	Average	Minimum	Median	Maximum
March	2,833	762	2,600	16,205
April	3.068	1,067	2,590	23,386
May	2,849	804	2,270	40,173
June	2,120	448	1,790	20,475
July	1,681	365	1,290	21,833
August	1,453	176	1,100	22,707
September	1,564	244	984	29,693
October	1,596	263	1,140	29,111
November	1,892	440	1,300	27,753
December	2,360	551	1,990	19,310
Annual	2,236	921	1,800	25,828

An annual as well as monthly flow duration curves for flows through the Project are included in Section B.5. The flow duration curves are based on flow data from 1996 to 2020 at the USGS Ivanhoe gage, adjusted for drainage area as described above. Additionally, Appendix A of Volume I includes supplemental flow duration figures with a truncated y-axis so magnitude, seasonality, and duration can be assessed.

Due to the small surface area of the impoundment, evaporation is not considered to be a significant factor. Leakage at the dam is also not a significant contributor to flows in the bypass reach.

B.2.4 Reservoir Storage Capacity

The gross storage capacity for the Byllesby impoundment is approximately 2,000 acre-ft with a total area of 239 acres. The gross storage capacity for Buck is approximately 661 acre-ft with a total area of 66 acres. Since each development is operated in a run-of-river mode, net storage capacity is not applicable. Storage-volume (storage capacity) curves for each development are included in Exhibit A, Figure B.2-1 and Figure B.2-2.

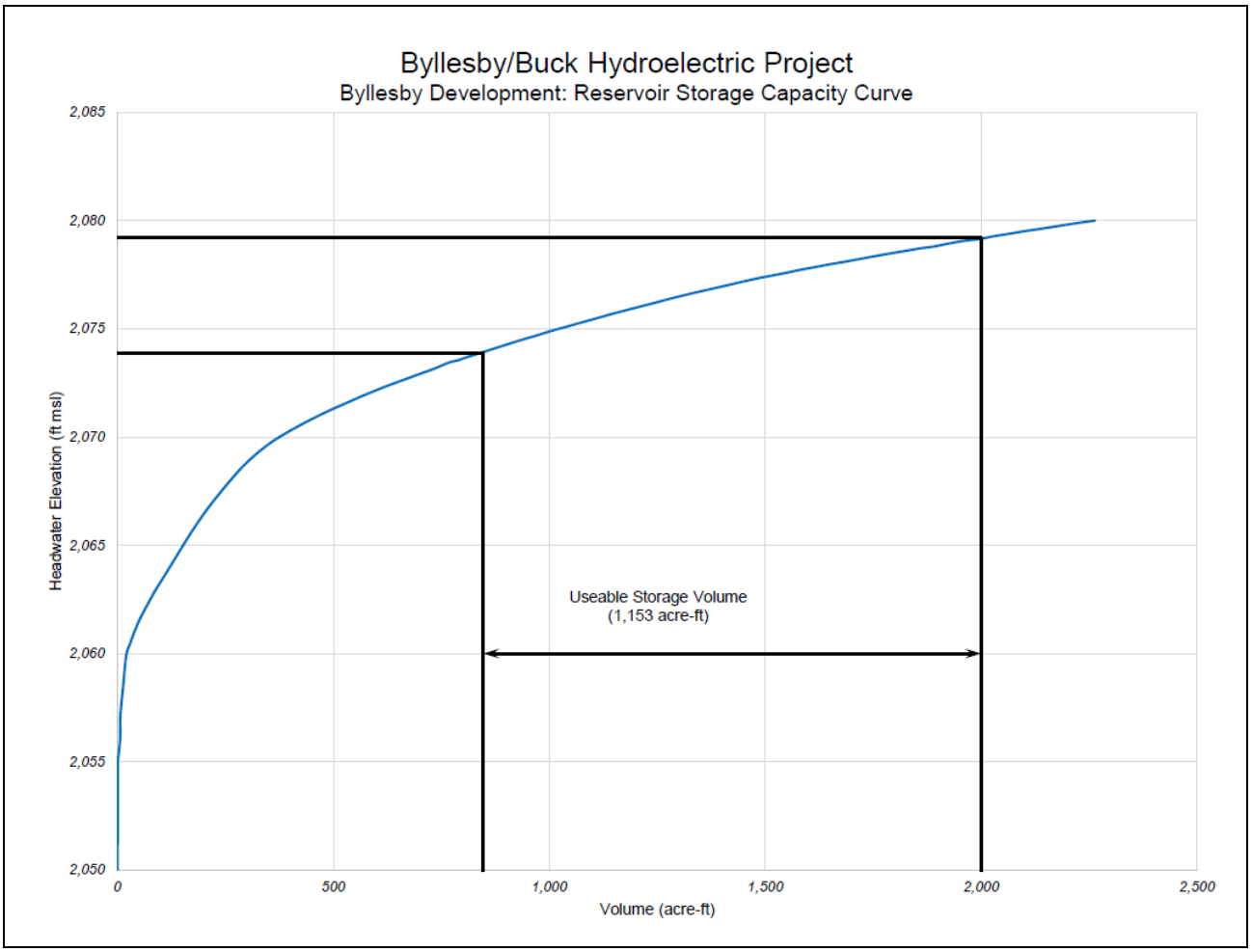


Figure B.2-1. Byllesby Development Reservoir Storage Capacity Curve

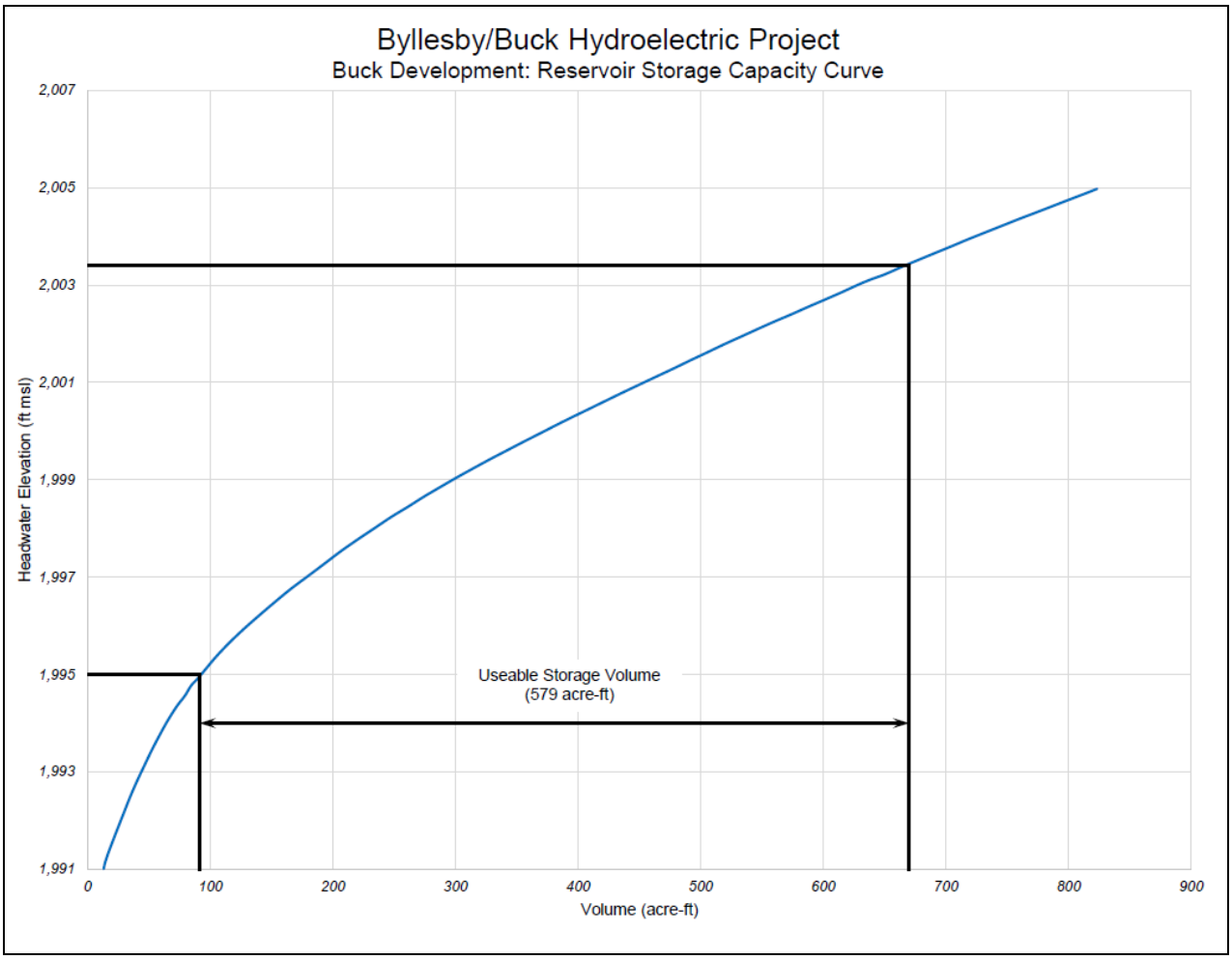


Figure B.2-2. Buck Development Reservoir Storage Capacity Curve

B.2.5 Hydraulic Capacity

B.2.5.1 Byllesby

The estimated combined maximum hydraulic capacity for all four existing turbine units installed at the Byllesby Development is 5,868 cfs. This estimate is based on manufacturer's turbine discharge information for all four units operating at full wicket gate opening and at a 56-ft head.

With the turbine-generator upgrades proposed by Appalachian for the new license term (Units 1, 2, and 4), the estimated combined maximum hydraulic capacity for all four turbine units is 5,511 cfs at full wicket gate opening and at a 54-ft head.

B.2.5.2 Buck

The estimated combined maximum hydraulic capacity for all three existing turbine units installed at the Buck Development is 3,540 cfs. This estimate is based on manufacturer's turbine discharge information for all three units operating at full wicket gate opening and at a 40-ft head.

With the turbine-generator upgrades proposed by Appalachian for the new license term (Units 1 and 3) the estimated combined maximum hydraulic capacity for all three turbine units is 3,570 cfs at full wicket gate opening and at a 42.4-ft head.

B.2.6 Tailwater Rating Curve

B.2.6.1 Byllesby

A tailwater rating curve for flows through the existing Byllesby generating units ranging is shown on Figure B.2-3. This rating curve was developed for the previous license application by curve fitting randomly selected discharges and elevations recorded from August 1988 through May 1990. A U.S. Army Corps of Engineers (USACE) HEC-II computer model of the tailwater area was also generated to estimate tailwater elevations for flows in excess of those recorded. The curve generated by the REC-II model was verified by the actual data for flows ranging from 0 cfs through 6,000 cfs, and an extended tailwater rating curve for flows up to approximately 600,000 cfs is shown on Figure B.2-4.

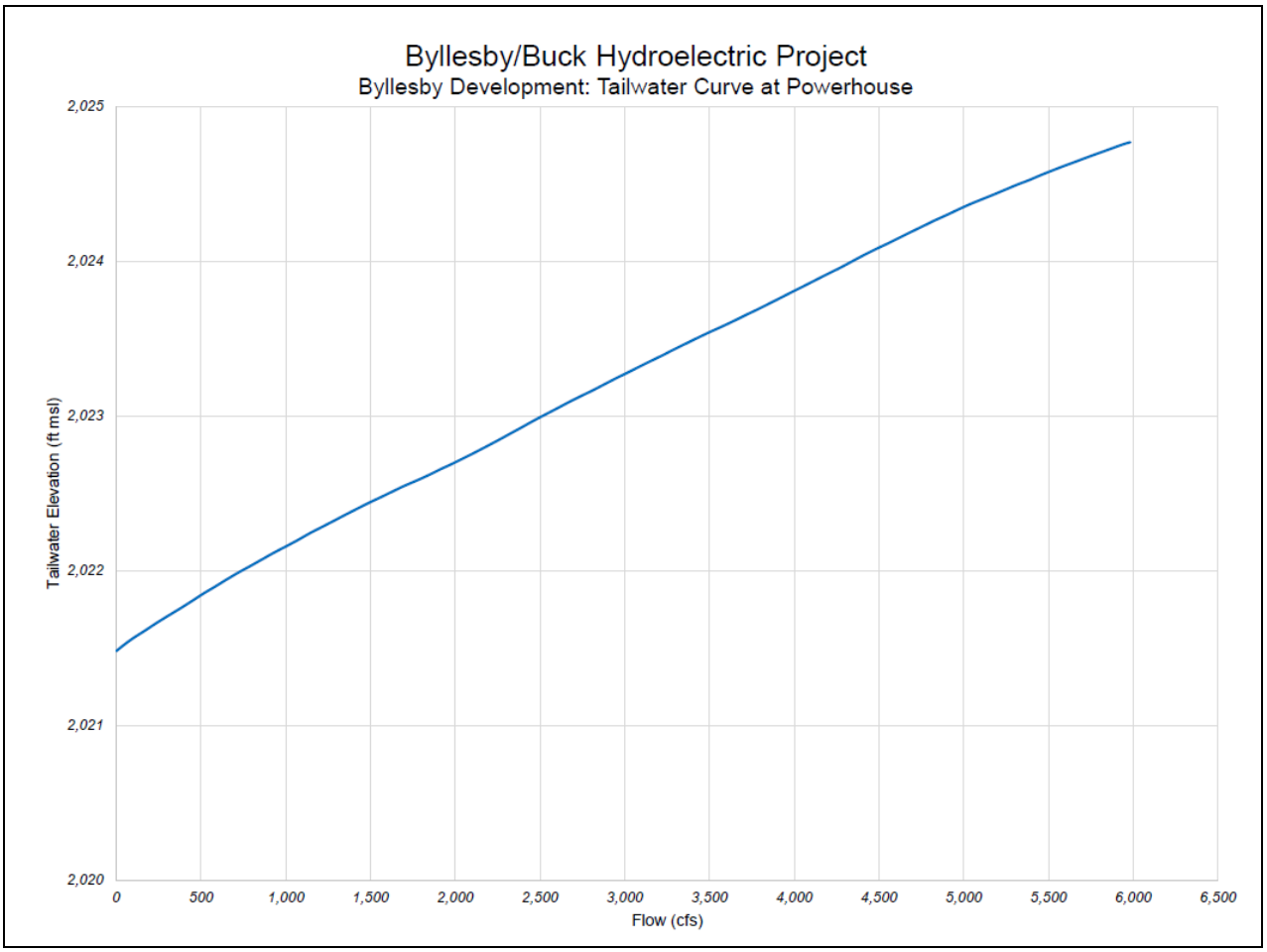


Figure B.2-3. Byllesby Development Tailwater Curve

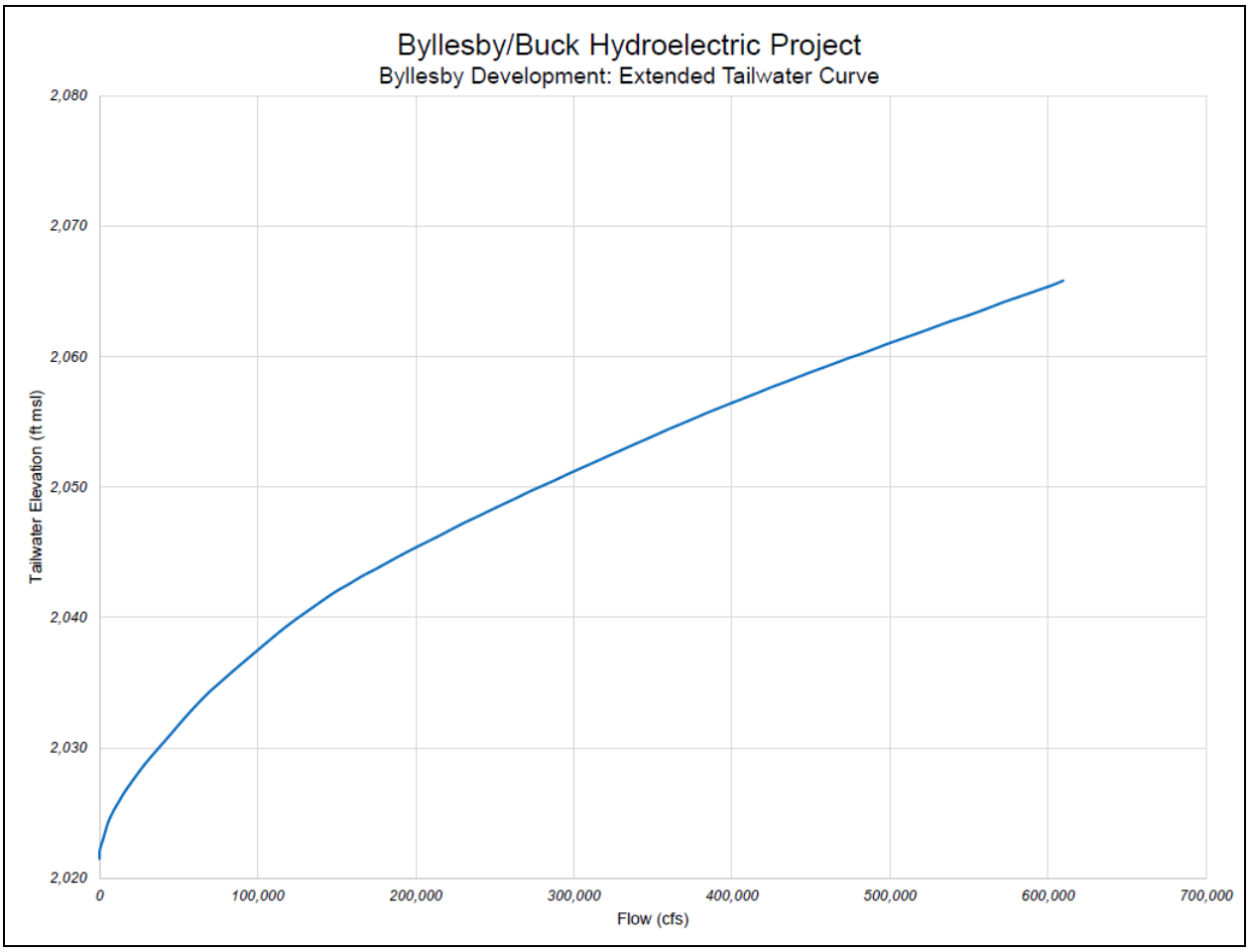


Figure B.2-4. Byllesby Development Extended Tailwater Curve

B.2.6.2 Buck

A tailwater rating curve for flows through the existing Buck generating units is shown on Figure B.2-5. This rating curve was developed for the previous license application by curve fitting randomly selected discharges and elevations recorded from August 1988 through May 1990. A USACE HEC-II computer model of the tailwater area was also generated to estimate tailwater elevations for flows in excess of those recorded. The curve generated by the HEC-II model was verified by the ·actual data for flows ranging from 0 cfs through 4,000 cfs, and an extended tailwater rating curve for flows up to approximately 600,000 cfs is shown on Figure B.2-6.

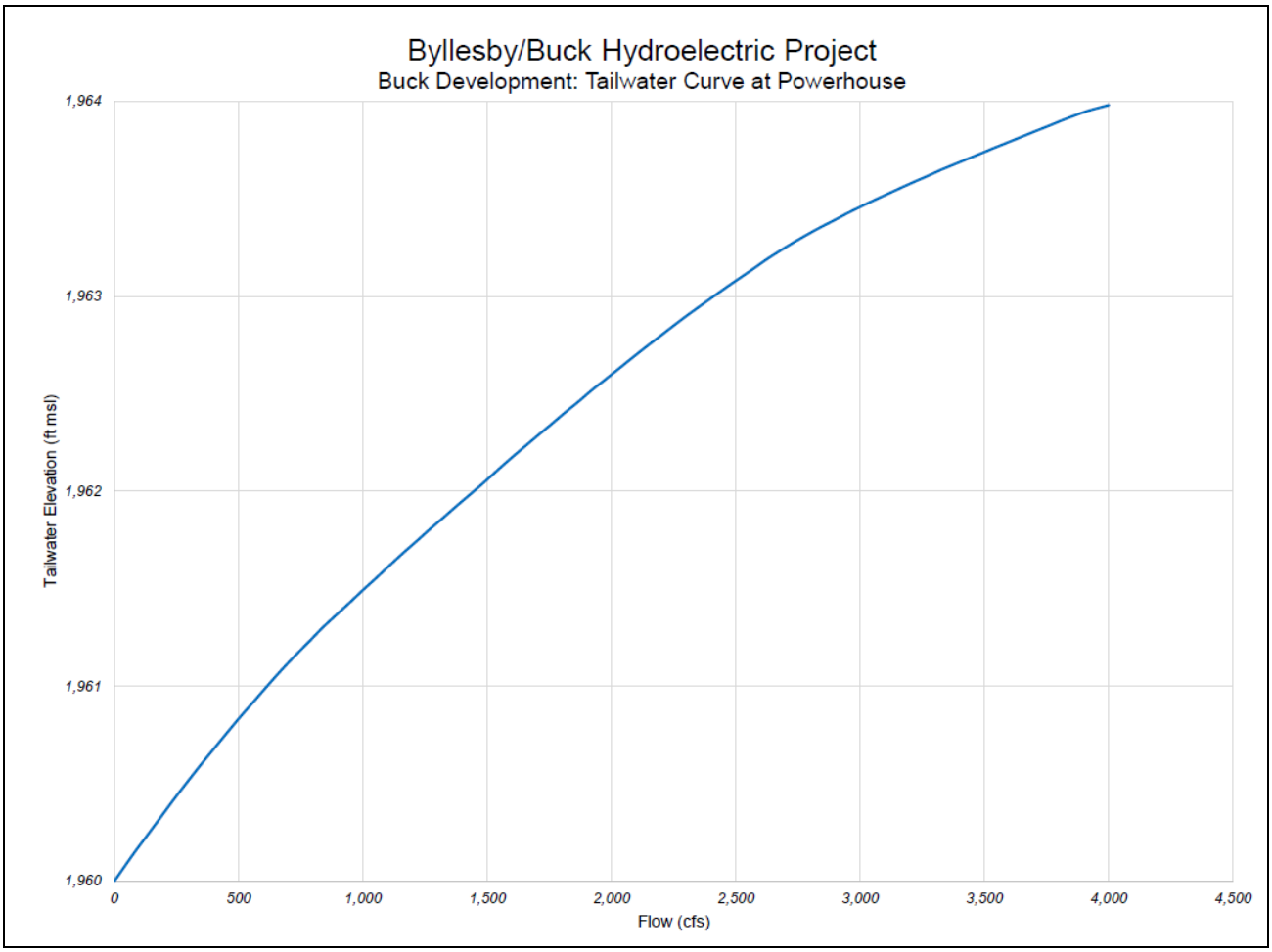


Figure B.2-5. Buck Development Tailwater Curve

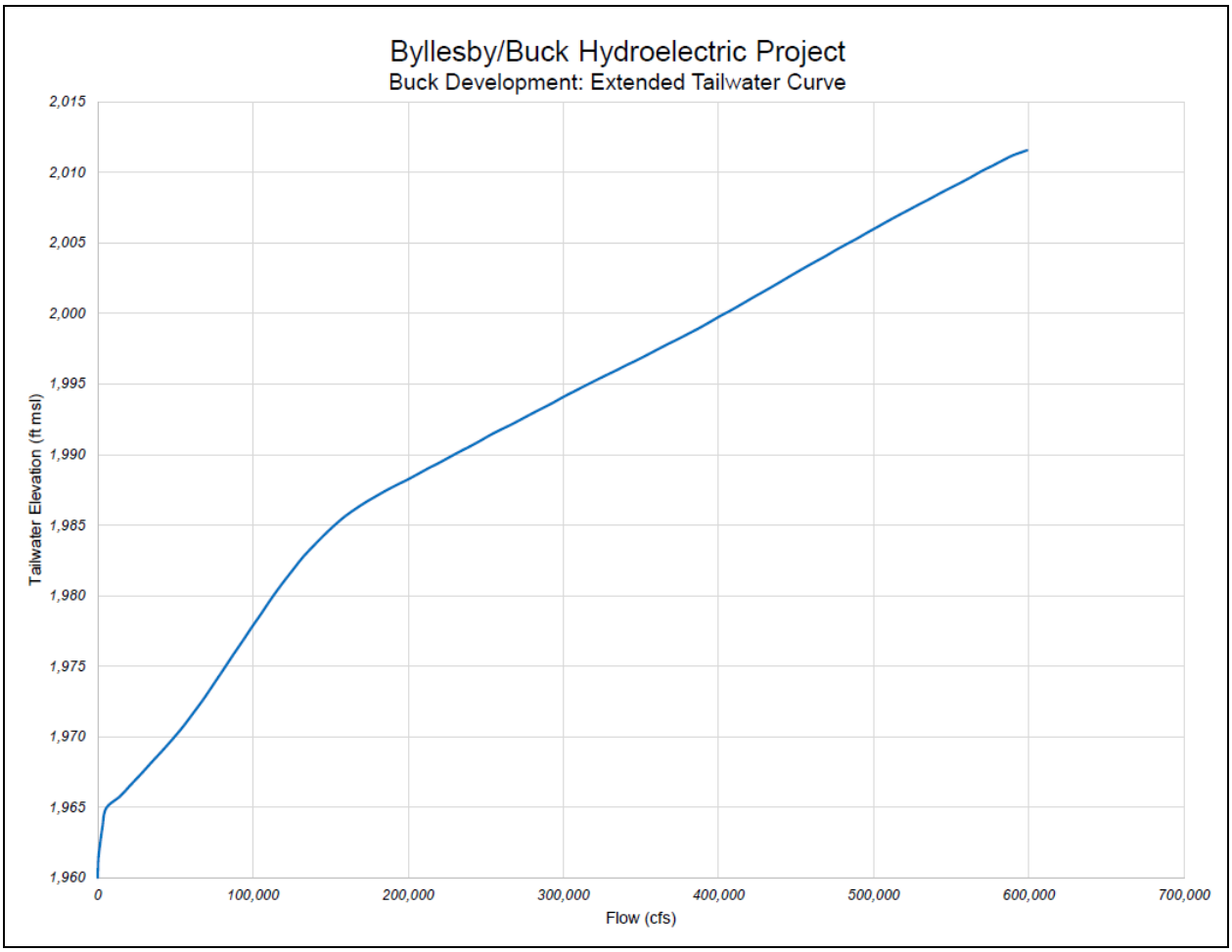


Figure B.2-6. Buck Development Extended Tailwater Curve

B.2.7 Head vs. Capability

The average head on the Project is based on the normal maximum forebay elevation and the normal tailwater elevation associated with the mean annual flow through the Project and is approximately 56.4 ft of net head for the existing Byllesby Development and 40 ft of net head for the existing Buck Development.

Minimum plant power output occurs when one unit operates at minimum discharge and maximum head conditions. Maximum plant power output occurs when both units are operating near full power output at approximately normal head conditions. The powerplant capability of the Byllesby and Buck developments from minimum output to maximum output is provided below.

B.2.7.1 Byllesby

Estimates of plant capability for the existing units were developed from manufacturer's unit performance data for various discharges and associated head conditions. The Byllesby head versus powerplant capability at various operating head conditions is shown in Figure B.2-7. For this figure, a minimum headwater elevation of 2079.2 ft was assumed. By referencing the tailwater rating curve for the Byllesby Development, head conditions for turbine discharges associated with cumulative plant loadings were developed.

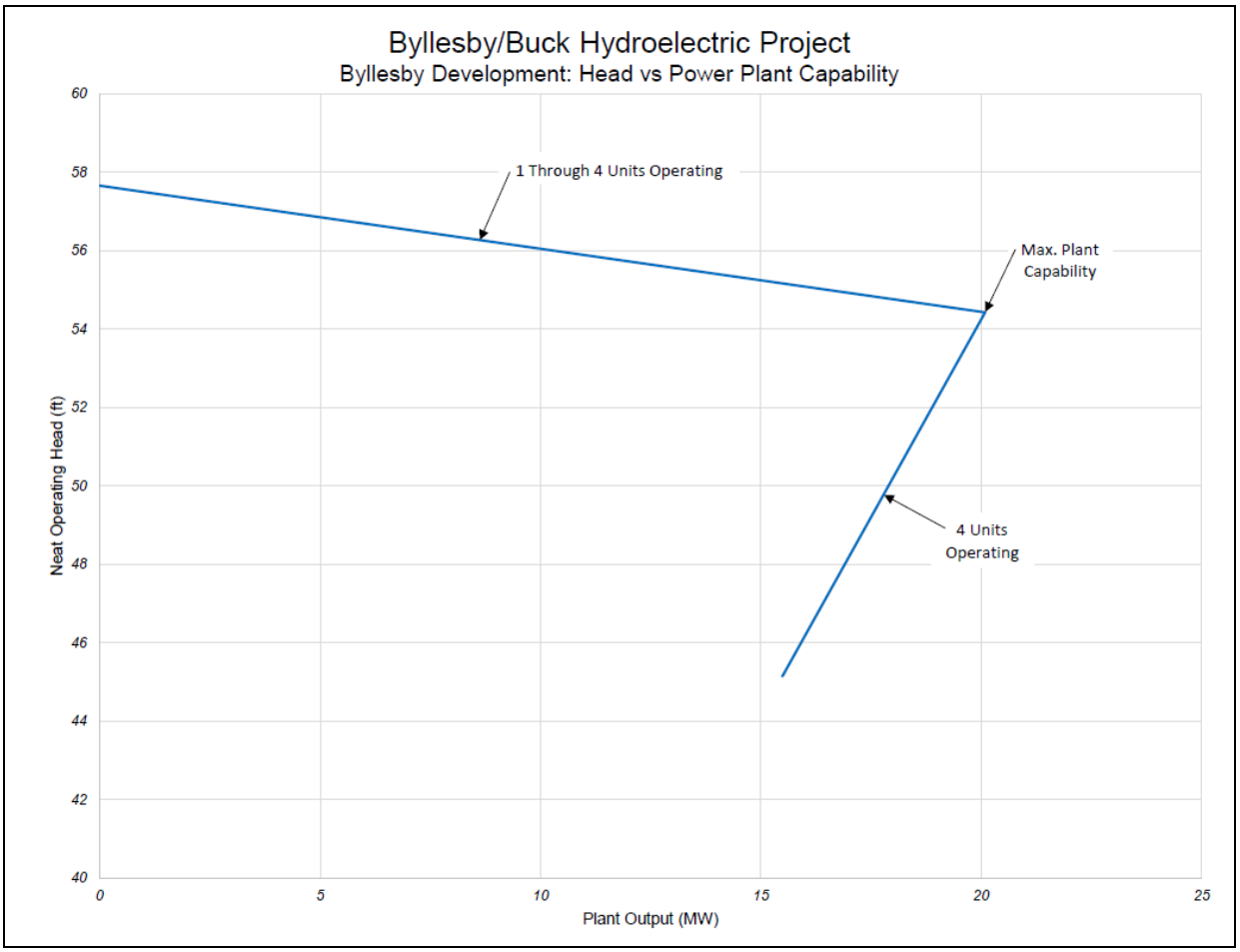


Figure B.2-7. Byllesby Development Head vs. Power Plant Capability

B.2.7.2 Buck

Estimates of plant capability for the existing units were developed from manufacturer's unit performance data for various discharges and associated head conditions. The Buck head versus powerplant capability at various operating head conditions is shown in Figure B.2-8. For this figure, a minimum headwater elevation of 2003.4 ft was assumed. By referencing the tailwater rating curve for the Buck Development, head conditions for turbine discharges associated with cumulative plant loadings were developed.

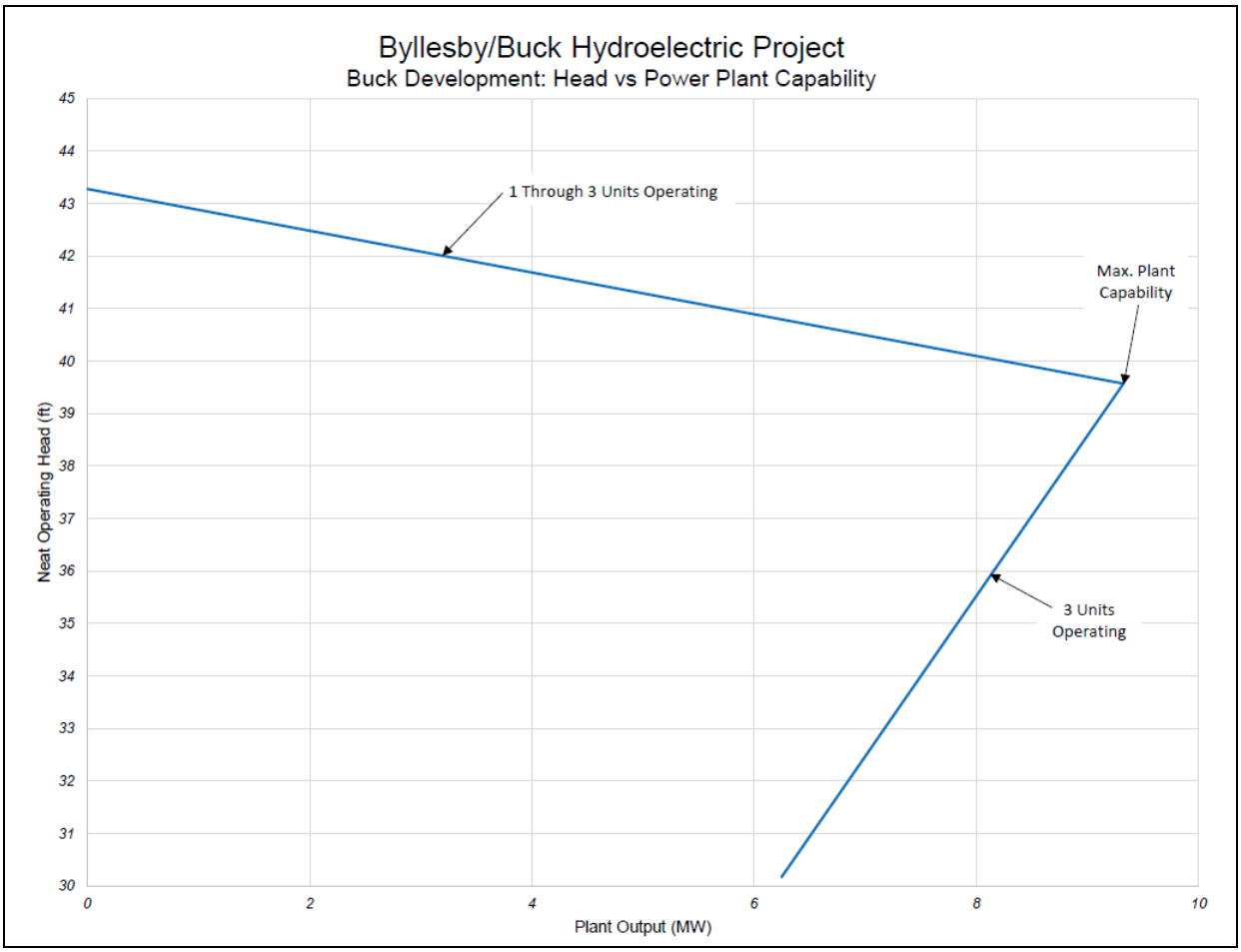


Figure B.2-8. Byllesby Development Head vs. Power Plant Capability

B.3 Power Utilization

Currently, Appalachian serves over 1 million customers, including both retail and wholesale customers, located in the states of Virginia, West Virginia, and Tennessee. Appalachian meets its customers' future capacity and energy requirements through operation of its fleet of generation resources and portfolio of power purchase agreements.

