Schoolfield Hydroelectric Project
(FERC No. 2411)

FINAL

Application for New License
Major Water Power Project

10 Megawatts or Less

Exhibit A – Project Description

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1 PROJECT DESCRIPTION

The 4,500-kilowatt (kW) Schoolfield Hydroelectric Project (Project) is located on the Dan River at approximately river mile 60.1 near the City of Danville, Virginia (Figure 1.0-1). The headwaters of the Dan River originate on the eastern slopes of the Blue Ridge Mountains in Patrick County, Virginia. From its headwaters, the river flows in a general eastward direction approximately 210 river miles to its terminus at Kerr Reservoir, near South Boston, Virginia, where it flows into the Roanoke River.

1.1 Hydraulic Turbines

The powerhouse contains six (6) identical turbines units. The maximum generation capacity of each turbine unit is 1,006 horsepower. The maximum hydraulic capacity of the Project is 2,160 cfs, and the minimum hydraulic capacity is 360 cfs. Information on the units is shown below.

Turbine Type	Propeller
Rated Capacity	1,006 horsepower
Runner diameter	5.42 feet
Nameplate head	27 feet
Nameplate speed	170 revolutions per minute (RPM)
Maximum hydraulic capacity	360 cubic feet per second (cfs) per unit
Minimum hydraulic capacity	360 cfs per unit

1.2 Generators

The Project powerhouse contains three (3) identical generating units. Each generating unit is connected to two turbine units. The maximum generating capacity at the Project is 4,500 kW, or 4.5 megawatts (MW). Information on the units is shown below.

Generator Type	Brushless AC, Ideal Electric Company
Kilowatts (kW)	1,500
Amps	231
Volts	4,160
Kilovolt-ampere (kVA)	1,667
Power factor	0.90
Frequency (Hz)	60
Speed (RPM)	600

1.3 Existing and Proposed Project Operations

1.3.1 Existing Operations

In accordance with Article 402 of the current Project license, the Project is operated in run-of-river mode to protect fish and wildlife resources in the Dan River. Run-of-river operations may be suspended during reservoir drawdown and refilling for inspection of the City of Danville Virginia's water supply intakes, which occurs on an as-needed basis, when river flows are naturally

low due to seasonal variability in river hydrology. The most recent inspection occurred in August 2016, and future inspections are expected to occur infrequently on an as-needed basis in the future.

During normal operations, Article 403 of the current Project license requires an instantaneous minimum flow of at least 300 cfs, which is usually provided via the turbine-generating units. If inflow is insufficient to operate the turbine-generating units, minimum flow is provided through one of the retired turbine bay gates near turbine-generating unit number 6. The maximum amount of flow through this gate is approximately 360 cfs. Following dewatering for inspection and maintenance of the City of Danville, Virginia's water supply intakes, an average 24-hour flow of 440 cfs is required downstream of the Project. The instantaneous minimum flow of at least 300 cfs is also adhered to during refill periods. The minimum flow requirement may be modified, if needed, for municipal water supply purposes, and after notification to the U.S. Fish and Wildlife Service (USFWS), Virginia Department of Wildlife Resources (VDWR), and the Virginia Department of Environmental Quality (VDEQ).

The Project is operated manually such that the onsite operator raises or lowers inlet roller gates to turn on or off the fixed-output turbine-generator units to approximate Project inflow. During normal operations when all the flashboards are up, the co-Licensees operate units to maintain a water level above 435.70 feet (flashboard crest = 437.7 feet). When flashboards are down, the co-Licensees will operate units to maintain a water level above 433.70 feet (spillway crest = 434.7 feet). When flashboards are being repaired, the co-Licensees will operate down to 433.70 feet to allow for repair or replacement of flashboards.

Spill can occur at the Project when flows are less than the maximum hydraulic capacity of the Project (2,160 cfs), due to the fixed hydraulic capacity of the turbine units (360 cfs per unit). Up to approximately 359 cfs can be spilled at the Project before enough water is available to bring an additional turbine unit on-line.

When inflow is forecasted to exceed the maximum hydraulic capacity the Project, excess flow is spilled over the dam. Inflow at the Project is forecasted on-site by examining upriver United States Geological Survey (USGS) gages.[1] During high flow conditions, when flow surpasses approximately 11,500 to 12,000 cfs the tailwater becomes too high and the turbine units are shut down to avoid damage to the units. In this situation, all flow is passed over the Project spillway. Similarly, during flood conditions, the Project is shut down and flow is passed over the spillway, and during flood conditions operations staff are also dispatched to the Project to continuously monitor operations and conditions.

If the turbine-generators trip off-line, the operator is automatically notified. When off-line, if there is no water flowing over the spillway and flashboards, operators will open the low- level gate to pass flow until units are back on-line or minimum flow is restored over the spillway and flashboards.

All operations information is recorded and stored every 10 minutes. Water level alarms are set and monitored 24 hour per day/7 days per week. Project operators are on-site 8 hours per day on weekdays and conduct morning and evening checks on the weekends. An alarm system will notify Project operators of issues when they are not on site. During high flow flood events Project operators are on-site 24 hours per day.

[1] The USGS gages are Dan River near Wentworth, NC (USGS No. 02071000), and Smith River at Eden, NC (USGS No. 02074000).

1.3.2 Proposed Operations

The co-Licensees propose to continue to operate the Project in run-of-river mode in accordance with the existing license with no proposed changes in the normal operations as described above.

The co-Licensees also propose the following:

1. Revise the Project boundary to conform to 18 CFR §4.41(h)(2), such that the boundary around the Project reservoir follows the contour of the normal maximum water surface elevation of 437.7 feet National Geodetic Vertical Datum of 1929 (NGVD 29) and metes and bounds around the principal Project works enclose only those lands necessary for operation and maintenance.
2. Remove the 13-mile-long transmission line from the Project boundary, as the current point of connection to the power grid is located at the substation immediately adjacent to the Project powerhouse.
3. Continue operations related to reservoir dewatering and refilling to perform inspection and maintenance of the City of Danville's water supply intakes (License Article 403). These operations would occur less frequently (on an as-needed basis rather than annually), and only during the November 1 through February 28 period to avoid impacts on aquatic biota.
4. Discontinue implementation of the existing the Wildlife Habitat Plan (License Article 405).
5. Continue the Sediment Flushing Plan (License Article 401) so that sediment flushing can occur as needed for any accumulated sediment in the forebay area, only during high flows (i.e., those greater than 3,000 cfs), and only during the November 1 through February 28 period to avoid impacts on aquatic biota.
6. Consult with the Virginia State Historic Preservation Officer before beginning any land-disturbing activities or alterations to known historic structures within the Project boundary. If the consulted parties agree that there will be no adverse impacts to any cultural resources, the proposed work will proceed. If the consulted parties conclude there may be adverse impacts, the co-Licensees will consult with the SHPO to develop alternatives for avoiding, minimizing, or mitigating the adverse effects.

1.4 Average Annual Energy Production

The average annual generation (2017-2020) at the Project is 15,220,362 kilowatt-hours per year (kWh/year).

1.5 Estimated Average Head

The estimated average head at the Project is 27 feet.

1.6 Reservoir

The reservoir has a surface area of 287 acres at the normal maximum water surface elevation of 437.7 feet NGVD 29. The reservoir has an estimated gross storage capacity of 1,952 acre-feet. As a run-of river facility, the Project has no net usable storage capacity.

1.7 Flow Data

The Project has minimum and maximum hydraulic capacities of 360 and 2,160 cfs, respectively. At the Project dam, the drainage area is approximately 1,900 square miles. USGS operates a gaging station on the Dan River (USGS Gage No. 02075045, Dan River at STP near Danville, VA), which is located approximately 5.2 river miles downstream of the Project dam and has a drainage area of 2,116 square miles. The gage has a period of record from October 19, 1995, to present for discharge, and October 1, 2007, to present for gage height. Table 1.7-1 provides average, median, maximum, and minimum annual and monthly flows of the Dan River at the Project dam from January 1, 1996, through December 31, 2020, prorated by 0.90 to account for the intervening drainage between the gage and the Project dam.[2] From January 1996 through December 2020, the monthly average flows at the Project ranged from 1,276 to 2,714 cfs. For the same period, the monthly median flows at the Project ranged from 893 to 2,309 cfs. Over the period of record analyzed, the average annual flow was 2,102 cfs, and the instantaneous peak flow was 45,270 cfs. Monthly flow duration curves are presented in Figures 1.7-1 through 1.7-4.

1.8 Project Facilities

Project facilities to be licensed consists of a dam with ogee spillway and flashboards, reservoir, headwall section, a brick powerhouse with three turbine-generating units, a tailrace channel, a transmission line, and appurtenant facilities. Figure 1.8-1 shows the location of the various Project facilities. Descriptions of the Project facilities are provided below.

1.8.1 Dam

The existing dam is a concrete structure with a curved ogee-type spillway with a crest elevation of 434.7 feet, NGVD 29, topped with three feet of wooden flashboards. The overall length is 910 feet, the total height is 25 feet, and 38 feet wide. The dam abuts the river left bank of the Dan River (looking downstream) and extends across the river where the dam abuts the headwall section. Figure 1.8.1-1 presents a photograph of the Project dam.

1.8.2 Reservoir

The reservoir for the Project has a surface area of about 287 acres, and a gross storage capacity of approximately 1,952 acre-feet at the Project's normal maximum water surface elevation of 437.7 feet, NGVD 29. The reservoir shoreline within the Project boundary is approximately 10 miles in length. Because the Project is operating in run-of-river mode there is negligible usable storage.

1.8.3 Forebay

A debris barrier trashrack lies in the Project forebay upstream of the powerhouse. It has a diagonal orientation where the farthest point upstream connects with a wingwall adjacent to the shoreline. The barrier trashrack extends 266 feet downstream where it connects at the junction of the

[2] The intervening drainage between the USGS gage and the Project dam is 216 square miles and represents approximately 10 percent of the total drainage area upstream of the gage.

powerhouse and dam. The barrier trashrack vertical bars are constructed of 0.3125-in steel bar rack with a 1.375-in clear spacing.

The barrier trashrack creates a triangular shaped intake forebay. The forebay is constructed of concrete and has a width of 271 feet at its widest point and a length of 175 feet at its longest point.

The intake trashracks are affixed to the abutments of each of the three turbine bays (Nos. 1 thru 3). The modular trashracks are composed of twelve panels that have a combined total width of 21.25 feet and a height of 18 feet at each of the three intake bays (Figure 1.8.3-1). The clear space between the 0.75-in wide intake bar racks is 3.25 in. There are also four retired turbine bays (Nos. 4 thru 7), as well as two City of Danville water intake bays (Nos. 8 thru 9) located in the forebay section.