B.4 Future Development

As described in Exhibit A and in the sections above, Appalachian proposes to upgrade six of the seven existing turbine-generator units at the Project in the new license term. Following completion of the upgrades, the authorized installed capacities for the Byllesby and Buck developments will be 20.3895 MW and 9.435 MW, respectively, with maximum hydraulic capacities of 5,511 cfs and 3,570 cfs, respectively. The upgrades are necessary to support plant modernization and life extension.

Appalachian Power Company has no current plans for future development of any other existing or proposed water power project on the New River.

B.5 Flow Figures

The following figures include unit discharge flows as well as annual and monthly duration flow curves for each development. Additional annual and monthly flows for each development are provided in Appendix A of this exhibit.

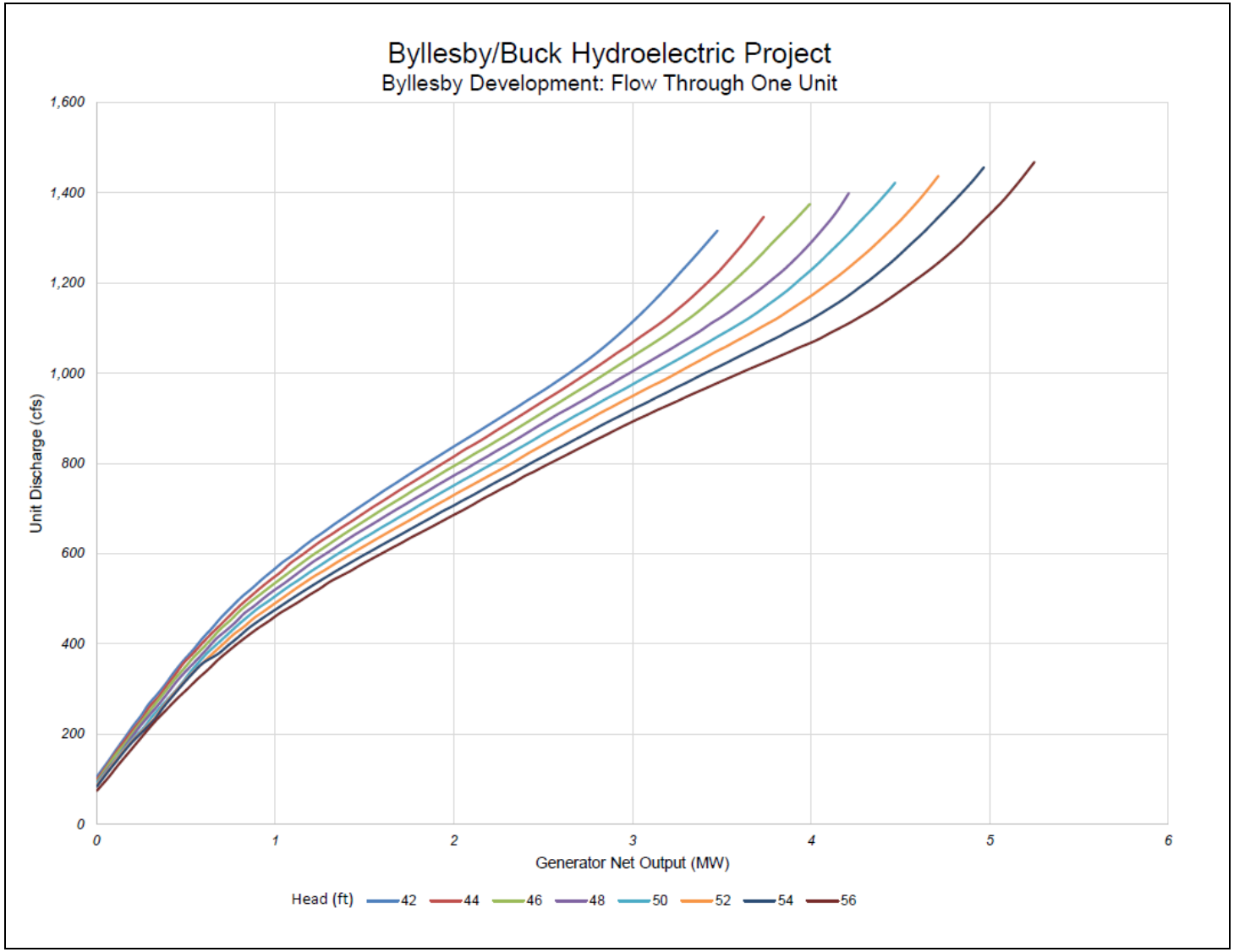


Figure B.5-1. Byllesby Development: Flow Through One Unit (Existing Units)

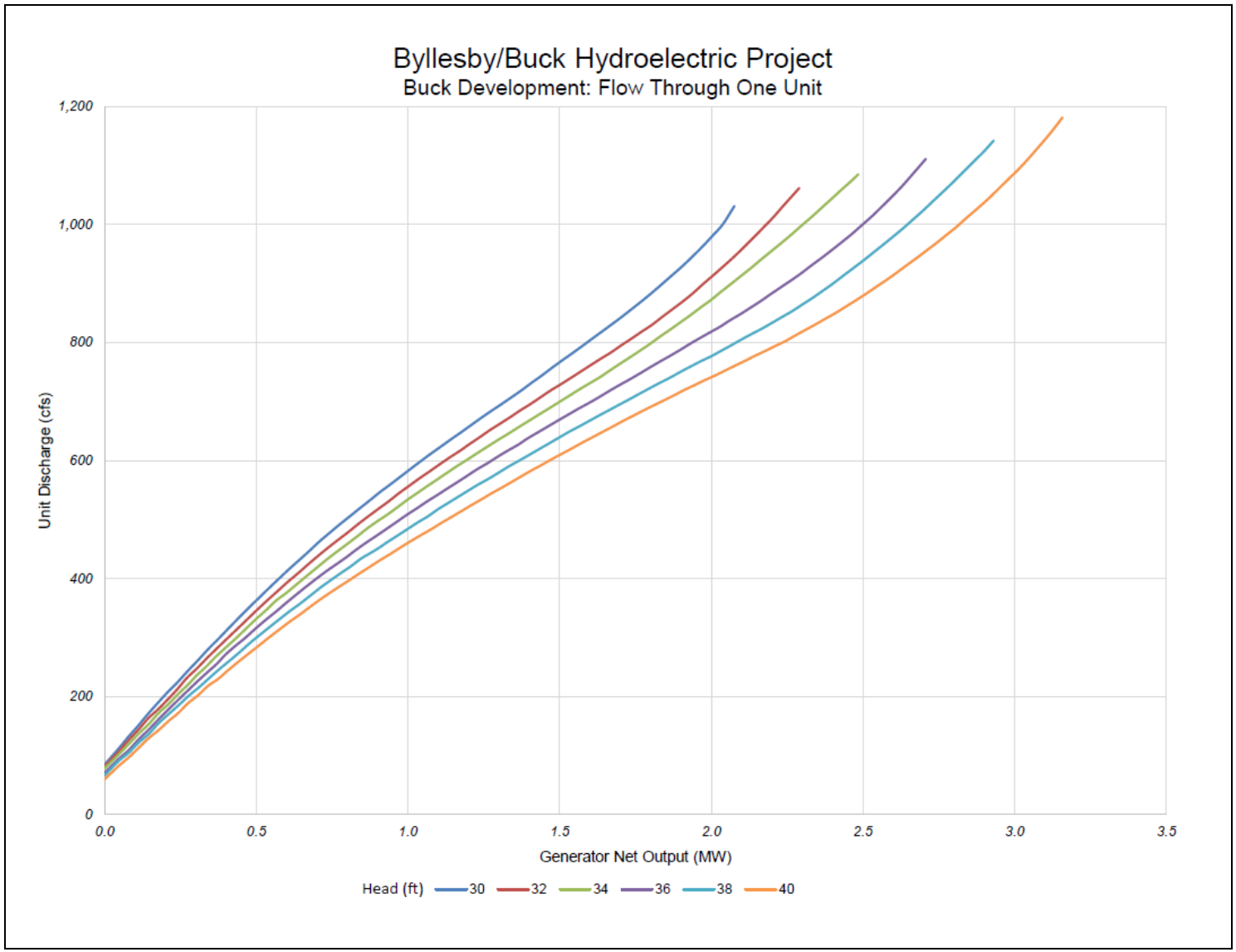


Figure B.5-2. Buck Development: Flow Through One Unit (Existing Units)