1.8.4 Headwall Section

The headwall section is between the Project powerhouse and the left (looking downstream) abutment of the dam. It is constructed of concrete and is approximately 72 feet in length and 29-feet wide. It also has six low level sluice gates, and a non-operating fish ladder[3] that was constructed in 1904 incorporated in the structure. Each gate is manually operated. All gates are 4.5 feet wide with sill elevations of 407.7 feet, NGVD 29; however, the height of the gates varies, with two 6.5-foot-high gates, another two gates are 6 feet in height, while the remaining two gates are 4.5 feet high. The maximum amount of flow through each gate at the normal impoundment elevation (with the flashboards in place) is approximately 775 cfs (per 6.5-foot-high gate), approximately 709 cfs (per 6-foot-high gate), and approximately 615 cfs (per 4.5-foot-high gate). However, only four low level gates are operational. They are the four gates (two 6.5-foot-high gates and two 6-foot-high gates) located closest to the spillway. Figure 1.8.4-1 presents a photograph of the headwall section.

1.8.5 Powerhouse

The powerhouse is constructed of concrete, steel, and brick. It is approximately 224 feet long by 35 feet wide. The powerhouse contains three identical 1.5 MW generating units for a total installed capacity of 4.5 MW. The generating units are connected to six identical propeller-type turbine, two turbines per generating unit. Figure 1.8.5-1 presents a photograph of the powerhouse exterior.

1.8.6 Tailrace

Turbine flows are discharged into a tailrace that is approximately 160 feet long, 220 feet wide, and 0.7 acres in area. Turbine discharge flows are separated from main river flows by a concrete tailrace wall approximately 160 feet in length, 5 feet wide, and 12.3-feet high. Figure 1.8.6-1 presents a photograph of the Project's tailrace.

1.8.7 Transmission Line

At the time the Project was licensed, a transmission line (34.5 kV) 13-miles in length, owned and maintained by the City of Danville, connected the Project to the power grid. The connection point

[3] The fish ladder is not operational because the construction of several dams without fish passage downstream of the Project preclude migratory species from reaching the Project.

to the power grid is now at the Project's substation within the existing Project boundary, and the 13-mile-long transmission line is no longer utilized by the Project. This change occurred in January 2017. Figure 1.8.7-1 present a photograph of the substation where the Project connects to the power grid.

1.8.8 Appurtenances

Appurtenant facilities at the Project include 4.16 kV generator leads, a 100-foot-long 5 kV underground service-connection cable, and a 3-phase 4.16/34.5 kV step-up transformer.

1.9 Estimated Project Cost

The Project Dam was originally constructed during 1902-04, the generating equipment was renovated during 1990-91. The Applicant does not have any records of the original construction costs.

1.10 Estimated Project Operations and Maintenance Cost of each Proposed Environmental Measure

The estimated costs of environmental measures for the Project are provided in Table 1.10-1 in 2022 dollars.

Table 1.7-1. Average, median, maximum, and minimum flows estimated at the Project based on flows measured at the USGS Gage No. 02075045, Dan River at STP near Danville, VA, from January 1, 1996 through December 31, 2020.[1,2]

Month	Flow (cfs)			
	Mean	Median	Maximum	Minimum
January	2,610	1,692	31,860	410
February	2,714	1,778	37,440	464
March	2,578	2,016	33,390	470
April	2,695	2,039	32,670	499
May	2,538	1,800	36,900	518
June	1,911	1,364	15,390	234
July	1,276	1,044	15,390	153
August	1,337	963	20,070	94
September	1,692	893	37,350	154
October	1,590	927	39,690	184
November	1,907	1,035	34,830	308
December	2,369	1,548	27,630	385
Average Annual	2,102	1,386	39,690	94

Source: USGS (2021)

1. Flows are prorated by 0.90 to account for the difference in drainage area between the gage and Project dam.
2. Data presented for January 1, 1996 through December 31, 2020.

Table 1.10-1. Estimated Costs of the co-Licensees Proposed Environmental Measures.

Proposed Measure	Capital Cost (2022 $)	Annual Operations and Maintenance Cost (2022 $)
Revise the Project boundary to conform to 18 CFR §4.41(h)(2), such that the boundary around the Project reservoir follows the contour of the normal maximum water surface elevation of 437.7 feet NGVD 29 and metes and bounds around the principal Project works enclose only those lands necessary for operation and maintenance.	$0	$0
Remove the 13-mile-long transmission line from the Project license, as the current point of connection to the power grid is located at the substation immediately adjacent to the Project powerhouse.	$0	$0
Continue operations related to reservoir dewatering and refilling to perform inspection and maintenance of the City of Danville's water supply intakes (License Article 403). These operations would occur less frequently (on an as-needed basis rather than annually), and only during the November 1 through February 28 period to avoid impacts on aquatic biota.	$0	$5,000
Discontinue implementation of the existing the Wildlife Habitat Plan (License Article 405).	$0	$0
Continue the Sediment Flushing Plan (License Article 401) so that sediment flushing can occur as needed for any accumulated sediment in the forebay area, only during high flows (i.e., those greater than 3,000 cfs), and only during the November 1 through February 28 period to avoid impacts on aquatic biota.	$0	$7,500
Consult with the Virginia State Historic Preservation Officer before beginning any land-disturbing activities or alterations to known historic structures within the Project boundary. If the consulted parties agree that there will be no adverse impacts to any cultural resources, the proposed work will proceed. If the consulted parties conclude there may be adverse impacts, the co-Licensees will consult with the SHPO to develop alternatives for avoiding, minimizing, or mitigating the adverse effects.	$0	$2,000