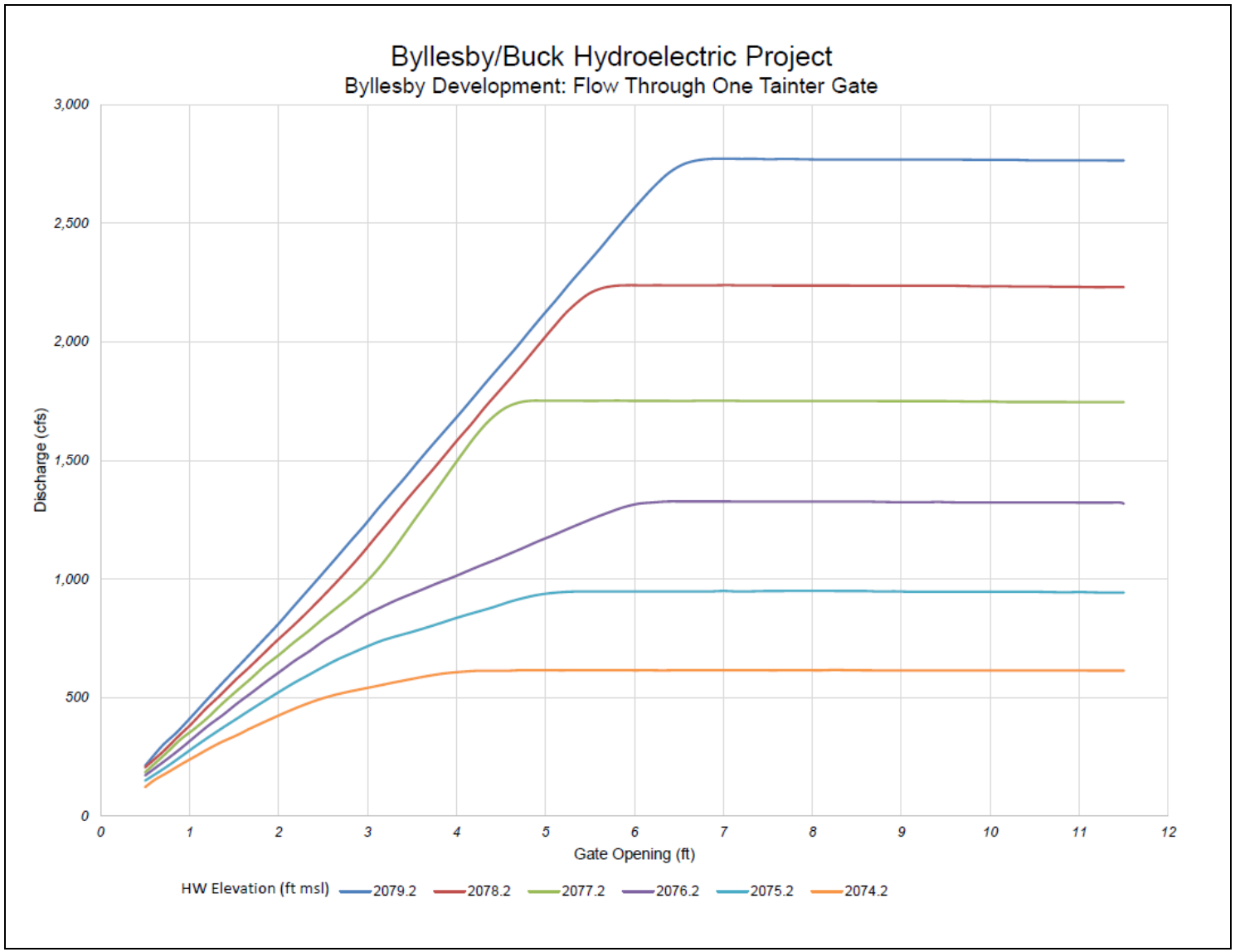


Figure B.5-3. Byllesby Development: Flow Through One Tainter Gate

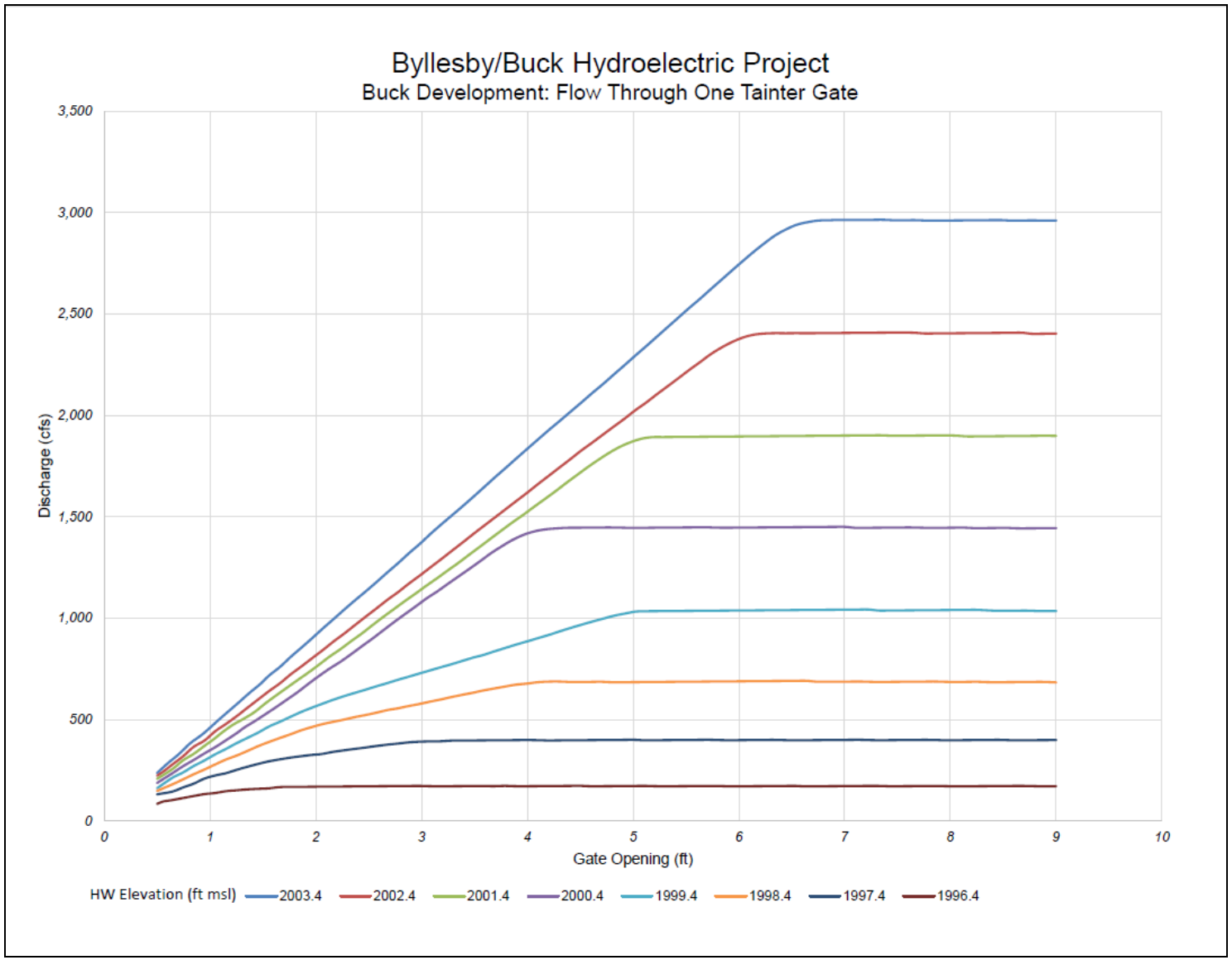


Figure B.5-4. Buck Development: Flow Through One Tainter Gate

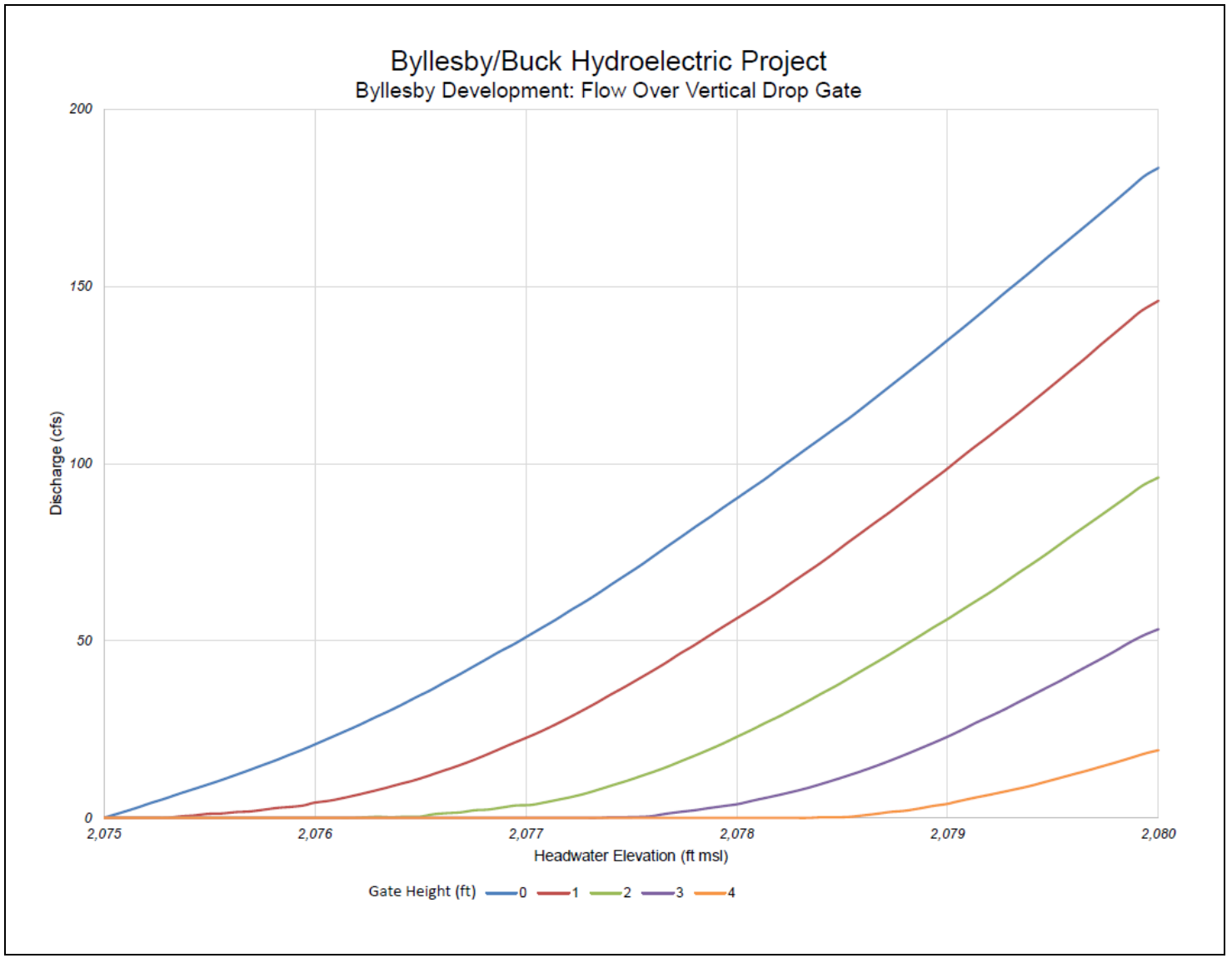


Figure B.5-5. Byllesby Development: Flow Over Vertical Drop Gate

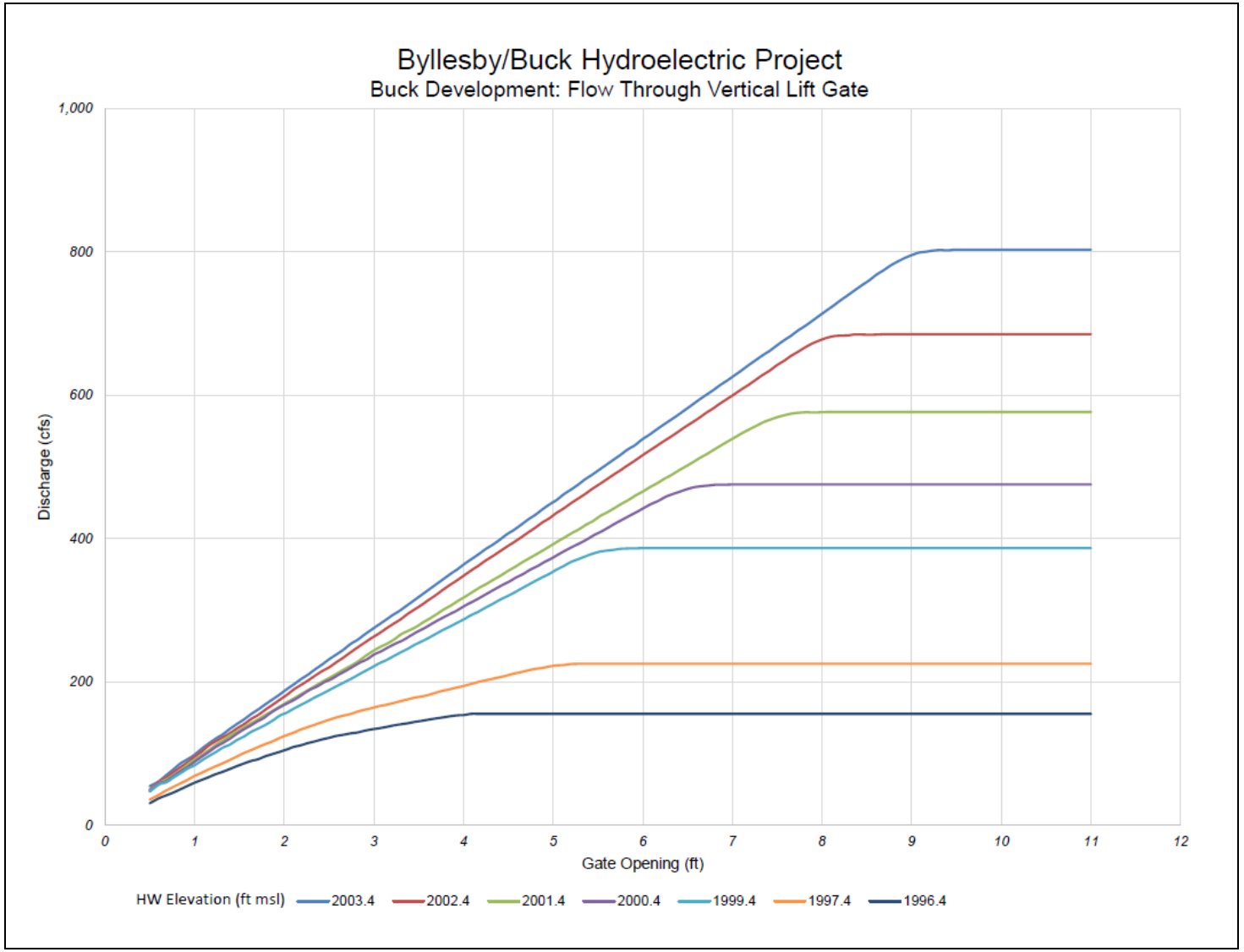


Figure B.5-6. Buck Development: Flow Through Vertical Lift Gate

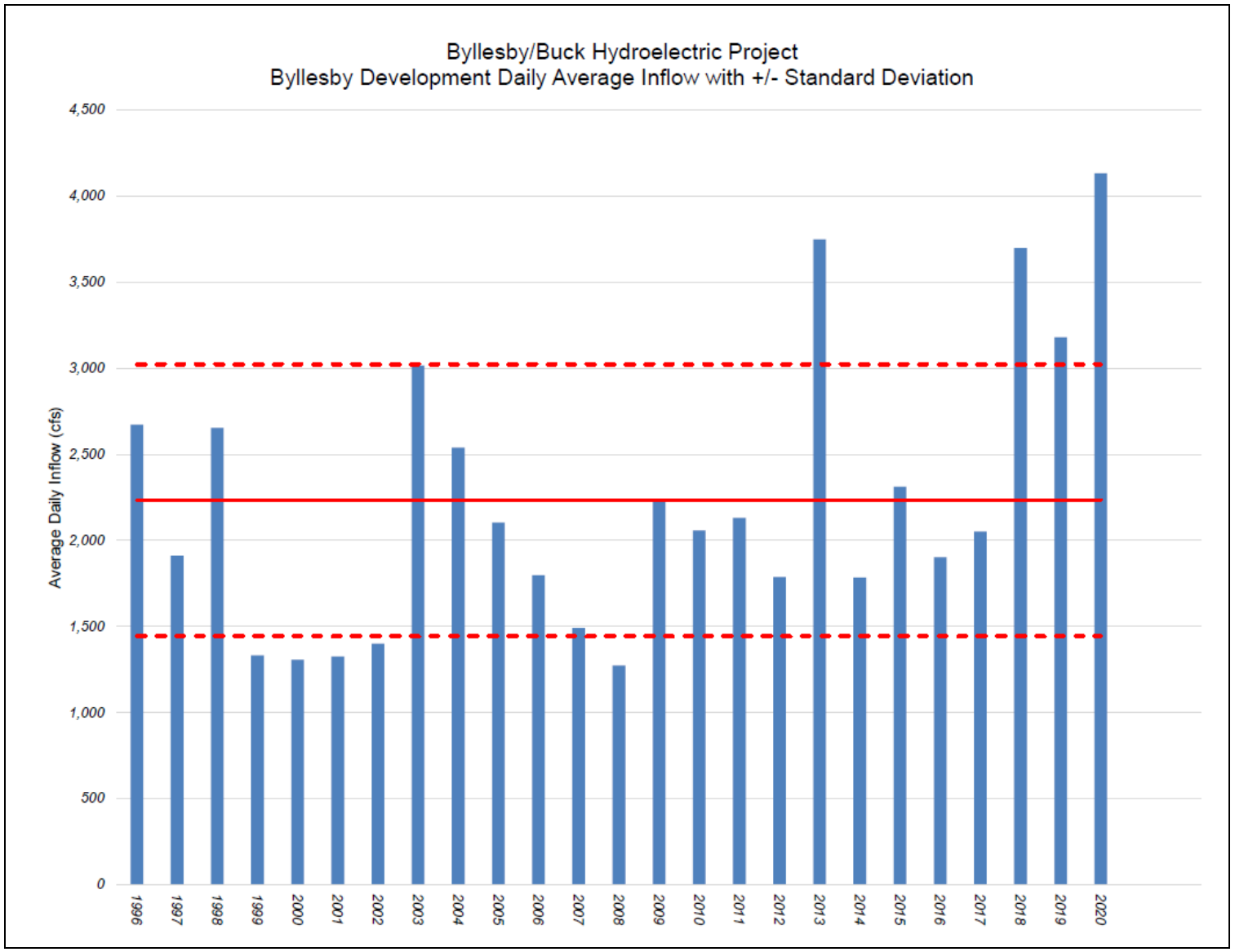


Figure B.5-7. Byllesby Development Daily Average Inflow

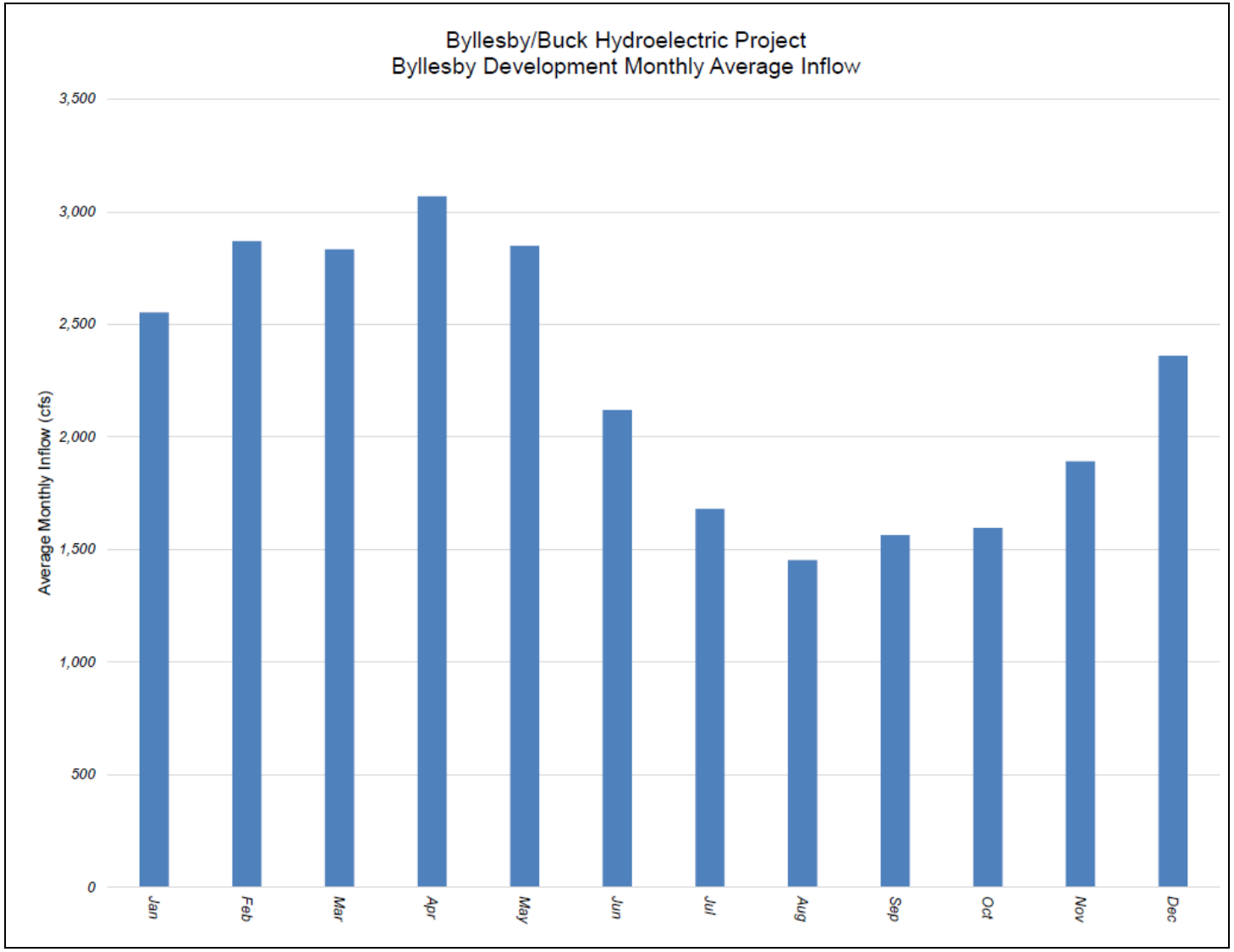


Figure B.5-8. Byllesby Development Monthly Average Inflow

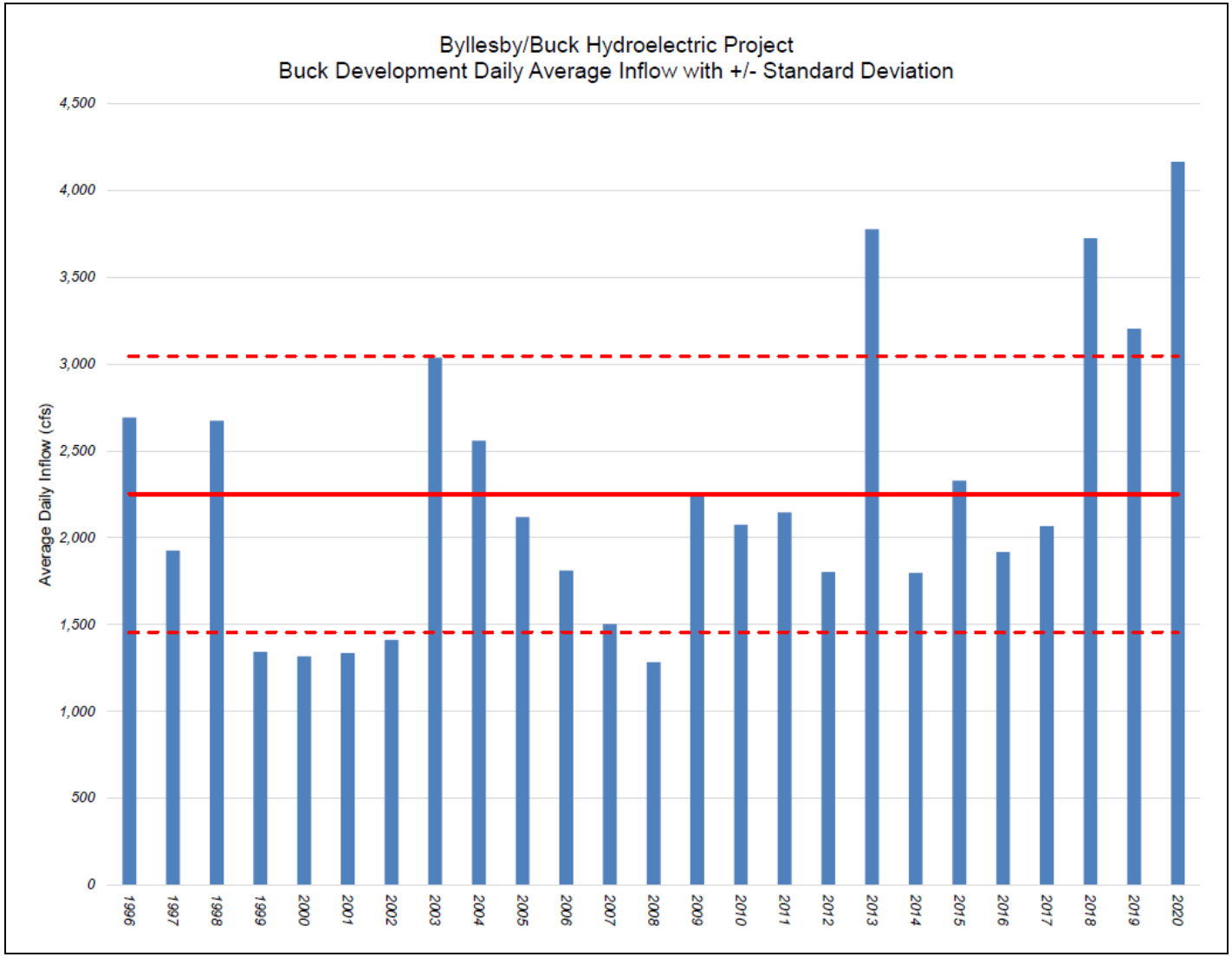


Figure B.5-9. Buck Development Daily Average Inflow

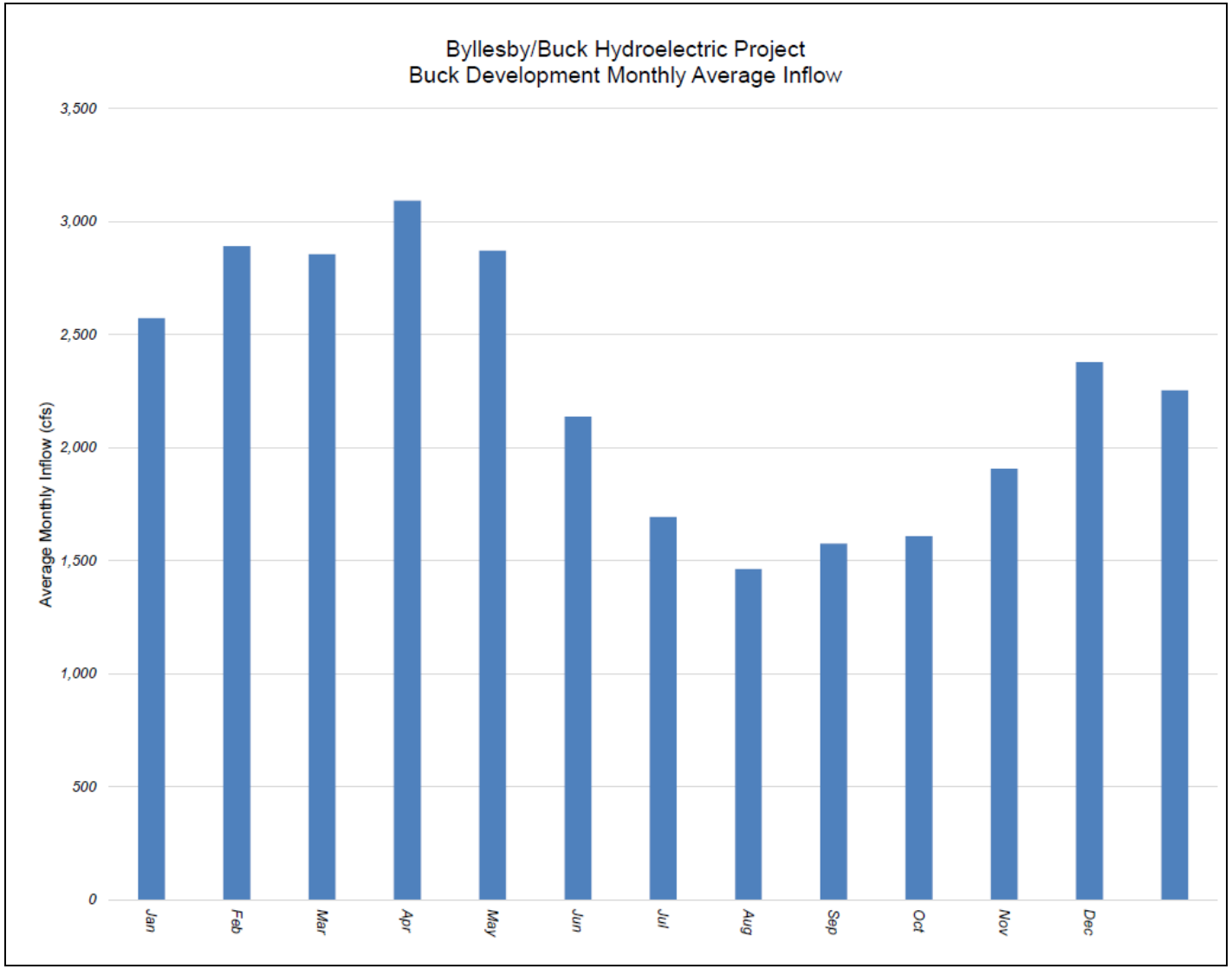


Figure B.5-10. Buck Development Daily Average Inflow

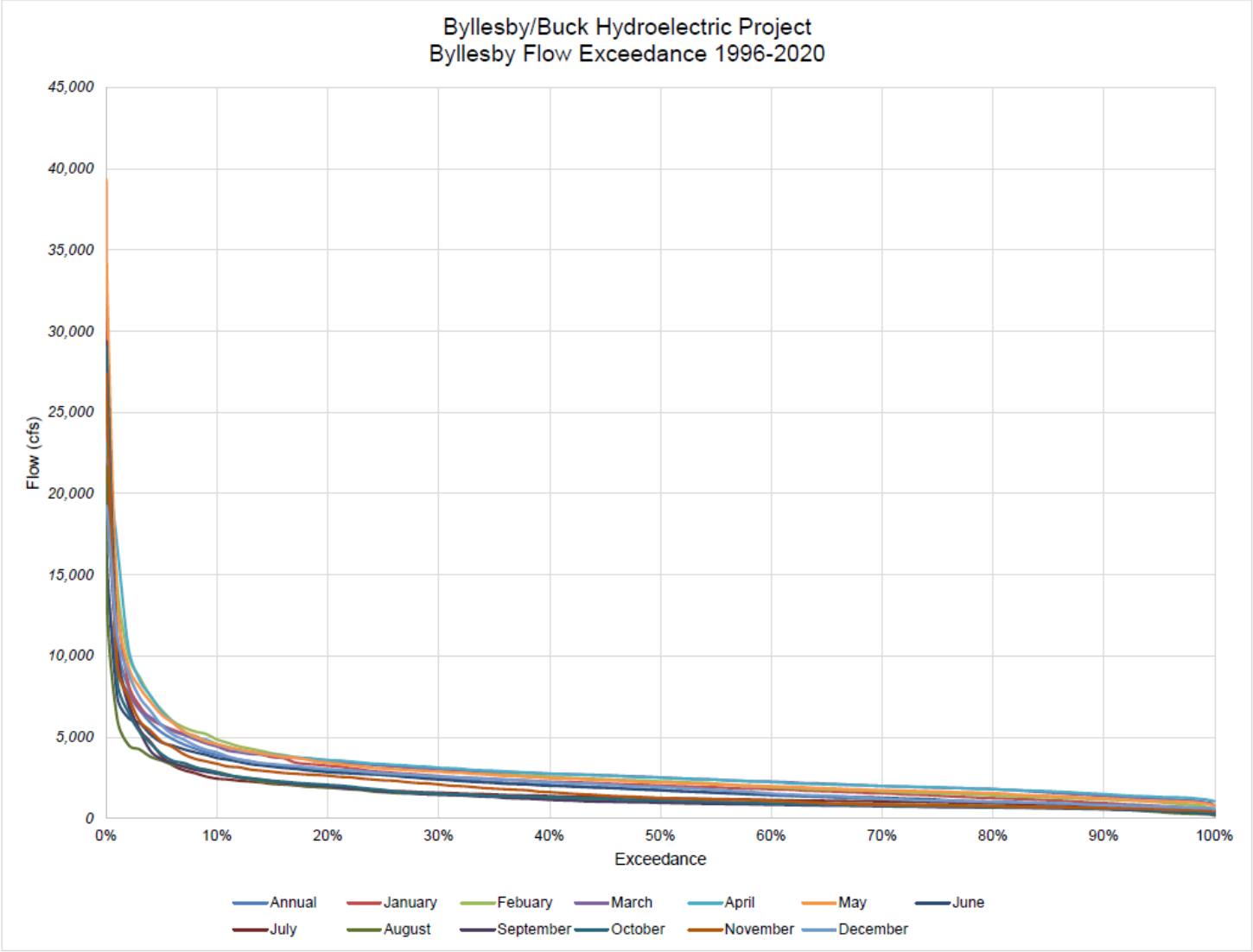


Figure B.5-11. Byllesby Development Monthly Flow Duration Curves

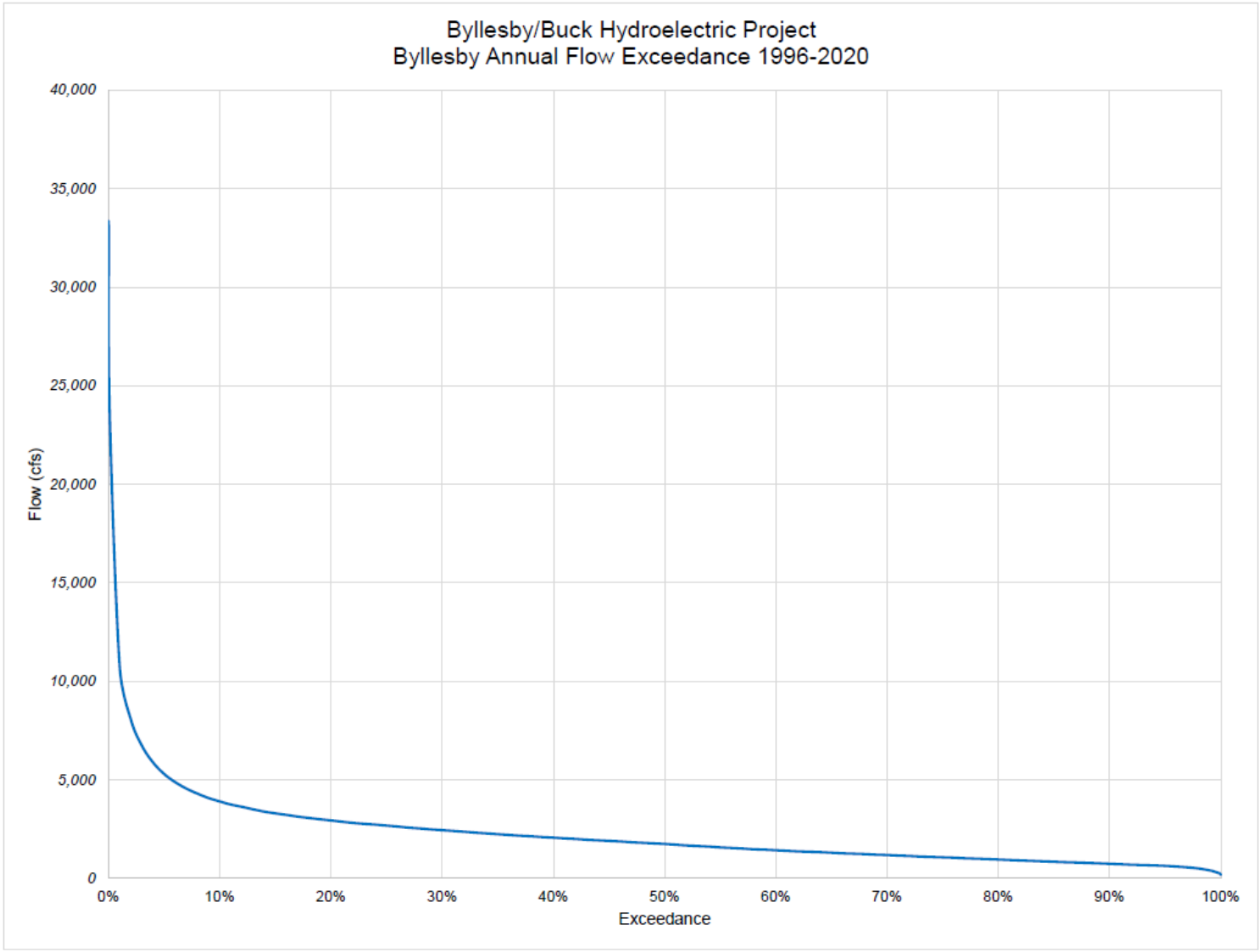


Figure B.5-12. Byllesby Annual Rating Curve

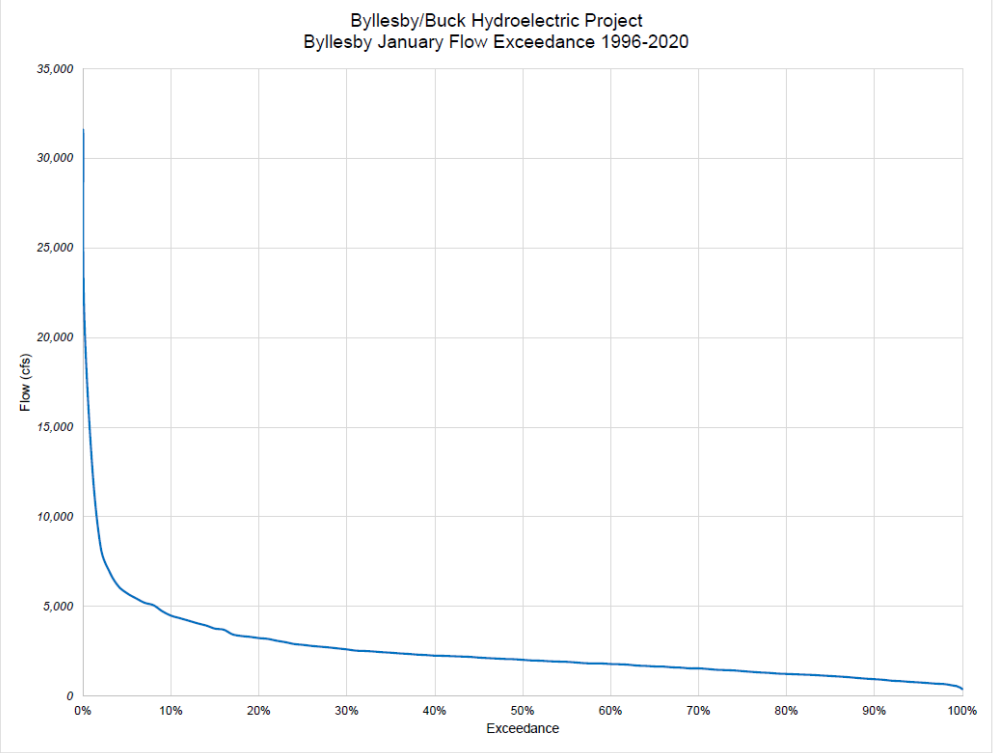


Figure B.5-13. Byllesby Development January Flow Duration Curve

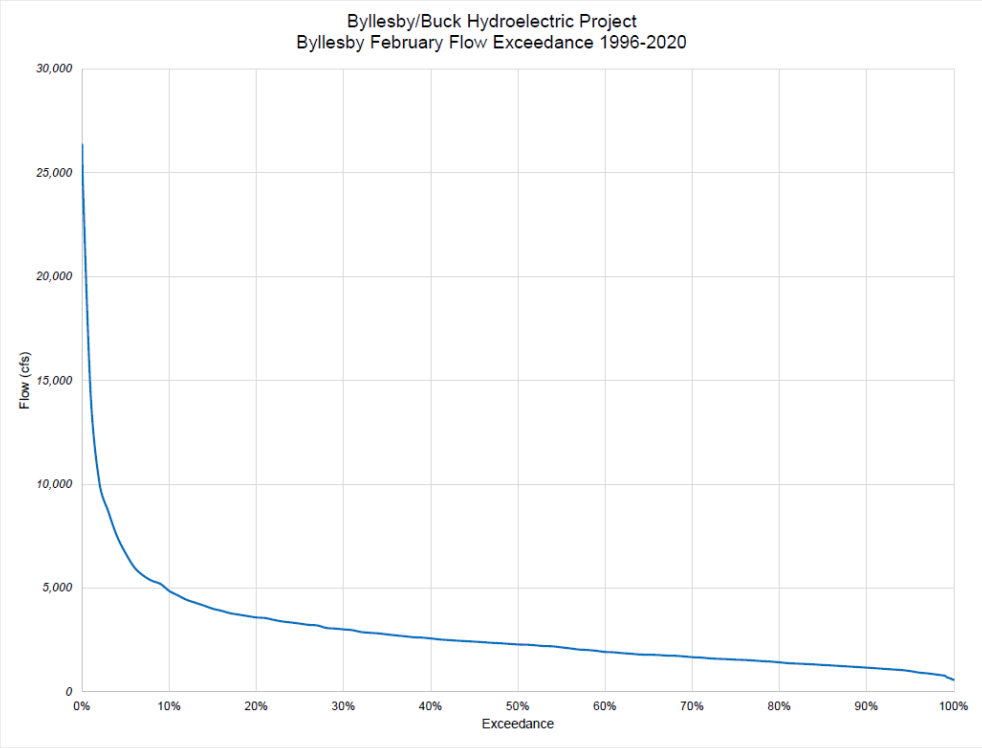


Figure B.5-14. Byllesby Development February Flow Duration Curve

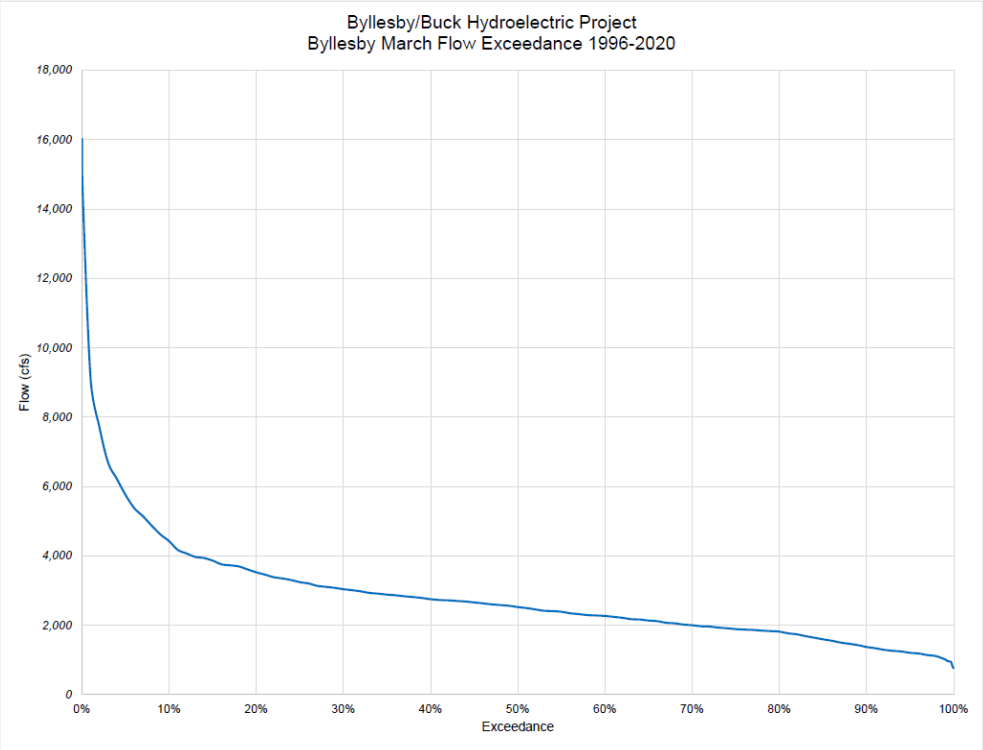


Figure B.5-15. Byllesby Development March Flow Duration Curve

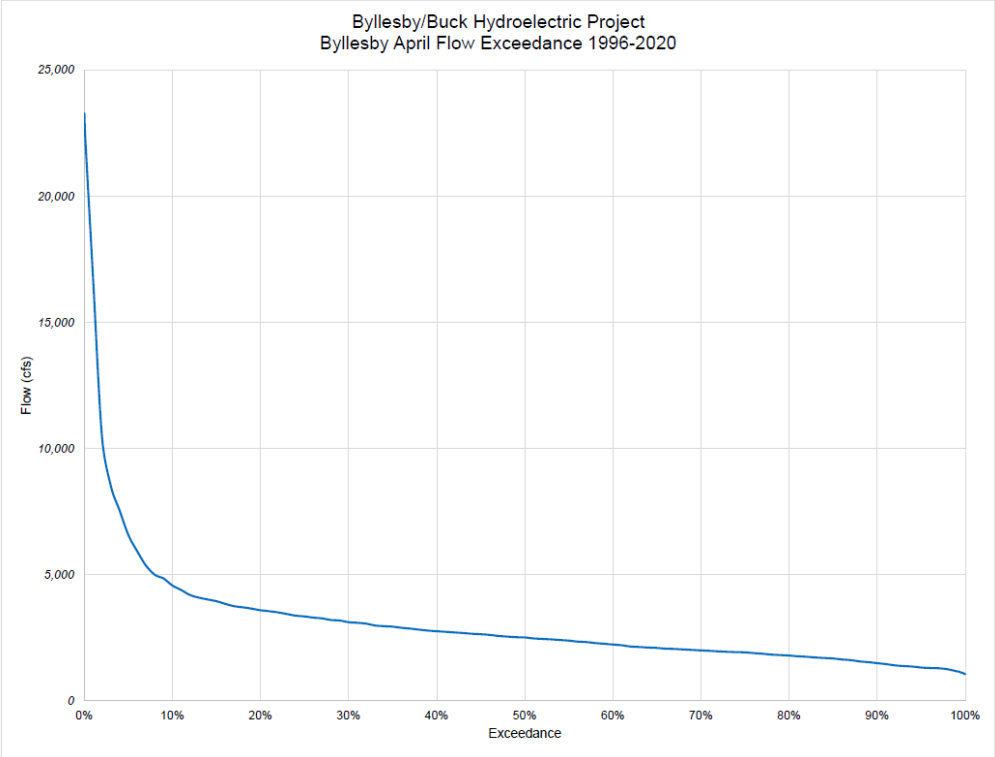


Figure B.5-16. Byllesby Development April Flow Duration Curve

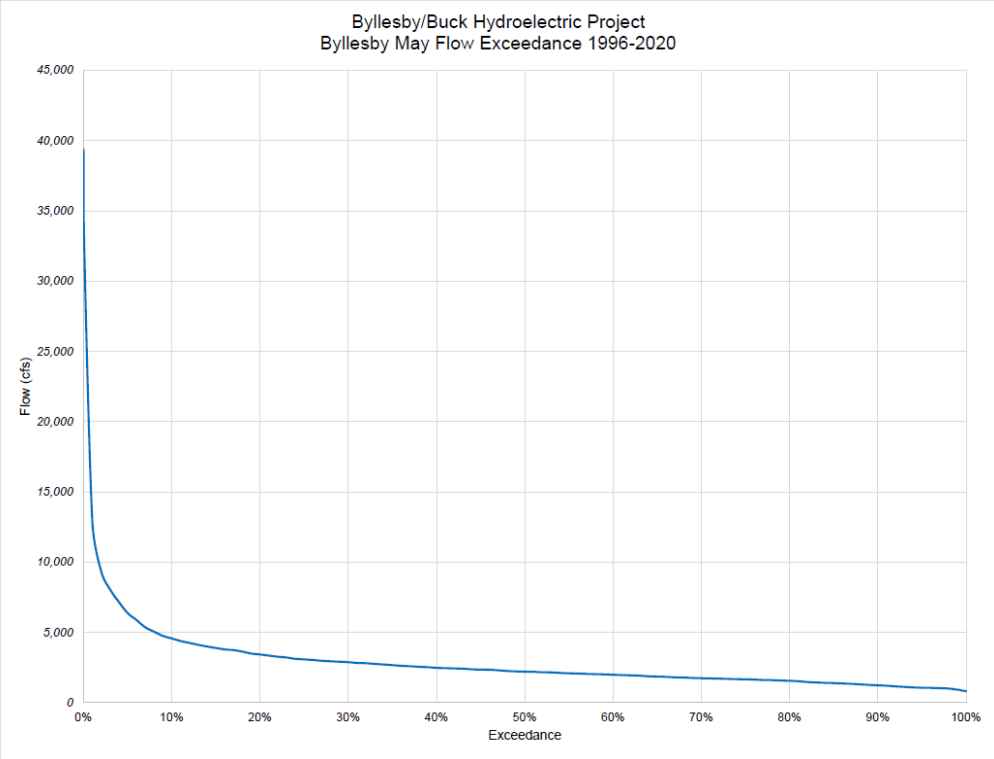


Figure B.5-17. Byllesby Development May Flow Duration Curve

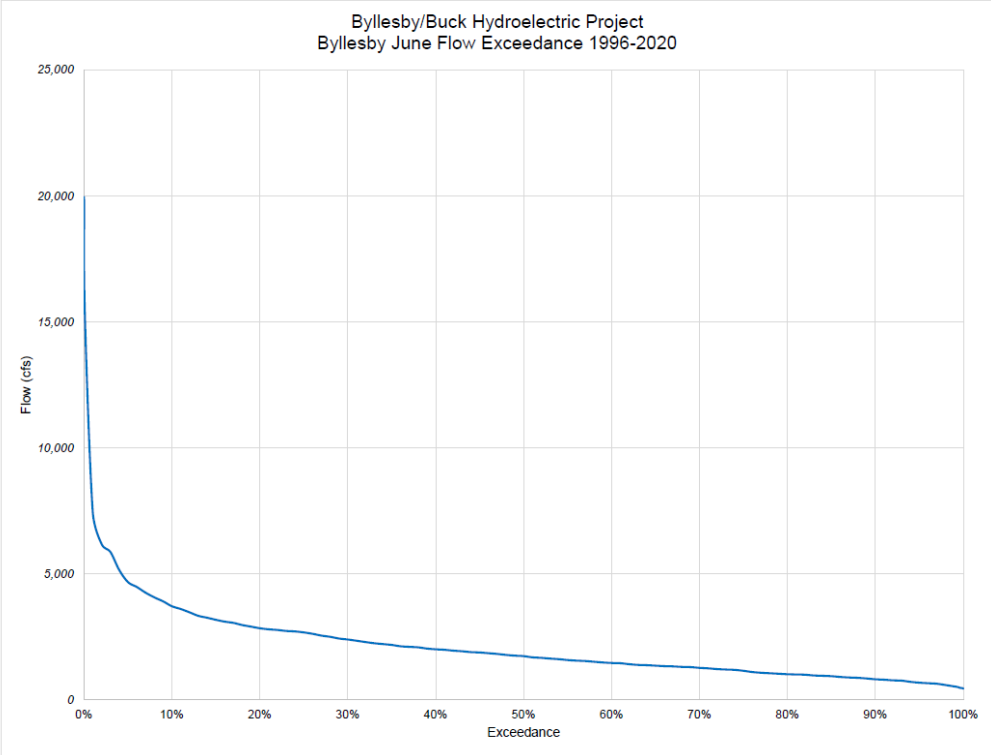


Figure B.5-18. Byllesby Development June Flow Duration Curve

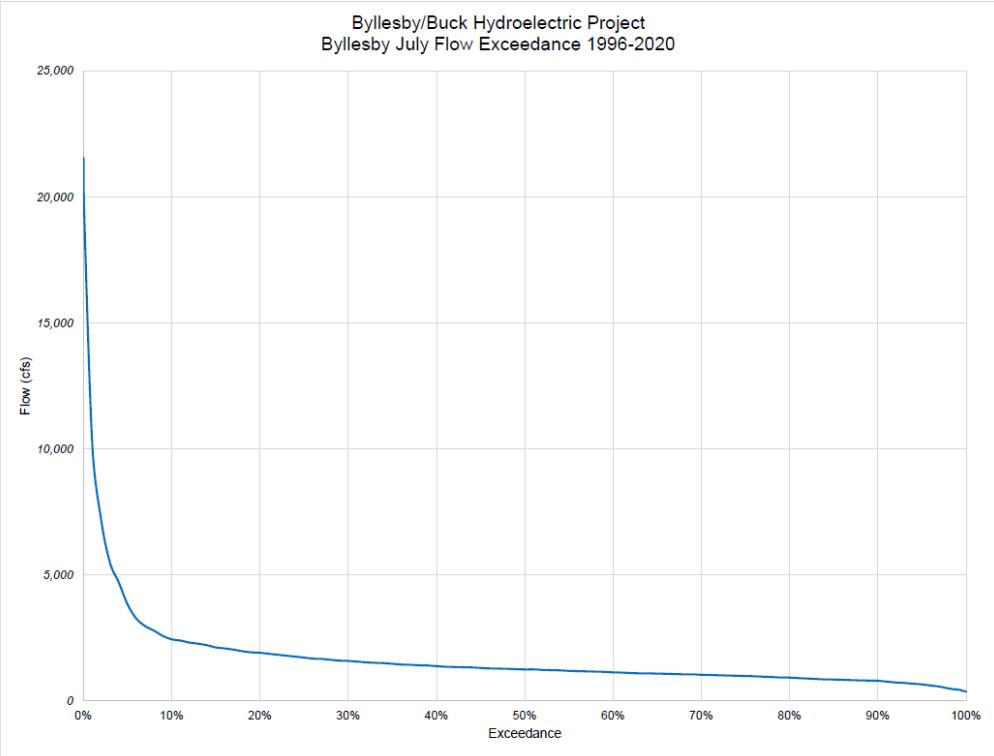


Figure B.5-19. Byllesby Development July Flow Duration Curve

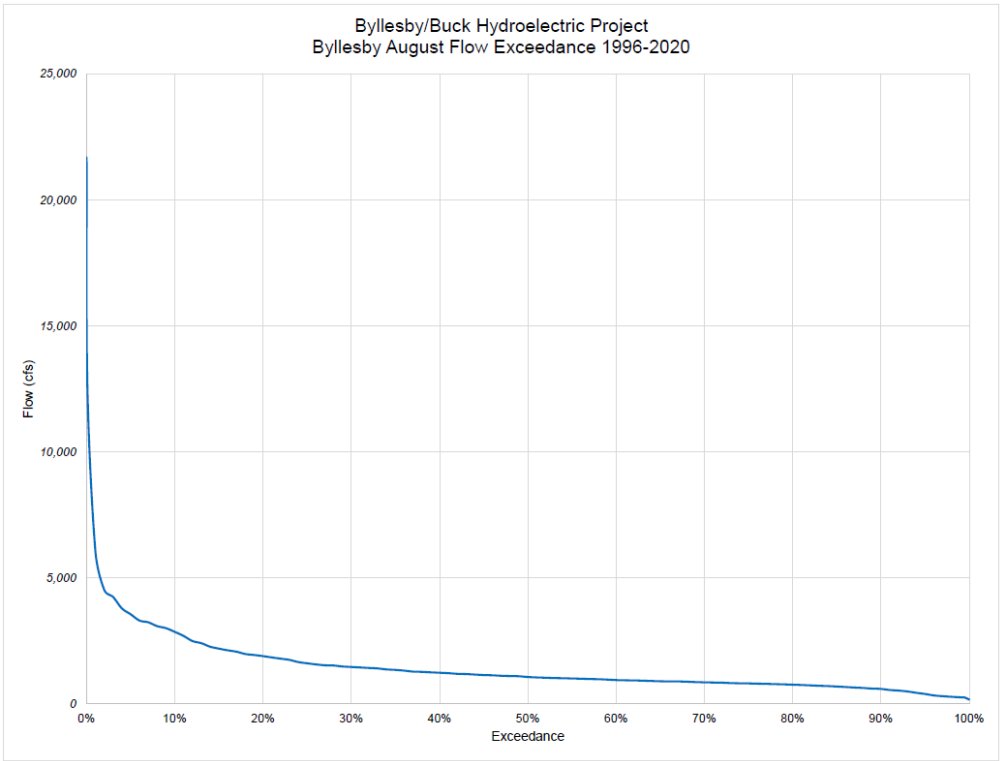


Figure B.5-20. Byllesby Development August Flow Duration Curve

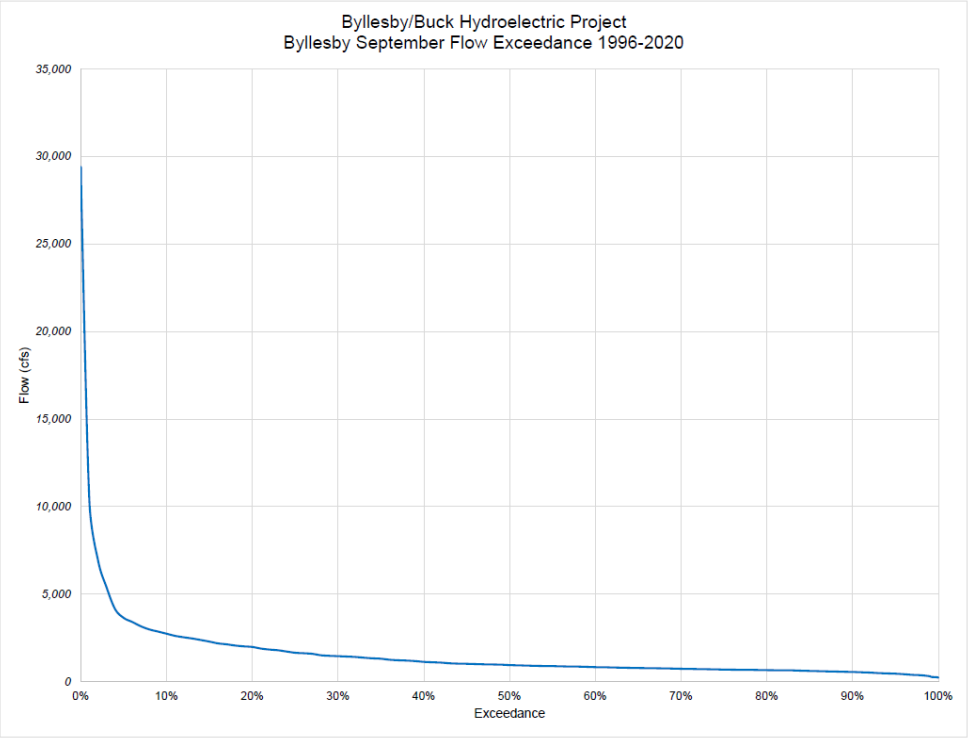


Figure B.5-21. Byllesby Development September Flow Duration Curve

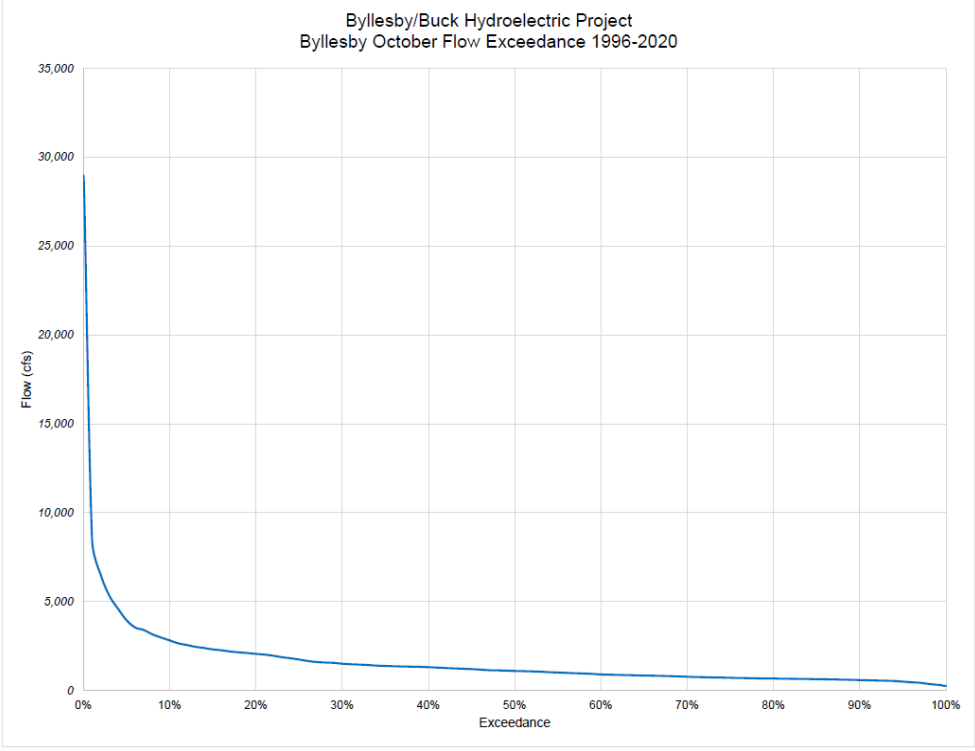


Figure B.5-22. Byllesby Development October Flow Duration Curve

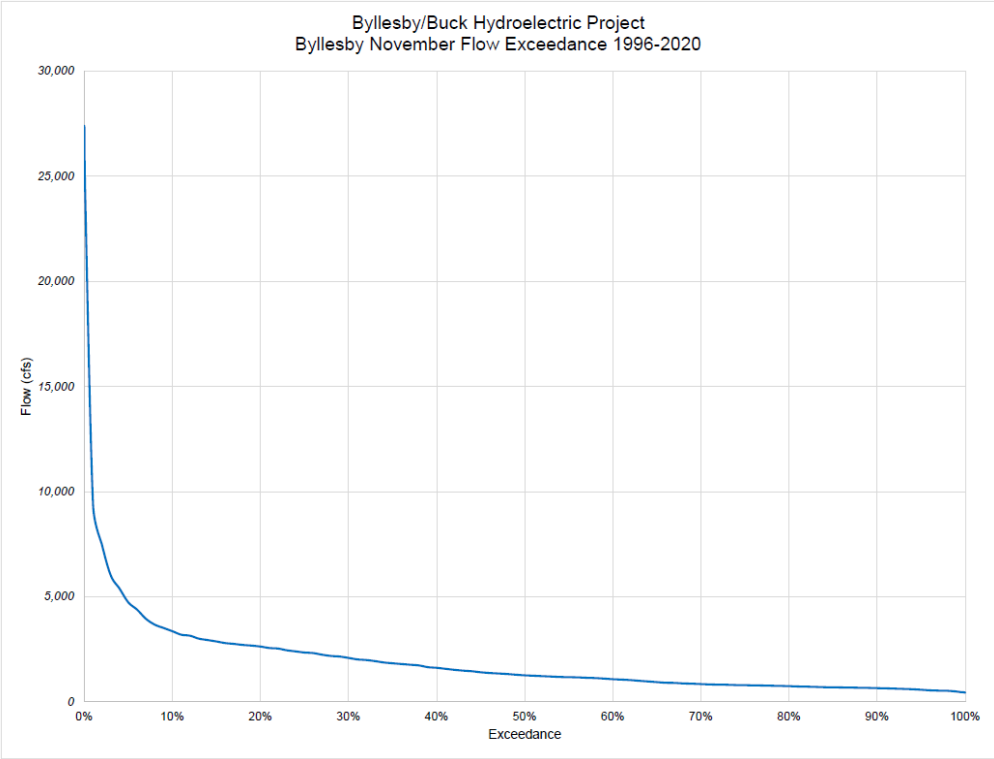


Figure B.5-23. Byllesby Development November Flow Duration Curve

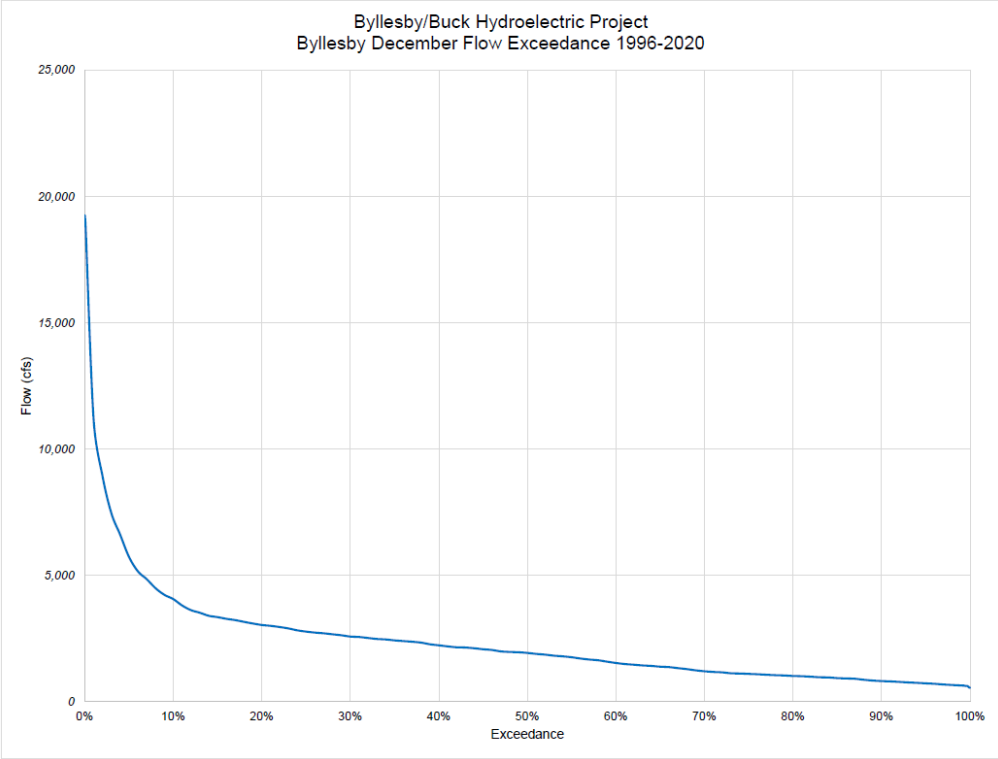


Figure B.5-24. Byllesby Development December Flow Duration Curve

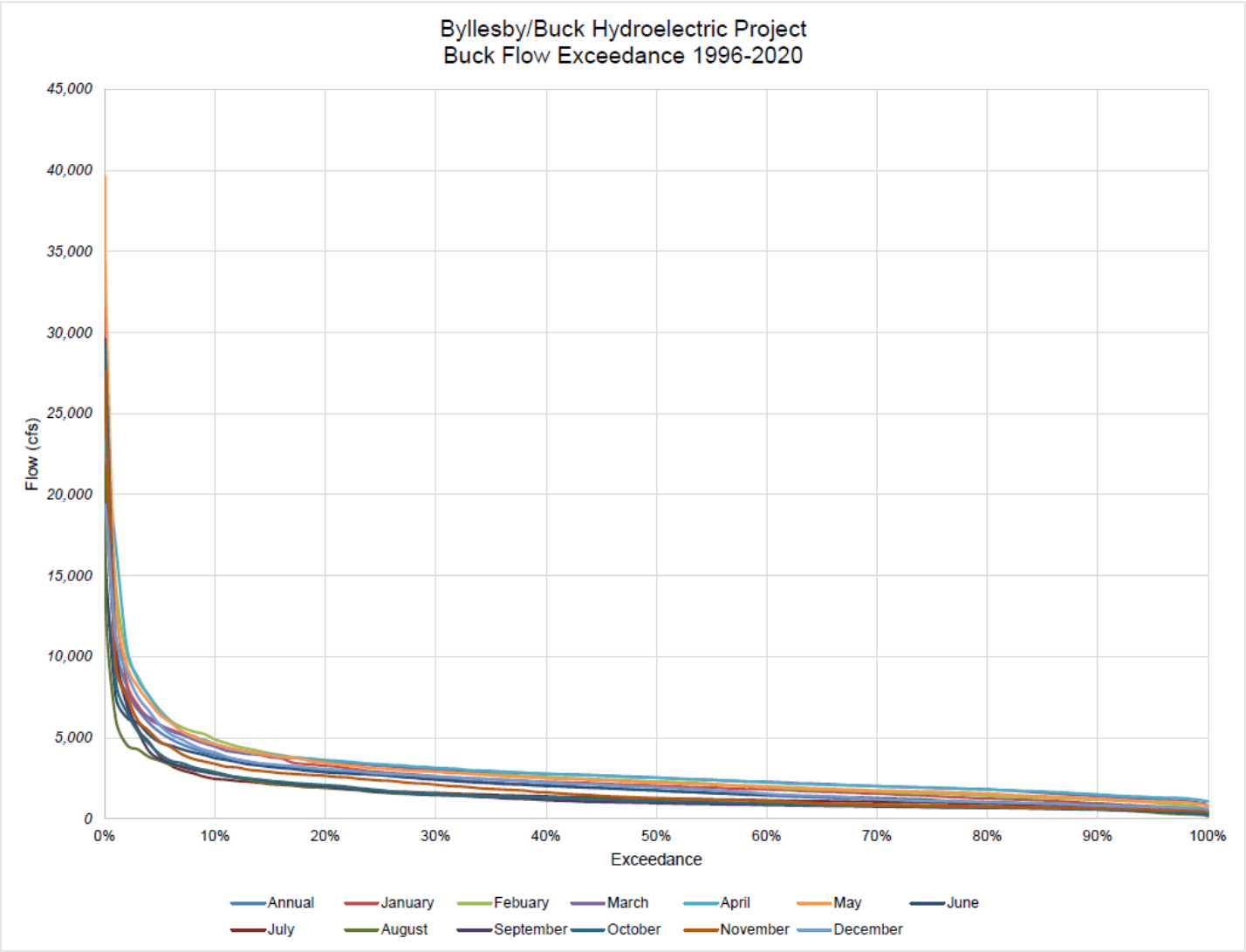


Figure B.5-25. Buck Development Monthly Flow Duration Curves

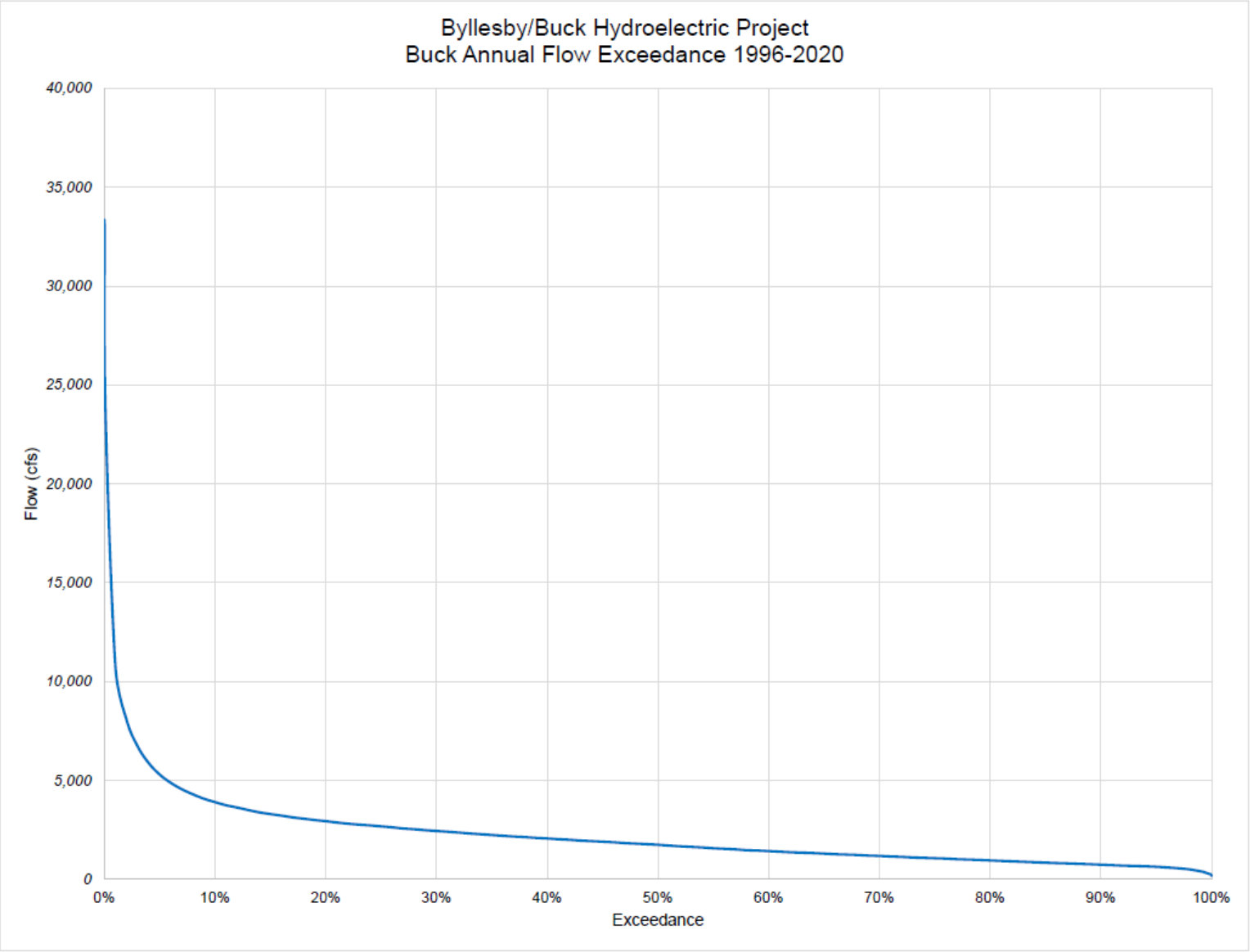


Figure B.5-26. Buck Development Annual Rating Curve

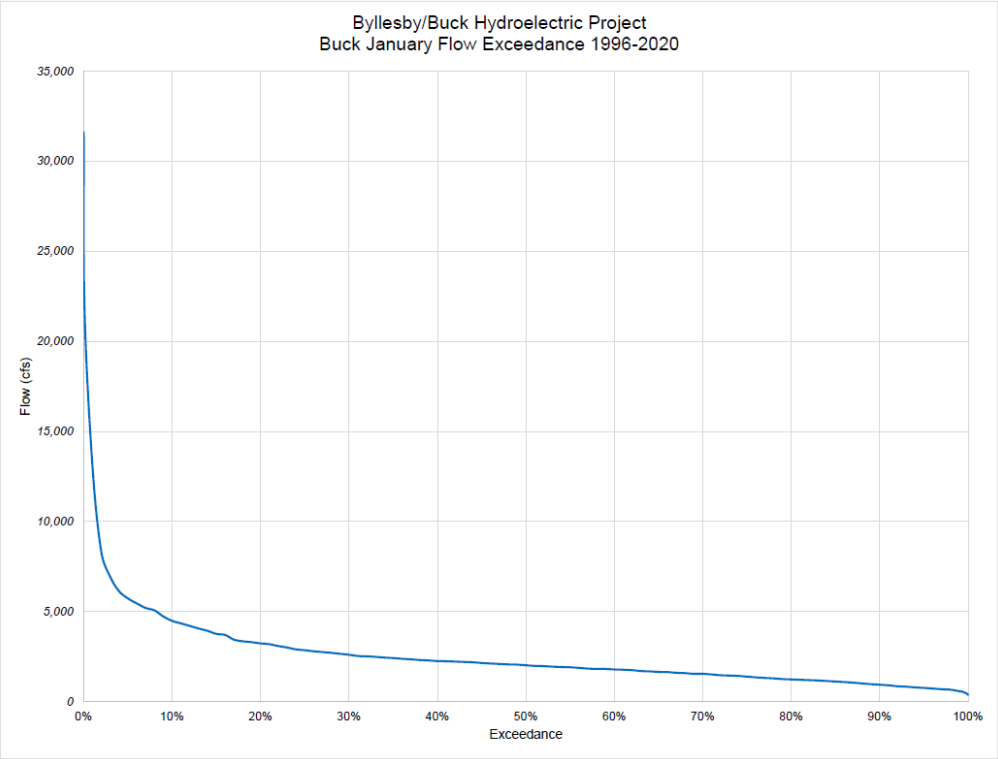


Figure B.5-27. Buck Development January Flow Duration Curve

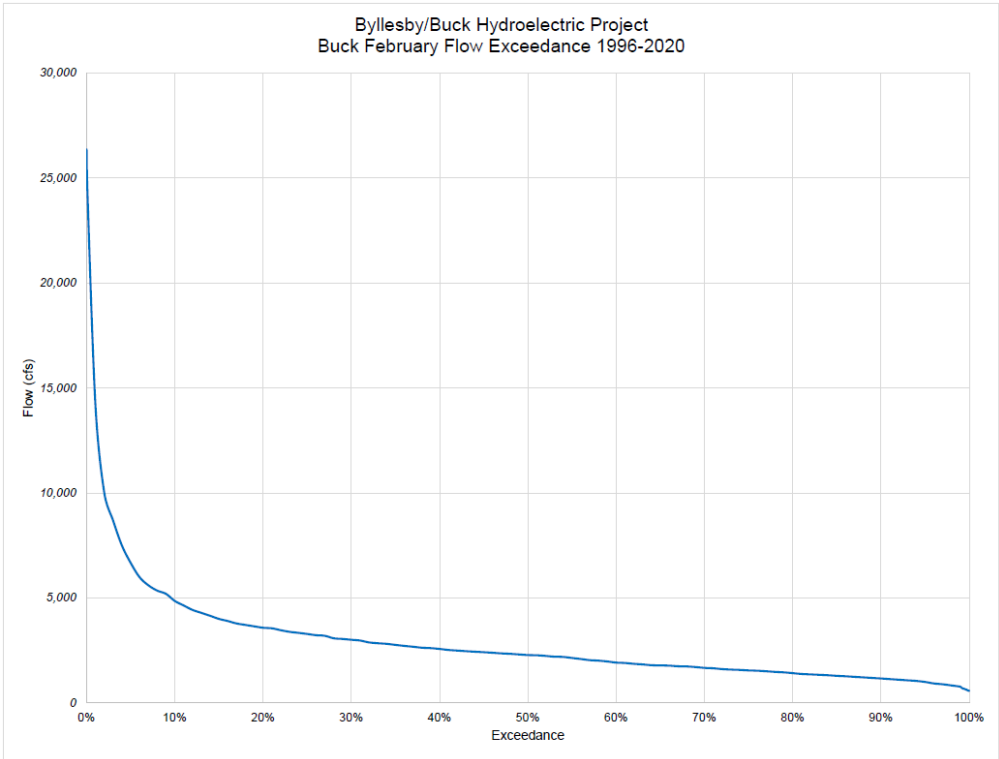


Figure B.5-28. Buck Development February Flow Duration Curve

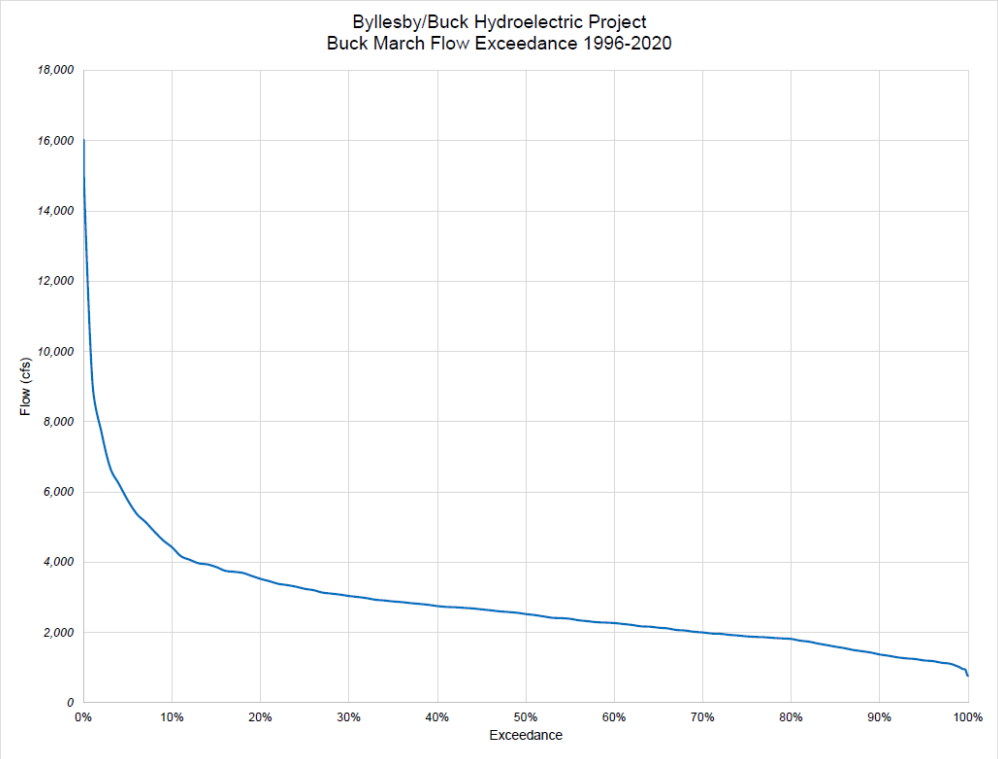


Figure B.5-29. Buck Development March Flow Duration Curve

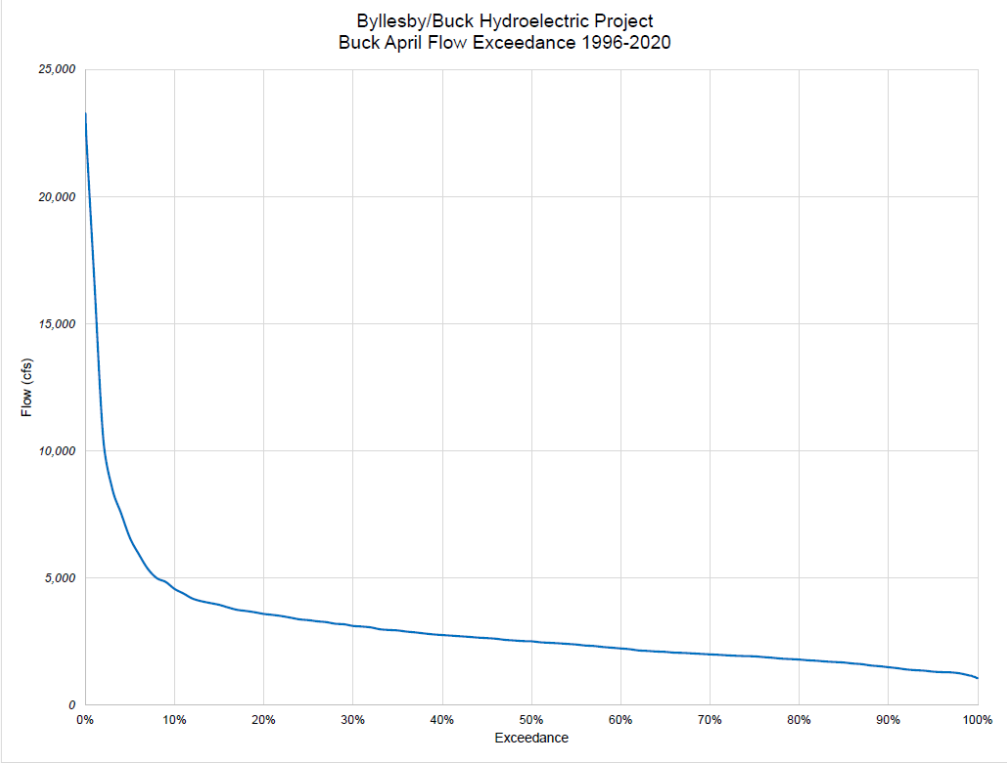


Figure B.5-30. Buck Development April Flow Duration Curve

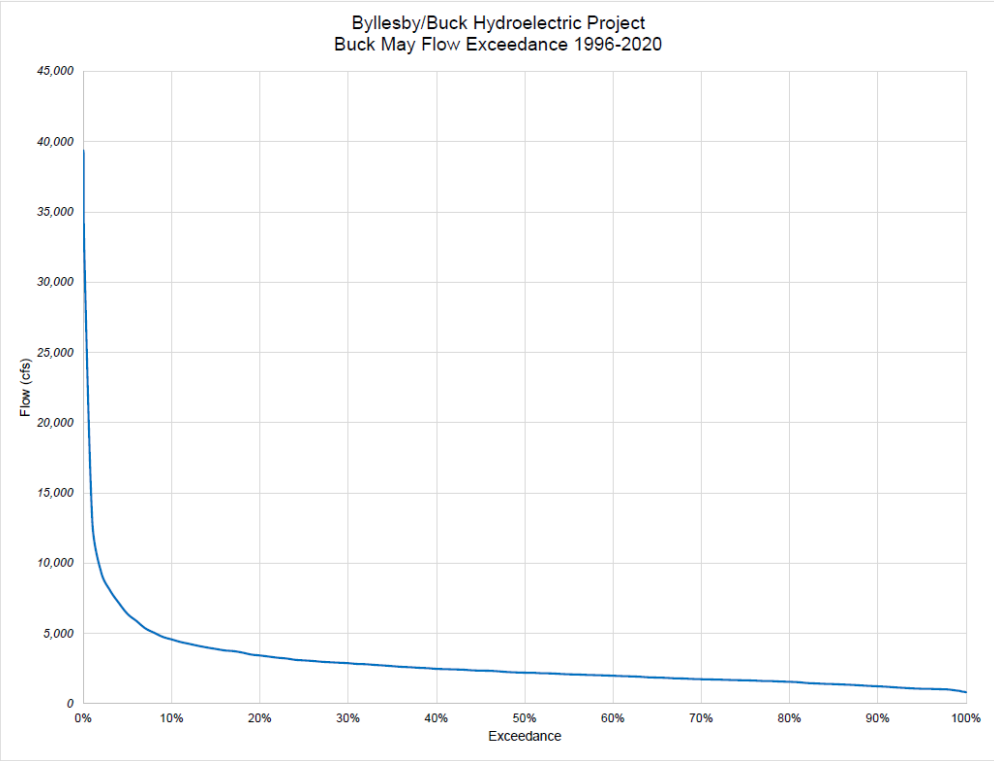


Figure B.5-31. Buck Development May Flow Duration Curve

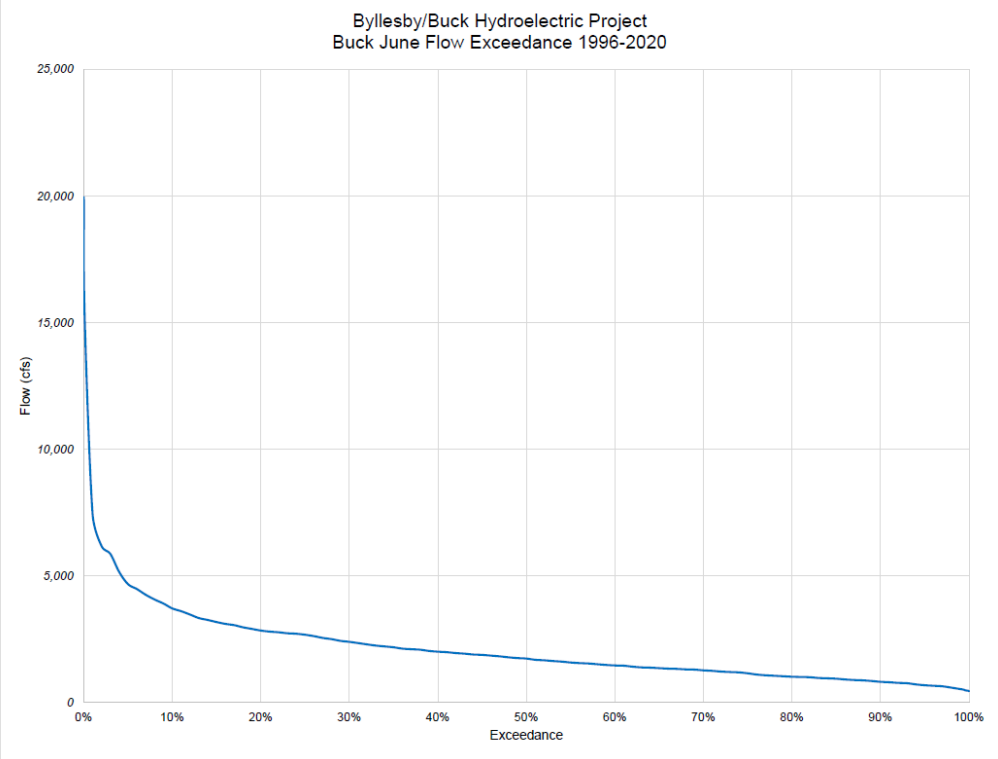


Figure B.5-32. Buck Development June Flow Duration Curve

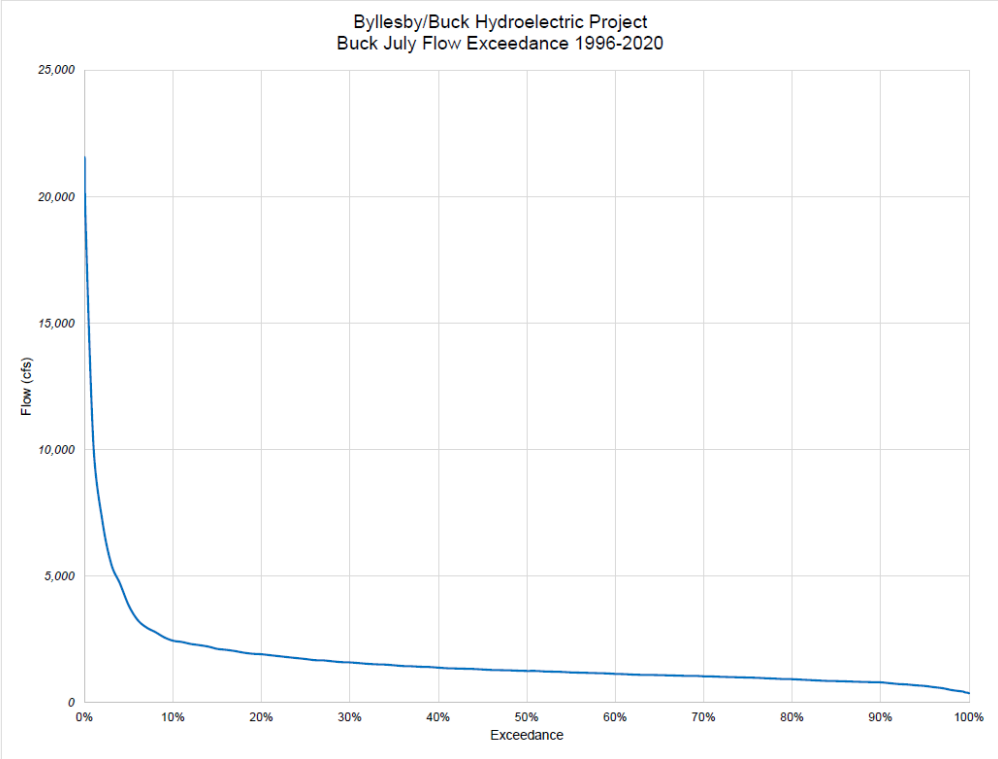


Figure B.5-33. Buck Development July Flow Duration Curve

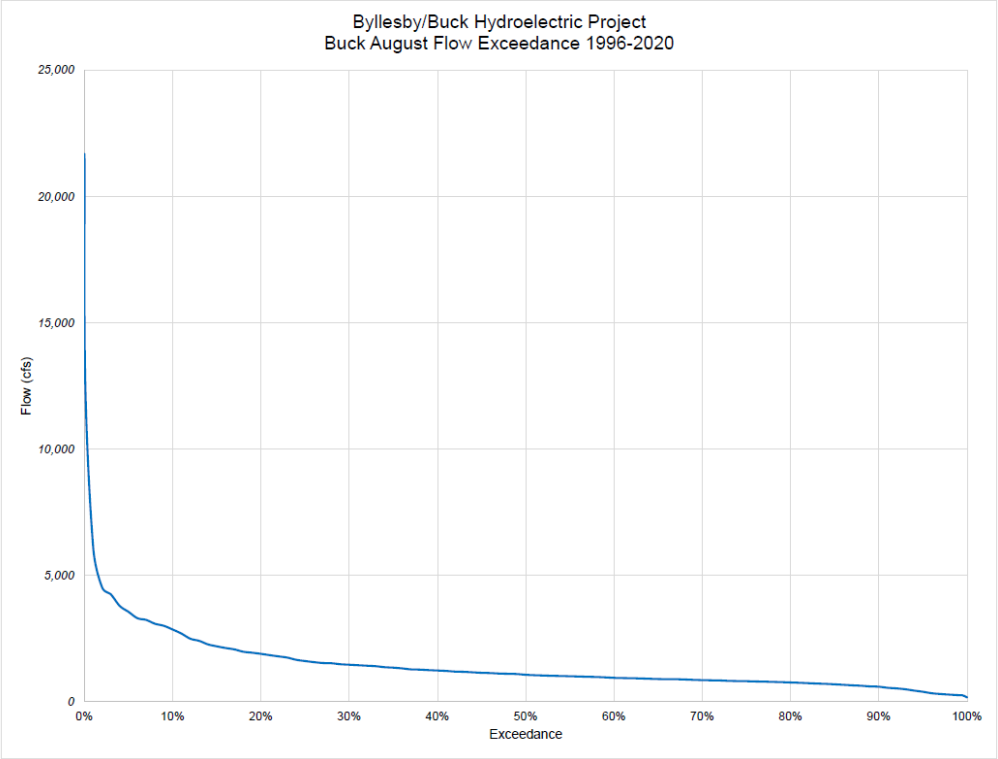


Figure B.5-34. Buck Development August Flow Duration Curve

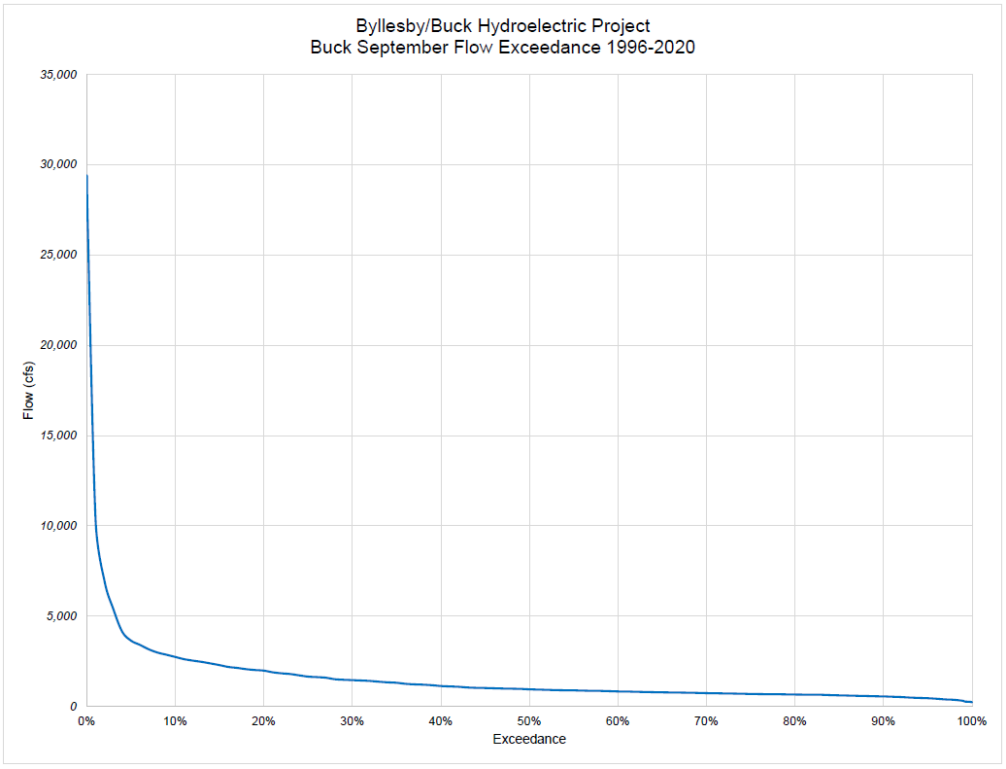


Figure B.5-35. Buck Development September Flow Duration Curve

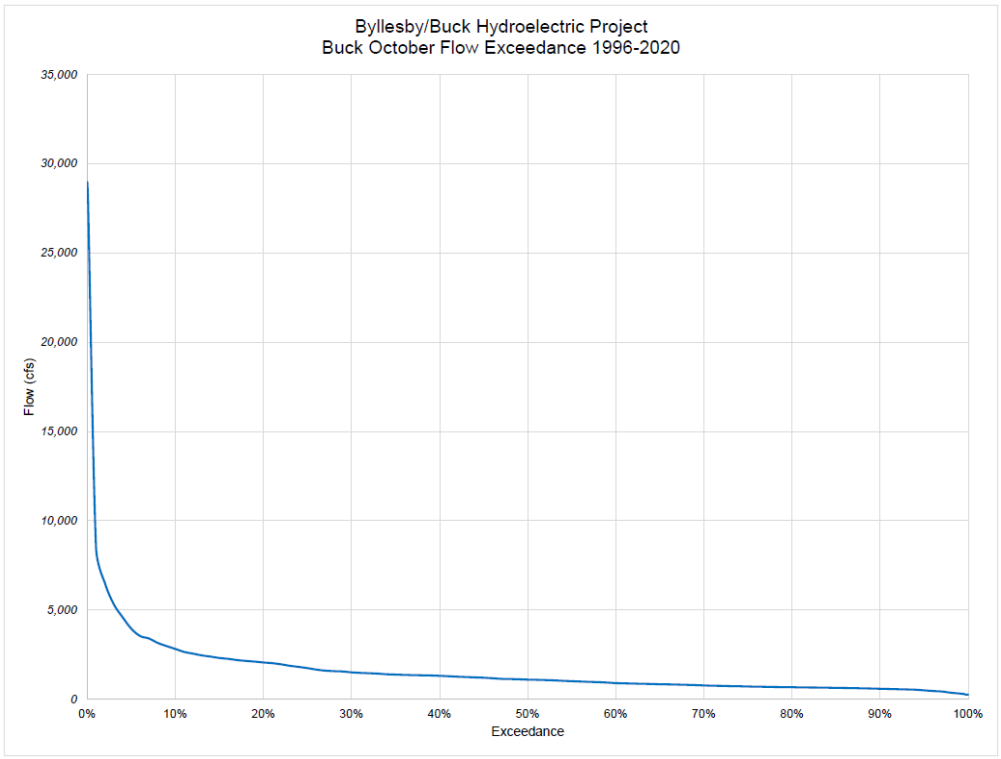


Figure B.5-36. Buck Development October Flow Rating Curve

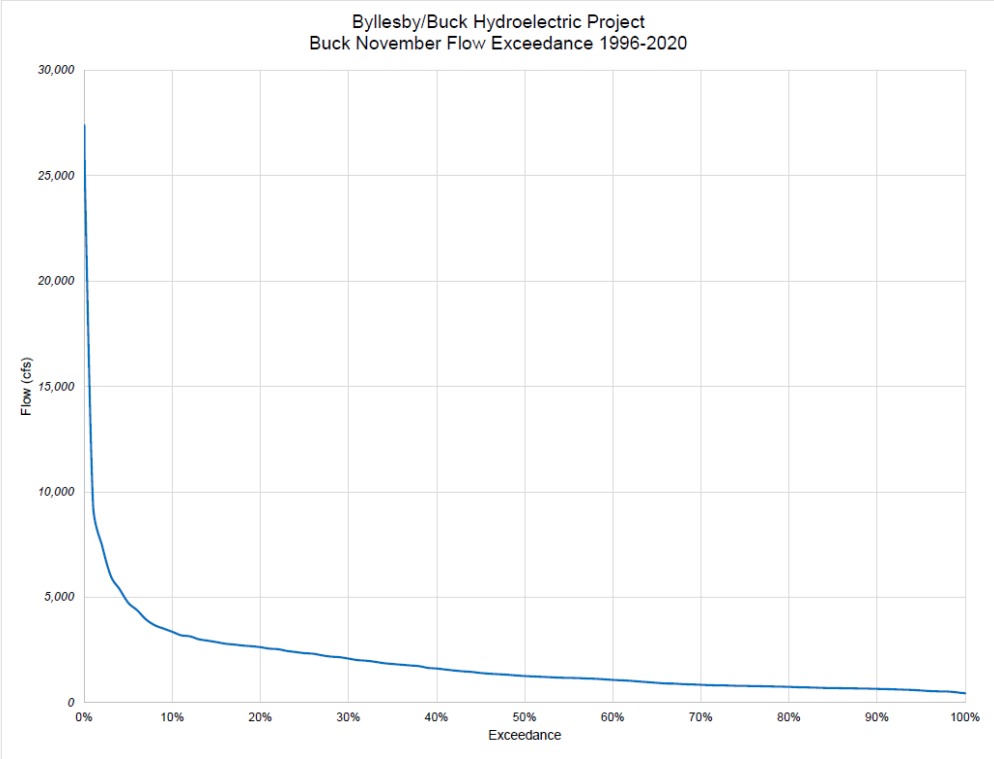


Figure B.5-37. Buck Development November Flow Duration Curve

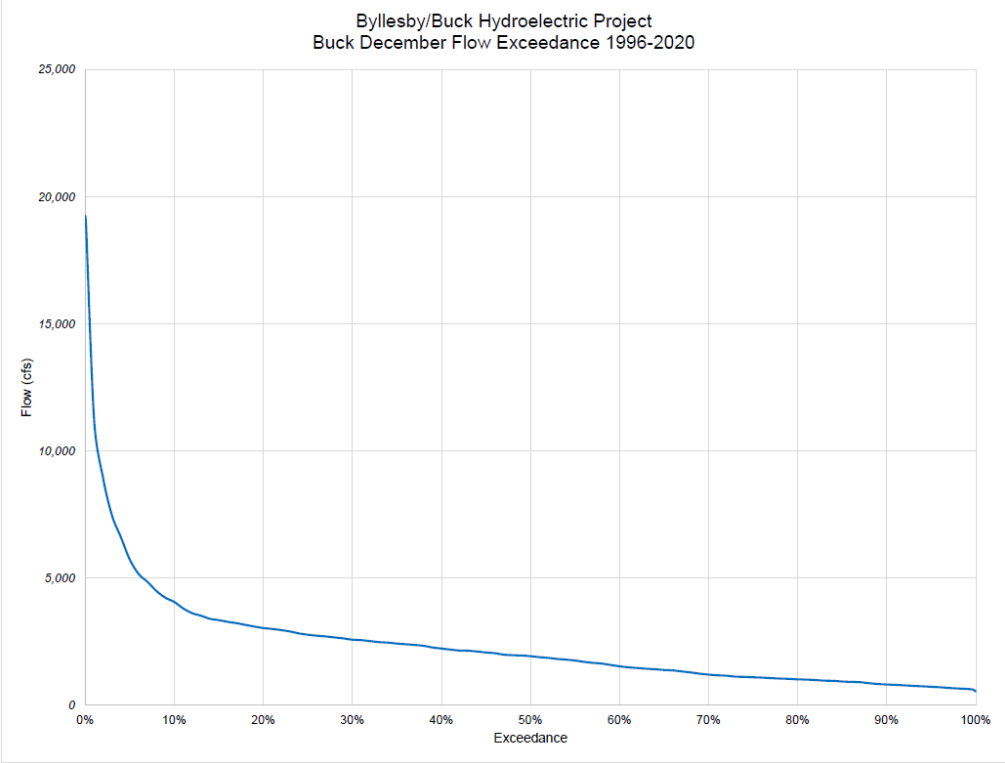


Figure B.5-38. Buck Development Decemeber Flow Duration Curve

This page intentionally left blank.

FINAL LICENSE APPLICATION

BYLLESBY-BUCK HYDROELECTRIC PROJECT (FERC NO. 2514)

EXHIBIT C

CONSTRUCTION HISTORY AND PROPOSED CONSTRUCTION SCHEDULE

This page intentionally left blank.

Exhibit C - Construction History and Proposed Construction Schedule (18 CFR §4.51(d))

C.1 Construction of Existing Facilities

Because 18 CFR §4.51(d)(1) requires a construction history only for applications for an initial license, a construction history is not required for this relicensing application for the Project. However, to provide general and background information, a brief summary of the construction history of the Project is included below.

The construction and major events/alterations/repairs to each development are listed below.

C.1.1 Byllesby Development

The Byllesby Dam was constructed in 1912 to provide hydropower for the New River Power Company and Appalachian acquired the development in 1926. Original engineering was performed by Viele, Black and Buck, Consulting Engineers, New York, NY.

- In 1928, severe deterioration led to removal and replacement of defective concrete.
- The August 1940 Flood of Record caused substantial damage to the generating machinery when the powerhouse was flooded.
- To address the dam's stability and factors of safety under the Probable Maximum Flood loading conditions, post tensioned rock anchors were installed in September 1992 and April 1993 in all water-retaining structures.
- Concrete restoration was conducted during 1993 and 1994 to repair freeze-thaw damage and spalled areas. Other improvements included underpinning the toe of the main spillway and concrete (to address undercutting), and pressure grouting the powerhouse substructure to control leakage.
- In 1998, an Obermeyer (pneumatic) gate was installed in the main spillway. The gate replaced the flashboards in one spillway bay.
- In 2000, the main spillway and auxiliary spillway timber walkways were replaced with steel grating.
- In 2002, concrete restoration on the downstream face of angled bulkhead was performed.
- In 2003, spillway Gates No. 2 and 3 were repaired. The lower section of the skin plate and all the vertical rib supports were replaced and repainted. The bottom and side seals were also replaced.

- In 2004, spillway Gates No. 1, 4, 5, and 6 were replaced.
- In 2006, concrete restoration was performed on the upstream side of the spillway crest. The concrete slab on the west side of powerhouse at the generator floor level was replaced. The trash racks in front of all 4 units were replaced and the steel support members were repaired or replaced as required. Work began on replacing the Unit 4 headgate.
- In 2007, concrete restoration was performed on the downstream spillway surface at the main spillway flashboard section Bay 8. Concrete restoration was also performed on the main spillway right abutment wall. The Unit 4 headgate installation was completed, and work began on replacement of the Unit 3 headgate.
- In 2008, the Unit 3 headgate installation was completed as well as replacement of the Unit 1 and 2 headgates.
- On the night of January 17, 2010 large blocks of ice broke free upstream of Byllesby Dam and the force of the ice on spillway resulted in eight sets of flashboards failing. The flood wave mixed with ice sheets reached Buck Dam, approximately 3 miles downstream, in less than 30 minutes.
- In 2010, the six spillway Tainter gates were automated to be operated from the COC. In addition, repairs were made to the concrete caps over two post tensioned anchor heads.
- In 2012, new spillway gate operators were installed on all six spillway Tainter gates.
- In January 2013, the right spillway abutment and the non-overflow bulkhead section of the dam were overtopped during a flood event. Minor scour occurred on the downstream side of the angled bulkhead. The powerhouse was flooded with approximately 1 to 2 ft of water, which forced the generation units offline. In addition the flood event silted in the forebay in front of the intakes and damaged the intake structures.
- In 2014, the forebay was dredged and the intake structure and screens were repaired. Concrete restoration of the downstream face of spillway bay 15 was performed. All flashboards on the main spillway and auxiliary spillway were replaced and repairs were made to all four generating units.
- In 2015, spillway Tainter gate anchors were installed.
- In 2016, two new Obermeyer gates were installed to replace the stanchion flashboards in Bays 12 and 13.
- In 2018, two new Obermeyer gates were installed to replace the stanchion flashboards in Bays 10 and 11.

C.1.2 Buck Development

The Buck Dam was constructed in 1912 to provide hydropower for the New River Power Company and Appalachian acquired the development in 1926. Original engineering was performed by Viele, Black and Buck, Consulting Engineers, New York, NY.

- In 1928, expansive concrete due to the use of phyllite aggregates and high alkali cement resulted in significant damage in the powerhouse causing misalignment between the turbine and generator which broke the turbines' stay rings. The concrete floor supporting the generators and turbines was removed to a depth of 5 ft below the scroll case floor and was replaced with a new concrete floor. The damaged stay rings were also removed, repaired, and replaced.
- Within ten years, additional concrete repairs were made to the 1928 work due to deterioration. The exterior concrete surfaces on the powerhouse substructure, bulkhead sections of the dam, and spillway were removed to an average depth of 4 inches, with some areas requiring as much as 18 inches locally. Stage grouting was used to stop leakage through construction joints. The new concrete facing was divided into panels with v-joint separations to localize cracking and allow sealing of the joints; it was met with limited success.
- The August 1940 Flood of Record resulted in substantial damage to the generating machinery when the powerhouse was flooded.
- The spillway bridge and gate piers were replaced in 1988.
- To address potential stability concerns under the Probable Maximum Flood loading conditions, post tensioned rock anchors were installed between April and November of 1993 in all water-retaining structures.
- Concrete restoration was conducted during 1993 and 1994, consisting of epoxy grouting for leakage control through structures and filling the undercut area of the spillway toe with concrete.
- In 2001, the monitoring program for the piezometers in the spillway and main dam was discontinued based on recommendations made by the independent consultant for the Fifth Part 12 Safety Inspection.
- In 2002, concrete repairs to the deck on top of the north non-overflow bulkhead section were performed. The deck was chipped down 6 inches and repoured. The concrete caps over the post-tensioned anchors heads were also restored.
- In 2006, the I.P. Morris vertical Francis turbine runner for Unit 3 was replaced with a new vertical Francis turbine runner manufactured by American Hydro.

- In 2007, the concrete caps over six post-tensioned anchors in the main spillway were restored.
- On the night of January 17, 2010 ice jams on the New River resulted in overtopping of the non-overflow bulkheads at the Buck Development. Large blocks of ice broke free upstream of Byllesby Dam and the force of the ice on spillway resulted in eight sets of flashboards failing. The flood wave mixed with ice sheets reached Buck Dam in less than 30 minutes. The surge of water raised the pond level several feet until 3 sets of flashboard bays finally failed 1 hour and 45 minutes later, allowing the Buck pond to begin dropping.
- Minor overtopping of the abutments at the Buck Dam occurred during the peak of the event; however, there was no loss of integrity of the water impounding structures. The damage was limited to minor erosion around the toe of the left concrete bulkhead, bent handrails, and damaged log boom sections.
- Also in 2010, the six spillway Tainter gates were automated so they could be operated from the COC.
- In 2012 and 2013, repairs were made to the concrete caps over several post-tensioned anchors where the concrete was cracked or eroded. Concrete restoration was also performed on the two left spillway bay downstream surfaces.
- On January 31, 2013, heavy rains contributed to high river flows on the New River in Southwest Virginia resulting in overtopping of the Byllesby and Buck dams creating an emergency condition. At the spillway bridge, the right abutment was over overtopped which washed out stone on the entrance road and eroded the fill material on the downstream shoreline where the water reentered the river. At the powerhouse, the right and left non-overflow bulkheads were overtopped. The loss of fill material was not a dam safety concern. The powerhouse was flooded by about six inches. The top of the head covers and guide bearings were flooded on all the units. All necessary repairs were made in 2013 and the forebay was returned to normal operating level in December 2013.
- In 2014, repairs were made to the intake structure. The horizontal support beams were replaced and the vertical support members were reinforced. The intake screens were also replaced.
- Repairs were made to the gate hoist anchorage in 2015.
- In 2017, two new Obermeyer gates were installed to replace the flashboards in Bays 7 and 8.
- In 2018-2019, two new Obermeyer gates were installed to replace the stanchion flashboards in Bays 9 and 10.

C.2 Construction of Proposed Facilities

During the new license term, Appalachian proposes to modernize the Byllesby and Buck developments to include replacement of Byllesby Units 1, 2, and 4 and Buck Units 1 and 3. All but one (Buck Unit 2) of the seven turbine-generator units installed at the Project are the original major components of the Project as constructed in 1912. The existing vertical Francis units would be replaced by fixed blade Kaplan units. Unit upgrade activities would be confined to within the powerhouse, and there would be minimal changes to operating parameters for the Project.

Appalachian is presently planning a three-phase unit replacement program for the Project. The first phase involves the replacement of Byllesby Unit 4 starting in 2024. The second phase involves the replacement of Byllesby Units 1 and 2 in 2025 and 2026; existing Byllesby Unit 3 would remain in place and would be operated as last unit on and first unit off. The third phase involves the replacement of Buck Units 1 and 3 in 2027 and 2028, respectively. Existing Buck Unit 2 would remain in place and would be operated as last unit on and first unit off.

This page intentionally left blank.

FINAL LICENSE APPLICATION

BYLLESBY-BUCK HYDROELECTRIC PROJECT (FERC NO. 2514)

EXHIBIT D

COSTS AND FINANCING

This page intentionally left blank.

Exhibit D - Costs and Financing (18 CFR §4.51(e))

D.1 Original Cost of Project

Since the Project is applying for a new license for an existing project, as compared to an initial license, a tabulated statement providing the actual or approximate cost of Project construction is not applicable.

D.2 Project Takeover Cost Pursuant to Section 14 of the FPA

Under Section 14(a) of the Federal Power Act (FPA), the federal government may take over any project licensed by the Commission upon the expiration of the original license. The Commission may also issue a new license in accordance with Section 15(a) of the FPA. If such a takeover were to occur upon expiration of the current license, the Licensee would have to be reimbursed for the net investment, not to exceed fair value, of the property taken, plus severance damages. To date, no agency or interested party has recommended a federal takeover of the Project pursuant to Section 14 of the FPA.

D.2.1 Fair Market Value

Fair market value is not defined in the FPA or its implementing regulations. The fair value of the Project depends on prevailing power values and license conditions, both of which are currently subject to change. The best approximation of fair value is likely to be the cost to construct and operate a comparable power generating facility. Because of the high capital costs involved with constructing new facilities and the increase in fuel costs associated with operating such new facilities (assuming a fossil-fueled replacement), the fair value would be considerably higher than the net investment amount. If a takeover were to be proposed, the Licensee would calculate fair value based on then-current conditions.

For the purposes of this Exhibit, Appalachian is providing the current net book value for the Project in Table D.2-1.

Table D.2-1. Byllesby-Buck Project Net Book Value

Utility Account	Through-Period	Book_Cost	Allocated_Reserve	Net_Book_Value
302 - Franchises and Consents	12/2021	$ 400,843	$ 371,430	$ 29,413
331 - Structures and Improvements	12/2021	$ 1,216,147	$ 1,017,947	$ 198,201
332 - Reservoirs, Dams & Waterway	12/2021	$ 7,441,024	$ 5,321,204	$ 2,119,820
333 - Water Wheels, Turbines, Generators	12/2021	$ 3,697,214	$ 2,977,955	$ 719,259
334 - Accessory Electric Equipment	12/2021	$ 1,081,017	$ 1,010,704	$ 70,313
335 - Misc Power Plant Equipment	12/2021	$ 1,037,294	$ 854,617	$ 182,677
337 - ARO Hydraulic Production	12/2021	$ 72,046	$ 58,475	$ 13,571
Total	**12/2021**	**$ 14,945,585**	**$ 11,612,332**	**$ 3,333,253**

D.2.2 Net Investment

The total lifetime investment in the Project through December 31, 2021 was approximately $14,945,585. The net investment in the Project (investment minus lifetime depreciation expense) through December 31, 2021 was approximately $3,333,253. This value should not be interpreted as the fair market value of the Project.

D.2.3 Severance Damages

Severance damages are determined either by the cost of replacing (retiring) equipment that is "dependent for its usefulness upon the continuance of the License" (Section 14, FPA), or the cost of obtaining an amount of power equivalent to that generated by the Project from the least expensive alternative source, plus the capital cost of constructing any facilities that would be needed to transmit the power to the grid, minus the cost savings that would be realized by not operating the Project. These values would need to be calculated based on power values and license conditions at the time of Project takeover.

The following calculation of severance damages is based on the assumption that severance damages are to be measured by the cost to Appalachian of effectively replacing the utility service provided by the Project.

The calculation of severance damages assumes that takeover of the Project would occur upon expiration of the license in 2024. However, it must be realized that an alternative source of comparable energy could not be constructed by this date. Therefore, the calculation should include the very substantial cost to Appalachian for temporary replacement of capacity which, in general, would be assumed to be at the then-current market price. Due to the highly conjectural nature of these calculations, these costs have not been included in the calculation of severance damages included herein.