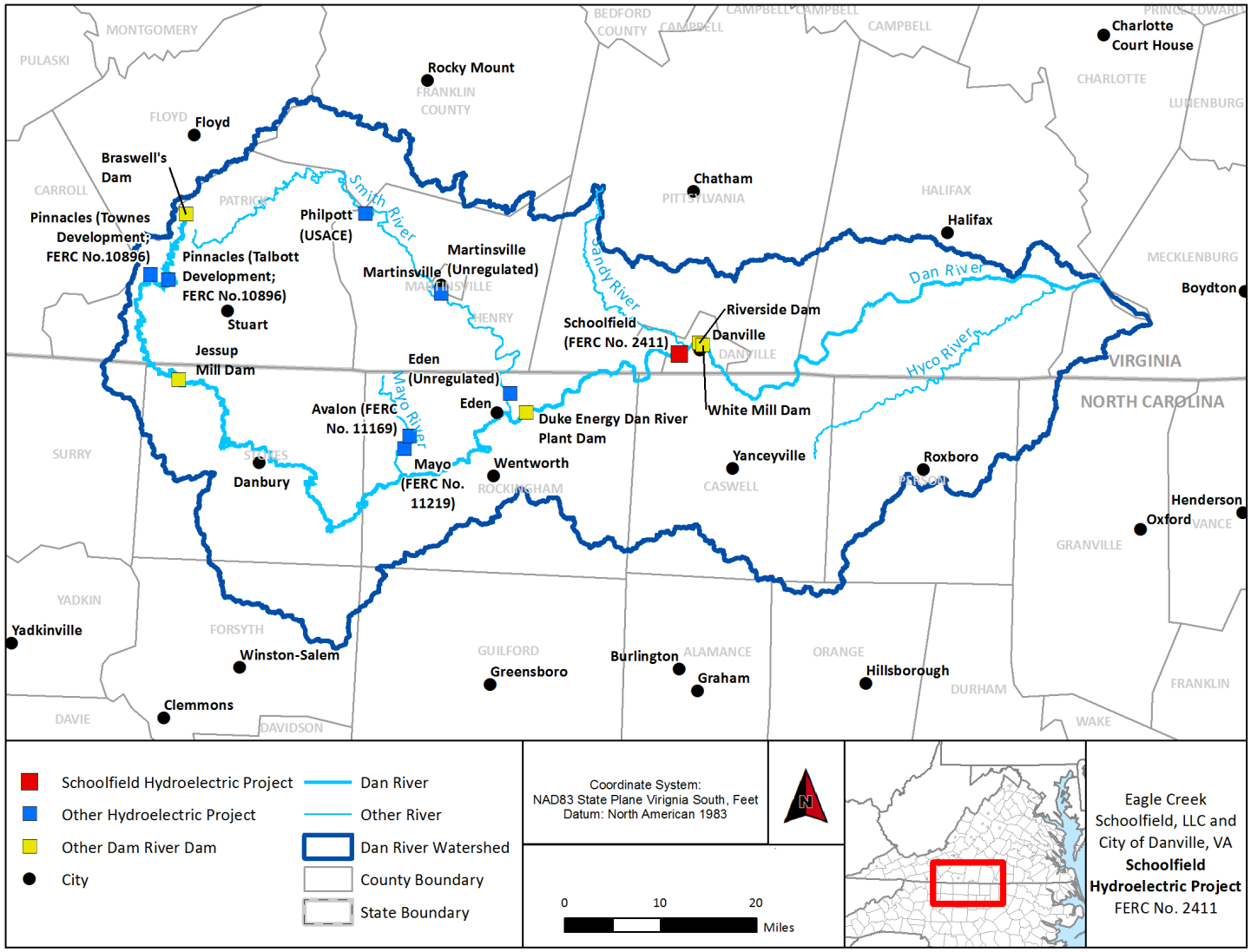

Figure 1-1. Schoolfield Hydroelectric Project general location.