The present worth of the annual cost of owning the replacement capacity was determined on the basis of the cost of the most likely alternative source of capacity and energy capable of providing dependable capacity and net output equivalent to that expected to be supplied by the Project over a 50-year period. The calculation assumes that the alternative power supply would consist of fractional shares of combined cycle peaking gas plant (see additional information in Exhibit H, Section H.1), which would be placed in service in 2029. (For the years 2024 through 2029, replacement energy would be supplied by the AEP System's existing capacity and is not included in the calculation below.) Out of recognition of the greater availability of the hydroelectric plants as compared with gas-fired plants, the amount of thermal capacity considered to be equivalent to the Project's capacity was increased by 30%.

The estimate of severance damages is calculated as follows:

(1)	Cumulative present worth of the annual cost of owning the replacement capacity (costs begin in 2029)		$24,000,000
(2)	Cumulative present worth of annual costs of replacement energy		$2,500,000
(3)	Estimated net investment in the Project	-	$2,600,000
(4)	Present value of annual costs of ownership (other than net investment costs) and operation of the Project	-	$3,562,500
Total severance damages			**$20,337,500**

On the basis of the calculation above, the amount due to Appalachian in case of takeover as of 2024 for net investment not exceeding the fair value plus severance is estimated to be $20,337,500.

Substantial additional detriments due to changes in operational flexibility, reserves, renewable generation goals and benefits, and other matters are not included in the above estimates. These estimates were developed by Appalachian within the limits of information available at the time the application was prepared and are being submitted without prejudice to Appalachian's right to reevaluate the entire question of the amount payable for takeover in light of information available at a later time.

D.3 Estimated Costs of New Development

D.3.1 Land and Water Rights

The Licensee currently holds all land and water rights necessary to construct, operate and maintain the Project, and is not proposing expansion of its land or water rights as a consequence of this license application.

D.3.2 Cost of New Facilities

Construction of new facilities during the new license term is not presently proposed by Appalachian. During the new license term, Appalachian does propose to modernize the Byllesby and Buck developments to include replacement of Byllesby Units 1, 2, and 4 and Buck Units 1 and 3. Appalachian's preliminary cost estimate for these upgrades over the new license term is $32,023,000.

Costs for new facilities proposed as PM&E measures for the new license term, are provided in Section D.4.1.5.

D.4 Estimated Average Annual Cost of Project

There is no fixed schedule for other elements of the Project's general life-extension program, rather a sequence of activities designed to be implemented when needed. Accordingly, there is not a fixed annual budget allocated for additional life-extension activities. These activities would be performed on an as-needed basis using existing planning procedures that provide short- and long-term windows to evaluate, schedule, and budget replacements and rehabilitation work in an orderly fashion.

D.4.1 Current Annual Costs

The average annual cost of the Project, including costs associated with existing and projected Project operations and maintenance, as well as local property and real estate taxes, but excluding income taxes, other taxes, depreciation, and costs of financing, for the period 2017-2021 was $1,045,809.

D.4.1.1 Cost of Capital (Equity and Debt)

Average annual Project capital costs for the period 2017-2021 were $808,100. Actual capital costs are based on a combination of funding mechanisms that include stock issues, debt issues, revolving credit lines, and cash from operations. For the period 2022-2026, the estimated average annual Project capital costs are $6,680,813.

D.4.1.2 Local, State, and Federal Taxes

Average annual property taxes for the period 2017-2021 were $83,921. Income taxes for the Project are incorporated into costs of the Licensee's consolidated business and are not separated out for the Project.

D.4.1.3 Depreciation and Amortization

As of December 31, 2021, the annualized composite rates of depreciation for the Project by plant account were as follows:

- 331 - Structures and improvements: 9.83%
- 332 – Reservoirs, dams and waterways: 12.90%
- 333 – Water wheels, turbines and generators: 11.69%
- 334 – Accessory electric equipment: 7.18%
- 335 – Miscellaneous power plant equipment 9.53%:

As of December 31, 2021, the total depreciation or amortization expense was $1,692,326

D.4.1.4 Operation and Maintenance Expenses

The average annual O&M expense for the Project, including corporate support costs, but excluding property and real estate taxes, for the period 2017-2021 was $978,154.

D.4.1.5 Estimated Capital and O&M Costs of Proposed PM&E Measures

Appalachian has proposed a number of measures for the PM&E of environmental resources associated with the Project. The proposed environmental enhancements will not require any new lands or water rights for which Appalachian does not already have ownership or rights. The estimated capital and annual costs of PM&E measures proposed by Appalachian at the Project are presented in Table D.4-1.

Table D.4-1. Preliminary Cost Estimate of Resource PM&E Measures Proposed by Appalachian at the Byllesby-Buck Project

Item	Capital Cost (2022 Dollars)	Incremental Operations & Maintenance or Annual Cost (2022 Dollars)
Continue to operate the Project in a run-of-river mode.	-	-
Continue funding of the USGS New River at Galax and Ivanhoe gages.	-	$25,400
Continue to provide a minimum flow of 360 cfs, or inflow through the Project, whichever is less, to the New River downstream of each powerhouse.	-	-

Item	Capital Cost (2022 Dollars)	Incremental Operations & Maintenance or Annual Cost (2022 Dollars)
Implement proposed modified ramping rate for spillway gate operations at the Buck development.	$5,000	-
Develop and implement a Bypass Reach Aquatic Resources Protection Plan in consultation with USFWS and VDWR and for FERC approval.	$50,000	$10,000
Conduct Project maintenance and new license implementation activities, as applicable, in accordance the USFWS's prevailing eagle management guidance and regulations.	$10,000	$5,000
Finalize and implement Recreation Management Plan in consultation with Project stakeholders, including provisions for improvements to existing Project facilities (Byllesby Boat Launch, Byllesby Dam Fishing Access, Byllesby Canoe Portage (Take-Out), New River Canoe Launch (Put-In), and Buck Canoe Portage (Take-Out and Put-In) and construction of the Non-Project Loafer's Rest Area and Fishing Trail.	$515,000	$25,000
Finalize in consultation with consulting parties (Tribes, SHPO, and FERC) the draft Historic Properties Management Plan.	$5,000	$1,500
Total	**$585,000**	**$66,900**

D.4.2 Annual Value of Project Power

Appalachian sells all of the electricity generated at the Project into PJM Interconnection[6] (PJM). Based on average 2021 revenue for the Project of $34.44/MWh and generation in 2021 of 73,233 MWh, in 2021 the value of Project power was $2,522,242.

D.5 Sources and Extent of Financial and Annual Revenues

If determined to be needed, Appalachian's general plan for financing the environmental enhancements and life-extension cost of the Project initially will be to issue short-term debt (either bank line of credit or commercial paper) and to generate internal funding consisting of depreciation, retained earnings, and deferred federal income taxes. If short-term financing options become unattractive, Appalachian will issue permanent securities (i.e., long-term debt, preferred stock, and common stock) to replace short-term debt. This financing plan will adhere to Appalachian's overall corporate construction financing requirements.

[6] The PJM Interconnection is a regional transmission organization that coordinates the movement of electricity in all or parts of 13 Mid-Atlantic and Midwestern states plus the District of Columbia.

D.6 Cost to Develop the License Application

The approximate cost to prepare the application for new license for the Project through February 28, is $2 million.

D.7 On-Peak and Off-Peak Values of the Project

The Project operates as a run-of-river generating facility. As per 18 CFR Â§ 4.51(e)(8), this section is not applicable to hydroelectric projects operating in run-of-river mode.

D.8 Estimated Average Increase or Decrease in Generation

The unit upgrades proposed by Appalachian are expected to increase average annual generation by approximately 25,927 MWh.

Appalachian is not presently proposing any PM&E measures or operational modifications at the Project that would cause a decrease in annual generation or decrease in the value of project power.

As discussed in Section E.15.3 of Exhibit E of this FLA, preliminary minimum bypass flow recommendations by USFWS (88 cfs at Byllesby and approximately 360 cfs at Buck) would result in an average annual reduction of generation (assuming the existing, not upgraded, equipment) of 11,506 MWh.

D.9 PURPA Benefits

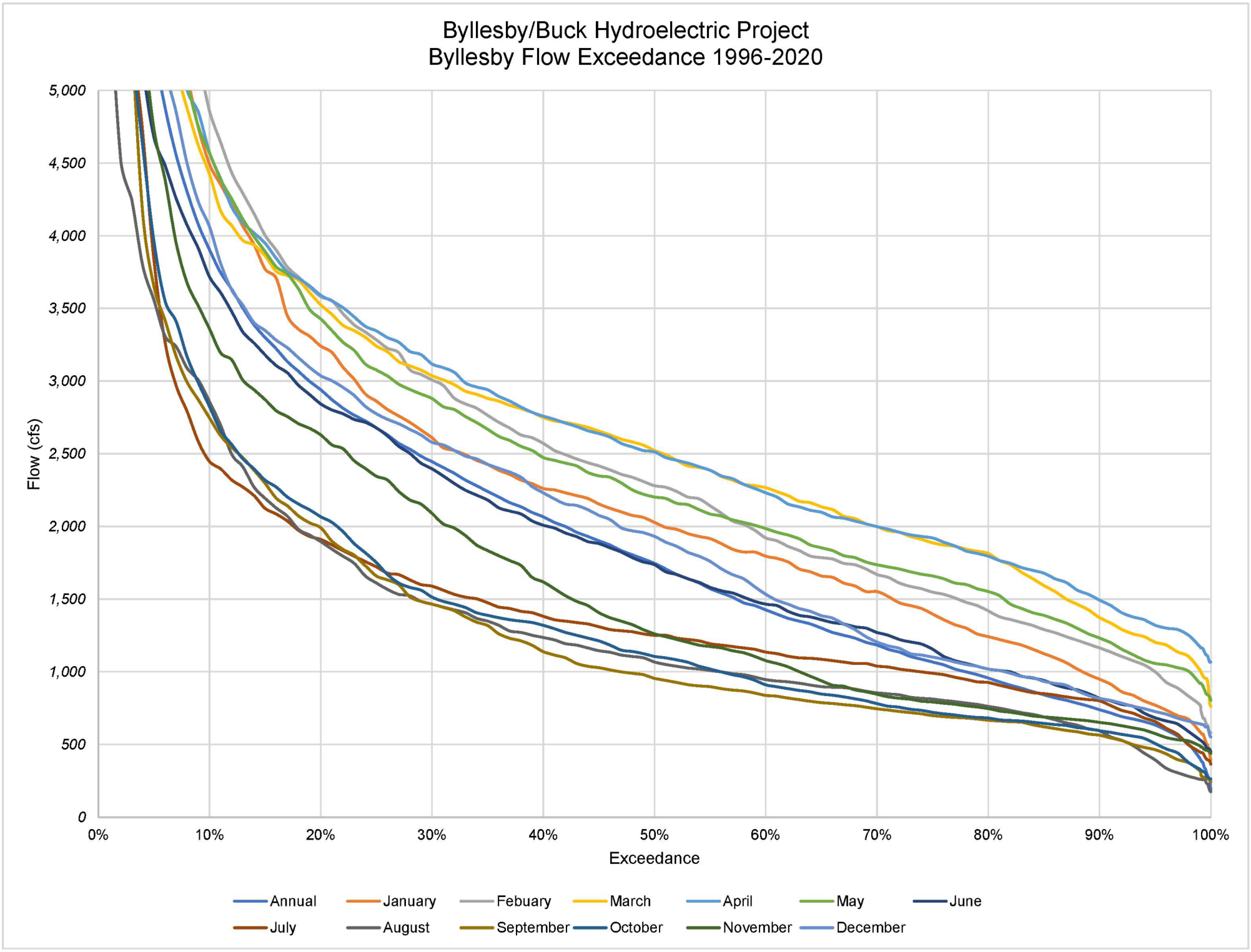
Appalachian will not be seeking benefits under Section 210 of the Public Utility Regulatory Policies Act (PURPA) of 1978 for qualifying hydroelectric small power production facilities in §292.203 of this chapter.