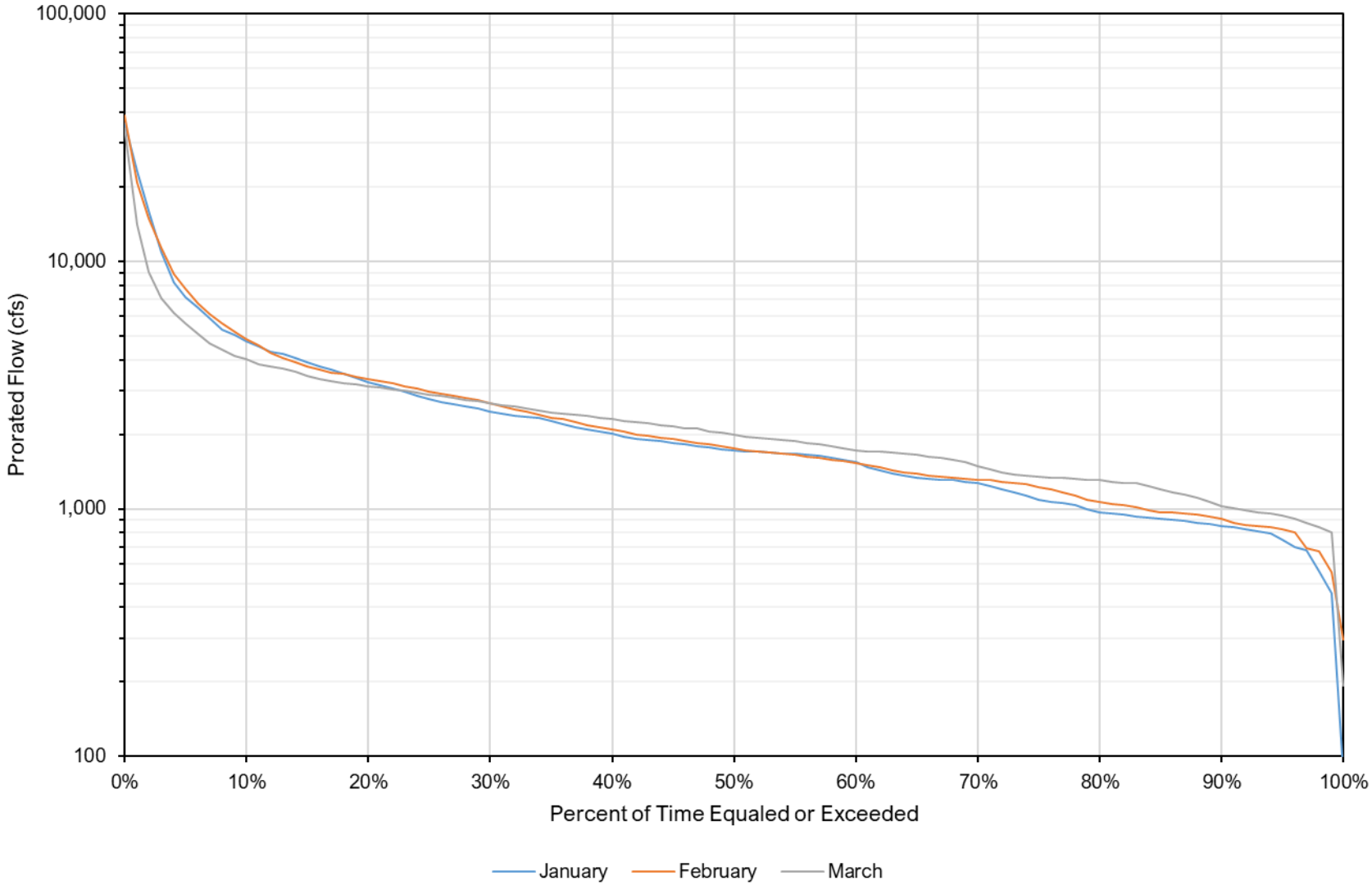

Figure 1.7-1. Flow duration curves of Dan River flow at the Project dam for January, February, and March.

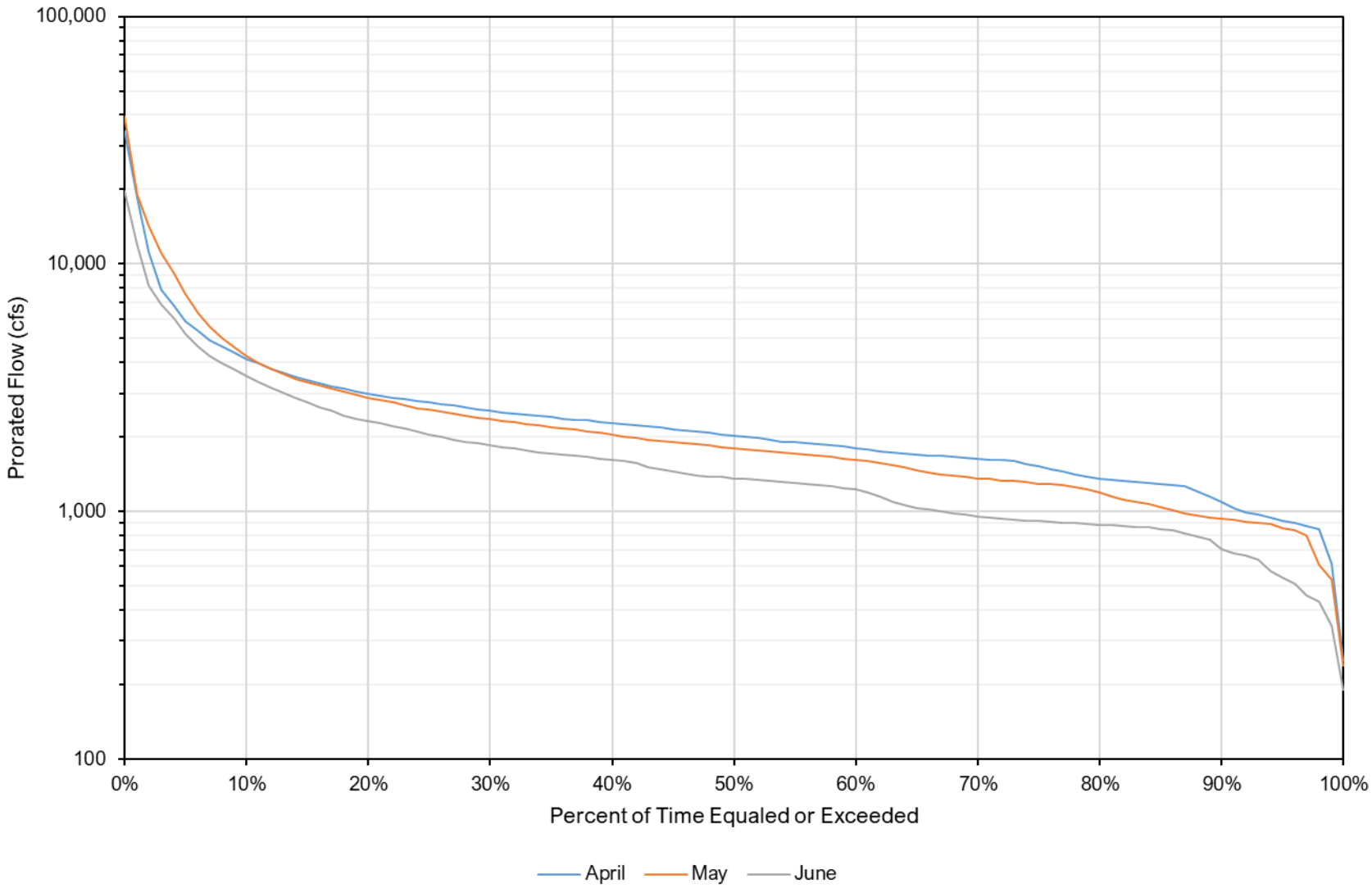

Figure 1.7-2. Flow duration curves of Dan River flow at the Project dam for April, May, and June.

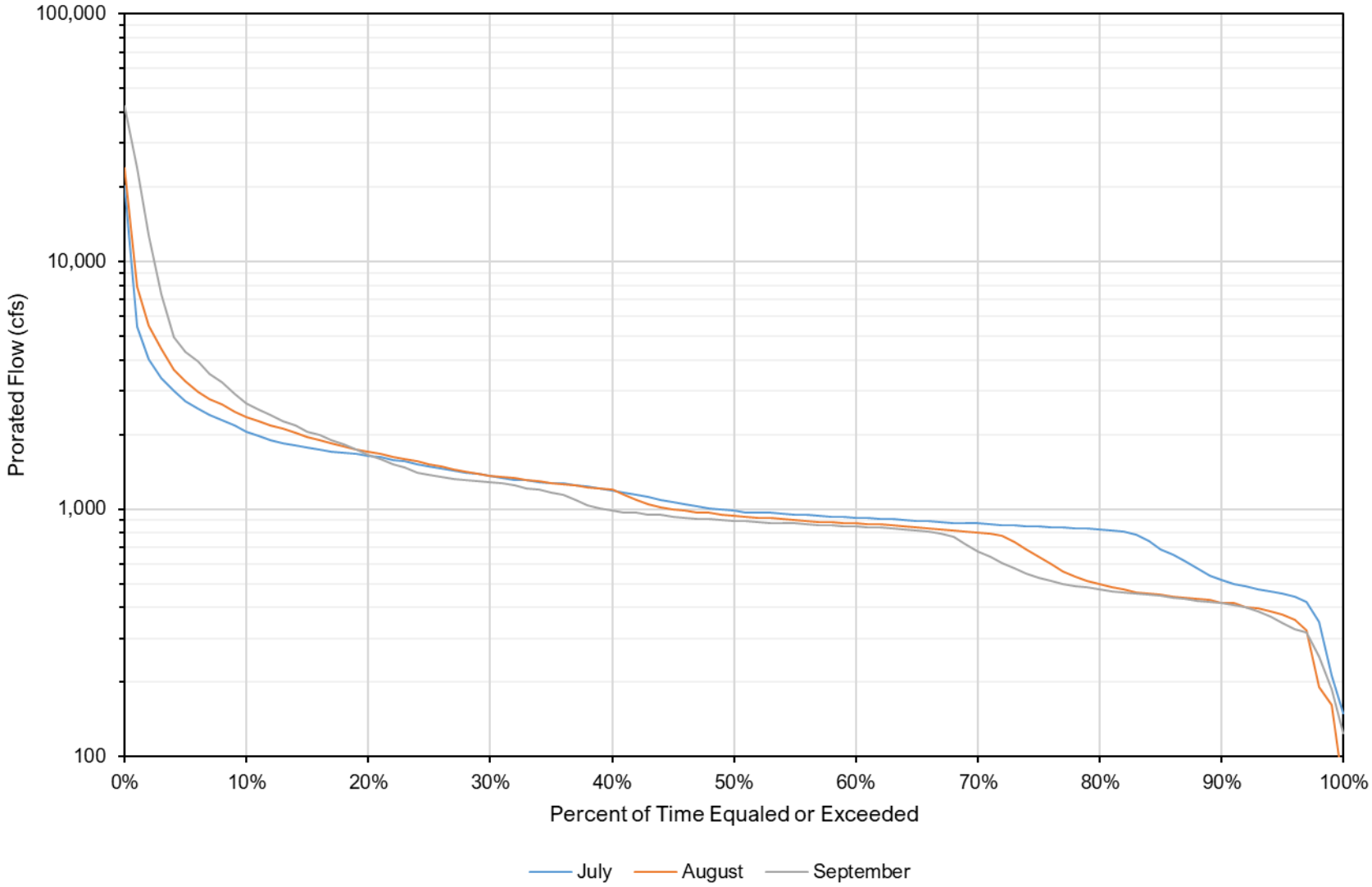

Figure 1.7-3. Flow duration curves of Dan River flow at the Project dam for July, August, and September.

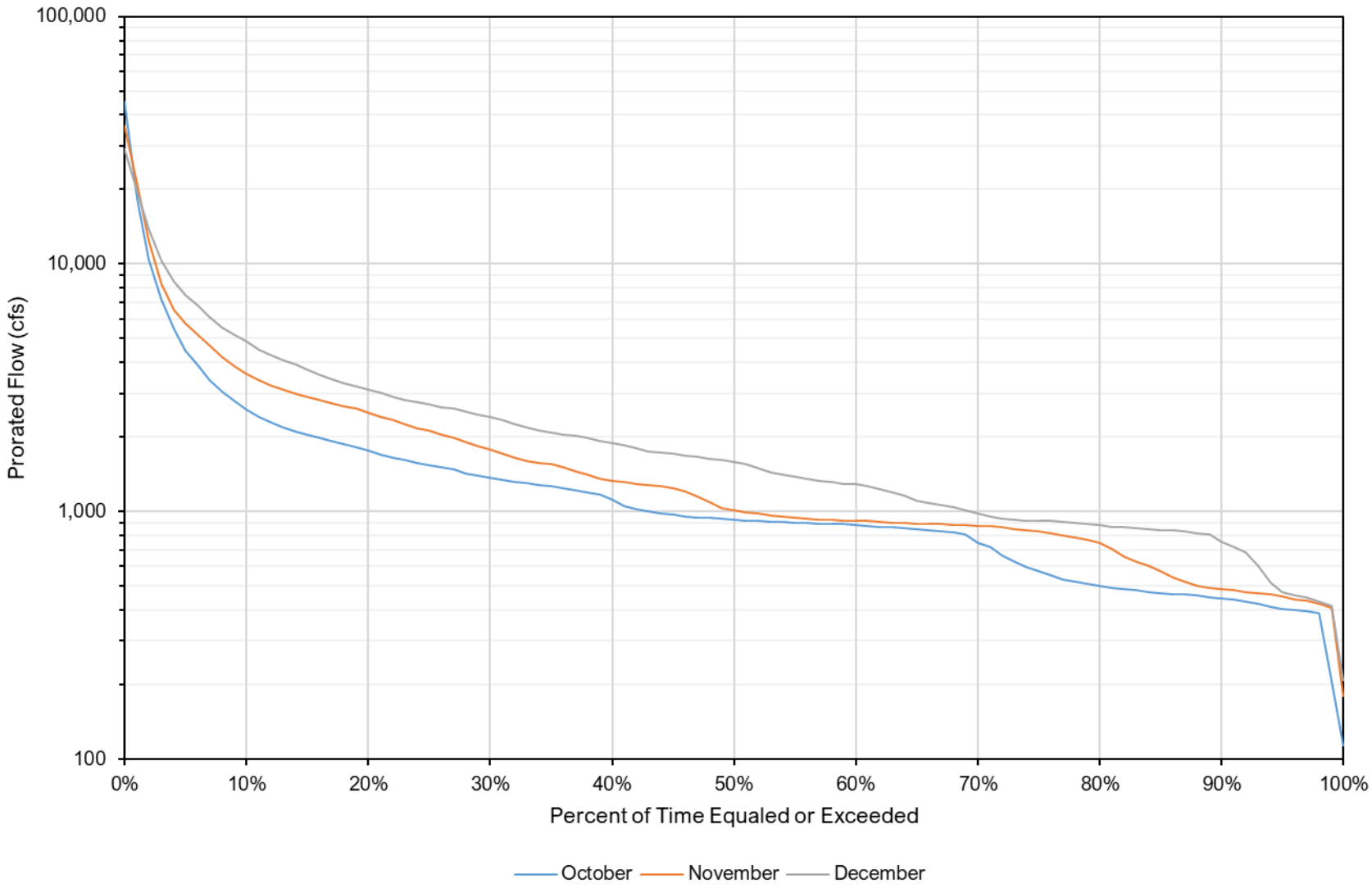

Figure 1.7-4. Flow duration curves of Dan River flow at the Project dam for October, November, and December.