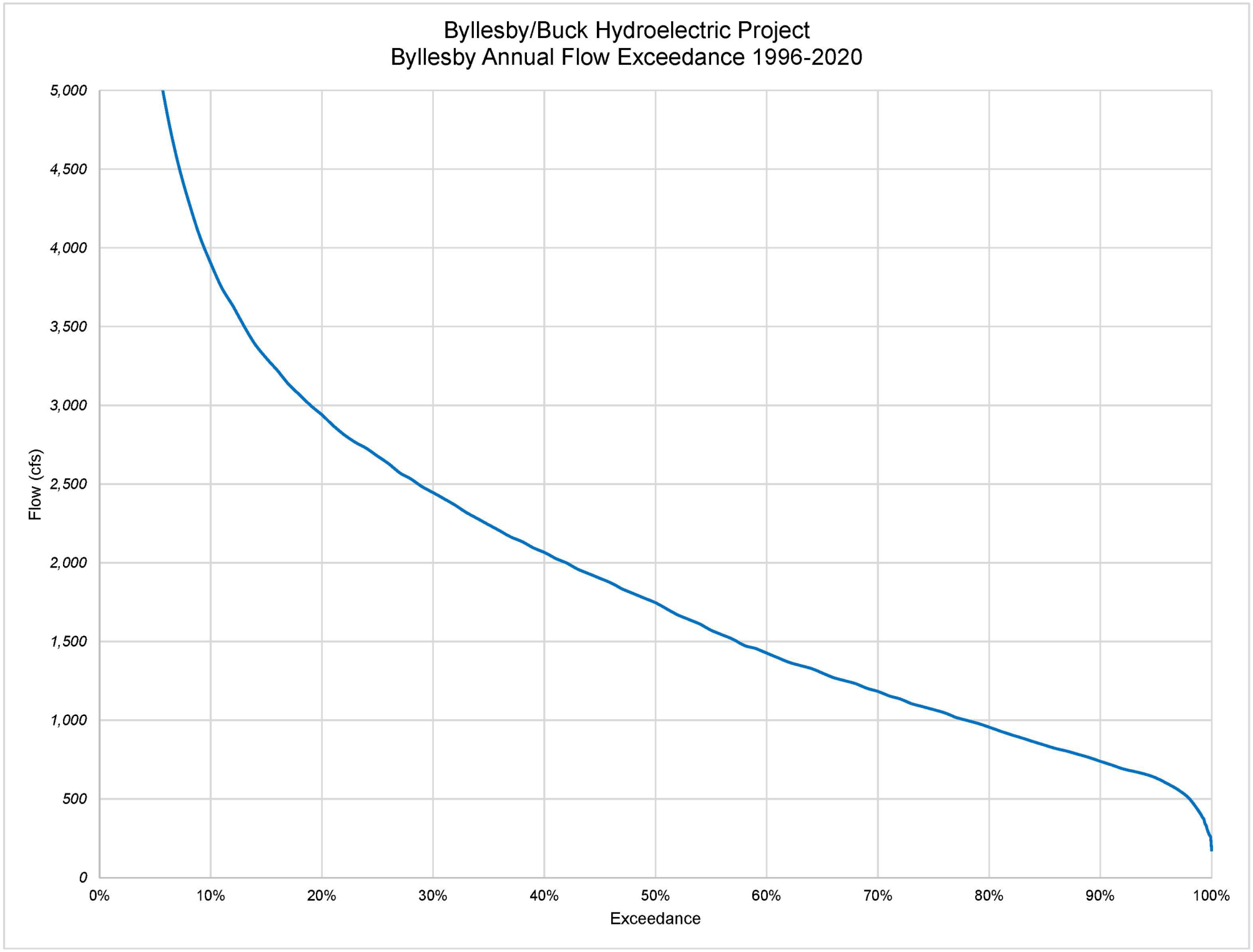
This page intentionally left blank.

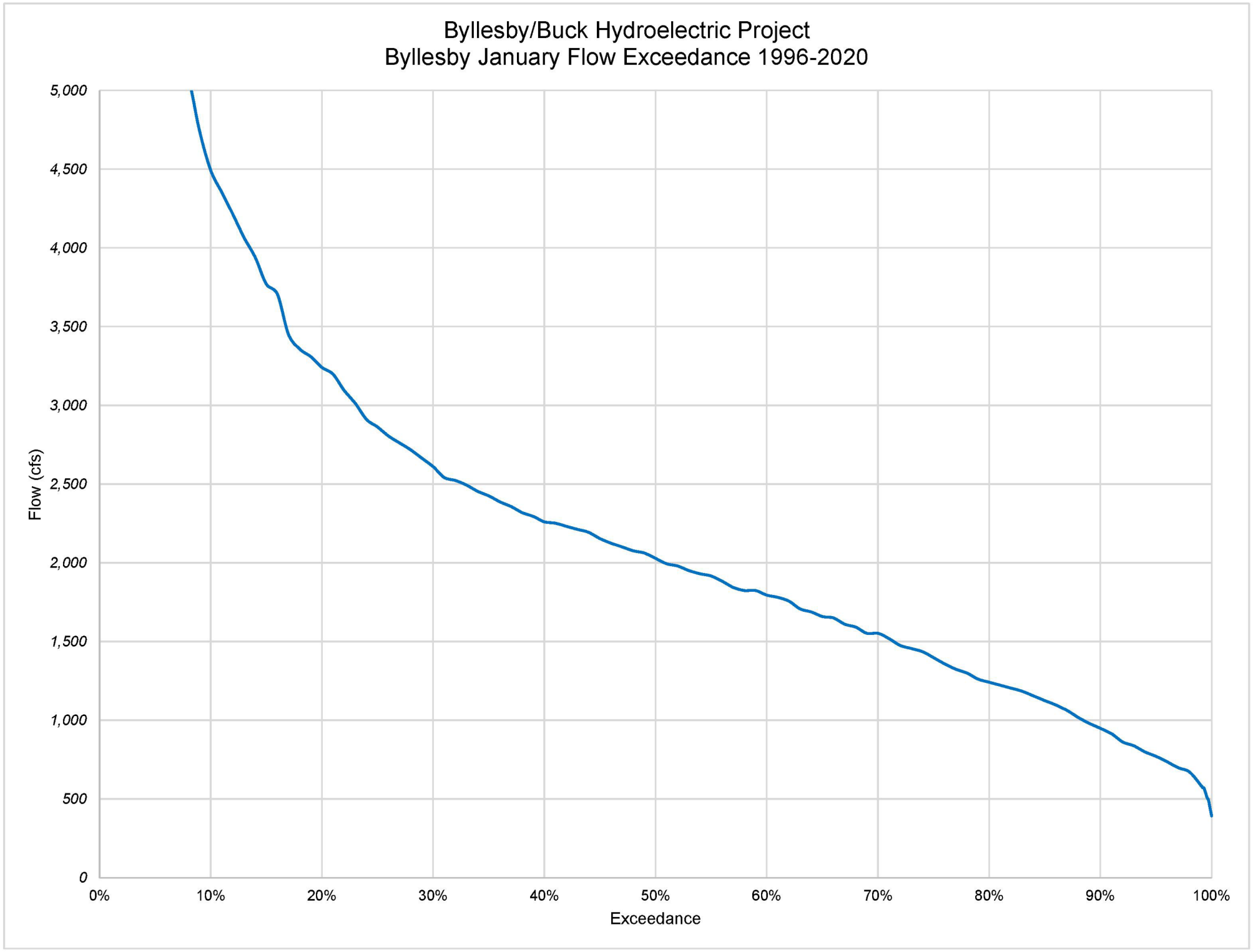
Appendix A

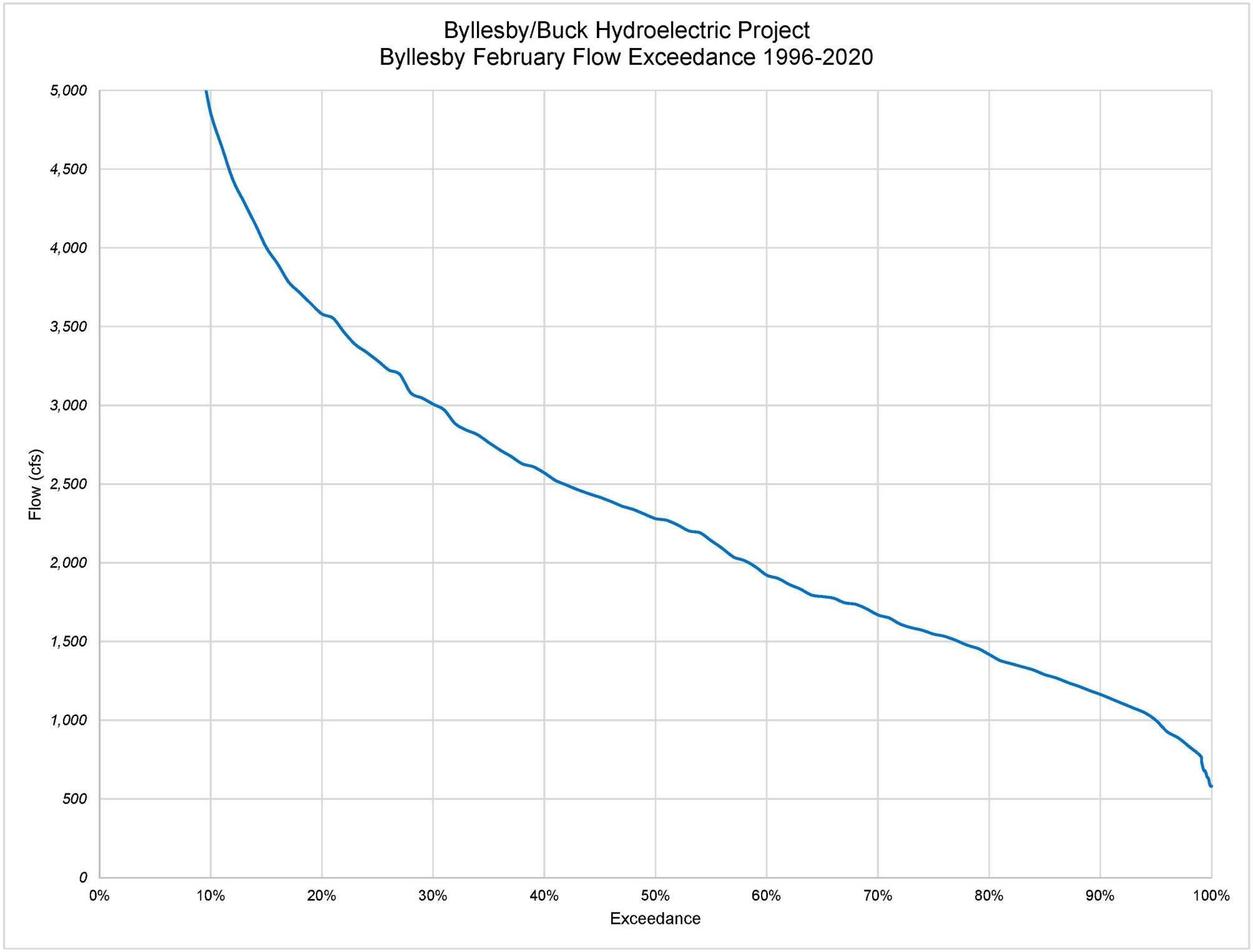
Appendix A – Byllesby-Buck Supplemental Flow Exceedance Plots (Exhibit B)

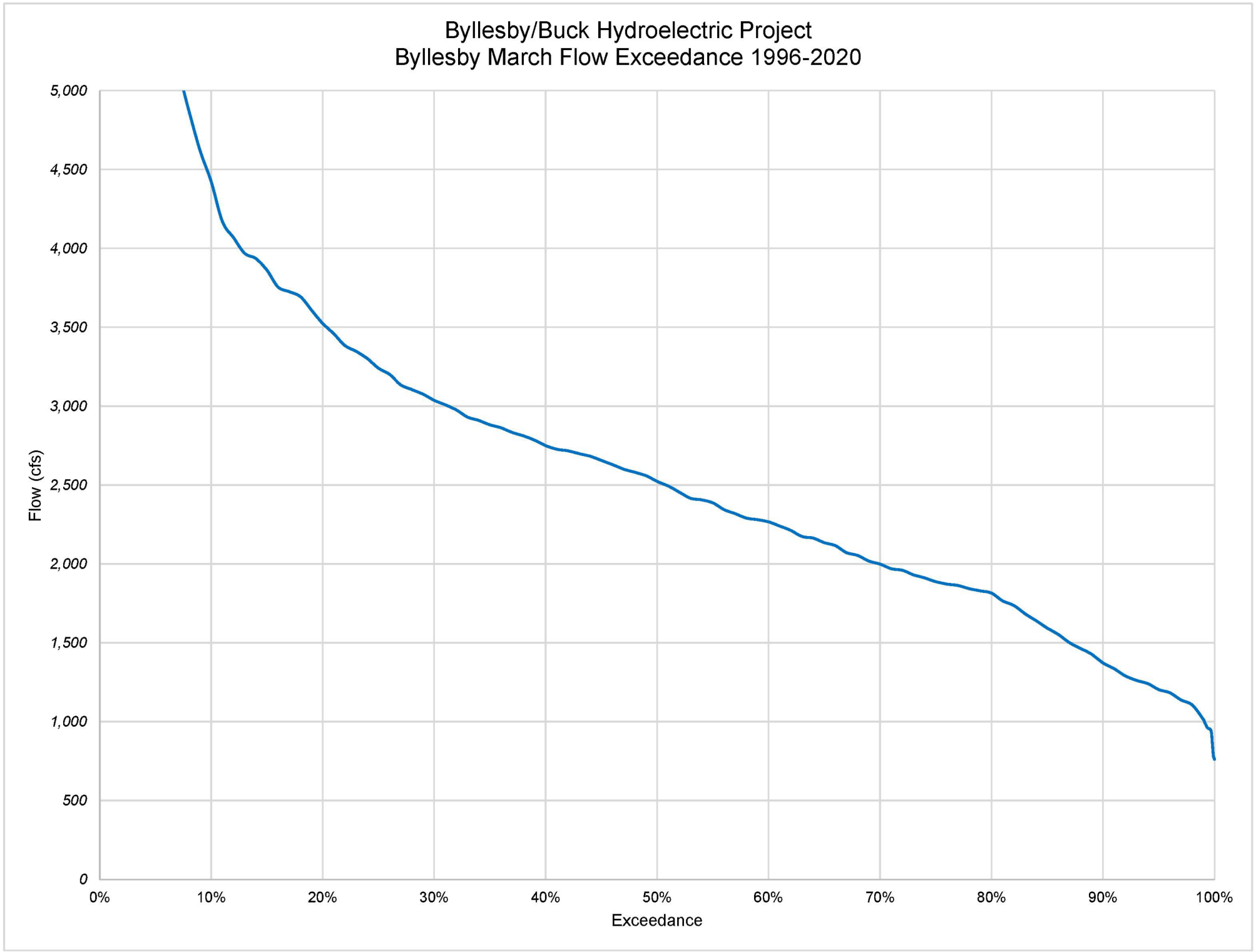
This page intentionally left blank.

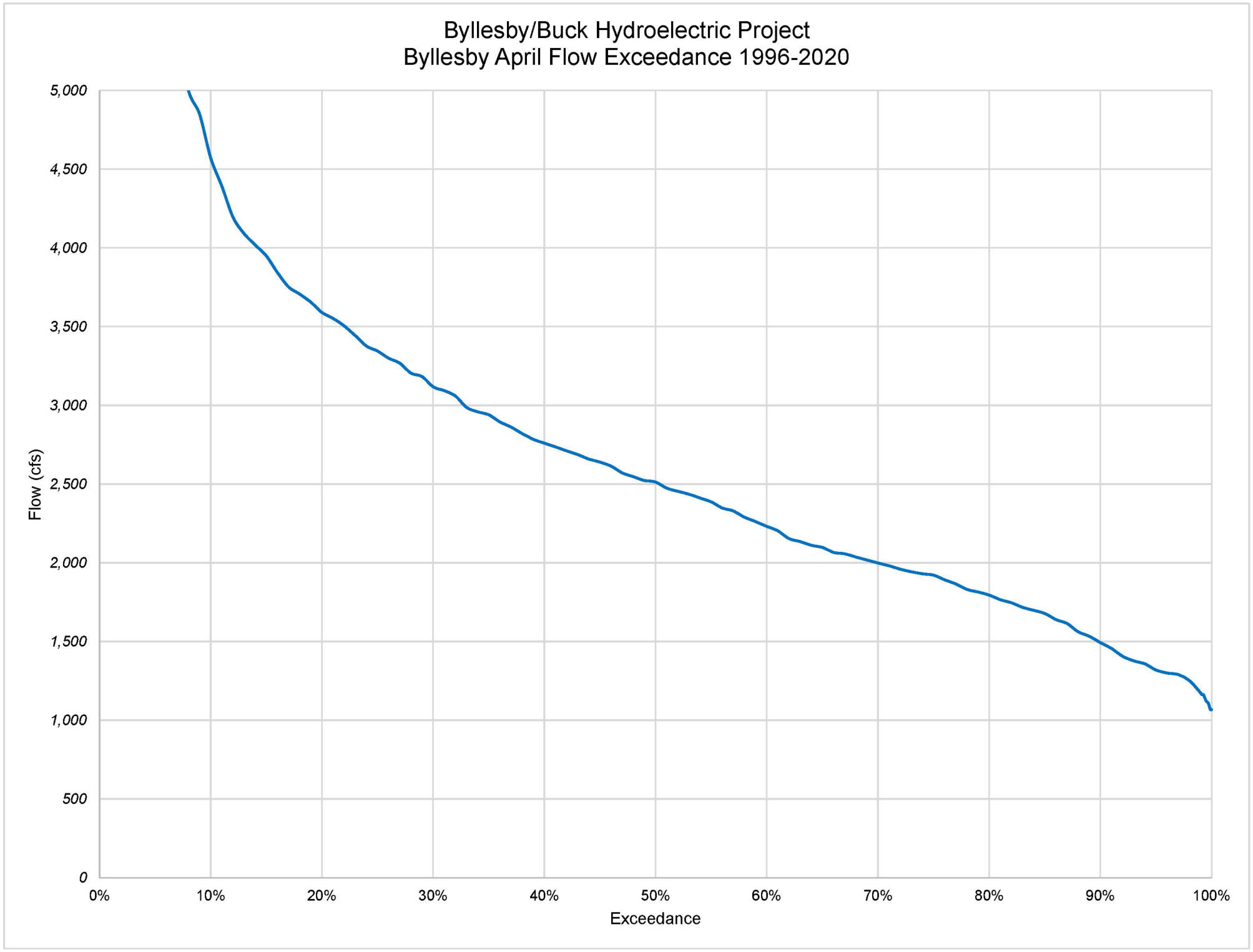

Byllesby/Buck Hydroelectric Project
Byllesby Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance
Annual
January
Febuary
March
April
May
June
July
August
September
October
November
December

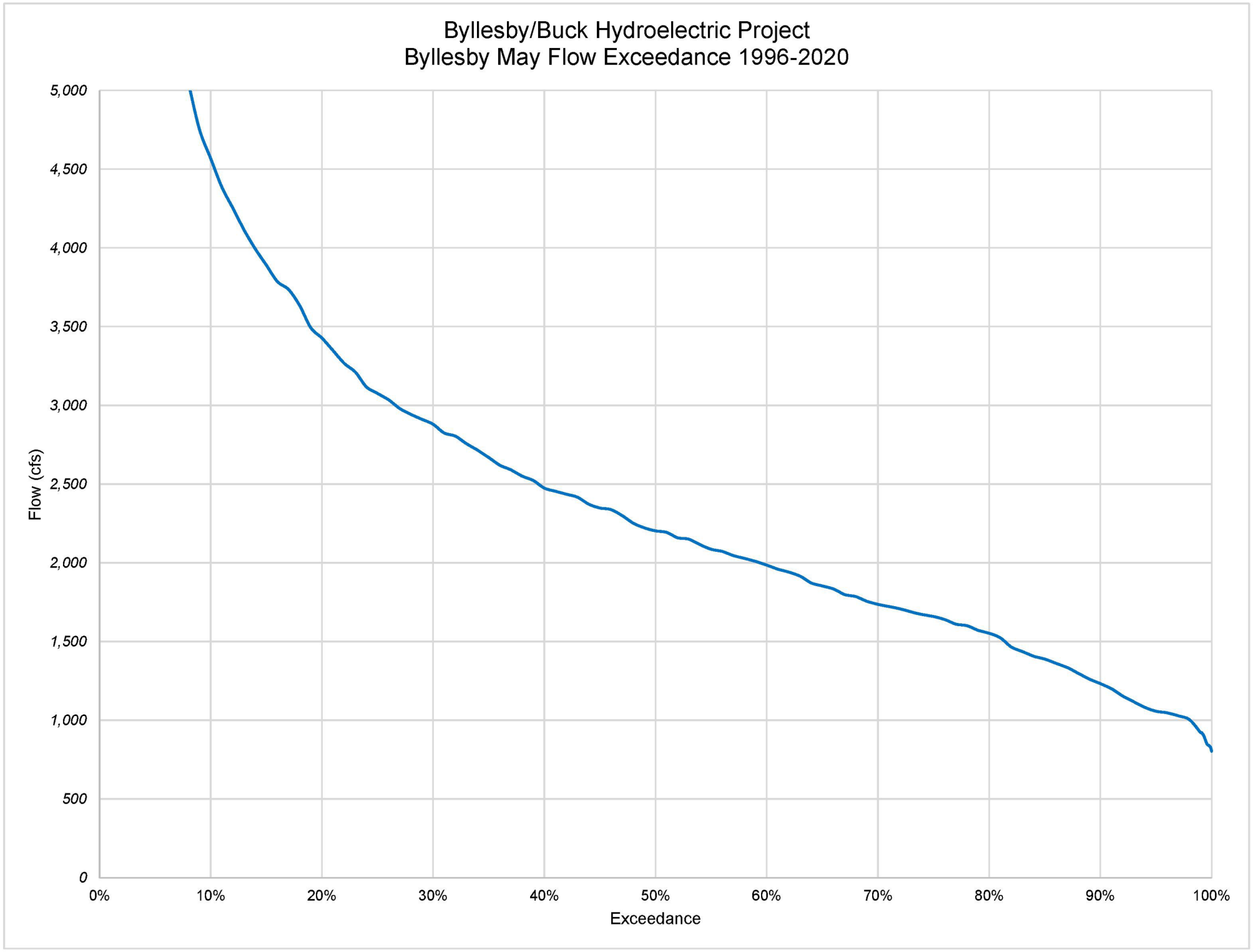

Byllesby/Buck Hydroelectric Project
Byllesby Annual Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

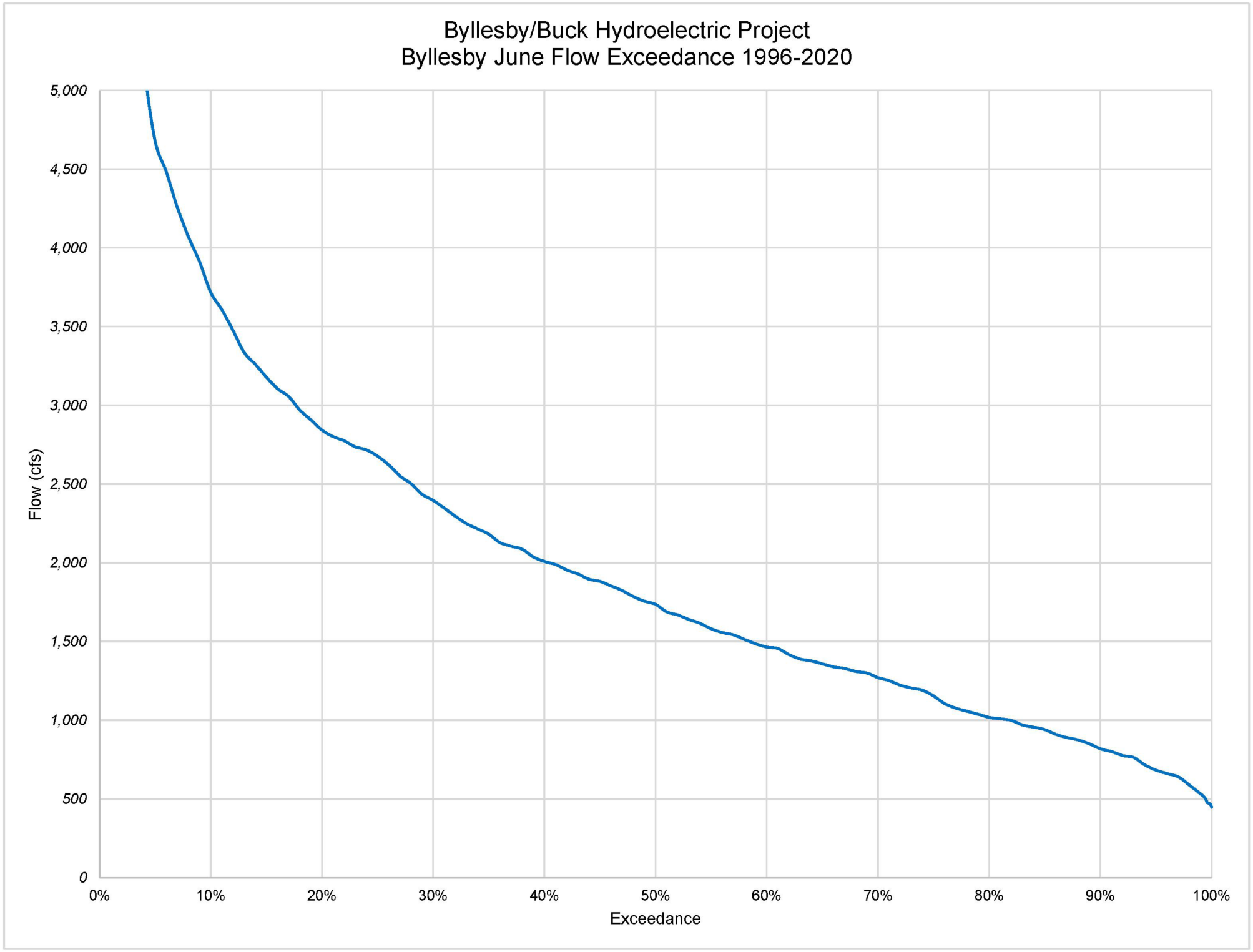

Byllesby/Buck Hydroelectric Project
Byllesby January Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

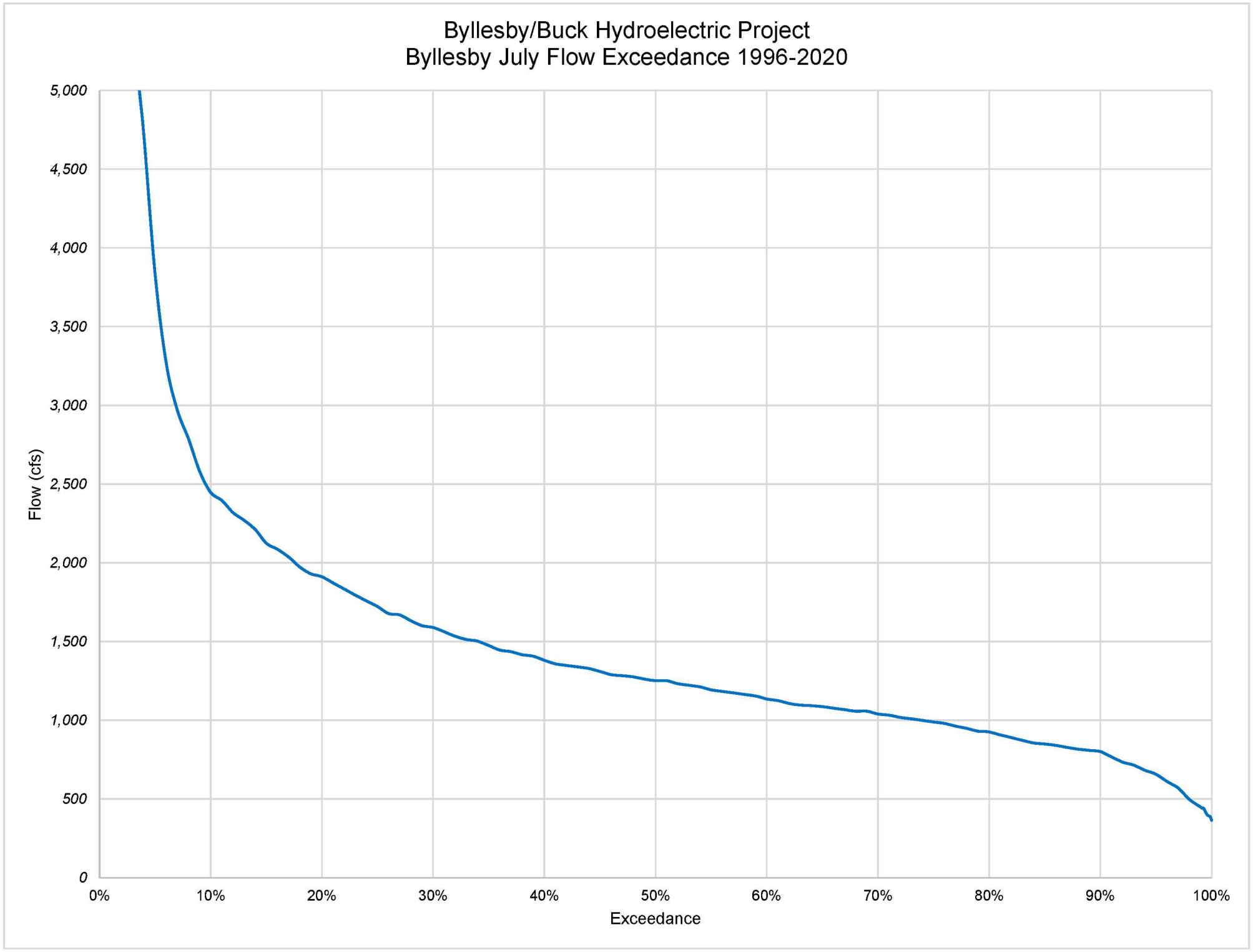

Byllesby/Buck Hydroelectric Project
Byllesby February Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

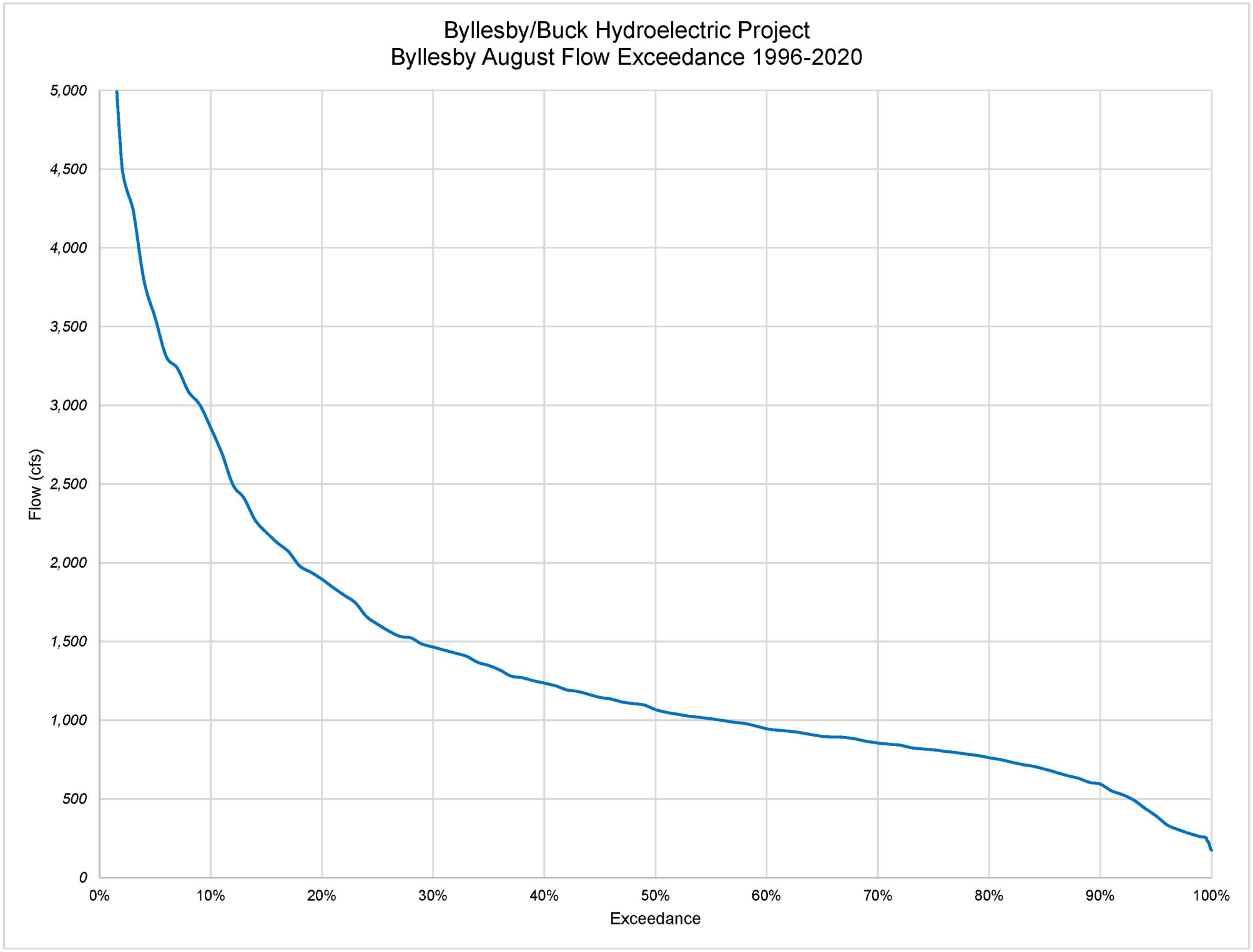

Byllesby/Buck Hydroelectric Project
Byllesby March Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