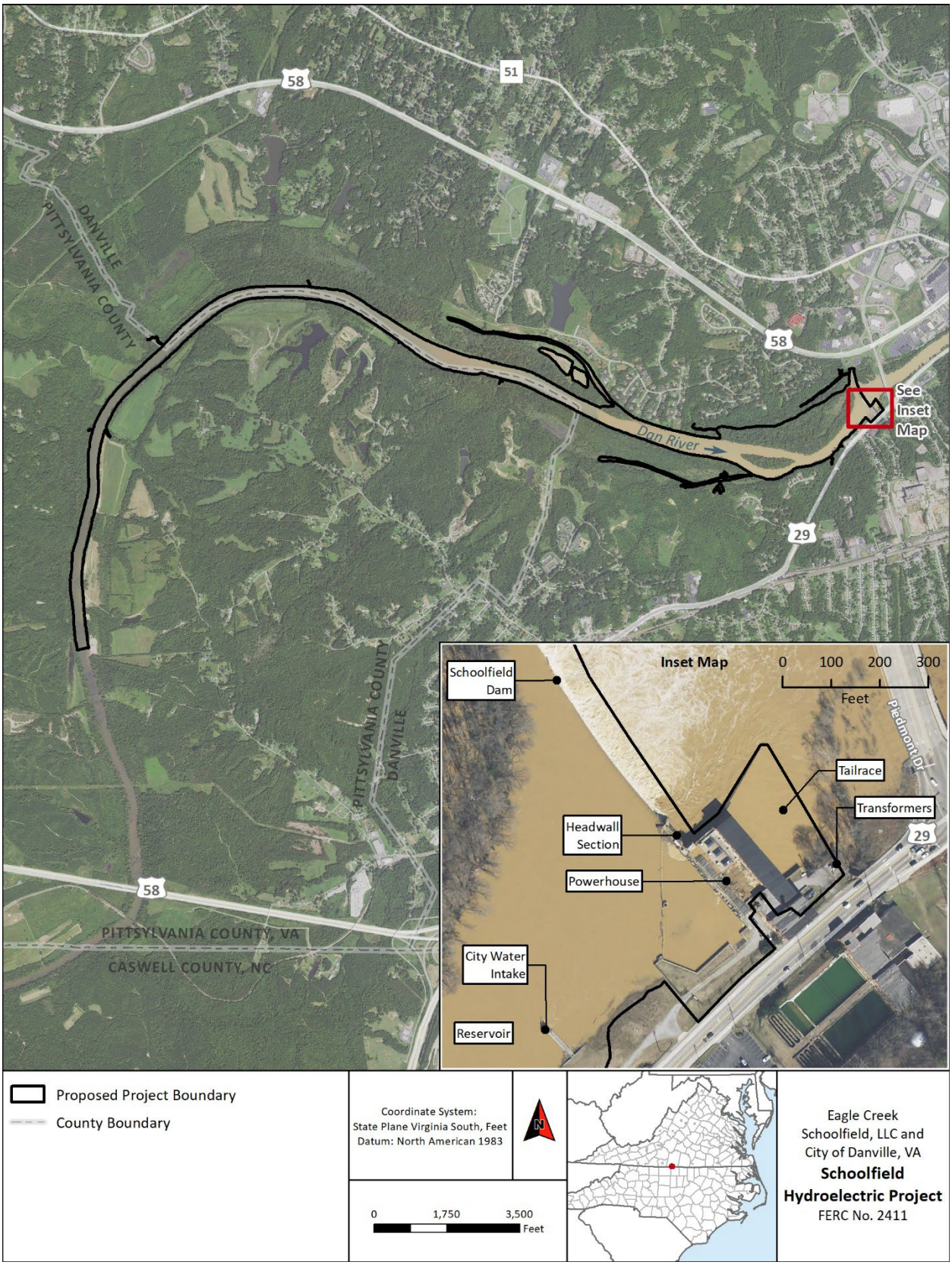

Figure 1.8-1. Schoolfield Hydroelectric Project facilities.

Figure 1.8.1-1. Photograph of the Project dam.

Figure 1.8.3-1. Trashracks located in each of the turbine intake bays at Schoolfield Project.

Figure 1.8.4-1. Photograph of the Project headwall section.

Figure 1.8.5-1. Photograph of the Project powerhouse exterior.

Figure 1.8.6-1. Photograph of the Project tailrace.

Figure 1.8.7-1. Photograph of the Project's substation.

2 PROJECT PURPOSE

Power generated by the Project is sold into the power grid. The Project provides valuable socioeconomic benefits for the region, and renewable power generation from the Project helps offset reliance on non-renewable fossil fuel sources.

3 PROJECT LICENSING COSTS

The estimated cost to develop the license application is $364,000 in 2022 dollars.

4 PEAK AND OFF-PEAK POWER VALUES

Not applicable; the Project is operated in a run-of-river mode.

5 CHANGE IN PROJECT GENERATION

The co-Licensees are not proposing a change in Project generation or operation; therefore, the co-Licensees do not expect an increase or decrease in Project generation or value of Project power.

6 PROJECT VALUE

The remaining undepreciated net investment or book value of the Project is $5,200,000 in 2022 dollars.

7 ANNUAL OPERATIONS AND MAINTENANCE COSTS

In 2022 dollars, the average annual operations and maintenance costs are estimated to be $187,000, and other expenses including insurance, taxes, and administrative costs average $202,000 annually. Therefore, the total average annual operation and maintenance cost is $389,000.

8 SINGLE-LINE ELECTRICAL DIAGRAM

A single-line electrical diagram will be filed with the final license application as Figure 8-1 to this Exhibit. However, this drawing is considered Critical Energy Infrastructure Information pursuant to the Commission's regulations and will be removed from the public volumes of the license application.

Figure 8-1. Single Line Diagram

(These drawings are considered Critical Energy Infrastructure Information [CEII] and have been removed from this document).

9 SAFE MANAGEMENT, OPERATION, AND MAINTENANCE OF THE PROJECT

The co-Licensees have safely managed, operated, and maintained the Project throughout the existing license term. These same practices will be continued under the new license, subject to any new terms and conditions contained therein.

10 LITERATURE CITED

U.S. Geological Survey. 2021. USGS 02075045 DAN RIVER AT STP NEAR DANVILLE, VA. https://waterdata.usgs.gov/nwis/dv?cb_00060=on&format=gif_default&site_no=02075045&referred_module=sw&period=&begin_date=1996-01-01&end_date=2020-12-31. Accessed September 22, 2021.