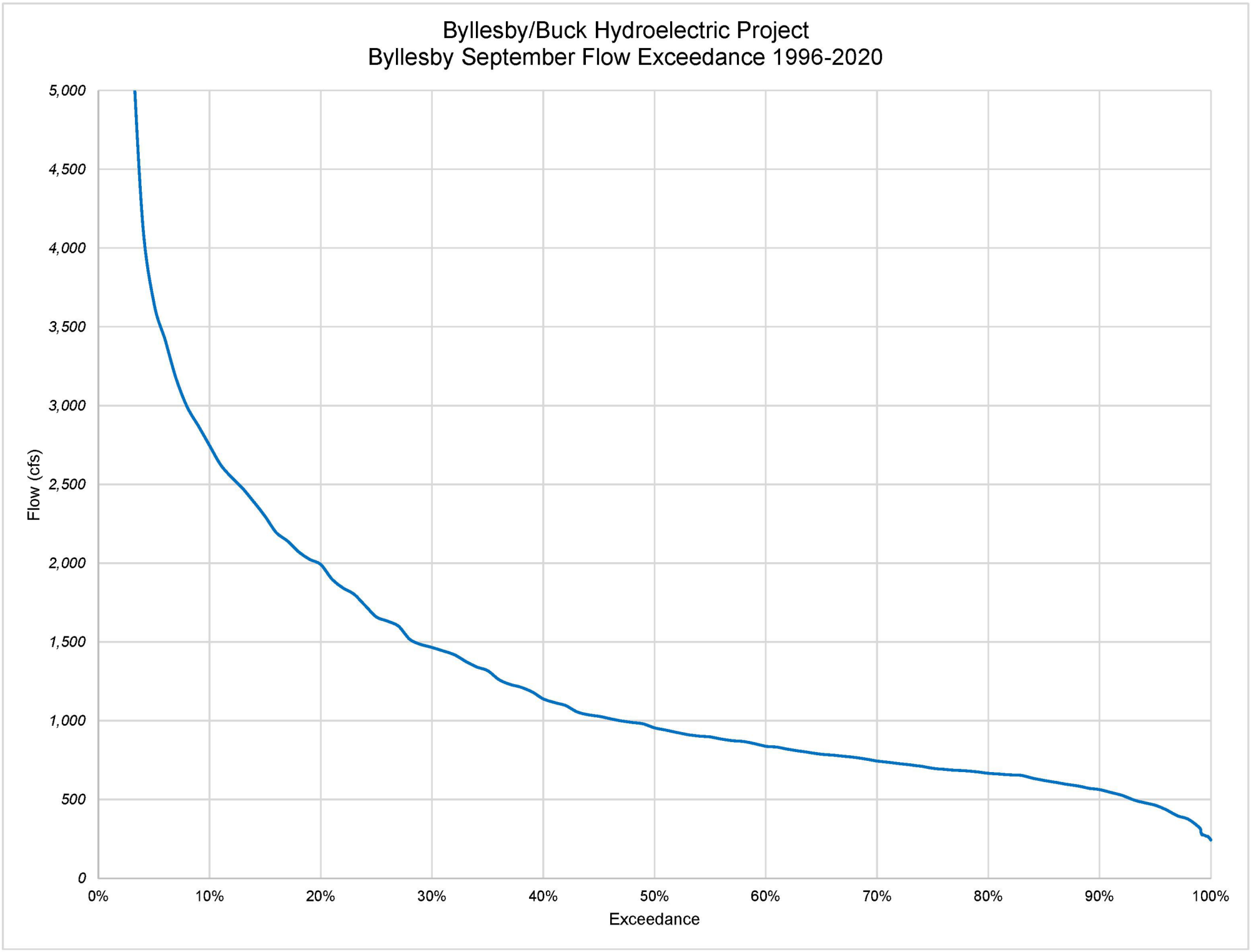

Byllesby/Buck Hydroelectric Project
Byllesby April Flow Exceedance 1996-2020
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

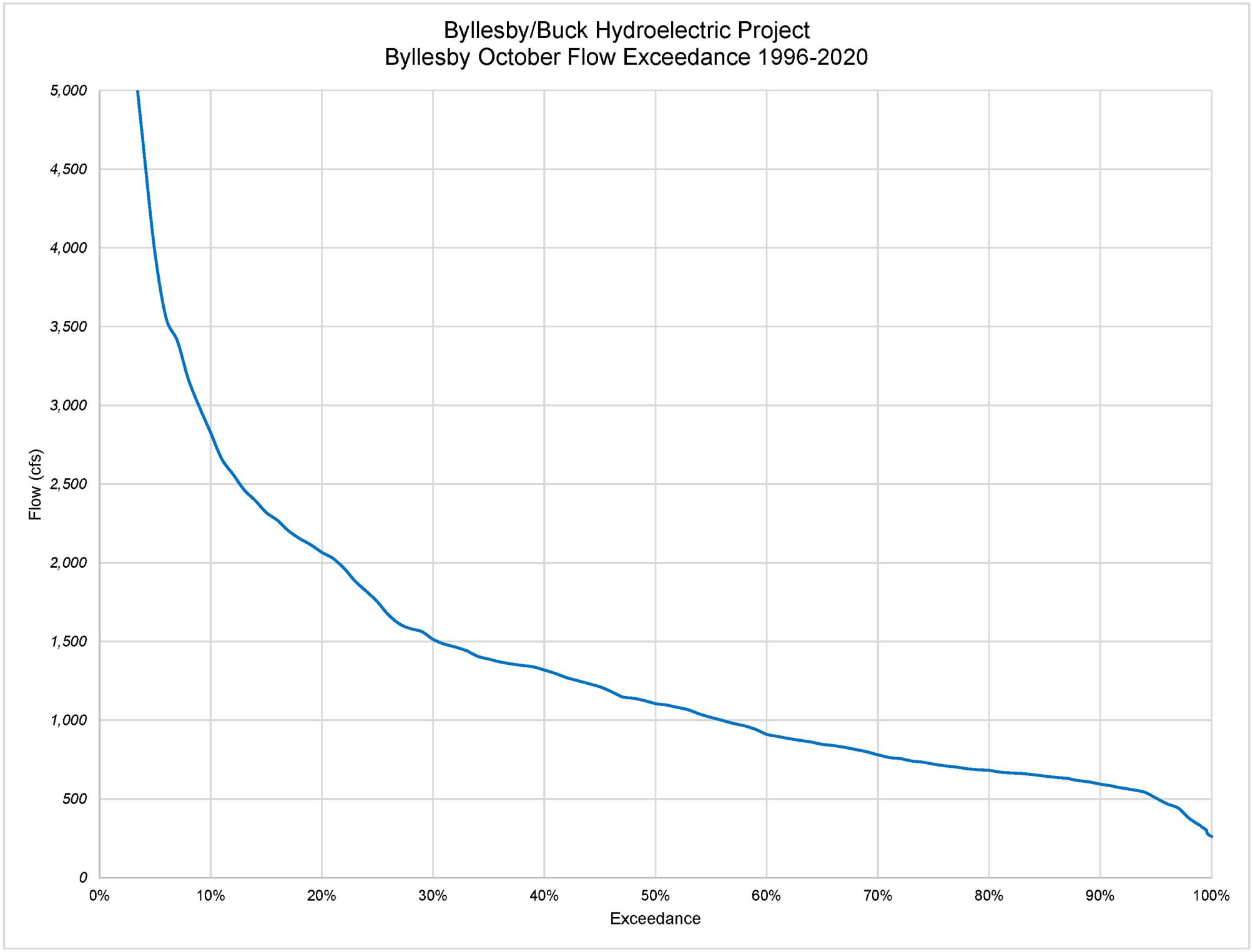

Byllesby/Buck Hydroelectric Project
Byllesby May Flow Exceedance 1996-2020
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

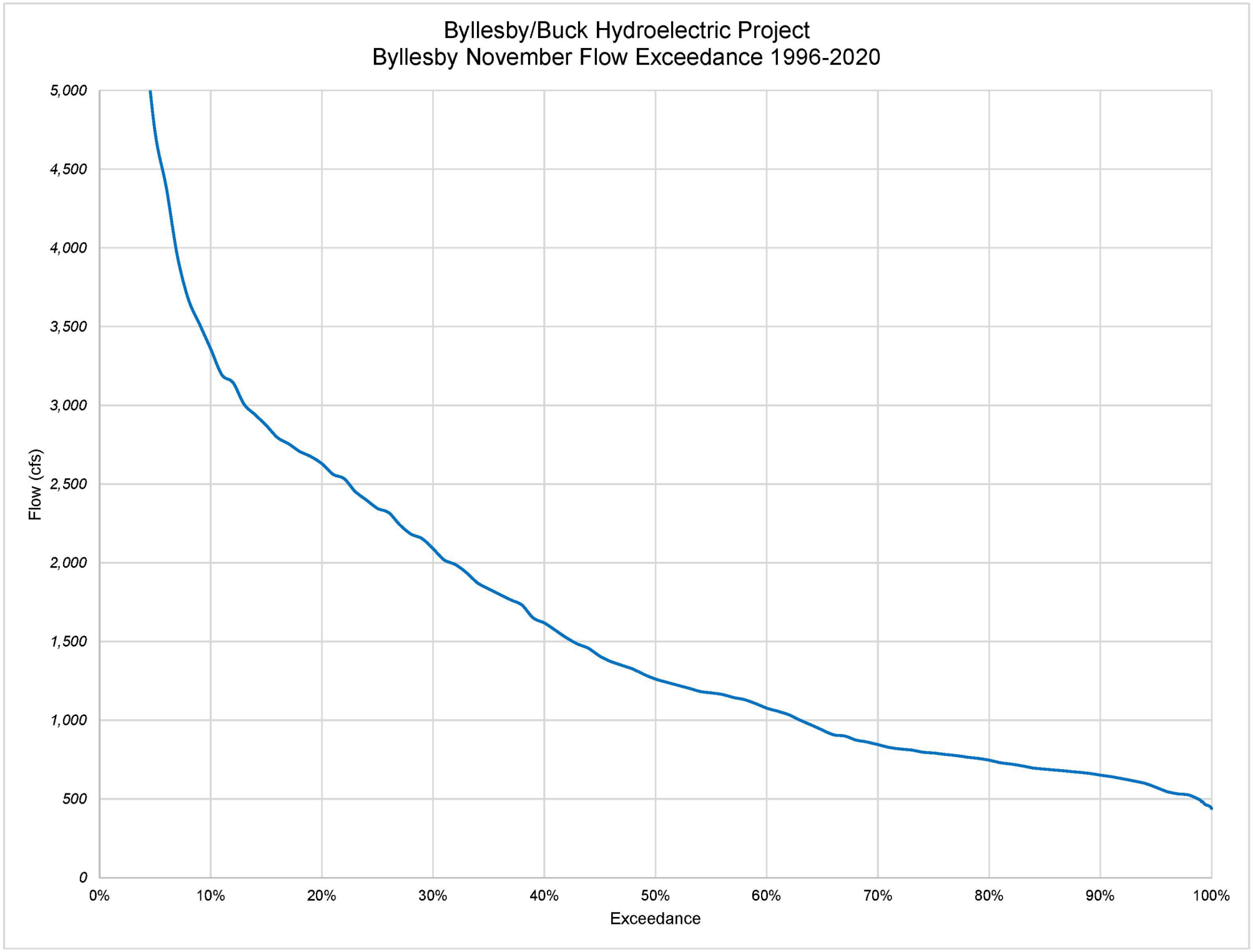

Byllesby/Buck Hydroelectric Project
Byllesby June Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

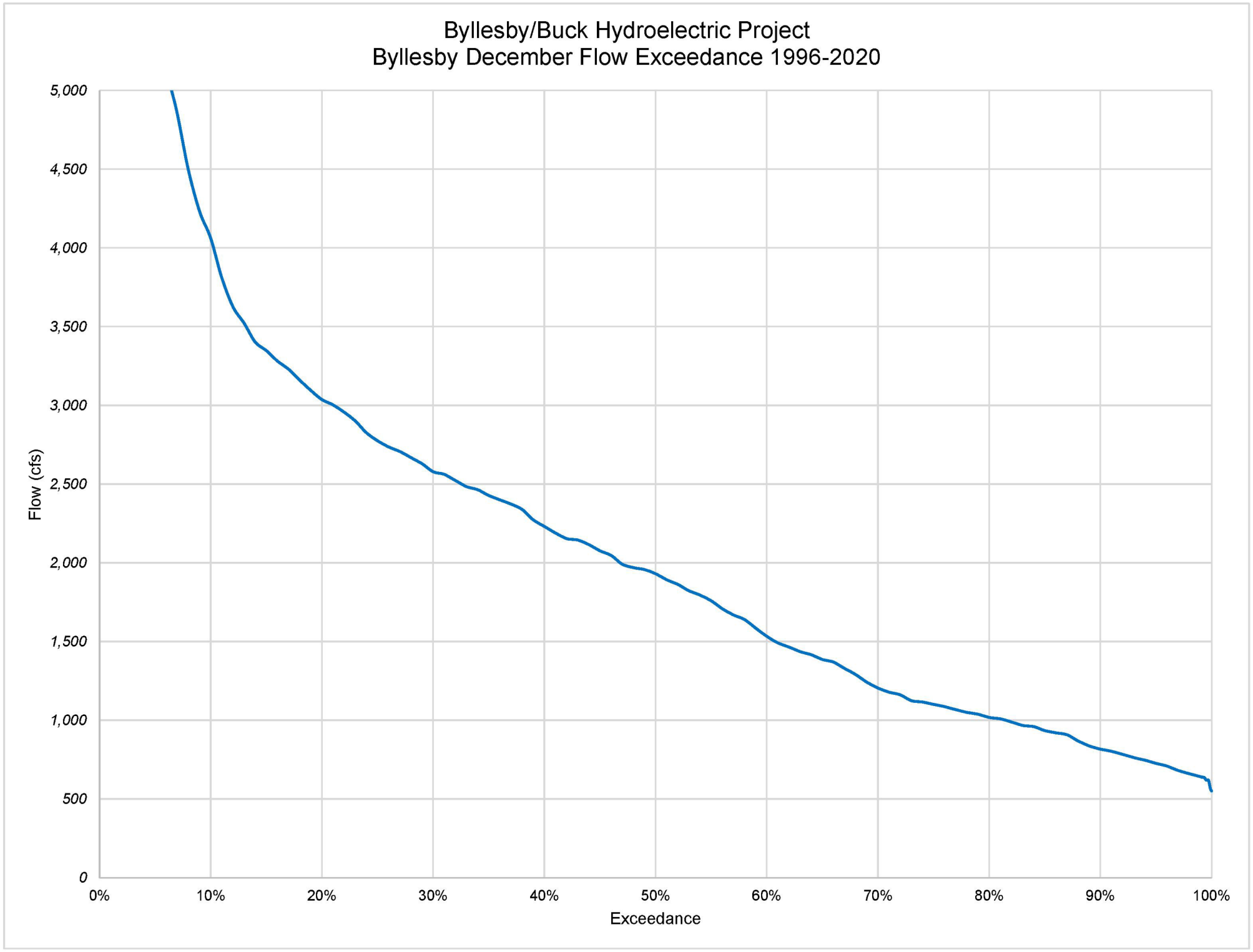

Byllesby/Buck Hydroelectric Project
Byllesby July Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

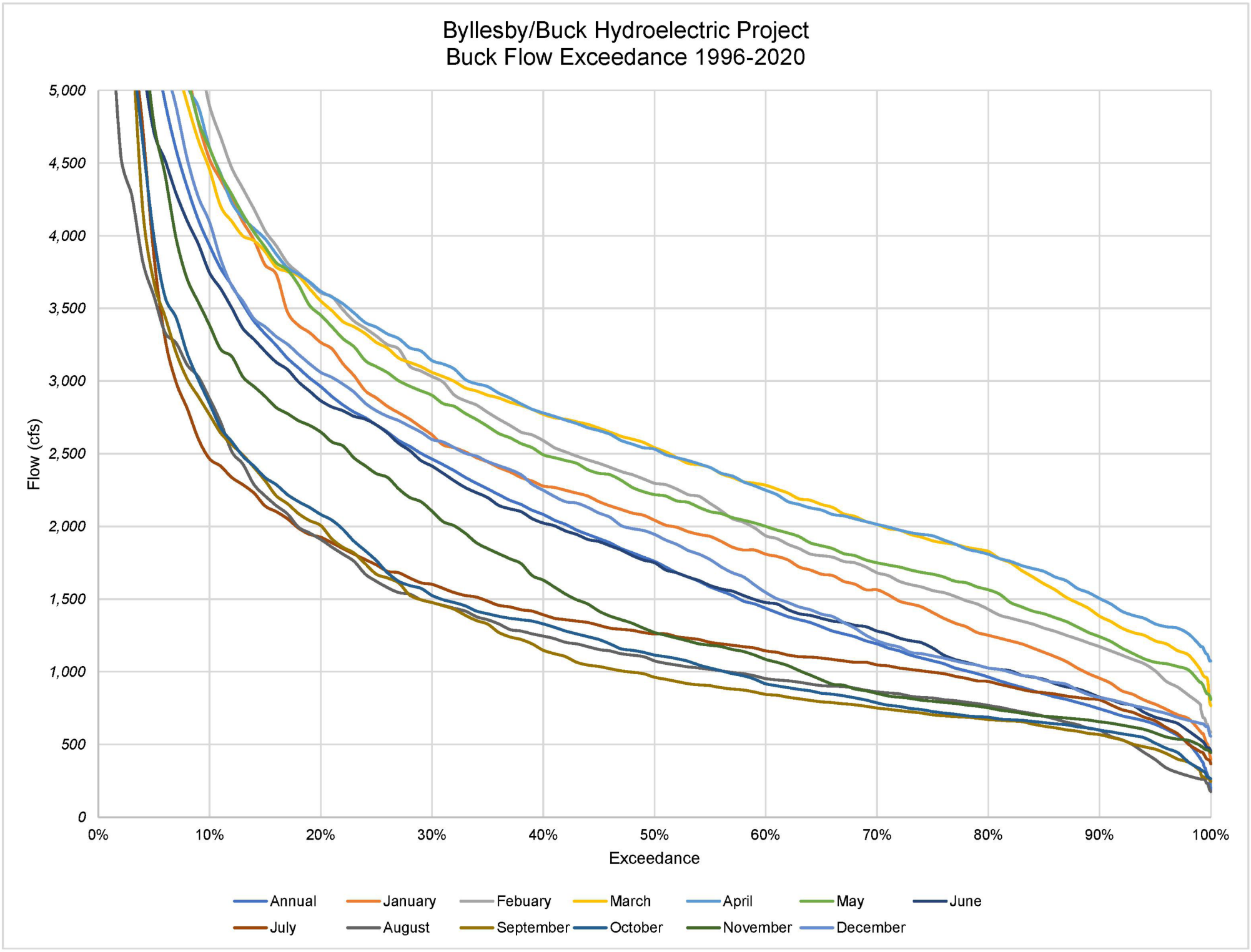

Byllesby/Buck Hydroelectric Project
Byllesby August Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

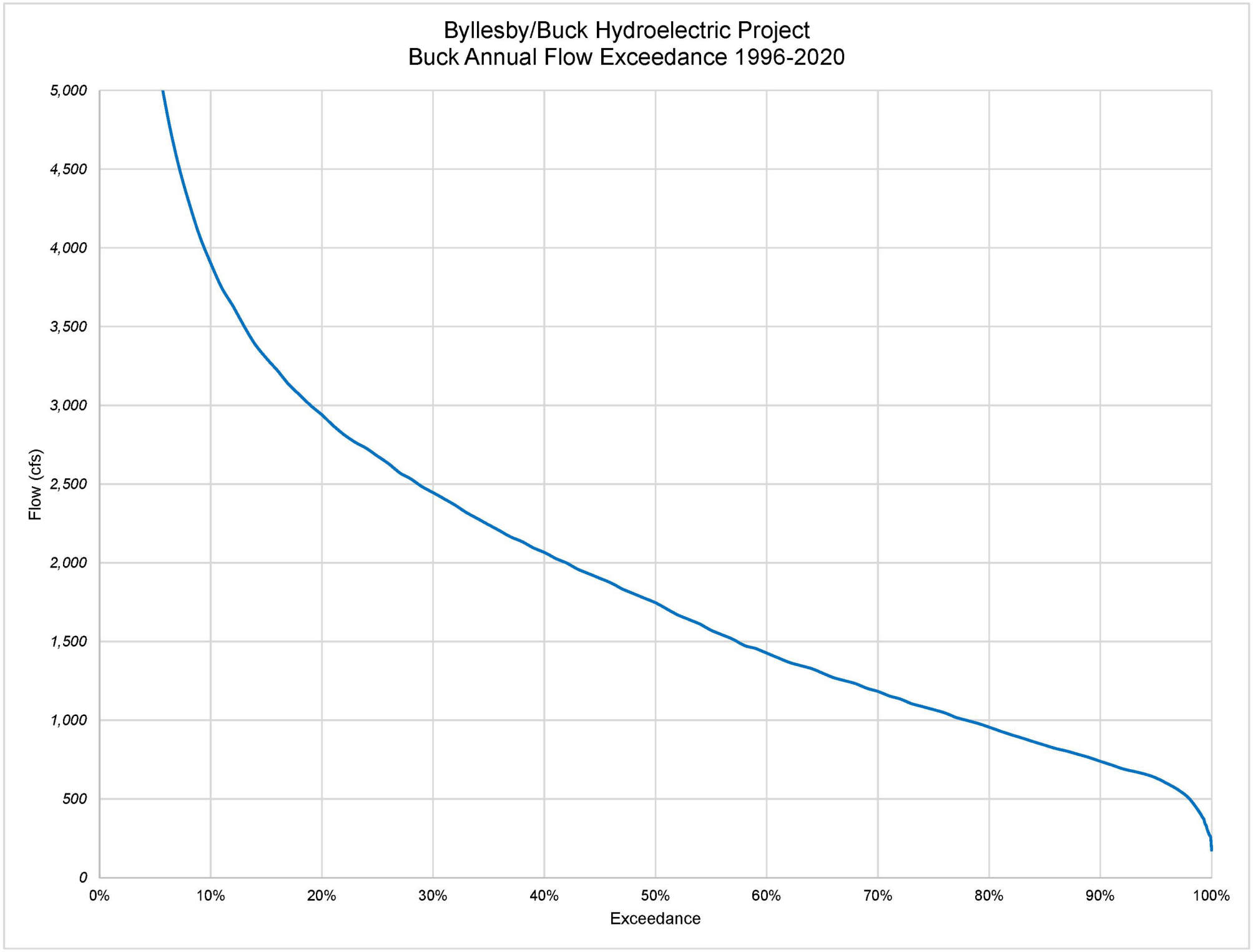

Byllesby/Buck Hydroelectric Project
Byllesby September Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

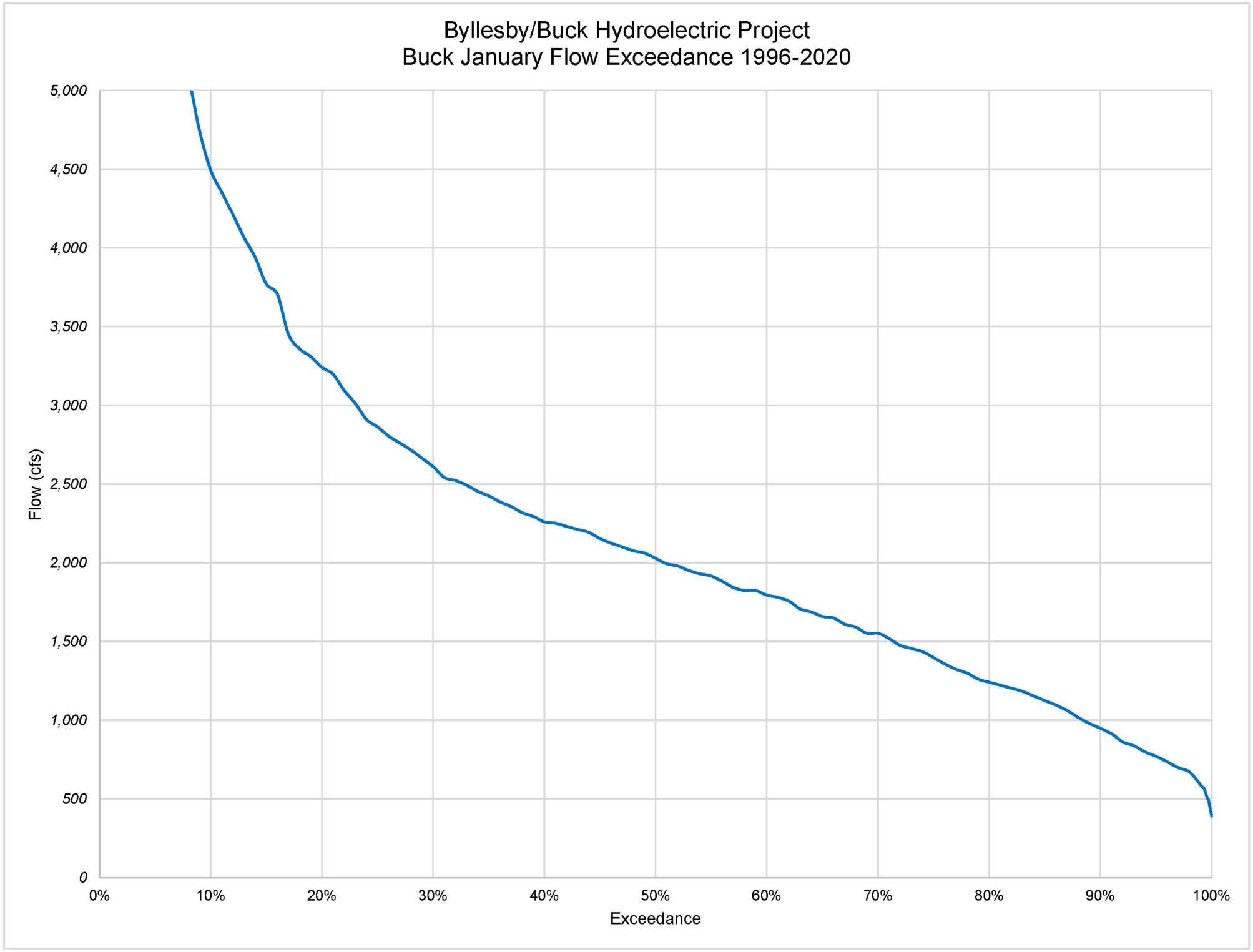

Byllesby/Buck Hydroelectric Project
Byllesby October Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

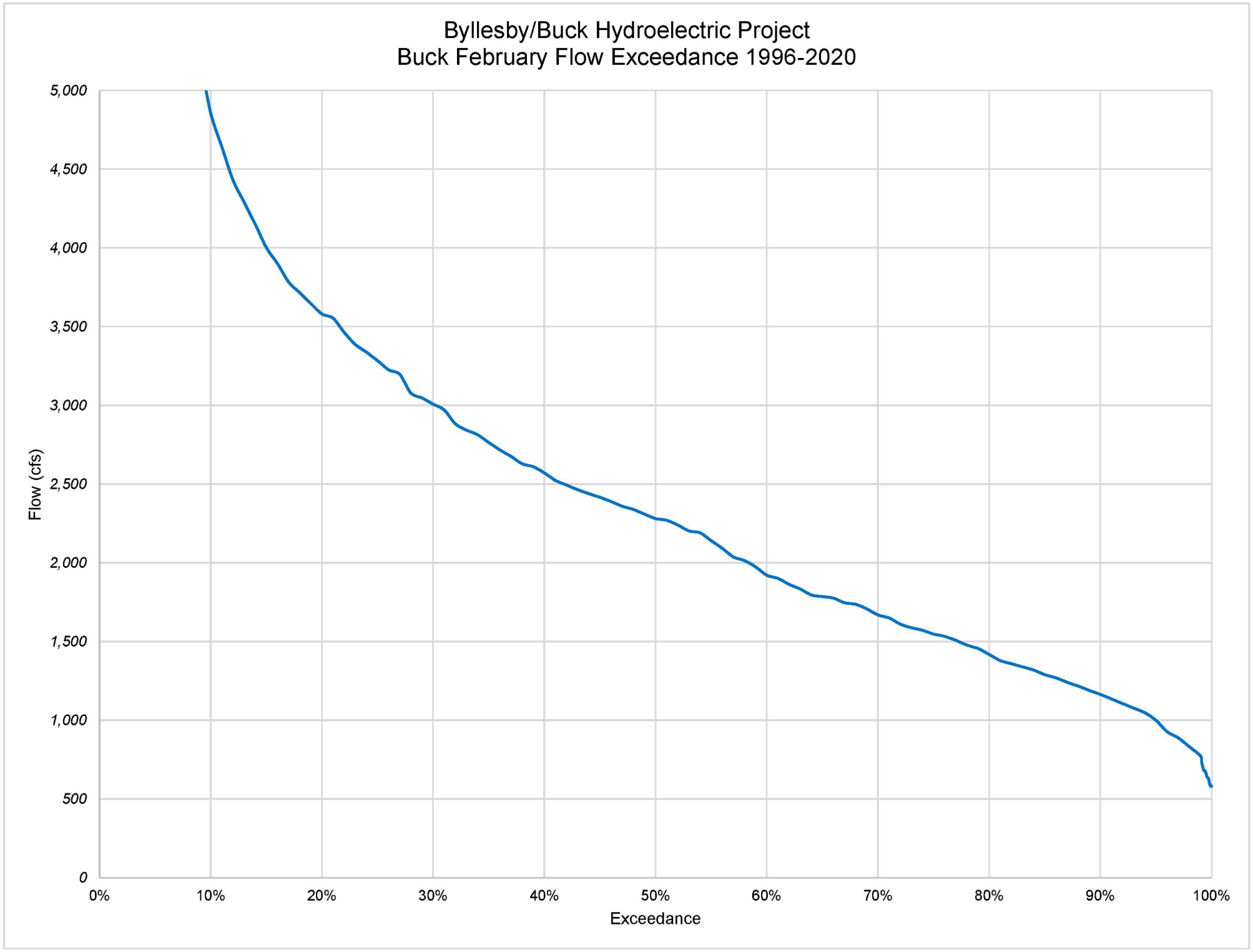

Byllesby/Buck Hydroelectric Project
Byllesby November Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

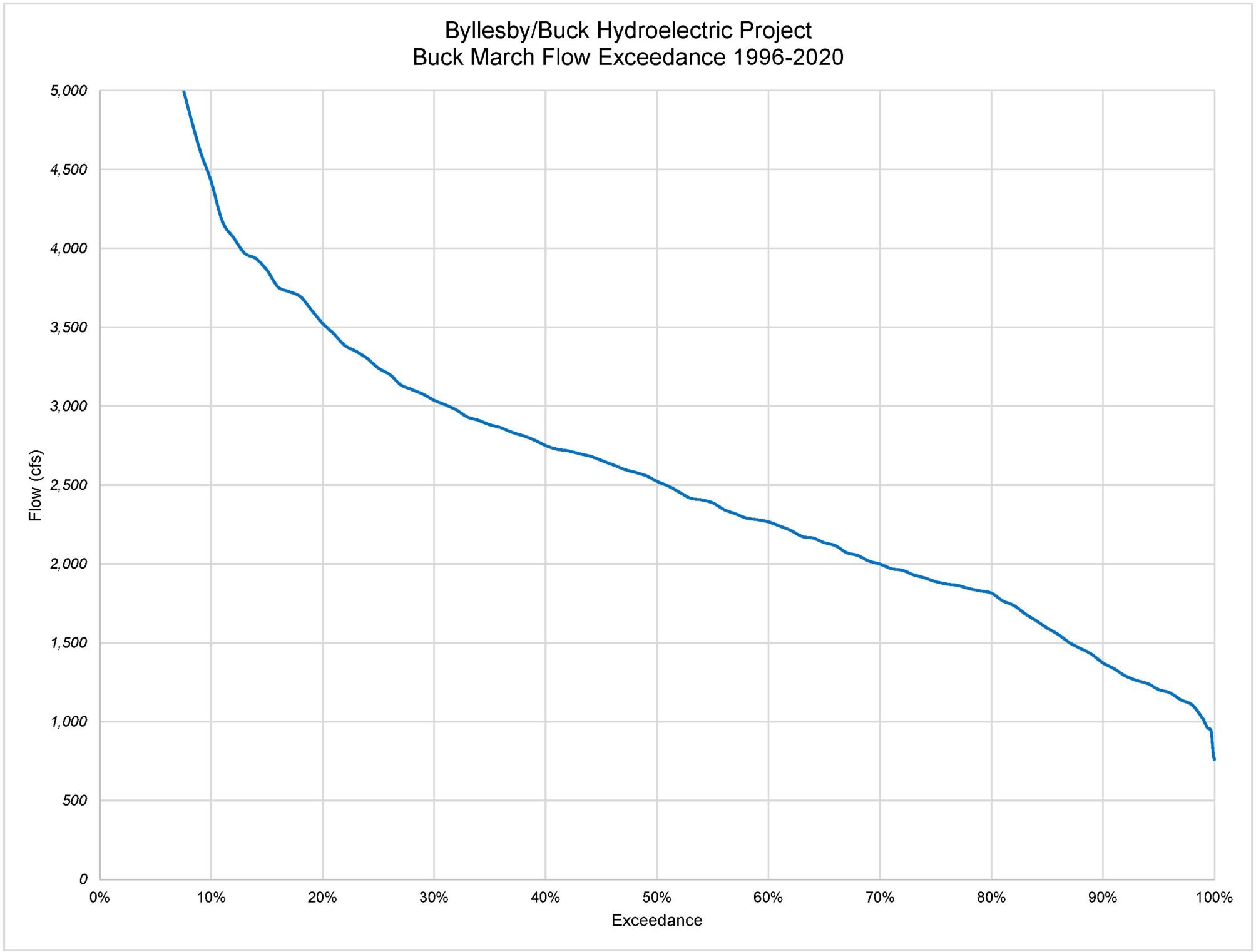

Byllesby/Buck Hydroelectric Project
Byllesby December Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

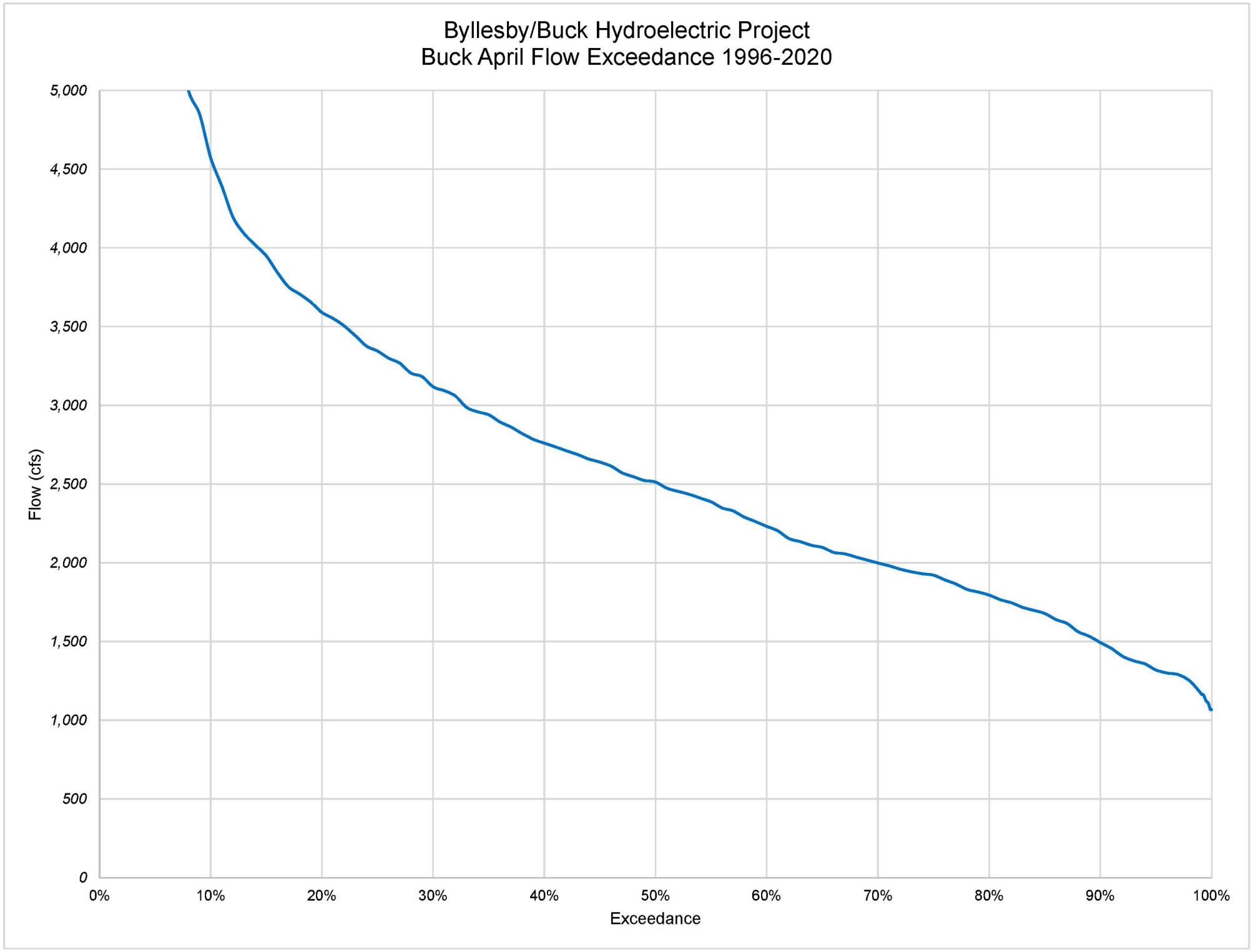

Byllesby/Buck Hydroelectric Project
Buck Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance
Annual
January
Febuary
March
April
May
June
July
August
September
October
November
December

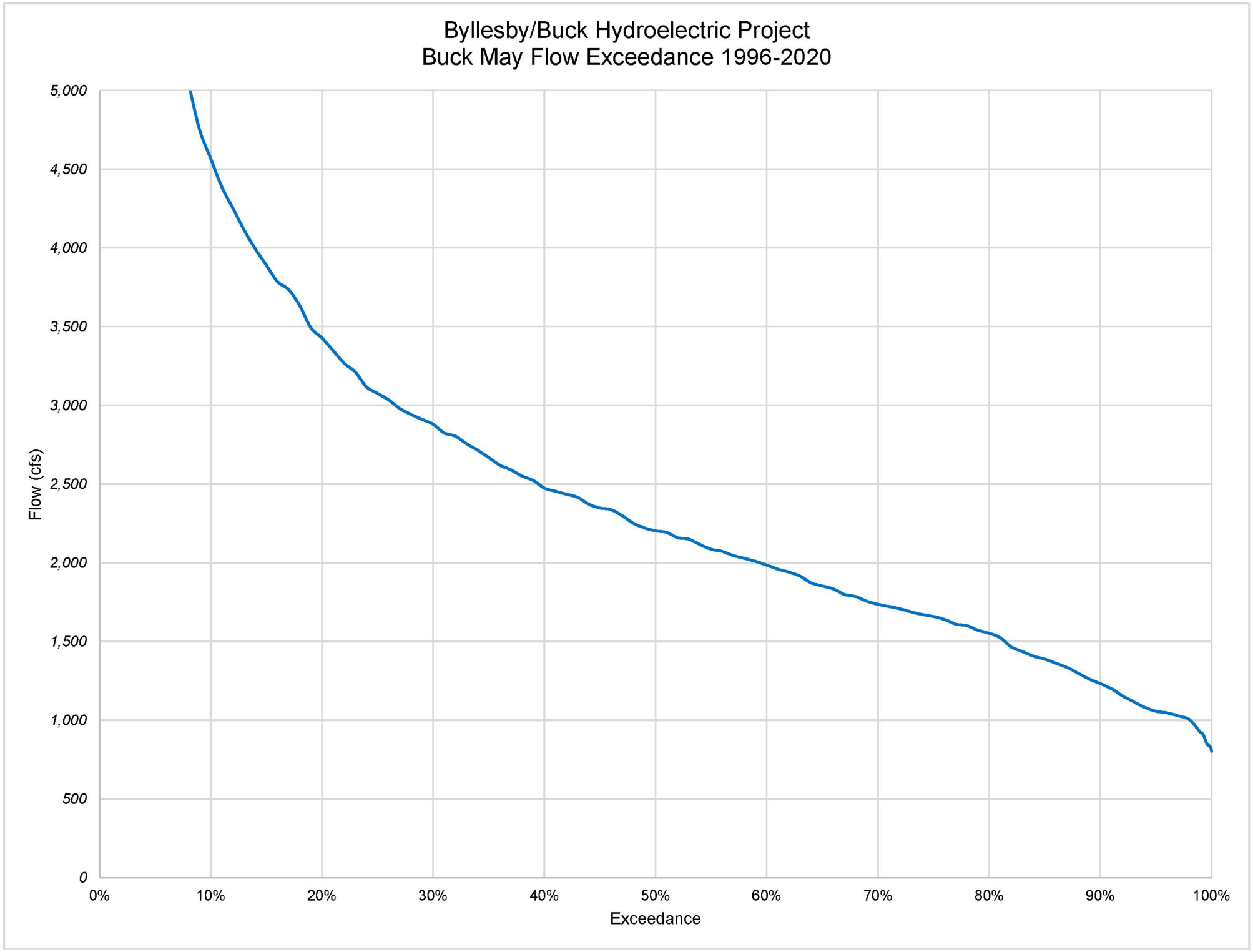

Byllesby/Buck Hydroelectric Project
Buck Annual Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

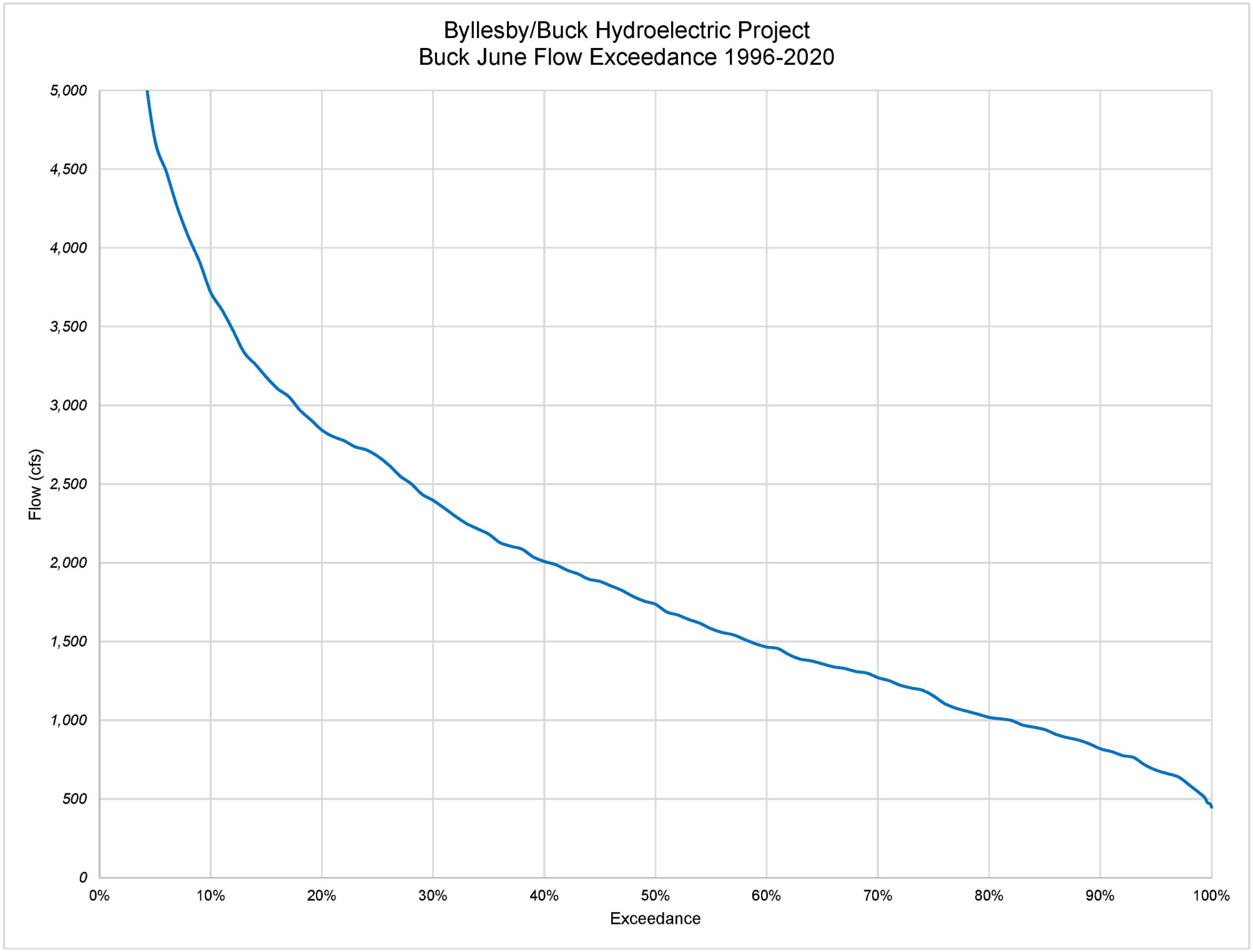

Byllesby/Buck Hydroelectric Project
Buck January Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

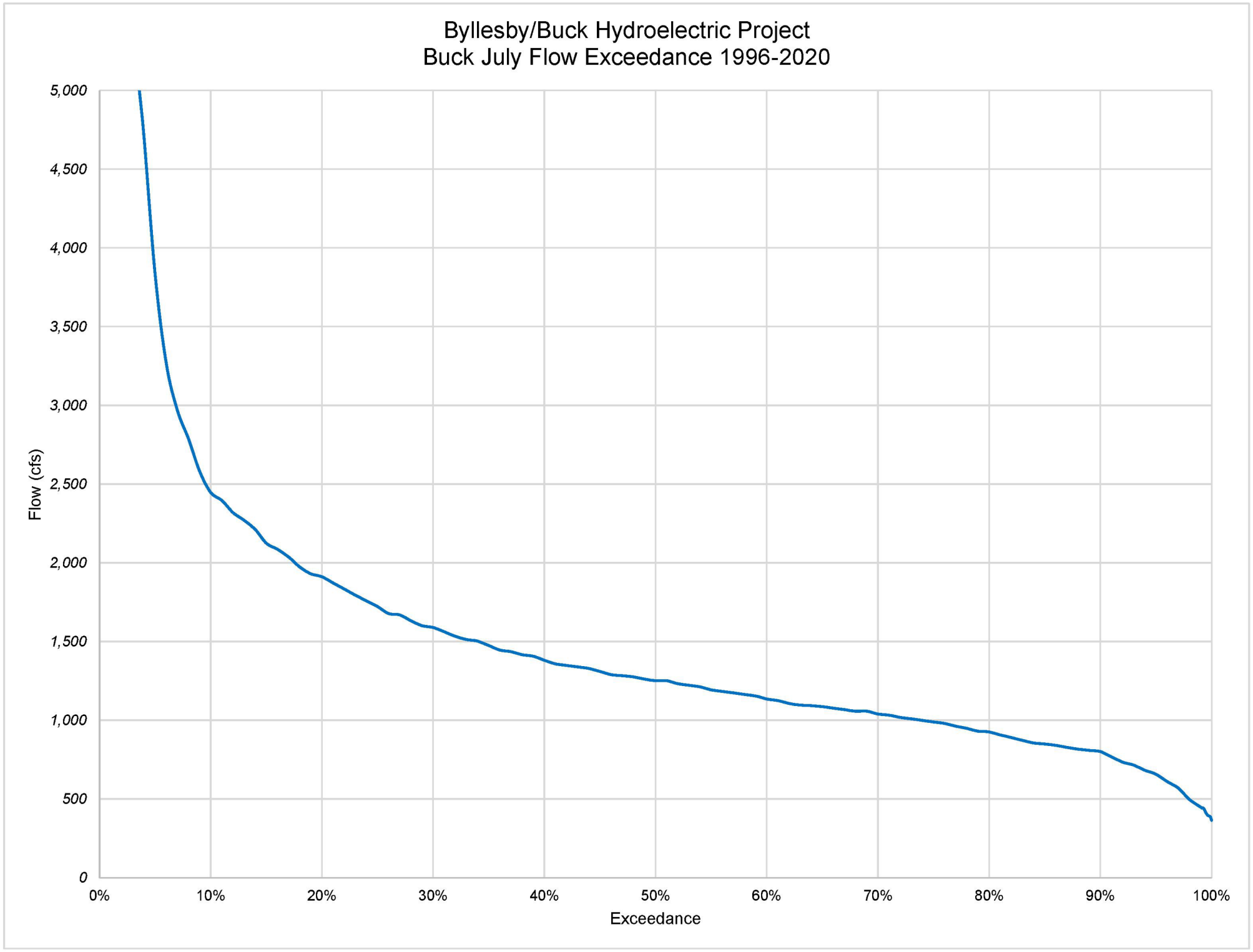

Byllesby/Buck Hydroelectric Project
Buck February Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

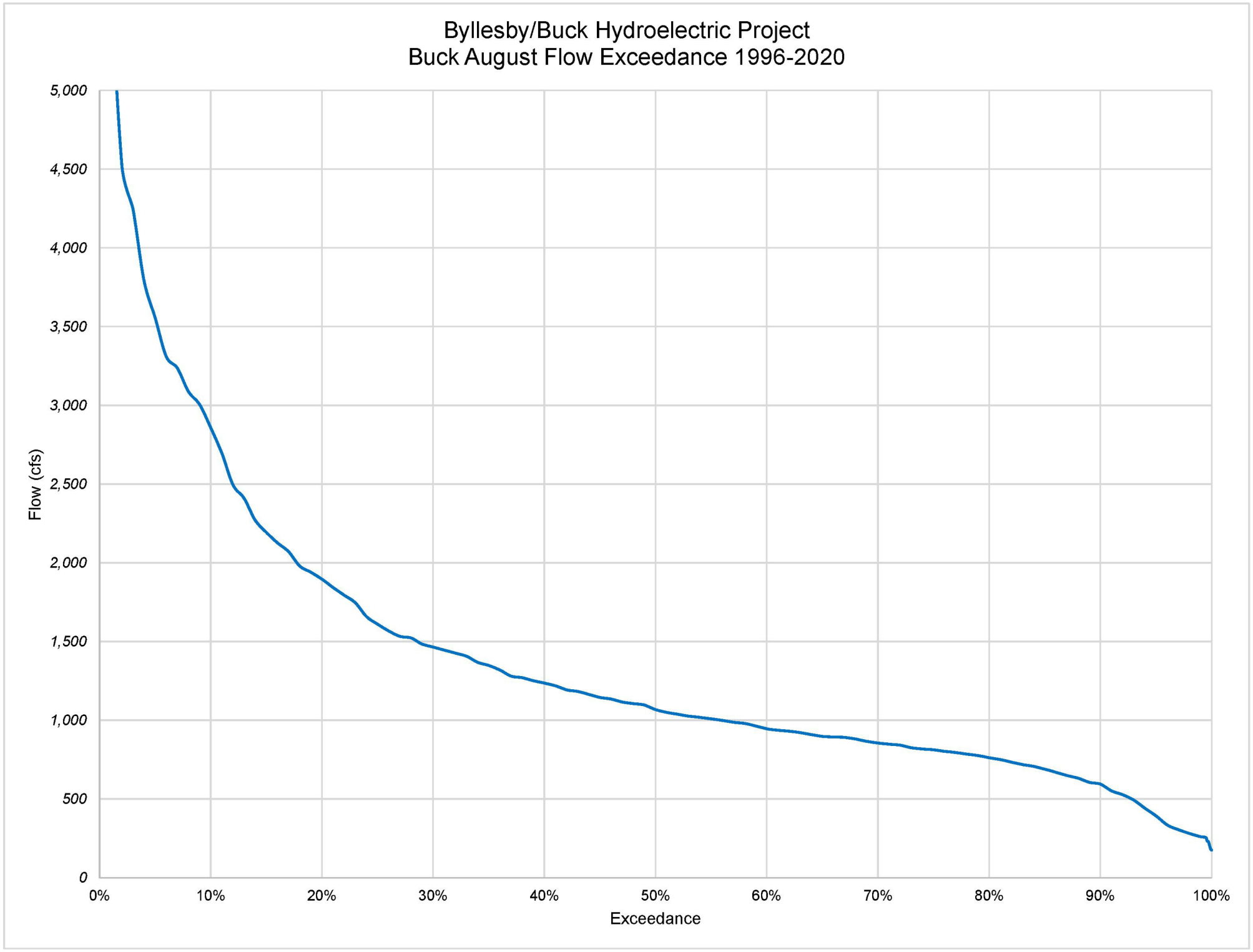

Byllesby/Buck Hydroelectric Project
Buck March Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

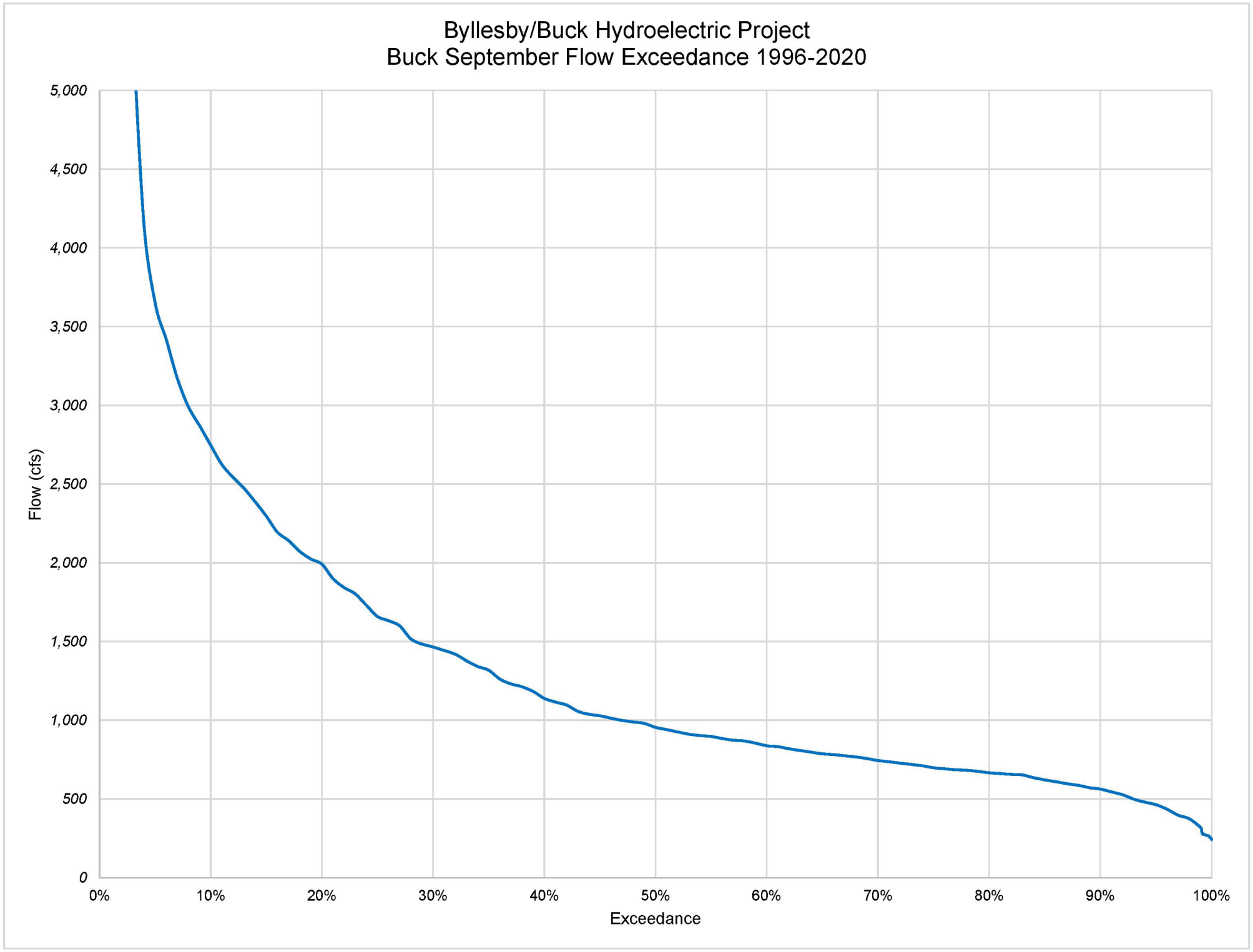

Byllesby/Buck Hydroelectric Project
Buck April Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

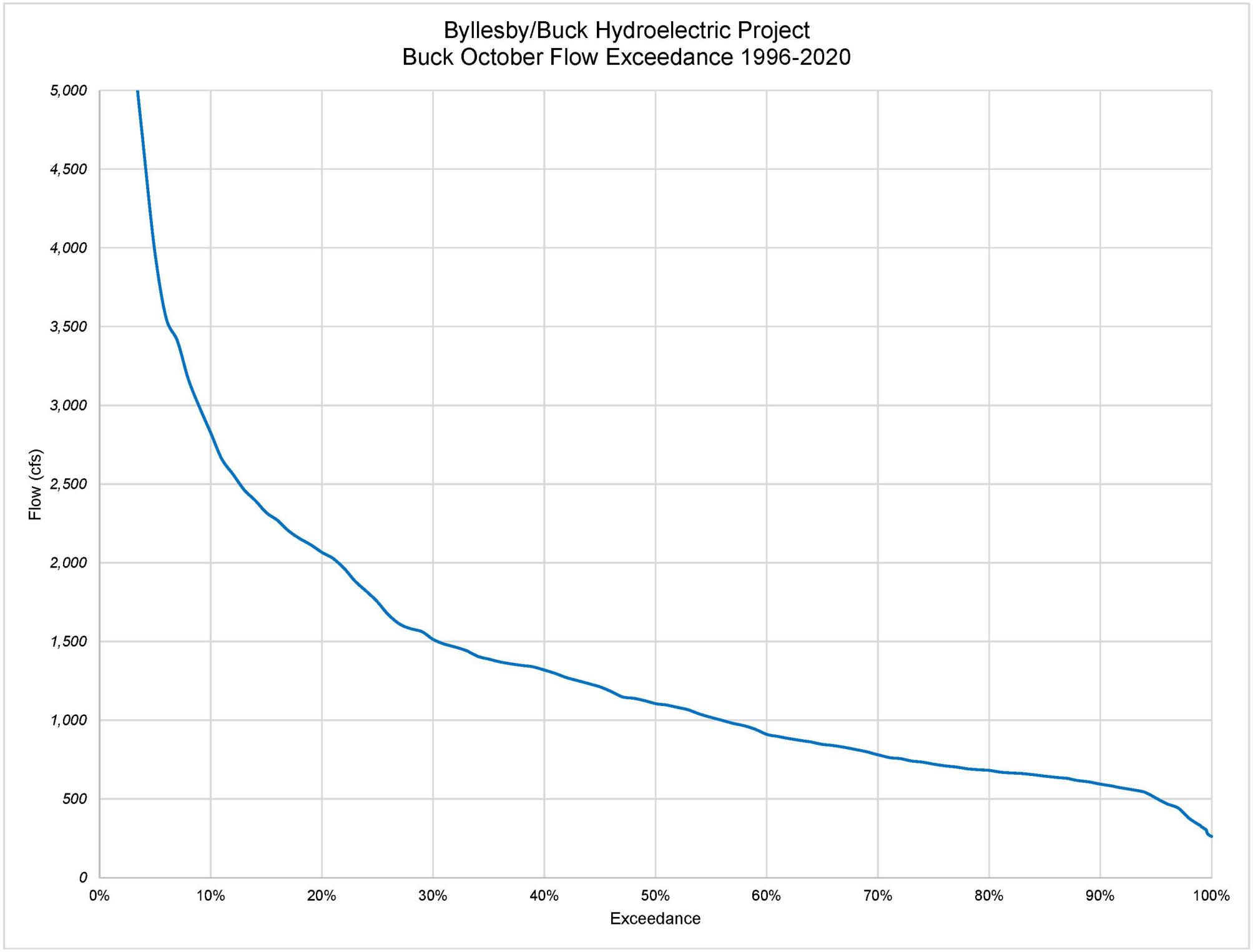

Byllesby/Buck Hydroelectric Project
Buck May Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

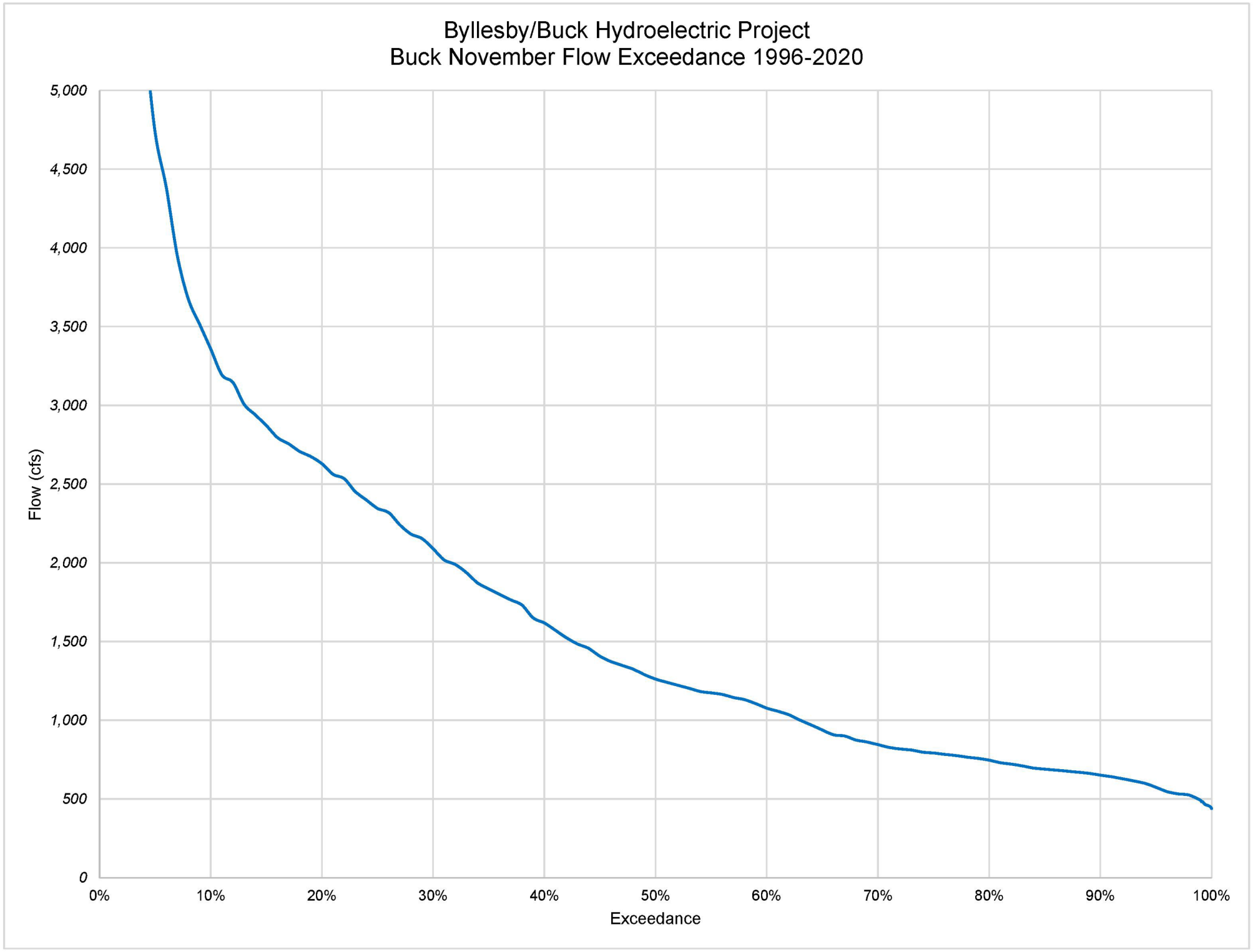

Byllesby/Buck Hydroelectric Project
Buck June Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

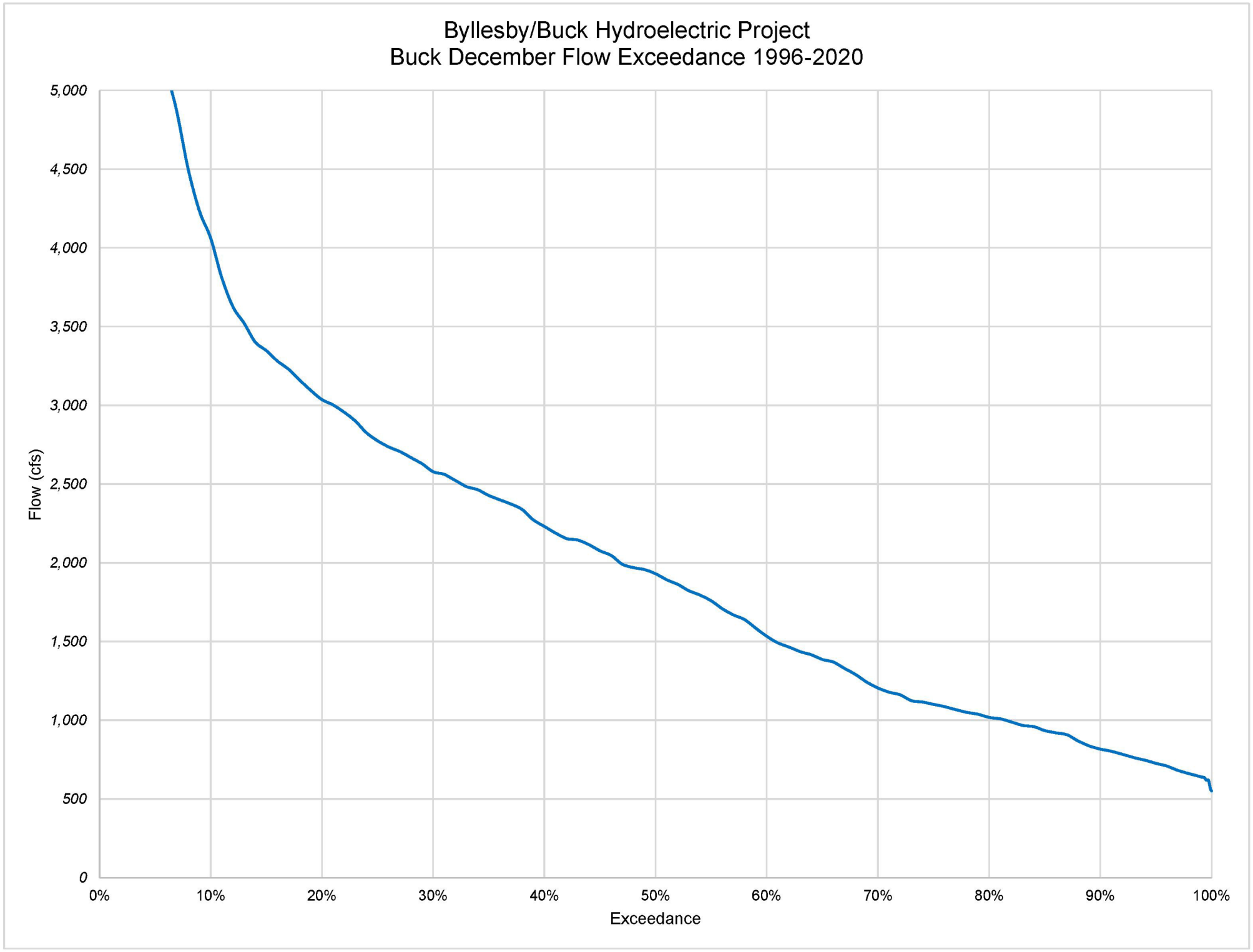

Byllesby/Buck Hydroelectric Project
Buck July Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Byllesby/Buck Hydroelectric Project
Buck August Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Byllesby/Buck Hydroelectric Project
Buck September Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Byllesby/Buck Hydroelectric Project
Buck October Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Byllesby/Buck Hydroelectric Project
Buck November Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Byllesby/Buck Hydroelectric Project
Buck December Flow Exceedance 1996-2020
Flow (cfs)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance