Commonwealth of Virginia

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Secretary of Natural and Historic Resources

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Director

VWP Individual Permit Number 22-2318
Effective Date: Month DD, YYYY
Expiration Date: Month DD, YYYY

VIRGINIA WATER PROTECTION PERMIT ISSUED PURSUANT TO THE STATE WATER CONTROL LAW AND SECTION 401 OF THE CLEAN WATER ACT

In compliance with § 401 of the Clean Water Act, as amended (33 USC § 1341) and the State Water Control Law and regulations adopted pursuant thereto, the Department has determined that there is a reasonable assurance that this VWP permit, if complied with, will protect instream beneficial uses, will not violate applicable water quality standards, and will not cause or contribute to a significant impairment of state waters or fish and wildlife resources. In issuing this VWP permit, the Department has not taken into consideration the structural stability of any proposed activities.

Permittee: Rivanna Water and Sewer Authority (RWSA)

Facility Crozet Water Supply System

Facility Address: 1525 Browns Gap Turnpike

Activity Location: The Crozet Water Supply System includes an intake in the Beaver Creek Reservoir and the Beaver Creek Dam located at 1525 Browns Gap Turnpike in Crozet, and the Crozet Water Treatment Plant (WTP) located approximately a mile away at 4673 Three Notch'd Road in Albemarle County, Virginia.

Activity Description: The permit authorizes the construction and operation of a new surface water intake structure located in Beaver Creek Reservoir, a pumping station, spillway, principal spillway riser modifications, a permanent road crossing and bridge, and a raw water transmission main from the pumping station to the Crozet WTP. The permitted withdrawal will be used as a municipal water supply. Other uses are not authorized by this permit. Permitted activities shall be conducted as described in the Joint Permit Application dated and received on October 5, 2022, and supplemental materials, revisions and clarifications received.

The Permittee's authorized water withdrawal shall not exceed:

420 million gallons per year,
66 million gallons per month,
2.2 million gallons per day

The permitted activity shall be in accordance with this Permit Cover Page, Part I - Special Conditions, and Part II - General Conditions.

_____ _____

Scott Morris, DBA, P.E. Date
Director, Water Division

Part I – Special Conditions

A. Authorized Activities

1. This permit authorizes the construction and operation of a surface water intake and associated infrastructure to withdraw surface water from the Beaver Creek Reservoir for the purposes of a public water supply. This permit authorizes the total impact to 0.36 acres of surface waters, consisting of 0.15 acres of permanent impacts and 0.21 acres of temporary impacts.

    a. Permanent impacts consist of no more than 0.07 acre (2900 ft^2) of open water and 0.08 acre (275 linear feet) of stream channel.

    b. Temporary impacts consist of no more than 0.18 acre (7,850 ft^2) of open water and 0.03 acre (35 linear feet) of stream channel.

    c. Authorized surface water impacts described under this condition shall be as depicted on the impacts map entitled "Impact Map" submitted with the Joint Permit Application October 5, 2023.

2. The permittee shall conduct authorized activities as described in the Joint Permit Application and supplemental materials, revisions, and clarifications. Any changes to the authorized activities or impacts map that affect permitted areas shall be submitted to the Department immediately upon determination that changes are necessary, and Department approval shall be required prior to implementing the changes.

3. The permit authorizes the temporary use of mechanical equipment in surface waters in accordance with all applicable permit conditions.

4. The permittee shall notify the Department of any changes in authorized impacts to surface waters, of any modifications of the intake structure, or any changes to the design or type of construction activities in surface waters authorized by this permit. Department approval shall be required prior to implementing the changes. Any additional impacts, modifications, or changes shall be subject to individual permit review or modification of this permit.

B. Permit Term

1. This permit is valid for fifteen (15) years from the date of issuance. A new permit may be necessary for the continuance of the authorized activities, including water withdrawals, or any permit requirement that has not been completed, including compensation provisions.

2. The permittee shall submit a new permit application at least 270 calendar days prior to the expiration of this permit if reissuance will be requested. A complete permit application is due by **DATE**, in accordance with 9VAC25-210-65**.**

C. Standard Project Conditions

1. This permit does not constitute, convey, or imply authority to any permittee to unlawfully or incidentally take any threatened or endangered species that is protected by Virginia laws or regulations, pursuant to § 3.2-1000 through -1011; § 29.1-563 through -570; and 4VAC15-20 *et seq*. In accordance with recommendations from the Virginia Department of Wildlife Resources (DWR) and Conservation and Recreation (DCR), the permittee shall comply with the most recent Time-of-Year-Restrictions (TOYR) recommended by the agency(ies) for this project.

2. The activities authorized by this permit shall be executed in such a manner that any impacts to beneficial uses are minimized. As defined in § 62.1-44.3 of the Code of Virginia, "beneficial use" means both instream and offstream uses. Instream beneficial uses include, but are not limited to, the protection of fish and wildlife habitat, maintenance of waste assimilation, recreation, navigation, and cultural and aesthetic values. The preservation of instream flows for purposes of the protection of navigation, maintenance of waste assimilation capacity, the protection of fish and wildlife resources and habitat, recreation, cultural and aesthetic values is an instream beneficial use of Virginia's waters. Offstream beneficial uses include, but are not limited to, domestic (including public water supply), agricultural uses, electric power generation, commercial, and industrial uses.

3. No activity shall substantially disrupt the movement of aquatic life indigenous to the water body, including those species which normally migrate through the area, unless the primary purpose of the activity is to impound water.

4. Flows downstream of the project area shall be maintained to protect all uses.

5. No activity shall cause more than minimal adverse effect on navigation, and no activity shall block more than half of the width of the stream at any given time.

6. The activity shall not impede the passage of normal or expected high flows, and any associated structure shall withstand expected high flows.

7. All required notifications and submittals shall include project name and permit number and be submitted electronically to Withdrawal.permitting@deq.virginia.gov or mailed to the office stated below, unless otherwise directed in writing by the Department subsequent to the issuance of this permit: Department of Environmental Quality, Attn: Water Withdrawal Permitting Program Manager, Office of Water Withdrawal Permitting, P.O. Box 1105, Richmond VA 23218.

8. All reports required by this permit and other information requested by the Department shall be signed by the permittee or a person acting in the permittee's behalf, with the authority to bind the permittee. A person is a duly authorized representative only if *both* criteria below are met. If a representative authorization is no longer valid because of a change in responsibility for the overall operation of the facility, a new authorization shall be immediately submitted to the Department.

    a. The authorization is made in writing by the permittee.

    b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager,

superintendent, or position of equivalent responsibility. A duly authorized representative may thus be either a named individual or any individual occupying a named position.

9. All submittals shall contain the following signed certification statement:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

10. Any fish kills or spills of fuels or oils shall be reported to the Department immediately upon discovery at 540-574-7800. If the Department cannot be reached, the spill or fish kill shall be reported to the Virginia Department of Emergency Management (VDEM) at 1-800-468-8892 or the National Response Center (NRC) at 1-800-424-8802. Any spill of oil as defined in § 62.1-44.34:14 of the Code of Virginia that is less than 25 gallons and that reaches, or that is expected to reach, land only is not reportable, if recorded per § 62.1-44.34:19.2 of the Code of Virginia and if properly cleaned up.

11. The Department shall be notified in writing within 24 hours or as soon as possible on the next business day when potential environmentally threatening conditions are encountered which require debris removal or involve potentially toxic substances. Measures to remove the obstruction, material, or toxic substance or to change the location of any structure are prohibited until approved by the Department.

12. Virginia Water Quality Standards shall not be violated in any surface waters as a result of the project activities.

13. All excavation, dredging, or filling in surface waters shall be accomplished in a manner that minimizes bottom disturbance and turbidity.

14. All in-stream activities shall be conducted during low-flow conditions whenever practicable.

15. Erosion and sedimentation controls shall be designed in accordance with the Virginia Erosion and Sediment Control Handbook, Third Edition, 1992. These controls shall be placed prior to clearing and grading and maintained in good working order to minimize impacts to state waters. These controls shall remain in place until the area is stabilized and shall then be removed.

16. All construction, construction access, and demolition activities associated with this project shall be accomplished in a manner that minimizes construction materials or waste materials from entering surface waters, unless authorized by this permit. Wet, excess, or waste concrete shall be prohibited from entering surface waters.

17. All fill material placed in surface waters shall be clean and free of contaminants in toxic concentrations or amounts in accordance with all applicable laws and regulations.

18. Measures shall be employed at all times to prevent and contain spills of fuels, lubricants, or other pollutants into surface waters.

19. Machinery or heavy equipment in temporarily impacted wetlands shall be placed on mats or geotextile fabric, or other suitable means shall be implemented, to minimize soil disturbance to the maximum extent practical. Mats, fabrics, or other measures shall be removed as soon as the work is complete in the temporarily impacted wetland.

20. Stream channel restoration activities shall be conducted in the dry or during low flow conditions. When site conditions prohibit access from the streambank or upon prior authorization from the Department of Environmental Quality, heavy equipment may be authorized for use within the stream channel. The equipment shall be stationed on cobble bars.

21. Temporary disturbances to wetlands, stream channels, and/or stream banks during project construction activities shall be avoided and minimized to the maximum extent practicable.

22. All temporarily disturbed wetland areas shall be restored to preconstruction conditions within 30 calendar days of completing work in the areas, which shall include re-establishing pre-construction contours, and planting or seeding with appropriate wetland vegetation according to cover type (emergent, scrub/shrub, or forested), except for invasive species identified on the Department of Conservation and Recreation's (DCR's) Virginia Invasive Plant Species List. The permittee shall take all appropriate measures to promote and maintain the revegetation of temporarily disturbed surface waters through the second-year post-disturbance.

23. All temporarily impacted streams and stream banks shall be restored to their original elevations and contours within 30 calendar days following the construction at that stream segment, and the banks shall be seeded or planted with the same vegetative cover type originally present along the banks, including supplemental erosion control grasses if necessary but not including invasive species identified on DCR's Virginia Invasive Plant Species List. The permittee shall take all appropriate measures to promote and maintain the revegetation of temporarily disturbed surface waters through the second-year post-disturbance.

24. All materials (including fill, construction debris, excavated materials, and woody materials, that are temporarily placed in wetlands, in stream channels, or on stream banks) shall be placed on mats or geotextile fabric, shall be immediately stabilized to prevent the material or leachate from entering surface waters, and shall be entirely removed within 30 calendar days following completion of that construction activity. After removal, disturbed areas shall be returned to original contours, shall be stabilized, and shall be restored to the original vegetated state within 30 calendar days. The permittee shall take all appropriate measures to promote and maintain the revegetation of temporarily disturbed surface waters through the second-year post-disturbance.

25. Temporary in-stream construction features such as cofferdams shall be made of non-erodible materials.

26. All non-impacted surface waters that are within the project or right-of-way limits, and that are within fifty feet of any project activities, shall be clearly flagged or demarcated for the life of the

construction activity within that area. The permittee shall notify all contractors and subcontractors that *no activities are to occur in these marked areas*.

27. All required Federal, State, and Local permits for impacts to state waters that are related to the construction of this project must be obtained prior to commencement of any construction activities. A summary of all necessary permits required for construction shall be submitted to the Department prior to commencement of any construction activities.

D. Surface Water Withdrawals

1. Surface water withdrawn from Beaver Creek Reservoir and authorized under this permit is to be used for a public water supply.

2. The withdrawal of water from Beaver Creek Reservoir shall not exceed the following:

    a. A maximum daily withdrawal of 2.2 million gallons per day (Mgal/d);

    b. A maximum monthly withdrawal of 66 million gallons (Mgal); and

    c. A maximum annual withdrawal of 420 million gallons (Mgal).

3. The permittee shall install intake screens with openings no larger than 1 millimeter in width and height for mesh screens or a slot size of 1 millimeter in width for wedgewire screens. The permittee shall ensure that the maximum screen face approach velocity does not exceed 0.25 feet per second.

4. The permittee shall estimate the previous days inflow in units of million gallons per day (Mgal/d) on a daily basis by monitoring the stream flow gages detailed herein and by applying the equation:

    "Inflow = Q_M x 0.1 x 0.646", where:

    a. Inflow= estimated streamflow into Beaver Creek Reservoir;

    b. Q_M = the previous day's provisional mean daily flow at USGS Gage No. 02031000 (Mechums River near Whitehall, VA);

    c. 0.1 = is the adjustment factor for drainage area (Intake drainage area of 9.51 square miles / Stream Gaging Station No. 02031000 drainage area of 95.3 square miles); and

    d. 0.646 is the conversion factor for CFS to Mgal/d.

5. During construction requiring drawdown of the Reservoir, release must be a minimum of 0.3 cfs on a daily basis.

6. Following construction and commissioning of infrastructure, the required release from the Reservoir must be a minimum of 90% of inflow, or the maximum release, whichever is lower, on a daily basis.

7. The permittee shall provide the following maximum release from the Reservoir to maintain in-stream flows in Beaver Creek:

Mechum's River Mean Flow (cfs) November 1st – March 1st	Maximum Required Release from Beaver Creek Reservoir (cfs)
0-19	1.5
20-29	1.9
30-59	2.3
60 +	3.1

The maximum required release shall be calculated each year on March 1st and applies until March 1st of the following year.

8. Within one (1) year (DATE) of the issuance of this permit, the permittee shall submit a plan, for Department review, detailing how the permittee will estimate stream inflow (Mgal/d) into the Beaver Creek Reservoir through the establishment of an upstream inflow gage or robust procedure for estimating inflows from withdrawals, releases, and recorded Reservoir elevation levels.

9. The permittee shall prepare and submit, for Department review, a plan for conducting and completing an evaluation of existing and future water demands and all potential water sources available to the permittee. The plan shall be submitted no later than the end of year 14 of the permit term (DATE)."

10. The permittee shall submit a Drought Management Plan to the Department for review within 180 days (DATE) of permit issuance. Any revisions to the plan shall be submitted to the Department for review prior to implementing the change. The plan shall include, at a minimum, the following:

    a. Development of drought stages including when and how each stage will be implemented.

    b. Description of the conservation measures to be implemented during each drought stage.

11. When a drought emergency is declared by the Commonwealth of Virginia in the Middle James Drought Evaluation Region from the Drought Response Plan or by Albemarle County in accordance with the County's (or Locality's) Drought Management Ordinance, the permittee shall implement either the provisions directed by the Commonwealth, the Drought Management Ordinance, or the mandatory conservation measures as detailed in *Attachment B* of this permit, whichever is the most restrictive. The permittee shall be responsible for determining when drought emergencies are declared. The permittee shall retain records documenting that mandatory conservation measures were implemented during declared drought emergencies.

E. Water Withdrawal Monitoring, Recordation and Reporting Conditions

1. Within 120 days (DATE) of the issuance of this permit, the Permittee shall submit a Monitoring and Operations Plan for Department review. The Plan should specifically address the following:

a. Procedures for operating the intake to ensure compliance with all water withdrawal conditions of this permit;

b. Procedures for estimating inflow in accordance with Part I D 4 including the time of day that the estimate will be made;

c. Procedures for estimating outflow.

d. A procedure for estimating the previous day's inflow at the intake location in the event that Gage No. 02031000 (Mechums River near Whitehall, VA) is damaged, disabled, or discontinued;

e. Procedures for recording withdrawals as well as all other monitoring and reporting requirements in Part I E 2 and E 6, including a sample of the reporting form or table that will be used.

2. On each day that pumping occurs, the permittee must monitor and record the following:

a. Date and time;

b. Total amount of water withdrawn each day; and

c. The provisional stream flow in cubic feet per second (cfs) as measured at the Stream Gage No. 02031000 (Mechums River near Whitehall, VA) and the required release as measured in cfs and Mgal/d.

3. The permittee shall monitor withdrawals from the Beaver Creek Reservoir on a daily basis using flow totalizer technology to confirm that the withdrawals are in compliance with this permit. Such meters shall produce volume determinations within plus or minus 10% of actual flows. A defective meter or other device must be repaired or replaced within 60 days. A defective meter is not grounds for not reporting the withdrawals. During any period when a meter is defective, generally accepted engineering practice shall be used to estimate withdrawals and the period during which the meter was defective must be clearly identified in the report.

4. The permittee shall record daily the following information regarding the outflow released from the Reservoir:

a. Date and time;

b. Actual outflow released in cfs; and

c. Required outflow to be released in cfs.

5. The permittee shall report any withdrawal not in compliance with Parts I D 2 or I D 5 or release not in compliance with Parts I D 5 or I D 6 by the fifth (5th) day of the month following the month in which the withdrawal or release occurred. Failure to report may result in compliance or enforcement activities. Reports shall include project name and permit number and be submitted

electronically to Withdrawal.permitting@deq.virginia.gov or mailed to the office stated below, unless otherwise directed in writing by the Department subsequent to the issuance of this permit: Department of Environmental Quality, Attn: Water Withdrawal Compliance Coordinator, Office of Water Compliance, P.O. Box 1105, Richmond VA 23218.

6. The permittee shall submit a water withdrawal monitoring report to the Department semi-annually. The semi-annual monitoring period shall be as follows: January through June and July through December. The daily records shall be tabulated by month. The report shall be submitted to the Department by February 10th and August 10th of every year within the permit term. Submittal of the report may take the form of electronic reporting, or another form determined to be acceptable by the Department. In the event the electronic reporting system is not available, the permittee may submit the report electronically to withdrawal.permitting@deq.virginia.gov. The report shall include the following information:

   a. The permittee's name and address;

   b. The permit number;

   c. The source (s) from which water is withdrawn;

   d. The location (latitude and longitude) of each point of water withdrawal;

   e. Information listed in Part I E 2;

   f. The cumulative volume (million gallons) of water withdrawn each month and for the calendar year;

   g. The average daily volume (million gallons per day) of water withdrawn as calculated on the last day of the monitoring period.

   h. In the last report for the calendar year, the largest single day withdrawal volume (million gallons) that occurred in the year and the month in which it occurred;

   i. The method of measuring each withdrawal;

   j. A summary of the dates on which the releases from the Reservoir did not meet the required volumes as determined in accordance with Part I D 5; and

   k. If during a semi-annual reporting period a drought emergency is declared, the report shall include a summary of mandatory conservation measures implemented during the drought event.

7. Water withdrawal monitoring and reporting activities shall comply with this section, Part I C, and Part II. All records and information that result from the monitoring and reporting activities required by this permit, including any records of maintenance activities to the withdrawal system, shall be retained for the life of the permit. This period of retention shall be extended automatically

during the course of any unresolved litigation regarding the regulated activity or as requested by the Department.

F. Stream Modifications, Including Intake/Outfall Structures

1. Redistribution of existing stream substrate for erosion control purposes is prohibited.

2. Material removed from the stream bottom shall not be deposited into surface waters unless otherwise authorized in this permit.

3. Riprap apron for all outfalls shall be designed in accordance with Virginia Erosion and Sediment Control Handbook, Third Edition, 1992, or the most recent version in effect at the time of construction.

4. For streambank protection activities, structures and backfill shall be placed as close to the streambank as practical, while still avoiding and minimizing impacts to surface waters to the maximum extent practical. No material shall be placed in excess of the minimum necessary for erosion protection.

5. Asphalt and materials containing asphalt or other toxic substances shall not be used in the construction of submerged sills, breakwaters, dams, or weirs.

6. Authorized stream relocation at Impact Site 8 shall be conducted done in the dry, unless specifically authorized by this permit, and all flows shall be diverted around the channelization or relocation area until the new channel is stabilized. The diversion shall be accomplished by leaving a plug at the inlet and outlet ends of the new channel during excavation. Once the new channel has been stabilized, flow shall be routed into the new channel by first removing the downstream plug and then the upstream plug. The new stream channel shall be constructed following the typical sections submitted with the application and should incorporate natural stream channel design principles to the greatest extent practicable. A low flow channel shall be constructed within the channelized or relocated area. The centerline of the channel shall meander, to the extent possible, to mimic natural stream morphology. The rerouted stream flow shall be fully established before construction activities in the old streambed can begin.

7. At least 30 calendar days prior to the initiation of land disturbance or construction activities at Impact Site 8, the permittee shall submit a stream relocation design plan to the Department for review.

G. Installation of Utilities

1. All utility line work in surface waters shall be performed in a manner that minimizes disturbance in each area. Temporarily disturbed surface waters shall be restored in accordance with Part I C 22, C 23, and C 24, unless otherwise authorized by this permit.

2. Material resulting from trench excavation may be temporarily side cast into wetlands not to exceed a total of 90 calendar days, provided the material is not placed in a manner such that it is dispersed by currents or other forces.

3. The trench for a utility line cannot be constructed in a manner that drains wetlands (e.g., backfilling with extensive gravel layers creating a French drain effect).

H. Road Crossings

1. Access roads authorized by this permit shall be constructed to minimize the adverse effects on surface waters to the maximum extent practicable and to follow as near as possible pre-construction contours and elevations.

2. Installation of pipes and road crossings shall occur in the dry via the implementation of cofferdams, sheet piling, stream diversions or other similar structures.

3. All surface waters temporarily affected by a road crossing shall be restored to their original elevations immediately following the removal of that particular temporary crossing. Temporary access roads shall be removed entirely following activity completion.

4. At crossings of streams, pipes and culverts must be installed to maintain low flow conditions and shall be countersunk at both inlet and outlet ends of the pipe or culvert, unless otherwise specifically approved by the Department of Environmental Quality on a case-by-case basis, and as follows: The requirement to countersink does not apply to extensions or maintenance of existing pipes and culverts that are not countersunk, floodplain pipes and culverts being placed above ordinary high water, pipes and culverts being placed on bedrock, or pipes and culverts required to be placed on slopes 5.0% or greater. Bedrock encountered during construction must be identified and approved in advance of a design change where the countersunk condition cannot be met. Pipes and culverts 24 inches or less in diameter shall be countersunk three inches below the natural stream bed elevations, and pipes and culverts greater than 24 inches shall be countersunk at least six inches below the natural stream bed elevations. Hydraulic capacity shall be determined based on the reduced capacity due to the countersunk position. In all stream crossings appropriate measures shall be implemented to minimize any disruption of aquatic life movement.

5. When countersinking culverts in streams, the permittee shall install the structure and any riprap or ancillary features in a manner to ensure reestablishment of the stream channel within 15 days post construction. When installing culverts in any surface water, the permittee shall install the culvert and ancillary features in a manner that will maintain the pre-construction hydrologic regime. Surface water depth within the impact area shall be consistent with depths upstream and downstream of the impact area.

6. Stream bottom elevations at road crossings shall be measured at the inlet and outlet of the proposed structure and recorded prior to construction and within one week after the completion of construction to ensure that the design elevations were met. This information shall be recorded on the *Monthly VWP Permit Inspection Checklist (Attachment D)* completed after the crossing is installed.

I. Stormwater Management Structures

1. The outfall and overflow structure shall be constructed and maintained to prevent downstream sediment deposition, erosion, or scour that may be associated with normal flow and any expected storm flows. Construction shall include the use of an appropriately sized riprap outlet protection apron at the outfall site.

2. Maintenance excavation shall follow the stormwater management plan approved by the Virginia Stormwater Management Program Authority and shall not exceed the original contours or designated maintenance areas of the facility.

3. Draining of a stormwater management facility shall be performed by a method that prevents downstream sediment deposition, erosion, or scour.

J. Project Construction Monitoring and Submittals (Impact Sites)

1. The permittee shall submit written notification at least ten (10) calendar days prior to the initiation of land disturbance or construction activities in permitted areas. The notification shall include preconstruction photographs, projected schedule for initiating and completing work at each permitted impact area.

   a. Preconstruction photographs shall be taken at each impact area prior to initiation of activities within impact areas.

   b. Photographs shall depict the impact area and the nonimpacted surface waters immediately adjacent to and downgradient of each impact area.

   c. Each photograph shall be labeled to include the following information: permit number, impact area number, date and time of the photograph, name of the person taking the photograph, photograph orientation, and photograph subject description.

2. Site inspections shall be conducted **once every calendar month** and recorded on the *Monthly VWP Permit Inspection Checklist* (*Attachment D)* by the permittee or the permittee's qualified designee during active construction within authorized surface water impact areas. Monthly inspections shall be conducted in the following areas: all authorized permanent and temporary impact areas; all avoided surface waters, including wetlands, stream channels, and open water; surface water areas within 50 feet of any land disturbing activity; and all on-site areas designated for permanent preservation. The *Monthly VWP Permit Inspection Checklist* (*Attachment D)* shall be completed in its entirety for each monthly inspection and shall be kept on-site and made available for review by Department staff upon request during normal business hours.

3. The *VWP Permit Construction Status Update Form* (*Attachment C)* enclosed with this permit shall be completed in June and December of every year for the duration of this permit. The *VWP Permit Construction Status Update Form* (*Attachment C)* shall include reference to the VWP permit authorization number and one of the following statements for each authorized surface water impact location:

   a. Construction activities not yet started;

b. Construction activities started;

c. Construction activities started but are currently inactive, or;

d. Construction activities complete.

4. The *VWP Permit Construction Status Update Form* (*Attachment C)* shall be submitted and must be received by the Department no later than January 10 and July 10 of every year.

5. The permittee shall notify the Department within 24 hours of discovering impacts to surface waters including wetlands, stream channels, and open water that are not authorized by this permit. The notification shall include photographs, estimated acreage and/or linear footage of impacts, and a description of the impacts.

6. The permittee shall submit written notification of completion within 30 calendar days after the completion of all activities in all permitted impact areas authorized under this permit.

Part II – General Conditions

A. Duty to Comply

The permittee shall comply with all conditions and limitations of the VWP permit. Nothing in this chapter shall be construed to relieve the permittee of the duty to comply with all applicable federal and state statutes, regulations, toxic standards, and prohibitions. Any VWP permit violation or noncompliance is a violation of the Clean Water Act and State Water Control Law and is grounds for enforcement action, VWP permit termination, VWP permit revocation, VWP permit modification, or denial of an application for a VWP permit extension or reissuance.

Nothing in this VWP permit shall be construed to relieve the permittee from civil and criminal penalties for noncompliance.

B. Duty to Cease or Confine Activity

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the activity for which a VWP permit has been granted in order to maintain compliance with the conditions of the VWP permit.

C. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any impacts in violation of the VWP permit that may have a reasonable likelihood of adversely affecting human health or the environment.

D. VWP Permit Actions

A VWP permit may be modified in whole or in part, revoked and reissued, extended, transferred, or terminated in accordance with 9VAC25-210-180 of the Virginia Administrative Code.

1. During the drafting and authorization of a permit modification, only those conditions to be modified shall be addressed with preparing a draft modified permit. VWP permit terms and conditions of the existing permit shall remain in full force and effect during the modification of the permit.

2. This VWP permit may be modified upon the request of the permittee or upon Department initiative when any of the following developments occur:

    a. When new information becomes available about the project or activity covered by the VWP permit, including project additions or alterations, that was not available at VWP permit issuance and would have justified the application of different VWP permit conditions at the time of VWP permit issuance;

    b. When a change is made in the promulgated standards or regulations on which the VWP permit was based;

c. When changes occur that are subject to "reopener clauses" in the VWP permit; or

d. When developments applicable to surface water withdrawals occur as specified in 9VAC25-210-380 of the Virginia Administrative Code.

3. When this VWP permit authorizes surface water withdrawals, it may be modified when any of the following developments occur:

a. When the Department determines that minimum instream flow levels resulting directly from the permittee's withdrawal of surface water are detrimental to the instream beneficial use, existing at the time of permit issuance, and the withdrawal of surface water should be subject to further net limitations or when an area is declared a surface water management area pursuant to §§ 62.1-242 through 62.1-253 of the Code of Virginia, during the term of the VWP permit.

b. Significant changes to the location of the surface water withdrawal system are proposed such that the Department of Environmental Quality determines a new review is warranted due to the potential effect of the surface water withdrawal to existing beneficial uses of the new location.

c. Changes to the permitted project or the surface water withdrawal, including increasing the storage capacity for the surface water withdrawal, that propose an increase in the maximum permitted withdrawal volumes or rate of withdrawal or that cause more than a minimal change to the instream flow requirements with potential to result in a detrimental effect to existing beneficial uses.

d. A revision to the purpose of the surface water withdrawal that proposes to include a new use or uses that were not identified in the permit application or a modification of the existing authorized use or uses such that the use description in the permit application and permit is no longer applicable. Examples of uses include, but are not limited to agricultural irrigation, golf course irrigation, public water supply, manufacturing, and electricity generation.

4. When the permittee has submitted a timely and complete application for reissuance of an existing VWP individual permit, but through no fault of the permittee, the Department does not reissue or reissue with conditions a VWP individual permit or the Department does not provide notice of its tentative decision to deny the application before an existing VWP individual permit expires, the conditions of the expiring VWP individual permit shall be administratively continued in full force and effect until the effective date of a reissued permit or the date on which the Department denies the application. Timely application shall be a minimum of 180 days for an individual permit or a minimum of 270 days for an individual permit for a surface water withdrawal, unless otherwise specified in the existing permit.

5. Any permittee desiring to continue a previously permitted activity after the expiration date of this VWP permit shall apply for and obtain a new permit or, if applicable, shall request an extension in accordance with 9VAC25-210-180 of the Virginia Administrative Code. Any permittee with

an effective VWP permit for an activity that is expected to continue after the expiration date of the VWP permit, without any change in the activity authorized by the VWP permit other than as may be allowed under 9VAC25-210-180, shall submit written notification requesting an extension. The permittee must file the request 90 days prior to the expiration date of the VWP permit. VWP permit modifications shall not be used to extend the term of a VWP permit beyond 15 years from the date of original issuance. When a permit term, other than that of an Emergency Virginia Water Protection Permit, is less than 15 years, an extension of the permit terms and conditions may be granted in accordance with 9VAC25-210-180. Emergency Virginia Water Protection Permits shall not exceed a duration of one year or shall expire upon the issuance of a regular Virginia Water Protection Permit, whichever comes first.

6. This VWP permit may be transferred to a new permittee only by modification to reflect the transfer, by revoking and reissuing the permit, or by automatic transfer. Automatic transfer to a new permittee shall occur if the current permittee: a) Notifies the Department of the proposed transfer of the permit and provides a written agreement between the current and proposed permittees containing the date of transfer of VWP permit responsibility, authorization, and liability to the new permittee; and b) the Department does not within 15 days notify the existing permittee of its intent to modify the VWP permit.

7. After notice and opportunity for a formal hearing pursuant to § 62.1-44.15:02 of the Code of Virginia, a VWP permit can be terminated for cause. Reasons for termination for cause are as follows:

   a. Noncompliance by the permittee with any condition of the VWP permit;

   b. The permittee's failure in the application or during the VWP permit process to disclose fully all relevant facts or the permittee's misrepresentation of any relevant facts at any time;

   c. The permittee's violation of a special or judicial order;

   d. A determination by the Department that the permitted activity endangers human health or the environment and can be regulated to acceptable levels by VWP permit modification or termination;

   e. A change in any condition that requires either a temporary or permanent reduction or elimination of any activity controlled by the VWP permit; and

   f. A determination that the permitted activity has ceased and that the compensation for unavoidable adverse impacts has been successfully completed.

8. The Department may terminate this permit without cause when the permittee is no longer a legal entity due to death, dissolution, or when a company is no longer authorized to conduct business in the Commonwealth. The termination shall be effective 30 days after notice of the proposed termination is sent to the last known address of the permittee or registered agent unless the permittee objects within that time. If the permittee does object during that period, the Department

shall follow the applicable procedures for termination under § 62.1-44.15:25 of the Code of Virginia and 9VAC25-230 of the Virginia Administrative Code.

9. This VWP permit may be terminated by consent, as initiated by the permittee. The permittee shall submit a request for termination by consent within 30 days of completing or canceling all permitted activities and all required compensatory mitigation requirements. When submitted for project completion, the request for termination by consent shall constitute a notice of project completion. The director may accept this termination on behalf of the Department. The permittee shall submit the following information:

   a. Name, mailing address, and telephone number;

   b. Name and location of the activity;

   c. The VWP permit number; and

   d. One of the following certifications:

      i. For project completion: "I certify under penalty of law that all activities and any required compensatory mitigation authorized by a VWP permit have been completed. I understand that by submitting this notice of termination that I am no longer authorized to perform activities in surface waters in accordance with the VWP permit, and that performing activities in surface waters is unlawful where the activity is not authorized by a VWP permit, unless otherwise excluded from obtaining a permit. I also understand that the submittal of this notice does not release me from liability for any violations of this VWP permit."

      ii. For project cancellation: "I certify under penalty of law that the activities and any required compensatory mitigation authorized by this VWP permit will not occur. I understand that by submitting this notice of termination that I am no longer authorized to perform activities in surface waters in accordance with the VWP permit, and that performing activities in surface waters is unlawful where the activity is not authorized by a VWP permit, unless otherwise excluded from obtaining a permit. I also understand that the submittal of this notice does not release me from liability for any violations of this VWP permit, nor does it allow me to resume the permitted activities without reapplication and issuance of another permit."

      iii. For events beyond permittee control, the permittee shall provide a detailed explanation of the events, to be approved by the Department, and the following certification statement: "I certify under penalty of law that the activities or the required compensatory mitigation authorized by this VWP permit have changed as the result of events beyond my control (see attached). I understand that by submitting this notice of termination that I am no longer authorized to perform activities in surface waters in accordance with the VWP permit, and that performing activities in surface waters is unlawful where the activity is not authorized by a VWP permit, unless otherwise excluded from obtaining a permit. I also understand that the submittal of this notice does not release me from liability for any

violations of this VWP permit, nor does it allow me to resume the permitted activities without reapplication and issuance of another permit.

E. Inspection and Entry

Upon presentation of credentials, the permittee shall allow the Department or any duly authorized agent of the Department, at reasonable times and under reasonable circumstances, to conduct the actions listed in this section. For the purpose of this section, the time for inspection shall be deemed reasonable during regular business hours. Nothing contained herein shall make an inspection time unreasonable during an emergency.

1. Enter upon any permittee's property, public or private, and have access to, inspect and copy any records that must be kept as part of the VWP permit conditions;

2. Inspect any facilities, operations, or practices (including monitoring and control equipment) regulated or required under the VWP permit; and

3. Sample or monitor any substance, parameter, or activity for the purpose of ensuring compliance with the conditions of the VWP permit or as otherwise authorized by law.

F. Duty to Provide Information

The Department may request (i) such plans, specifications, and other pertinent information as may be necessary to determine the effect of an applicant's discharge on the quality of state waters or (ii) such other information as may be necessary to accomplish the purposes of this chapter. Any owner, permittee, or person applying for a VWP permit or general permit coverage shall provide the information requested by the Department.

G. Monitoring and Records Requirements

1. Monitoring of parameters, other than pollutants, shall be conducted according to approved analytical methods as specified in the VWP permit. Analysis of pollutants will be conducted according to 40 CFR Part 136 (2017), Guidelines Establishing Test Procedures for the Analysis of Pollutants.

2. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

3. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart or electronic recordings for continuous monitoring instrumentation, copies of all reports required by the VWP permit, and records of all data used to complete the application for the VWP permit, for a period of at least three years from the date of permit expiration. This period may be extended by request of the Department at any time.

4. Records of monitoring information shall include:

a. The date, exact place and time of sampling or measurements;

b. The name of the individuals who performed the sampling or measurements;

c. The date and time the analyses were performed;

d. The name of the individuals who performed the analyses;

e. The analytical techniques or methods supporting the information such as observations, readings, calculations and bench data used;

f. The results of such analyses; and

g. Chain of custody documentation.

H. Property rights

The issuance of a VWP permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize injury to private property or any invasion of personal rights or any infringement of federal, state or local laws or regulations.

I. Reopener

This VWP permit may be reopened for the purpose of modifying the conditions of the VWP permit to meet new regulatory standards duly adopted by the board. Cause for reopening VWP permits includes, but is not limited to when the circumstances on which the previous VWP permit was based have materially and substantially changed, or special studies conducted by the board or the permittee show material and substantial change, since the time the VWP permit was issued and thereby constitute cause for VWP permit modification or revocation and reissuance.

J. Compliance with State and Federal Law

As to the permitted activity(ies), compliance with a VWP permit constitutes compliance with the VWP permit requirements of the Law and regulations.

K. Severability

The provisions of this VWP permit are severable.

L. Oil and Hazardous Substance Liability

Nothing in this VWP permit shall be construed to preclude the institution of legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under § 311 of the Clean Water Act or §§ 62.1-44.34:14 through 62.1-44.34:23 of the State Water Control Law.

M. Unauthorized Discharge of Pollutants

Except in compliance with a VWP permit, unless the activity is otherwise exempted or excluded, no person shall dredge, fill, or discharge any pollutant into, or adjacent to surface waters; withdraw surface water; otherwise alter the physical, chemical, or biological properties of state waters regulated under this chapter and make them detrimental to the public health, to animal or aquatic life, or to the uses of such waters for domestic or industrial consumption, for recreation, or for other uses; excavate in wetlands; or on or after October 1, 2001, conduct the following activities in a wetland:

1. New activities to cause draining that significantly alters or degrades existing wetland acreage or functions;

2. Filling or dumping; or

3. Permanent flooding or impounding.

PERMIT DECISION RATIONALE
Virginia Water Protection Individual Permit No. 22-2318
Crozet Water Supply, Albemarle County, Virginia

This document provides the pertinent information concerning the legal basis, scientific rationale, and justification for the issuance of the VWP permit listed below. The Department of Environmental Quality (Department) has reviewed the application for the Virginia Water Protection (VWP) Individual Permit Number 22-2318 and has determined that the project qualifies for an individual permit. Based on the information provided in the application and in compliance with (§ 401 of the Clean Water Act as amended (33 USC 1341 et seq.) the State Water Control Law and regulations, the Department has determined that there is a reasonable assurance that the activity authorized by this permit will protect instream beneficial uses, will not violate applicable water quality standards, and will not cause or contribute to significant impairment of state waters or fish and wildlife resources, provided the permittee complies with all permit conditions. Surface water impacts have been avoided and minimized to the maximum extent practicable.

Approved:

_____
Scott Morris, DBA, P.E.
Director, Water Division

_____
Date

The following details the application review process and summarizes relevant information for developing the Part I - Special Conditions for permit issuance.

1. Contact Information:

Permittee / Legal Responsible Party

Rivanna Water and Sewer Authority (RWSA)
695 Moores Creek Lane
Charlottesville, VA 22902
(434) 977-2970
bmawyer@rivanna.org

Facility Name and Address

Crozet Water Supply System
1525 Browns Gap Turnpike
Charlottesville, VA 22901

Agent Legal Name and Address:

Hazen and Sawyer
Attn: Linda Diebolt
4011 WestChase Boulevard, Suite 500
Raleigh, NC 27607
(919) 906-1775
ldiebolt@hazenandsawyer.com

2. JPA Processing Dates:

Pre-Application Panel Held:	March 12, 2018
Received Application:	October 5, 2022
1st Request for Additional Information Sent:	October 18, 2022
Response to 1st Request for Additional Information Received:	November 3, 2022
Application Complete:	November 7, 2022
2nd Request for Additional Information Sent:	July 17, 2023
Response to 2nd Request for Additional Information Received:	July 31, 2023
Letter(s) sent to Local Government(s):	August 9, 2023
Letters sent to Tribal Nations:	August 9, 2023
Letters sent to Riparian Landowners:	August 9, 2023
Coordination with VDH, VDWR, VDCR, VMRC:	August 11, 2023
Permit Fee Deposited by Accounting:	October 3, 2023
Draft Permit Package Issued:	February 13, 2024
Notification of Public Notice sent to Local Government:	[Date]
Public Notice Published:	[Date]
End of 30-Day Public Comment Period:	[Date]
Received Verification of Publication:	[Date]
Public Meeting or Hearing [If applicable]:	[Date]

3. Project Location:

The Crozet Water Supply System includes the Beaver Creek Reservoir and the Beaver Creek Dam located at 1525 Browns Gap Turnpike in Crozet, Virginia. The Crozet Water Treatment Plant (WTP) is located approximately a mile away at 4673 Three Notch'd Road in Crozet, Virginia.

City/County: Albemarle County
Waterbody: Beaver Creek Reservoir, Beaver Creek
Basin: James
Subbasin: Middle James
Section: 10g
Class: III
Special Standards: PWS
HUC: 020802040102
U.S.G.S. Quadrangle: Crozet

4. Project Description:

Rivanna Water and Sewer Authority (RWSA) proposes the continuation of an existing surface water withdrawal system for the purposes of a public water supply. The Crozet Water Supply System was previously excluded from VWP permitting in accordance with 9VAC25-210-310 A 1, as it was in operation prior to July 1, 1989. This exclusion will become invalid with the issuance of this VWP permit due to RWSA requesting an increased volume of withdrawal and associated upgrades and expansion of the water supply system. Construction work to expand the capacity of the Crozet WTP from 1 million gallons per day (Mgal/d) to 2.1 Mgal/d commenced in 2018 and was completed in 2021. The remaining project components include:

- Raw Water Intake and Tunnel. The project consists of the construction of a new steel-frame intake tower in Beaver Creek Reservoir. The new intake will improve reservoir withdrawal capability with the installation of airburst equipped wedgewire screens and five intakes set at various depths to optimize access to the lower-level strata of the reservoir. The reservoir volume will not change as a result of the project. A hypolimnetic oxygenation system will introduce oxygen-saturated water at the new intake location, improving the quality of water withdrawn. The raw water intake tower will be supported by drilled piles and will be constructed in the wet by divers. A connecting tunnel between the pumping station and the intake will be installed by a microtunnel boring machine that will be launched from a wet well shaft beneath the pump station on shore and wet-retrieved in the reservoir at the intake location. The 96-inch tunnel will be constructed to convey the five 16-inch intake pipes to the intake tower in the reservoir. The intake screens will have screen openings no larger than 1 mm and an intake velocity of no greater than 0.25 feet per second to protect aquatic species. Upon completion and commissioning of the new intake, the existing intake will not be used for any further surface water withdrawals but will be used to convey reservoir releases.

- Pumping Station. A new pumping station will be installed on the shoreline of Beaver Creek Reservoir. The new pumping station will consist of a deep shaft utilizing variable speed vertical turbine pumps to send withdrawn water to the Crozet WTP via the raw water transmission main. In conjunction with the intake, the pumping station shaft will be around the depth of 65 feet to

provide adequate submergence for the vertical turbine pumps and access to various reservoir levels. The initial capacity of the pumping station will be 2.2 Mgal/d, with provisions in the design to allow for expansion up to 2.75 Mgal/d to accommodate for future demands of the system. Upon completion and commissioning of the new intake and pumping station, the existing pumping station will be demolished as it is located where the new dam concrete chute spillway will be located.

- Dam Rehabilitation. Installation of a new reinforced-concrete spillway consisting of a labyrinth-crested weir and chute spillway over the existing earthen embankment to bring Beaver Creek Dam No. 1 into compliance with current Department of Conservation and Recreation (DCR) and Natural Resources Conservation Services (NRCS) requirements for high-hazard potential dams. The proposed chute spillway will incorporate the existing principal spillway conduit outfall. Reservoir releases to lower Beaver Creek will be through the existing principal spillway conduit.

- Principal Spillway Rise Modifications. The existing 10-inch by 10-inch sluice gates will be retrofitted with electric operators that will allow for remote opening of the gates to facilitate releases when the reservoir elevation drops below the riser's spillway. In addition, the reinforced concrete pipe conduit connecting the riser to the pump station will be partially demolished (along with the existing pump station) and integrated with the rehabilitated dam spillway design so that water is released into the dam spillway at an elevation of 497 feet before continuing into lower Beaver Creek.

- Raw Water Transmission Main. Approximately 3,800 feet of 24-inch raw water main will be installed from the new pumping station to the Crozet Water Treatment Plant. The raw water main will traverse a wooded upland area from the pumping station to Brown's Gap Turnpike. From Brown's Gap Turnpike to the Crozet WTP, the raw water main will be installed within existing roadway easements along the existing raw water main. The raw water main will traverse one jurisdictional intermittent stream, an unnamed tributary to Beaver Creek Reservoir. The raw water line will be attached to the bridge that will span the stream; therefore, the stream crossing will not result in impacts to the stream. No jurisdictional wetlands are in proximity to the raw water main corridor. Upon completion and commissioning of the new raw water main, the existing line will be abandoned in place.

- Road Crossing. A narrow intermittent stream, an unnamed tributary to Beaver Creek Reservoir, will be crossed by an approximately 12-foot wide, 450-foot long access road that will provide permanent access to the pump station from Brown's Gap Turnpike. The roadway crossing will be a precast concrete bridge that will span the stream. The bridge will be placed on concrete abutments on either side of the stream. No impacts to the stream are expected as a result of the installation of the road crossing.

Existing Water Supply System

RWSA owns and operates the existing Crozet Water Supply System, which provides potable water to the Community of Crozet and surrounding areas in Albemarle County, Virginia. The existing system includes an intake in Beaver Creek Reservoir, a pumping station, Beaver Creek Dam No. 1, Buck's Elbow Storage Tank (2 million gallon capacity), the Crozet WTP, and associated water lines.

Beaver Creek Reservoir was constructed in 1963 to provide water supply storage, flood storage, and sediment storage for the Crozet service area. Three main tributaries flow into the reservoir: Parrott Branch, Watts Branch, and Beaver Creek. Beaver Creek Dam No. 1 impounds approximately 568 million gallons (Mgal) of water below the principal spillway riser. The total reservoir storage at normal pool is approximately 1,700 acre-feet (554 Mgal), with a usable storage of approximately 1,500 acre-feet (489 Mgal) and the remaining 200 acre-feet (65 Mgal) as sediment storage.

Beaver Creek Dam No. 1 (Dam) is 60 feet in height. Water that is withdrawn by the rise is conveyed through the Dam via a 42-inch diameter reinforced-concrete pipe conduit. The conduit discharges into a concrete chamber adjacent to the pump station. Water in the concrete chamber is controlled by a downstream discharge weir and enters the pump station wet well via a series of wall openings. Excess water in the wet well that is not pumped to the Crozet WTP flows over the discharge weir and into lower Beaver Creek, ultimately converging with the Mechums River 1.8 miles downstream of the Dam.

The Crozet WTP treats raw water from the Beaver Creek Reservoir using flocculation, sedimentation, and filtration. The WTP was constructed in 1966 and has a Virginia Department of Health (VDH) permitted capacity of 1.0 Mgal/d. Construction work to expand the capacity of the Crozet WTP from 1 million gallons per day (Mgal/d) to 2.1 Mgal/d commenced in 2018 and was completed in 2021.

RWSA manages the system as a wholesaler to the Albemarle County Service Authority (ACSA). Under this wholesale agreement, RWSA collects, treats, and sells finished water to ACSA. The finished water is delivered from RWSA's supply system to the service area through existing water distribution lines. RWSA manages a portion of the distribution system (from the Crozet WTP leading to Buck's Elbow storage tank), with the remainder operated by ACSA. 90 percent of the water that is withdrawn is sold to ACSA, with the remaining ten percent used in the water treatment process.

5. Project Purpose & Need:

Purpose of Water Uses and Basis of Need

Pursuant to 9VAC25-210-360, the applicant shall demonstrate to the satisfaction of the Department that the project meets an established need for water to meet the project purpose. The project purpose is to upgrade and expand the existing surface water withdrawal system serving as the public water supply for the Community of Crozet and surrounding areas in Albemarle County, Virginia. Domestic public water supplies are an established offstream beneficial use for state waters as defined in §62.1-44.3 of the Code of Virginia.

Beaver Creek Dam No. 1 was originally classified as a Class (b) structure using Natural Resources Conservation Service (NRCS) classification criteria. A Class (b) structure was defined as a structure located in predominantly rural or agricultural areas where failure may damage isolated homes, main highways, minor railroads, or cause interruption of use or service of relatively important public utilities. NRCS hazard classification criteria have since been revised to designate Class (b) structures as "Significant Hazard Structures". In addition, Virginia Dam Safety regulations did not exist at the time the project was constructed, and recent dam breach inundation modeling indicated that the dam be reclassified as high hazard potential per current Virginia Department of Conservation and Recreation (DCR) guidelines. As Beaver Creek Dam No. 1 does not meet current DCR or NRCS requirements in regards to design, safety, and performance standards, rehabilitation is required to bring the Dam into compliance.

As demands for finished water have increased, there have been occasions where daily WTP production has approached the 1 Mgal/d Virginia Department of Health (VDH) permit limit. To address expectations of continued population growth in the Crozet service area, and in conjunction with rehabilitation of Beaver Creek Dam No. 1, RWSA proposes actions to expand and reinforce the Crozet Water Supply System to ensure and provide for the current and future drinking water needs of the community it serves.

The Crozet service area's residential population has been steadily increasing, growing from 2,753 in 2000 to nearly 7,000 in 2019. RWSA projects a linear population growth trend to continue through 2075 (See Table 1), with population projections at approximately 11,000 at the end of the 15-year permit term.

Table 1: Crozet Service Area Residential Population Projection Through 2075

Year	Residential Population Projection
2020	7,562
2025	8,539
2030	9,516
2035	10,493
2040	11,470
2045	12,447
2050	13,424
2055	13,995
2060	14,566
2065	15,137
2070	15,708
2075	16,279

Department staff reviewed population projections for the region, utilizing Weldon Cooper 2020 census data and Weldon Cooper population projections for 2030 through 2050 (See Table 2). Weldon Cooper shows a positive population growth trend from 2020 through 2050 for the City of Charlottesville and Albemarle County. Weldon Cooper does not analyze population at a community level.

Table 2: Weldon Cooper Population Growth Projections (2020-2050)

	Total Population			
	2020	**2030**	**2040**	**2050**
Albemarle County	112,395	124,016	138,523	155,102
City of Charlottesville	46,553	48,920	48,939	49,691
	Percent Growth			
	2020-2030		**2030-2040**	**2040-2050**
Albemarle County	10.3		11.6	11.9
City of Charlottesville	5.0		0.03	1.5

Water Need: Demand Projection

The Department permits water withdrawals to meet the justified water demands over the 15-year permit term. Staff evaluated the applicant's demand projections from the Joint Permit Application (JPA) and supplemental information provided.

A comprehensive demand analysis was developed for RWSA culminating in the 2019 Drinking Water Infrastructure Plan - Crozet Area (DWIP). The DWIP assessed demand projections for the Crozet service area through the year 2075. The foundation of the DWIP is a series of finished water demand projections based on historical planning documents, current zoning, and finished water production records and billing data from ACSA. Using the projected demands, the DWIP also identifies the phasing of infrastructure needed to meet the projected incremental increases in demand.

The average day demand for treated water was determined to be 0.513 Mgal/d in 2019, which served as the starting point for future growth curves projected in the DWIP. In-plant water use was estimated at approximately 10% of the treated water demand. Therefore, overall raw water demands were estimated by adding 10% to the treated water demand projections. The DWIP identified the peak day factor (maximum daily demand/average daily demand) as 1.68, based on the estimated 95th percentile highest peak day ratio derived from the analysis of 2006-2017 water withdrawal data.

Baseline demand forecasts were calculated as follows: unit treated water demands were multiplied by the changes in population and then added to the then current demands (0.513 Mgal/d) to project annual average water demands in future planning years. The average daily demand at each future planning year was multiplied by the maximum daily demand/average daily demand ratio to project future maximum daily treated water demands. To account for the range of plausible future finished water demand scenarios that could occur over the planning horizon, a series of alternative treated water demand forecasts were developed. Some of these alternative growth curves fell above and some fell below the baseline growth curve. Of these alternative scenarios, the recommended growth curve balances water industry trends, current Crozet billing data, and a level of conservatism that addresses the importance to a water system to meet its obligation to provide drinking water to its customers. Population and employment growth were assumed to be linear throughout the projection.

Based on the analysis, the raw water withdrawals required at the full build out (Year 2075) is an average daily withdrawal of 1.65 Mgal/d and a maximum daily withdrawal of 2.8 Mgal/d. Projected demands at the end of the 15-year permit term is an average daily withdrawal of 1.10 Mgal/d and a maximum daily withdrawal of 1.85 Mgal/d (See Table 3). For redundancy, RWSA proposes a maximum day of 2.2 Mgal/d to match the WTP capacity, including a buffer, and to allow the plant to occasionally shut down for maintenance while still meeting demands.

Table 3: Raw Water Demand Projections 2025-2040

	2025	**2030**	**2035**	**2040**
Average Day (Mgal/d)	0.77	0.88	0.99	1.10
Maximum Day (Mgal/d)	1.30	1.47	1.66	1.85

RWSA reports significant growth in annual finished water production over recent years, with water production increasing from 124 Mgal/year in 2007 to 217 Mgal/year in 2019. Department staff evaluated the applicant's projections and finished water production to recent historic reporting of raw water withdrawals (See Table 4). The reported 15 year (2008-2022) average annual withdrawal is 196 Mgal/year, with an average daily demand of 0.5 Mgal/d, which is consistent with RWSA's initial demand outlined in the joint permit application (JPA) and DWIP.

Table 4: Historical Annual Withdrawal Data from VAHydro

Reporting Year	Total Annual Withdrawal (million gallons/year)
2022	261.754
2021	284.313
2020	250.56
2019	239.373
2018	226.785
2017	213.273
2016	202.41
2015	167.038
2014	153.17
2013	157.576
2012	174.037
2011	156.8
2010	162.163
2009	147.544
2008	143.398
2007	137.612

Department staff evaluated the applicant's demand using the daily average volume of 1.10 Mgal/d projected for Year 2039.

- Average Daily: 1.10 x 1.05 = 1.15 Mgal/d
  - System losses (5 percent)
- Peak (maximum) day: 1.15 x 1.68 x 1.10 = 2.1 Mgal/d
  - Peak Day Factor (1.68) obtained from application.
  - VDH certification (10 percent capacity)
- Maximum Monthly: 1.15 x 1.7 x 1.10 x 31 = 66.66 million gallons (Mgal)
  - Peak Month Factor (1.7) obtained from historical records.
  - VDH certification (10 percent capacity)
- Maximum Annual: 1.15 x 366 = 420.9 Mgal

Note: The peak day factor (1.68) used was the same value used in the applicant's analysis of their demand. The peak month factor of 1.7 was calculated using the highest factor from the last fifteen years of the systems reported data for the existing facility.

The requested and calculated water demand volumes for the intake on the proposed reservoir are summarized in the below table:

Table 5: Requested and Calculated Water Demand Volumes

	JPA Water Demand Volumes for Year 2039	Staff Calculated Demand Volumes	Recommended Withdrawal Limits
Average Daily Volume (Mgal/d)	1.10	1.15	N/A
Peak Day Volume (Mgal/d)	1.85	2.10	2.2
Maximum Monthly Volume (Mgal)	39	66	66
Maximum Annual Volume (Mgal)	420.3	420.9	420

The volumes in the recommended withdrawal limits column based on the permit term will be used as the water need used to set limits in the permit.

6. Alternatives Evaluated to Meet the Water Need (Least Environmentally Damaging Practicable Alternative):

Pursuant to 9VAC25-210-360 3 C, the applicant is required to evaluate each alternative for the purpose of establishing the least environmentally damaging practicable alternative. The applicant considered the following alternatives as part of their application:

1. Permit increased withdrawals from the existing Beaver Creek Reservoir/construct new intake, pumping station, and transmission main.
2. Raise Beaver Creek Reservoir Dam to increase storage capacity.
3. Transfer water from Sugar Hollow Reservoir to Beaver Creek Reservoir.
4. Connect to the Charlottesville Urban Water System.
5. Develop groundwater wells.
6. Divert water from Lake Albemarle.
7. Build a new reservoir in an alternate location.
8. Demand conservation.

The initial criteria used by RWSA to evaluate the alternatives above included, but was not limited to, the ability to meet the raw water capacity and dam safety requirements, practicality of implementation, and the identification of environmental of community impacts. Alternatives that best met those criteria were identified as preferred actions and moved on to the second step of the selection process. In the second step, the following additional criteria were used to evaluate the remaining alternatives: location and/or layout, relative constructability, cost, and actions that prioritized avoidance and minimization of environmental and community impacts.

Based on the evaluation, Alternative 1: increased withdrawals from the existing Beaver Creek Reservoir and construction of a new intake, pumping station, and raw water transmission main were identified as the preferred alternative. This alternative meets the project's water supply requirements, is the least

environmentally damaging, presents the fewest impacts to the community, and is in accordance with Albemarle County's Comprehensive Plan goals of good residential expansion.

Once the preferred alternative was identified, a detailed site selection analysis was conducted to quantify impacts and finalize the project's location and limits of disturbance. Six potential sites around the perimeter of Beaver Creek Reservoir were selected as potential locations for the new raw water pump station and intake. Because the pump station infrastructure must be separated from the principal spillway riser and conduit to incorporate measurement and control for MIF releases to Beaver Creek, expanding the existing pumping station was not considered. In addition, the dam rehabilitation involves constructing the spillway through the earthen embankment and necessitates relocation of the existing pump station infrastructure. Additional requirements were developed to ensure the final pump station footprint would be fully contained within Albemarle County-owned property and an analysis of environmental impacts associated with each alternative site was developed. The following criteria was used to assess each site:

- Access to existing roads and construction requirements for new access roads
- Overall topography and presence of adjacent steep slopes
- Overall space for construction of pump station relative to the current location
- Minimization of environmental impacts
- Need to acquire permanent easements
- Constructability
- Cost

Based on the evaluation, the selected site is located on the south end of Beaver Creek Reservoir, between Beaver Creek Dam No. 1 and the southernmost tributary to the reservoir. The selected site avoids and minimizes impacts to surface waters to the best extent possible.

7. Evaluating Water Withdrawal Volumes Based on Beneficial Use Impacts and Flow-by/Release Requirements:

§ 62.1- 11 E establishes that the "right to the use of water or to the flow of water in or from any natural stream, lake or other watercourse in this Commonwealth is and shall be limited to such water as may reasonably be required for the beneficial use of the public to be served." The Department is directed by § 62.1-44.15:22 to establish limits that preserve instream flow "to the volume of water that may be withdrawn as a part of the permitted activity and conditions necessary to protect beneficial uses." Pursuant to 9VAC25-210-370 B 3, the Department shall take into consideration the combined effect on the hydrologic regime of the surface water within an affected stream reach due to consumptive water uses in the development of instream flow conditions for new withdrawals. Further, 9VAC25-210-370 D 1 requires a determination that the amount of the surface water withdrawal is limited to the amount of water that can be put to beneficial use.

<u>Department Recommended Withdrawal Limitations</u>

The permit limits surface water withdrawals to the volume justified based upon the application materials submitted and staff modeling analyses. Staff concluded that the water demand and statement of need is reasonable and has been adequately justified by the application through the information submitted in the VWP permit application process. Based upon this information, the permit proposes the following limits on the withdrawal volumes:

- Maximum Daily: 2.2 Mgal/d
- Maximum Monthly: 66 Mgal
- Maximum Annual: 420 Mgal

Based on the material provided in the JPA, as supplemented by the applicant, and the applicable permit term for the proposed withdrawal to be put to beneficial use, staff have determined the proposed withdrawal volumes for the project, as limited in the draft permit, complies with applicable standards identified in 9VAC25-210-370 D 1.

Return Flow / Consumptive Use

Water withdrawn from Beaver Creek Reservoir is treated at the Crozet WTP and distributed to the service area or used in WTP processes. Water distributed to customers and the WTP is transferred to Moore's Creek Wastewater Treatment Plant (WWTP), which discharges into Moore's Creek.

Consumptive use was determined assuming 0.27 Mgal/d is being distributed to customers with sewered connections and then outdoor use, with 0.08 Mgal/d distributed to septic-only customers. Return flows were determined assuming 0.11 Mgal/d is used in the water treatment process and then sent to Moore's Creek WWTP, with 0.64 Mgal/d distributed to customers with sewered connections and then sent to Moore's Creek WWTP. Based on the average daily withdrawal of 1.1 Mgal/d, total consumptive use is estimated to be 0.35 Mgal/d with total return flows estimated at 0.75 Mgal/d.

Cumulative Impact Analysis

A cumulative impact analysis was conducted by staff on the withdrawal volumes requested, minimum instream flows, the current water supply system, and cumulative impacts to existing beneficial uses and existing water users. Based upon the results of the analysis, staff determined the proposed project as limited in the draft permit, will protect existing beneficial uses while meeting the applicant's purpose and need.

The staff modeling analysis is attached (Attachment A).

Flow-by and Inflow Release Requirements

RWSA proposes to implement a minimum instream flow (MIF) protocol in order to ensure adequate downstream flows in Beaver Creek while also serving the project's purpose as a public water supply. The proposed MIF protocol is a tiered structure where the release flow rate is a function of the streamflow measured at the downstream USGS Mechums River gage (Gage No. #02031000) and reservoir storage. RWSA developed the following (Table 6) MIF after multiple discussions and meetings with the Department and feedback from the Virginia Department of Wildlife Resources (DWR) from 2017-2020:

Table 6: RWSA Proposed Minimum Instream Flow Protocol

Tier	**Mechums Gage Discharge**	**Downstream Release (MIF)***	**Reservoir Storage**
1	$\geq$ 66 cfs	30% of inflow	$\geq$ 80%
2	< 66 cfs	50% of inflow	$\geq$ 80%

3	< 32 cfs	90% of inflow	≥ 80%
4	< 17 cfs	100% of inflow	≥ 80%
Low storage	Any	30% of inflow	< 80%

The proposed MIF would be implemented during times when the reservoir level is below the normal/full pool level and water is no longer spilling over the principal spillway riser. The MIF protocol has a maximum release of 1.55 cfs (1 Mgal/d) and an absolute minimum release of 0.1 cfs. When reservoir storage drops below 80%, the release rate is set to 30% of inflow to preserve system storage.

Through the modeling analysis conducted by Department staff (See Attachment A), the RWSA proposed MIF above is not recommended. Modeling staff determined that the proposed MIF provides more than 200 days of storage remaining during the most extreme drought simulated. The trigger that reduces MIF to 30% of inflow whenever storage drops below 80% is too sensitive, triggering nearly one (1) out of four (4) years of the simulation. This would result in large reductions in the percentage of flow in Beaver Creek under low flow conditions, with over 60% flow reduction during drought emergency conditions (when flows are below the 5th percentile). The goals of the original tiered framework are over-ridden by this storage remaining trigger; therefore, staff found the proposed storage remaining and instream flows to be poorly balanced.

For the purposes of this evaluation, it will be assumed that the Mechum's River gage flow reading, multiplied by 0.1 will provide a reasonable estimate of Beaver Creek reservoir inflow. Since actual inflows to Beaver Creek are historically unknown and difficult to estimate from recorded data, it is recommended that the permit include the establishment of an upstream inflow gage, or robust procedure for estimating inflows from withdrawals, releases, and recorded reservoir elevation levels (See Special Condition Part I D 8).

The objective of the modeling analysis is to develop permit rules that can ensure both off stream demands and downstream beneficial uses at all times. Modeling staff recommends utilizing a tiered maximum release based on inflow with a recharge trigger to vary maximum releases (See Table 7). This will serve to anticipate summer conditions where inflows may drop precipitously and, by lowering the maximum release, the reservoir can recover storage more effectively during small storm events, ensuring that the reservoir stays full farther into the summer, and maintaining a higher level of storage remaining at the end of a drought period. Under the Department recommended release schedule (Table 7), RWSA must release a minimum of 90% of inflow at all times, not to exceed the maximum required release. The maximum required release is calculated each year on March 1st and applies until March 1st of the following year.

Table 7: Department Recommended Release Schedule

Mechum's River Mean Flow (cfs) November 1st – March 1st	**Percent (%) of Inflow Release Required**	**Maximum Required Release from Beaver Creek Reservoir (cfs)**
0 - 19	90	1.5
20 - 29	90	1.9
30 - 59	90	2.3
60+	90	3.1

For the full modeling analysis, see Attachment A: Department Modeling Summary.

Determination of Safe Yield

RWSA conducted a safe yield analysis of Beaver Creek Reservoir utilizing a variety of operating and physical assumptions. For all scenarios assessed, the critical drought was based on 2001-2002 hydrology. RWSA's analysis demonstrates that Beaver Creek Reservoir has a sufficient capacity to supply a 1.65 Mgal/d safe yield under the proposed MIF protocol with a 60-day reserve storage. This safe yield is sufficient to meet the initial and projected annual average daily demands of the system through 2075.

8. Water Supply Plan Review:

The Department is required by § 62.1-44.15:20 C to give full consideration to any relevant information contained in the state water supply plan described in Subsection A of § 62.1-44.38:1. The regional water supply plan used was developed in accordance with the Water Supply Planning Regulation 9VAC25-780. These plans provided the basis of the staff review of the proposed project.

The Crozet System is included in the Regional Water Supply Plan for Albemarle County, City of Charlottesville, and Town of Scottsville (2011). Water Supply Plan demand projections for the facility were included in the Plan and could be considered in the evaluation of the permit request. The Water Supply Plan states that existing sources for the facility were projected to meet demands through 2060.

9. Surface Water Impacts:

This permit authorizes the total impact of 0.36 acres of surface waters, consisting of 0.15 acres of permanent impacts and 0.21 acres of temporary impacts. Permanent impacts are to 0.07 acre of open water and 0.08 acre (275 linear feet) of stream channel. Temporary impacts are to 0.18 acre of open water, and 0.03 acre (35 linear feet) of stream channel.

Water quality impacts are expected to be temporary and minimal provided the permittee abides by the conditions of the permit. A loss of state waters shall occur. However, the impacts have been avoided and minimized to the greatest extent practicable.

10. Compensation for Unavoidable Impacts:

No compensation is required for this project as the permanent wetland impacts are less than 0.1 acre, and permanent stream impacts are less than 300 linear feet. Temporary impacts will be restored to preconstruction conditions and require no compensation.

11. Site Inspection:

A site inspection by Department staff was conducted on January 24, 2024 for a State Surface Waters Determination by the Department. No discrepancies were found between the site and the submitted application.

12. Relevant Regulatory Agency Comments:

As required by § 62.1-44.15:20 C and the Joint Permit Application review process, the Department consulted the appropriate state regulatory agencies and coordinated with various federal regulatory agencies. Agencies may submit written comments on proposed permits within 45 days after notification

by the Department. Any written agency comments received were given full consideration and addressed in the VWP individual permit Part I - Special Conditions.

Summary of State Agency Comments and Actions

By email dated August 11, 2023, comments were requested from the following state agencies: Virginia Department of Wildlife Resources (DWR), Virginia Department of Conservation and Recreation (DCR), Virginia Marine Resources Commission (VMRC), the Department of Historical Resources (DHR), and the Virginia Department of Health (VDH). Failure to provide comments within 45 calendar days of the Department request for comments infers that the agency has no comments on the project activities. Comments were not received from VDH, DWR, or DHR.

VMRC

VMRC provided comments in a letter dated September 14, 2023. The comments are summarized below:

- VMRC received the applicant's Joint Permit Application (JPA) on October 2, 2022.
- After completion of the JPA review process, a No Permit Necessary determination was issued by VMRC on July 7, 2023, given the addition of Section 28.2-1203(A)9 to the Code of Virginia (due to the passage of SB 1811 and HB2181) by the General Assembly, and per the Memorandum of Agreement recently created and signed by VMRC and DEQ.
- VMRC will no longer require permits for the proposed use of non-tidal state-owned submerged lands when in-stream impacts are necessary for the project's installation or construction.
- VMRC, pursuant to §28.2-1200 et seq of the Code of Virginia, has jurisdiction over encroachments in, on, or over the beds of bays, oceans, rivers, streams, or creeks which are the property of the Commonwealth.
- If any portion of the subject project involves any encroachments channelward of ordinary high water along non-tidal, natural rivers and streams with a drainage area greater than 5-square miles, a permit may be required from VMRC or DEQ.
- Any jurisdictional impacts will be reviewed by the VMRC during the JPA process.
- Should the proposed project change, a new review by this agency may be required relative to these jurisdictional areas.

DCR

DCR provided comments in a memorandum dated and received September 14, 2023. The comments are summarized below:

- DCR searched its Biotics Data System for occurrences of natural resources from the area outlined on the submitted map. Natural heritage resources are defined as the habitat of rare, threatened, or

endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations.

- According to the information currently in Biotics, natural heritage resources have not been documented within the submitted project boundary including a 100-foot buffer.

- The absence of data may indicate that the project area has not been surveyed, rather than confirm that the area lacks natural heritage resources.

- The project boundary does not intersect any of the predictive models identifying potential habitat for natural heritage resources.

- Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and the DCR, DCR represents VDACS in comments regarding potential impacts on state listed threatened and endangered plant and insect species. The current activity will not affect any documented state listed plants or insects.

- There are no State Natural Area Preserves under DCR's jurisdiction in the project vicinity.

- The Virginia Department of Wildlife Resources (DWR) maintains a database of wildlife locations, including threatened and endangered species, trout streams, and anadromous fish waters that may contain information not documented in this letter. Their database can be accessed at https://services.dwr.virginia.gov/fwis/.

Summary of Federal Agency Comments and Actions

By email dated August 11 2023, comments were requested from the following federal agencies: the U.S. Army Corps of Engineers (USACE), the Fish and Wildlife Service (FWS), and the Environmental Protection Agency (EPA), and the U.S. Department of Agriculture (USDA). Comments were not received from USACE, FWS, or USDA.

EPA

EPA provided comments in an email dated and received September 25, 2023. The comments are summarized below:

- Consistent with Nationwide Permit 58, which states that "compensatory mitigation at a minimum of one-for-one ratio will be required for all losses of stream bed that exceed 3/100-acre and require pre-construction notification," EPA recommends providing compensatory mitigation for permanent impacts proposed to 120 linear feet (0.06 acre) of Beaver Creek.

- Or providing additional information to justify why either some other form of mitigation would be more environmentally appropriate, or the adverse effects of the proposed activity are no more than minimal.

Staff Actions/Responses are summarized below:

- *For a surface water withdrawal VWP permit through the Department, no compensation is required for this project as the permanent wetland impacts are less than 0.1 acre, and permanent stream impacts are less than 300 linear feet.*

- *Special Condition F 7 requires the permittee to submit a plan for the re-routed stream, ensuring the new stream location will be of comparable value as documented on the USM for the existing stream prior to relocation.*

13. Public Involvement during Application Process:

Pre-Application

Prior to the submittal of the JPA, a pre-application meeting was held on November 29, 2017. In addition, RWSA and the Department convened a pre-application review panel to receive comments on the proposed project from stakeholder agencies. The panel meeting was held on March 12, 2019. Representatives from the Virginia Marine Resources Commission (VMRC), the Department of Wildlife Resources (DWR), the Virginia Department of Health (VDH), and the Virginia Department of Historic Resources were invited to attend.

A pre-application public notice was not required, as the project outlined in this application is neither a new or expanded project proposing to withdraw 90 million gallons or more a month and complies with applicable standards identified in with 9VAC25-210-320 B.

Riparian Landowner Notification

Staff notified riparian landowners located adjacent to the impact area and within one-half mile downstream of each distinct impact area by letter dated August 9, 2023.

Local Government Notification

Staff notified the Albemarle County Administrator of the joint permit application by letter dated August 9, 2023.

Tribal Nation Notification

Staff notified Tribal Nations of the joint permit application by letter dated August 9, 2023.

Public Meetings

RWSA held multiple public meetings (June 2018, December 2020, and October 6, 2021) in the planning phase of the project to allow the public opportunities to provide comments and questions regarding the proposed project and address community concerns. In addition, RWSA regularly holds board meetings in which the public is invited to attend and given the opportunity to provide comments.

14. Public Comments received during Comment Period: AND/OR
14. Changes in Permit Part I - Special Conditions Due to Public Comments:

The public notice was published in [Name of Newspaper and Date Published] on XXX. The public comment period ran from XXX to XXX.

[No public comments were received during the public comment period. Therefore, no changes have been made to the permit conditions.]

15. Special Conditions:

The following conditions were developed to protect instream beneficial uses, to ensure compliance with applicable water quality standards, to prevent significant impairment of state waters or fish and wildlife resources, and to provide for no net loss of wetland acreage and function through compensatory mitigation and success monitoring and reporting.

Section A Authorized Activities

No. 1 addresses the activities authorized by this permit, including impact types and limits.
No. 2 states that the authorized activities shall be conducted in accordance with the application materials and any subsequent materials received during the application process.
No. 3 authorizes the temporary use of mechanical equipment in surface waters.
No. 4 requires the applicant to notify the Department of any changes to the authorized activities or of new activities which require a VWP permit.

Section B Permit Term

Nos. 1 and 2 addresses the permit term and re-issuance process to ensure that all permit conditions are completed.

Section C Standard Project Conditions

No. 1 requires that the permittee adhere to time-of-year restrictions recommended by the Department of Wildlife Resources or the Department of Conservation and Recreation for the protection of fish and wildlife resources.
No. 2 addresses the requirement for the minimization of adverse impacts to beneficial uses.
No. 3 ensures that the project will be executed in a manner that limits the disruption of the movement of aquatic life.
No. 4 ensures that downstream flows will be maintained to protect both instream and off-stream beneficial uses.
No. 5 ensures the minimization of adverse effects on navigation.
No. 6 ensures the passage of high flows.
Nos. 7 through 11 set forth reporting requirements as required by current law and regulations.
No. 12 prohibits the violation of Water Quality Standards in surface waters as a result of project activities.
No. 13 ensures that dredging and filling operations will minimize stream bottom disturbances and turbidity.
No. 14 requires instream activities to be conducted during low-flow conditions to protect instream beneficial uses.
No. 15 requires erosion and sediment controls to be designed in accordance with the Virginia Erosion and Sediment Control Handbook, Third Edition, 1992.

Nos. 16 through 18 provide requirements and limitations on the entry of various materials (including concrete, fill, construction and waste material, fuels, lubricants, and untreated stormwater runoff) into state waters.
Nos. 19 and 20 limit the use of machinery and equipment in surface waters to protect beneficial uses.
Nos. 21 through 24 require temporary disturbances to surface waters during construction to be avoided and minimized to the maximum extent practicable and the restoration of such temporary disturbances.
No. 25 requires that temporary in-stream construction features be made of non-erodible materials.
No. 26 requires the identification of all non-impacted surface waters in the vicinity of the proposed activity to prevent unpermitted impacts.
No. 27 requires the permittee to submit a summary of all necessary permits required for construction prior to the commencement of any construction activities.

Section D Surface Water Withdrawals

No. 1 states the use of the water withdrawal is for a public water supply.
No. 2 establishes the water withdrawal limits for the intake on Beaver Creek Reservoir.
No. 3 requires the permittee to install intake screens with openings no larger than 1 millimeter and a maximum velocity of 0.25 fps.
No. 4 states the method that should be used to determine inflow to the reservoir.
No. 5 establishes the required release from the Reservoir during construction activities requiring drawdown of the Reservoir.
No. 6 establishes the required release from the Reservoir following completion of construction.
No. 7 establishes the maximum release from Beaver Creek Reservoir, to be calculated each year on March 1st.
No. 8 requires the permitee the permittee to submit a plan detailing how the permitee will estimate inflow in the Beaver Creek Reservoir.
No. 9 requires the permittee to submit a plan for conducting an evaluation of existing and future demands and all potential water sources available to the permittee.
No. 10 requires the permittee to submit a Drought Management Plan for Department review and approval.
No. 11 requires conservation measures to protect instream flows during drought events.

Section E Water Withdrawal Monitoring, Recordation, and Reporting Conditions

No. 1 requires the permittee to submit a Monitoring and Operations Plan to the Department for review and approval.
Nos. 2 and 3 requires the daily monitoring and recording of water withdrawal activities to ensure compliance with the withdrawal limitations.
No. 4 requires the daily monitoring and recording of reservoir releases.
No. 5 requires the permittee to report any withdrawal not in compliance with permit conditions by the fifth (5th) day of the month following the month in which the withdrawal or release occurred.
No. 6 requires the permittee to submit a water withdrawal monitoring report to the Department semi-annually.
No. 7 states that the monitoring and reporting activities shall comply with the permit. Any records shall be retained for the life of the permit and potentially longer due to any unresolved litigation.

Section F Stream Modifications, Including Intake/Outfall Structures

No. 1 prohibits the use of stream substrate for erosion control to avoid additional impacts to state waters.

No. 2 requires upland disposal of material removed from stream substrate to avoid unpermitted impacts to surface waters.
No. 3 ensures riprap placement conforms to current law and regulation.
Nos. 4 and 5 direct the placement and contents of materials for the construction of submerged structures, and on-bank storage and staging of materials, to protect water quality and fish and wildlife resources.
No. 6 addresses the requirements for stream channelization or relocation to avoid additional impacts to state waters.
No. 7 requires the permittee to submit a stream relocation design plan for Department review and approval.

Section G Installation of Utilities

No. 1 requires the minimization of disturbance to surface waters and restoration to preconstruction conditions following utility line installation.
No. 2 sets a 90-day time limit for temporary side casting during trench excavation to minimize impacts to surface waters.
No. 3 provides the requirements for trench construction to avoid the drainage of surface waters.

Section H Road Crossings

No. 1 provides specifications for access road construction to minimize adverse effects to surface waters.
No. 2 ensures pipes and culvert construction is conducted in the dry to protect water quality and wildlife habitat.
No. 3 requires that temporary impacts be restored immediately following construction to minimize impacts to water quality and fish and wildlife resources.
No. 4 requires measurement of stream bottom elevations at road crossings to ensure for the re-establishment of a natural stream bottom and low flow channel to maintain instream beneficial uses.
No. 5 summarizes requirements for pipe and culvert placement and countersinking to provide for the re-establishment of a natural stream bottom and low flow channel to maintain instream beneficial uses.
No. 6 summarizes the requirements for stream channelization or relocation activities to protect instream beneficial use.

Section I Stormwater Management Facilities

No. 1 defines the general requirements for stormwater management facility construction to minimize adverse effects to aquatic resources and provide for long-term aquatic resources protection and enhancement.
No. 2 provides limits and guidance for maintenance excavation to avoid unpermitted impacts to surface waters.
No. 3 requires correct draining methods to minimize sedimentation of surface waters.

Section J Project Construction Monitoring and Submittals (Impact Sites)

Nos. 1 through 6 addresses monitoring, submittals and notifications required for monitoring construction activities within authorized impact areas.

16. General Conditions:

General Conditions are applied to all VWP individual permits, as stated in the VWP Permit Program regulation.

17. General Standard:

This project may result in minimal, temporary impacts to beneficial uses related to the propagation and growth of aquatic life as defined in the General Standard. Provided the permittee abides by the conditions of the permit, no substances shall enter state waters in concentrations, amounts or combinations that would contravene established standards or interfere with beneficial uses or are inimical or harmful to human, animal, plant, or aquatic life.

18. Staff Findings and Recommendations:

- The proposed activity is consistent with the provisions of the Clean Water Act and State Water Control Law and will protect beneficial uses.
- The amount of the surface water withdrawal is limited to the amount of water that can be put to beneficial use.
- The proposed permit addresses avoidance and minimization of surface water impacts to the maximum extent practicable.
- Based on the size and location of the surface water withdrawal, the withdrawal is not likely to have a detrimental impact on existing instream or offstream uses.
- The effect of the impact will not cause or contribute to a significant impairment of state waters or fish and wildlife resources; adverse impacts on other existing beneficial users; or a violation of water quality standards.
- The proposed permit conditions address no net loss of wetland acreage and function through compensatory mitigation.
- This permit is proposed to prevent unpermitted impacts.
- The draft permit reflects the required consultation with and full consideration of the written recommendations of VMRC, VDH, VDACS, DCR and DWR.

Staff recommends VWP Individual Permit Number 22-2318 be issued as proposed.

Attachment A: Department Modeling Summary

Technical Evaluation – Beaver Creek Reservoir VWP 22-2318

09/26/2023

1.1. Project Introduction

The Crozet Water Supply System includes the Beaver Creek Reservoir, and the Beaver Creek Dam located at 1525 Browns Gap Turnpike in Crozet, Virginia. The Crozet Water Treatment Plant (WTP) is located approximately a mile away at 4673 Three Notch'd Road in Crozet, Virginia.

1.2. Location Map

No location map available for this facility model

2. Model Overview and Scenario Descriptions

River Model Description River segment model overview not provided.

Facility & Intake Model Description The Beaver Creek Reservoir (BCR) is simulated as a reservoir receiving direct stream inflow from Beaver Creek, with a drainage area of 9.52 square miles. The model simulates withdrawals according to historical monthly use patterns, and reservoir releases according to existing conditions (no mandatory minimum instream flows), and under proposed VWP permit operational rules. Flow alterations due to the operation of BCR impact flows immediately downstream of the dam, covering a stretch of Beaver Creek that is approximately 2.0 miles long, before it joins with Mechum's River. While the most obvious effects of BCR operations are exhibited in the portion of Beaver Creek below the dam, Mechum's River can be impacted to a noticeable extent during drought flows, since Beaver Creek watershed makes up just under 10% of the Mechum's River watershed above USGS gage 02031000. For example, if flows from Beaver Creek dam were restricted to 50% of inflow into the reservoir, downstream flow in Mechum's River would be decreased by approximately 5%, which during an extreme drought event could have a significant impact on downstream beneficial uses. As part of the larger Rivanna Water and Sewer Authority, wastewater from the Crozet system is discharged far down stream at the Moore's Creek WWTP, and thus, flows in Mechum's River are not influenced by wastewater return from the Beaver Creek reservoir project.

Evidence gathered during permit development suggests that the use of Mechum's River as a surrogate inflow gage can have limitations, especially during drought periods. The VAHydro rainfall-runoff model in this area provides a robust simulation of mean flow conditions, and an average 90-day low flow error of less than 20%, however, VAHydro simulated considerably more 90-day low flow during the 2002 drought than was observed at the Mechum's River USGS gage. Therefore, in this technical evaluation we will aim for >= 100 days remaining storage at the end of the drought period to ensure a greater margin of safety. Since actual inflows to Beaver Creek are historically unknown and difficult to estimate from recorded data, it is recommended that this permit include the establishment of an upstream inflow gage, or robust procedure for estimating inflows from withdrawals, releases and recorded reservoir elevation levels.

Several scenarios presented in this analysis make use of "Recharge Triggers" to limit the maximum release from 1.0-2.0 mgd depending on the amount of estimated winter recharge. Winter recharge is estimated as a function of mean inflow from November 1st to February 28/29. Recharge triggers were selected to coincide roughly with Virginia Drought Management Task Force thresholds which are the 5% 10% and 25% non-exceedance values. This results in the following a maximum release that varies from 1.0 to 3.0 mgd depending on recharge flows (see table 2.1.1 below) when recharge inflows are greater than 6 cfs (~60 cfs at Mechums gage) maximum release is 3.0 cfs, release is reduced to 1.5 mgd when recharge inflow is between 3-6 cfs, and maximum release is 1.0 mgd when recharge inflow is less than 3 cfs.

2.1.1. Maximum Required Release Triggers Based on Recharge

Flow at Mechums/BC	Maximum Release (mgd / cfs)
0 / 0	1.0 / 1.547
20 / 2.0	1.25 / 1.8564
30 / 3.0	1.5 / 2.3205
60 / 6.0	2.0 / 3.094

These triggers resulted in the distribution of maximum releases in table 2.1.2 based on inflow to the Beaver Creek reservoir from 1984-2020, where a maximum release of 2.0 mgd/3.09 cfs is maintained during 75% of the simulation corresponding to times of robust winter flows and are reduced only in years after dry winters have occurred. This serves to anticipate summer conditions where inflows may drop precipitously, and by lowering the maximum release the reservoir can recover storage more effectively during small storm events, ensuring that the reservoir stays full further into the summer, and maintaining a higher level of storage remaining at the end of the drought period.

2.1.2. Frequency Distribution of Simulated Maximum Releases Based on Recharge Triggers

	0%	1%	5%	10%	25%	50%	90%	100%
Mean Flow Nov-Feb (recharge flow)	0.34	1.06	1.81	3.29	5.76	9.46	21.15	61.85
Maximum Required Release	1.55	1.55	1.55	2.32	2.32	3.09	3.09	3.09

Note, while the applicant has requested a condition that specifies that the "… proposed MIF would be implemented during times when the reservoir level is below the normal/full pool level and water is no longer spilling over the principal spillway riser.". This approach is *not* modeled in this analysis, nor is it recommended as a permit operational rule, since the objective is to develop permit rules that can insure both off stream demands, and downstream beneficial uses at all times. This type of management schema would result in outflow from the reservoir to be roughly equal to inflow minus withdrawal when the reservoir is full, which leaves the very real possibility that negligible flows might leave the dam under conditions when the reservoir is full, but inflows are only a small amount greater than demands. Since the objective of the model scenarios is to develop permit rules that can ensure sustained withdrawal from Beaver Creek reservoir, and maintenance of flows for downstream beneficial uses, these models simulate permit rules which ensure that MIFs are met at all times.

The following model scenarios were simulated in order to determine the most effective means of meeting the project need and all other in-stream beneficial uses:

- **Current Conditions, 0.69 MGD, No Required Minimum Instream Flow.** (Current 0.0 MIF) - This scenario models the current condition in the system,

with an average 252 mgy (0.69 mgd) demand, and no required minimum instream flow (MIF) release.

- **Inflow-Tiered release w/30% MIF When Less Than 80% Storage** (Tiered Release w/Q30 < 80% Storage) - This scenario shows the outcomes associated with a 420 mgy/1.15 mgd average demand, with a tiered minimum instream flow that prioritizes greater releases during dry conditions, with the exception of times of reservoir storage drawdown greater than 20%. When reservoir remaining storage is above 80%, releases range from 30% to 100% of estimated project inflow depending on inflow levels, but releases are reduced to 30% of inflow at any time that storage drops below 80%.

- **Tiered Release Based on Inflows w/Recharge Trigger to Vary Maximum Release** (Tiered Release w/Recharge Trigger) - This scenario simulates an annual demand of 420 MGY (1.15 mgd), and uses a set of 3-tiered percent of inflow releases, which emphasize greater percent releases during drought periods, coupled with a maximum release rate that varies from 1.0-2.0 mgd depending on the amount of estimated winter recharge (for more information see section 2 “Model Overview and Scenario Descriptions”. Winter recharge rules succeed in anticipated summer conditions when inflows may drop precipitously and lowers the maximum release in order to allow the reservoir to recover storage during small storm events, ensuring that the reservoir stays full further into the summer, and the maintains a higher level of storage remaining at the end of the drought period.

- **Current Demands (0.69 mgd) with Recharge-Tiered MIF** (0.69 mgd w/Recharge Tiered) - This scenario simulates current demand with the same MIF schema as the proposed scenario with tiered releases and a max release that changes as a function of winter recharge flow. It shows the likely outcomes of the permit in the near term, and in the event that future water demand growth is less than projected. This scenario provides an excellent starting point to make comparisons to other proposed future scenarios; however, it should be noted that because this permit is yet to be issued, this scenario only represents conditions that will exist in the near future after permit issuance.

2.2. Table of Modeled Demand Limits:

Description	Current 0.0 MIF	Tiered Release w/Q30 < 80% Storage	Tiered Release w/Recharge Trigger	0.69 mgd w/Recharge Tiered
Average Daily Volume (MGD)	1.00	1.15	1.15	0.69
Peak Day Volume (MGD)	2.30	2.80	2.80	NA
Maximum Annual Volume (MG)	365.00	420.30	420.30	NA

Historical Intake Flows and Drought Flow Indicators

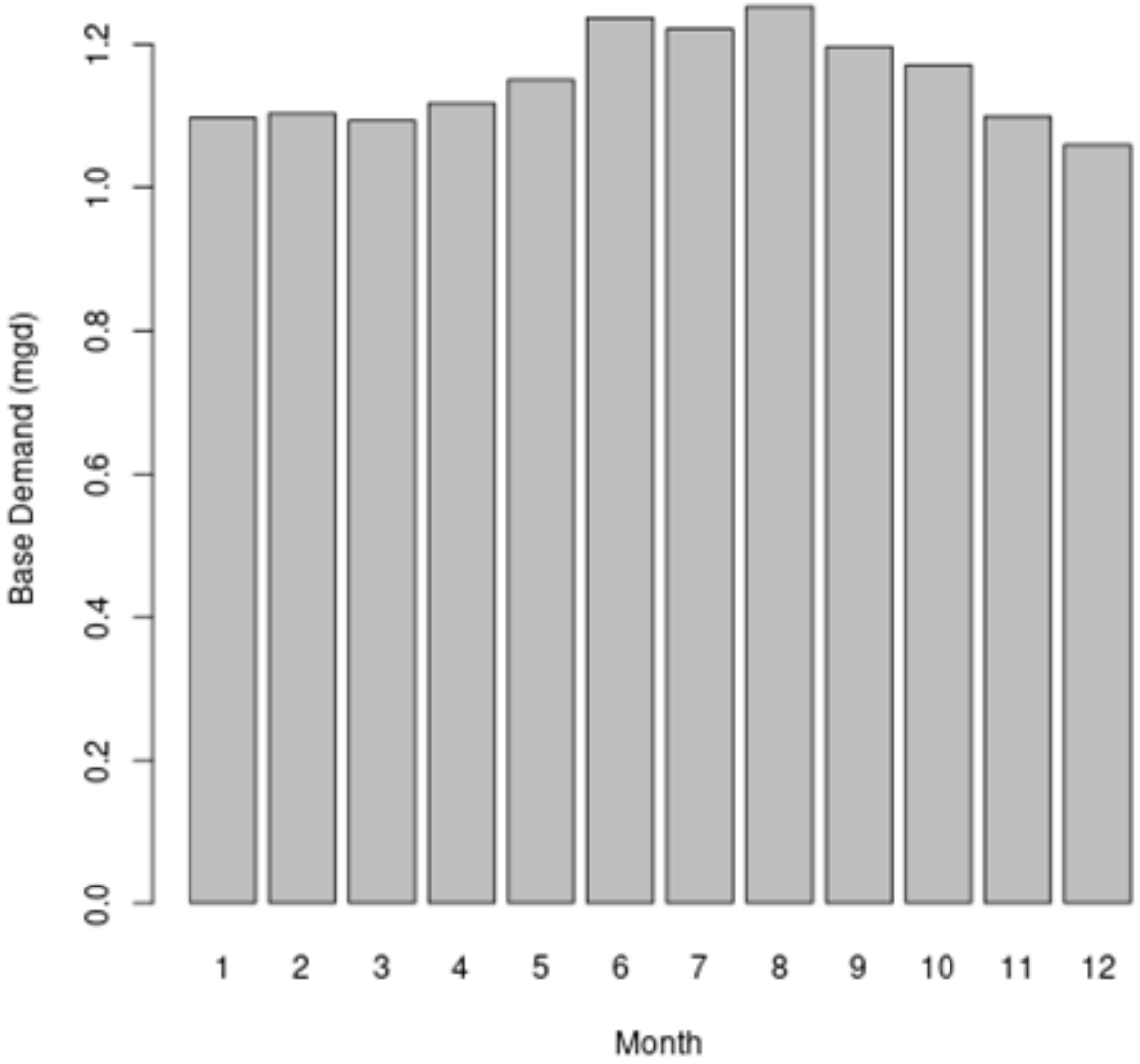
The VAHydro model is used to estimate flows at the project intake, including the impact of all cumulative withdrawals and discharges upstream of the intake location and are presented in Table 1. The Virginia Drought Assessment and Response Plan[1] employs non-exceedance flow percentiles as indicators of drought conditions at particular stream-gaging stations used to monitor drought conditions. Representative daily stream flows above the 25th percentile for return flow frequency represent normal conditions with respect to drought. Representative daily stream flows between the 10th and 25th percentiles represent drought watch conditions. Representative daily stream flows between the 5th and 10th percentiles represent drought warning conditions. Representative daily stream flows below the 5th percentile indicate drought emergency conditions.

Month	Min	5%	10%	25%	30%	50%	Mean
Jan	0.2	1.7	2.3	4.3	5.1	8.5	11.8
Feb	0.8	2.5	3.5	5.6	6.1	9.0	12.9
Mar	0.7	2.3	3.1	5.6	6.4	9.9	14.3
Apr	0.9	2.4	3.1	5.0	5.6	7.9	12.0
May	1.5	2.6	3.3	4.7	5.1	7.3	10.7
Jun	0.6	1.5	2.0	3.6	4.0	5.4	7.4
Jul	0.5	1.1	1.5	2.2	2.4	3.4	4.8
Aug	0.4	0.9	1.2	1.8	2.1	3.0	4.1
Sep	0.2	0.7	0.9	1.5	1.7	2.8	7.0
Oct	0.1	0.6	1.0	1.8	2.1	4.0	7.0
Nov	0.1	0.7	1.0	2.3	2.7	4.8	9.1
Dec	0.3	0.7	1.5	4.2	4.8	8.0	11.3

Table 1: Modeled monthly current flow statistics for Crozet Beaver Creek Reservoir in cubic feet per second (cfs). Columns show the minimum (Min) and average (Mean) modeled flow, and a range of non-exceedance flow percentiles, that is, the percent of flows that do *not* exceed the given value. For example, the "10%" states that only 10% of flows in the given month are expected to be less than the indicated value, and therefore, 90% of the flows in that month are expected to be greater than the given value. For example, in the table below the 10% column states that 10% of flows within the month of January would be less than 2 cfs.

[1] Virginia Drought Assessment and Response Plan, developed by the Drought Response Technical Advisory Committee in response to Executive Order #39, March 28, 2003.

2.3. Current Facility Base Demand Before Conservation: Inflow-Tiered Release, 1.15 MGD Demand



3. Results

3.1. Summary

Presented below are 4 scenarios to examine the alternatives for this permit re-issuance. A summary of how permit rules affect available water for this permit, and how this operation may impact instream beneficial uses, and other downstream water withdrawals is presented.

- **Current Conditions, 0.69 MGD, No Required Minimum Instream Flow.** - The current demand of 0.66mgd with zero minimum instream flow results in the most significant instream impacts during drought flows, with over 50% reduction in flow during the most critical drought periods (defined as less than the 5% non-exceedance flow). Because demands are relatively small as compared to the size of the impoundment, there are some drought conditions where flow alteration is less than that with other scenarios that have an MIF due to the fact that the small demand leaves the reservoir full and spilling during some moderate droughts. However, this lack of MIF results in an inefficient use of storage, and alteration to the natural flow variability that is needed to protect aquatic life.
- **Inflow-Tiered release w/30% MIF When Less Than 80% Storage** - While this scenario succeeds in providing greater than 200 days of storage remaining during the most extreme drought simulated, it cannot be recommended because the trigger that reduces MIF to 30% of inflow whenever storage drops below 80% is far too sensitive, triggering nearly 1 out of 4 years. This results in large reductions in the percentage of flow in Beaver Creek under low-flow conditions, with over 60% flow reduction during drought emergency conditions (when flows are below the 5th percentile). Essentially, the goals of the original tiered framework are over-ridden by this storage remaining trigger, and so storage remaining, and instream flows are poorly balanced.

- **Tiered Release Based on Inflows w/Recharge Trigger to Vary Maximum Release** - The Recharge-Tiered maximum release schedule meets the requested 420 mgy (1.15 mgd) demand, while improving storage remaining during drought to 50% more than a similar simulation without these recharge triggers ("tiered-only") but exhibits higher spring and fall flow decreases than the "tiered-only" operations as a consequence. Because considerable uncertainty exists in the determination of inflows for the Beaver Creek reservoir, this increased storage remaining provides for an effective margin of safety as compared to the "tiered-only" scenario and provides a middle ground between the "tiered-only" and the "Tiered Release w/Q30 < 80% Storage" scenario. As compared to the current "No MIF" scenario, these rules decrease flows between the 10-30th percentile in fall, winter and spring and decrease flows between the 30-50th percentile during summer. However, these decreases are offset by increases flows from minimum-25th percentile in the summer, and improvement in flow variability.
- **Current Demands (0.69 mgd) with Recharge-Tiered MIF** - By combining the lower annual demand of current operations, approximately 252 mgy (0.69 mgd), with the tiered release schema from the proposed permit scenario, this gives a reliable water supply coupled with a more sustainable set of instream flows that are not only more protective of drought flows, but also preserve more natural variability than the current no-permit operational schema.

3.2. Conclusion

- **Tiered Release Based on Inflows w/Recharge Trigger to Vary Maximum Release** - This scenario is recommended because it balances remaining storage

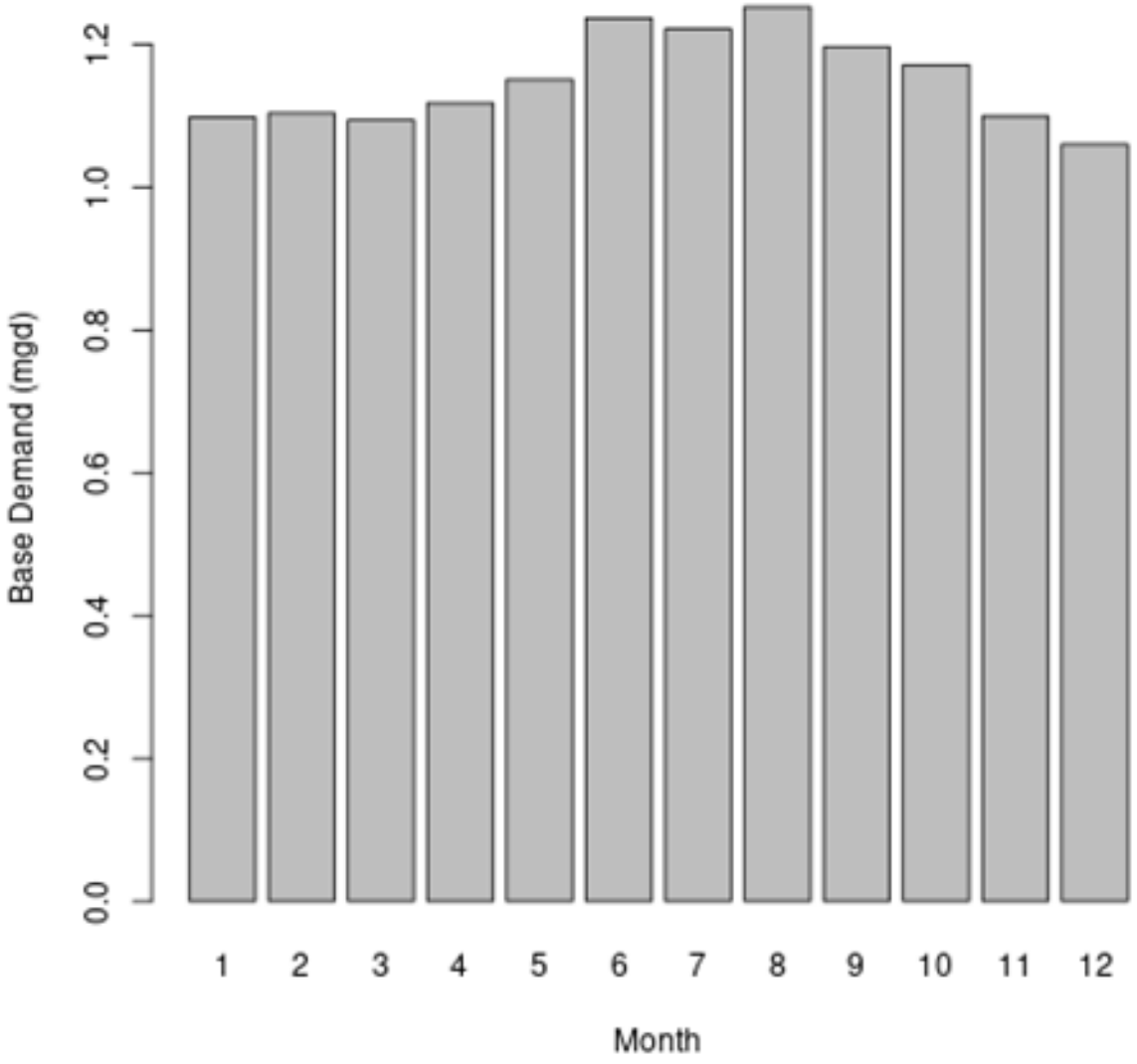
and instream flows by using a recharge flow informed maximum release trigger, and a set of minimum instream flow percentages that is tiered according to river flow, both of which serve to maximize refill at during high and moderate flow periods in order to provide for higher percent of instream flows during drought. Despite nearly a 100% increase in demands met as compared to current conditions, summertime flow alterations from the 10th percentile and lower are vastly improved over the current operating condition. Note, while the applicant has requested a condition that specifies that the "… proposed MIF would be implemented during times when the reservoir level is below the normal/full pool level and water is no longer spilling over the principal spillway riser.". This approach is *not* modeled in this scenario, nor is it recommended as a permit operational rule, since the objective is to develop permit rules that can insure both off-stream demands, and downstream beneficial uses, and this type of management schema would result in outflow from the reservoir to be roughly equal to inflow minus withdrawal, which leaves the very real possibility that negligible flows might leave the dam under conditions when the reservoir is full, but inflows are only a small amount greater than demands.

3.2.1. Consumptive Use Table for Proposed Scenario

Modeled monthly consumptive use statistics in the Beaver Creek Reservoir in cubic feet per second (cfs). Columns show the modeled non-exceedance flow percentiles and the consumptive user % due to cumulative demands for Tiered Release Based on Inflows w/Recharge Trigger to Vary Maximum Release. Simulated demands include all up-stream demands and demands at Crozet Beaver Creek Reservoir and all upstream point-source flows. Fields that are marked as 'n/a' indicate that the baseline flow for that time period/percentile was below the model accuracy threshold of 0.1 cfs.

Month	Min	5%	10%	25%	30%	50%	Mean
Jan (Jan%)	0.2 (+0%)	1.5 (-8%)	1.6 (-30%)	2.1 (-51%)	2.3 (-54%)	6.5 (-24%)	9.9 (-16%)
Feb (Feb%)	0.8 (+6%)	1.6 (-35%)	1.9 (-47%)	2.3 (-58%)	3 (-51%)	6.7 (-25%)	10.6 (-17%)
Mar (Mar%)	0.7 (+0%)	1.6 (-29%)	2 (-36%)	3.1 (-45%)	4.2 (-34%)	8 (-19%)	12.5 (-13%)
Apr (Apr%)	0.9 (+0%)	1.7 (-32%)	1.9 (-38%)	2.4 (-51%)	3.1 (-44%)	5.8 (-26%)	10 (-16%)
May (May%)	1.5 (+0%)	1.7 (-36%)	1.9 (-42%)	2.4 (-48%)	2.7 (-48%)	5.1 (-30%)	8.7 (-18%)
Jun (Jun%)	0.6 (+6%)	1.5 (+0%)	1.6 (-19%)	2.2 (-40%)	2.3 (-42%)	3.3 (-39%)	5.7 (-23%)
Jul (Jul%)	0.5 (+0%)	1.1 (+0%)	1.5 (+1%)	1.7 (-21%)	1.8 (-24%)	2.3 (-34%)	3.5 (-27%)
Aug (Aug%)	0.4 (+0%)	0.9 (+0%)	1.2 (+0%)	1.6 (-12%)	1.7 (-18%)	2.1 (-30%)	2.9 (-28%)
Sep (Sep%)	0.2 (+7%)	0.7 (+1%)	0.9 (+3%)	1.5 (+1%)	1.6 (-7%)	2.1 (-28%)	5.5 (-21%)
Oct (Oct%)	0.1 (+0%)	0.6 (+1%)	1 (-1%)	1.6 (-11%)	1.7 (-20%)	2.3 (-42%)	5.3 (-25%)
Nov (Nov%)	0.1 (+0%)	0.7 (+0%)	1 (+0%)	1.6 (-28%)	1.8 (-35%)	2.3 (-52%)	7.2 (-21%)
Dec (Dec%)	0.3 (+0%)	0.7 (-2%)	1.5 (-5%)	1.9 (-56%)	2.2 (-55%)	5.2 (-35%)	9 (-20%)

3.2.2. Demand Chart for Preferred Scenario



3.3. Detailed Cumulative Impact Analysis

The following “Summary of Results” table summarizes the cumulative impacts to flows, aquatic life, and off-stream demand for the project. The section entitled “River Segment Model Statistics” contains mean flows (Flow Out), and drought flows (30 and 90 Day Low Flow), as well as an estimated Consumptive Use Fraction (See description below) as a result of all withdrawals (Cumulative Withdrawal) and discharges (Cumulative Point Source) in the watershed. Minimum Days of Storage Remaining describes the number of days of remaining storage available during the driest period of the model simulation (applicable to impoundment models only). Total Number of Days with Storage < 50% describes the number of days in the simulation in which reservoir levels fall below 50% of full storage. The section entitled “Facility Model Statistics” shows the withdrawals, return flows (Point Source), and the model estimate for potential conservation-required/unmet-demand due to demands exceeding the allowable withdrawal at the intake, or drought triggers based on the cumulative conditions in the watershed and the flow-by rules in effect. There will be one or more columns in this table representing each scenario considered for this analysis.

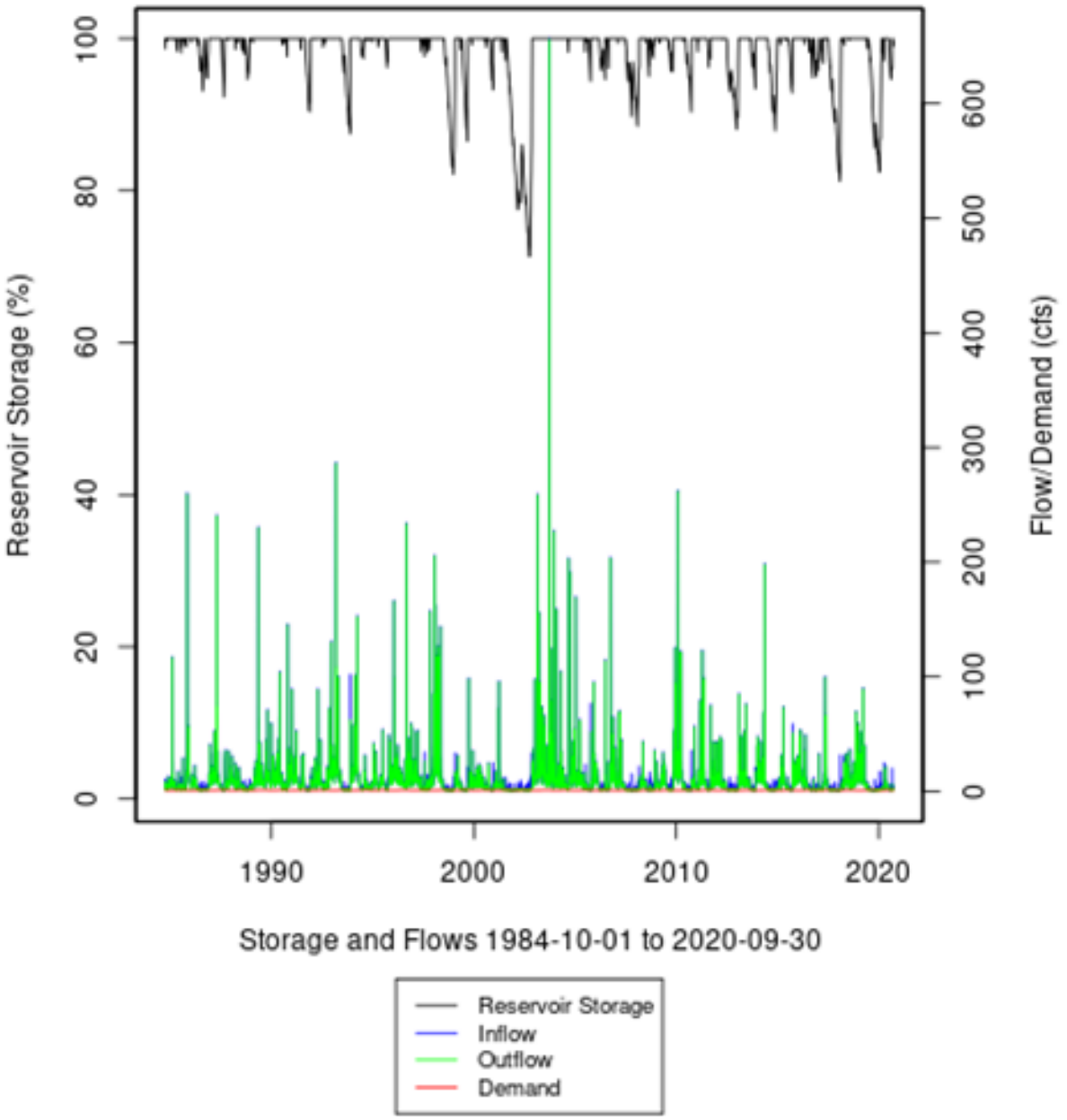
3.3.1. Summary of Results:

Description	Current 0.0 MIF	Tiered Release w/Q30 < 80% Storage	Tiered Release w/Recharge Trigger	0.69 mgd w/Recharge Tiered
River Segment Model Statistics:	Beaver Creek - VAHydro 1.0	Beaver Creek - VAHydro 1.0	Beaver Creek - VAHydro 1.0	Beaver Creek - VAHydro 1.0
Flow Out (cfs) - (i.e mean flow)	8.3	7.55	7.55	8.26
Minimum Days of Storage Remaining	481.24	240.32	117.64	482.56
30 Day Low Flow (cfs) (i.e drought flow)	0.34	0.1	0.34	0.34
90 Day Low Flow (cfs) (i.e drought flow)	0.88	0.33	0.85	0.86
Consumptive Use Fraction	0.11	0.19	0.19	0.11
Cumulative Withdrawal (MGD)	0.66	1.15	1.15	0.69
Cumulative Point Source (MGD)	0	0	0	0
Withdrawal (MGD)	0.66	1.15	1.15	0.69
Point Source (MGD)	0	0	0	0
Facility Model Statistics:	CROZET WTP:Beaver Creek Reservoir	CROZET WTP:Beaver Creek Reservoir	CROZET WTP:Beaver Creek Reservoir	CROZET WTP:Beaver Creek Reservoir
Base Demand (MGY)	242.67	419.97	419.97	252.36
Withdrawal (MGY)	242.67	419.97	419.97	252.36
Conservation/Unmet Demand (MGY)	0	0	0	0
Requested Demand (MGD)	0.66	1.15	1.15	0.69
Withdrawal Met (MGD)	0.66	1.15	1.15	0.69
Point Source (MGD)	0.57	0.98	0.98	0.59
Groundwater Demand (MGD)	0	0	0	0
Maximum 30 day conservation/unmet demand (MGD)	0	0	0	0

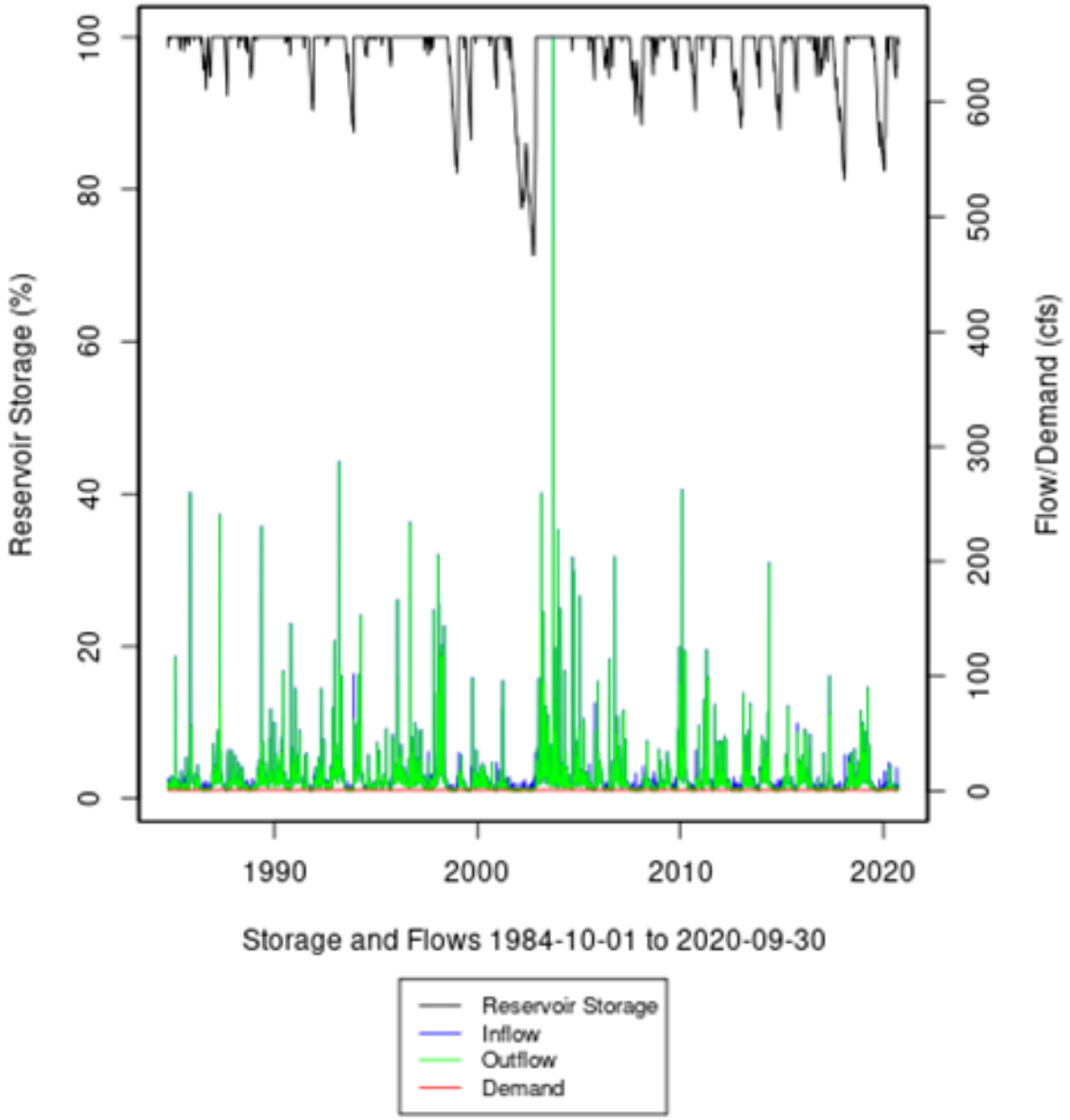
3.3.2. Analysis of Reservoir Storage:

The following reservoir storage plots depict changes in reservoir storage under each scenario (indicated in black), as well as simulated inflow to the reservoir (blue), simulated outflow from the reservoir (green), and system demand for the given scenario (red). For water supply reservoirs, a minimum of 60 days of remaining storage over the course of the simulation is recommended. System demand varies seasonally.

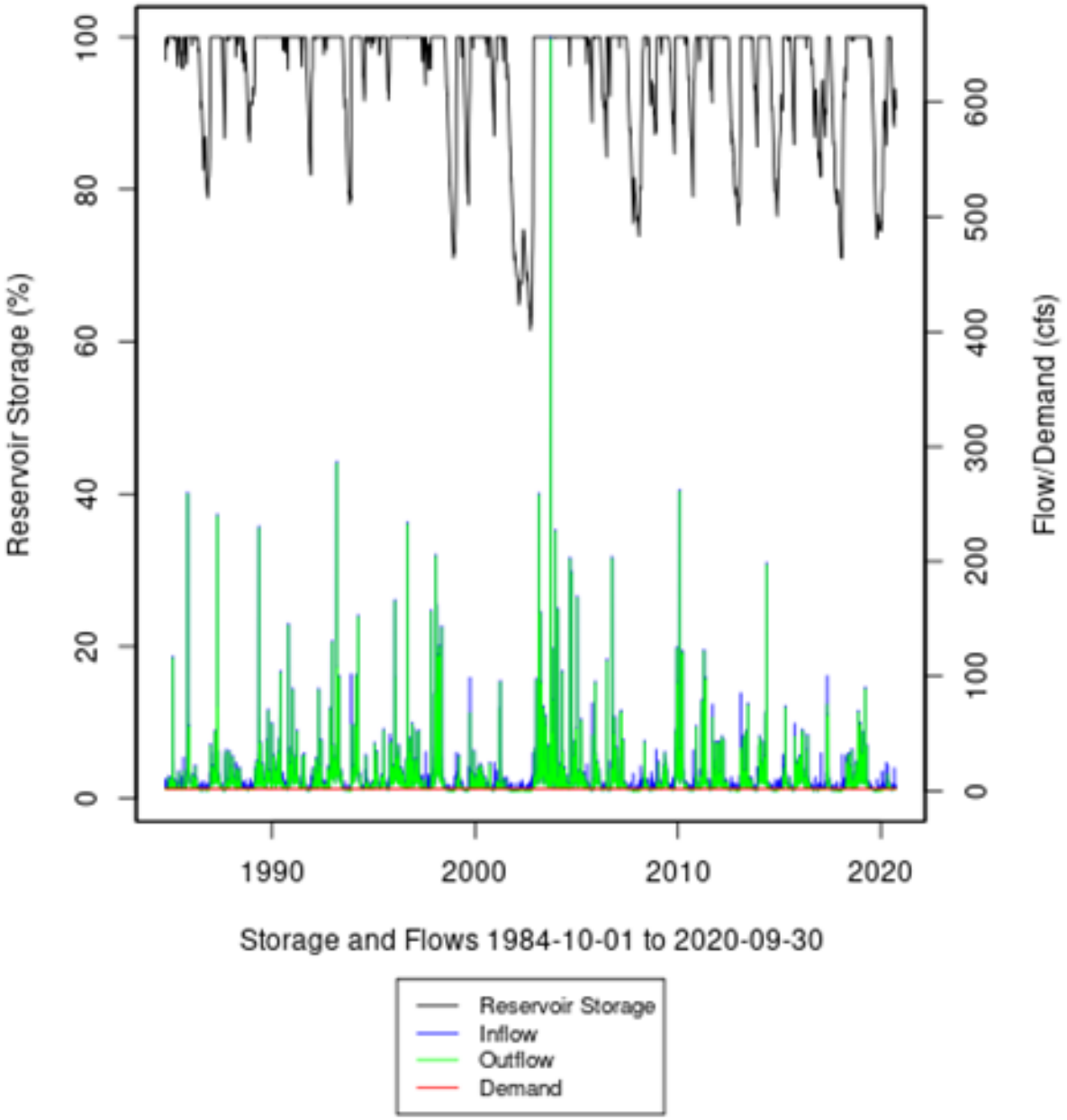
3.3.2.1. Reservoir Storage: Current 0.0 MIF



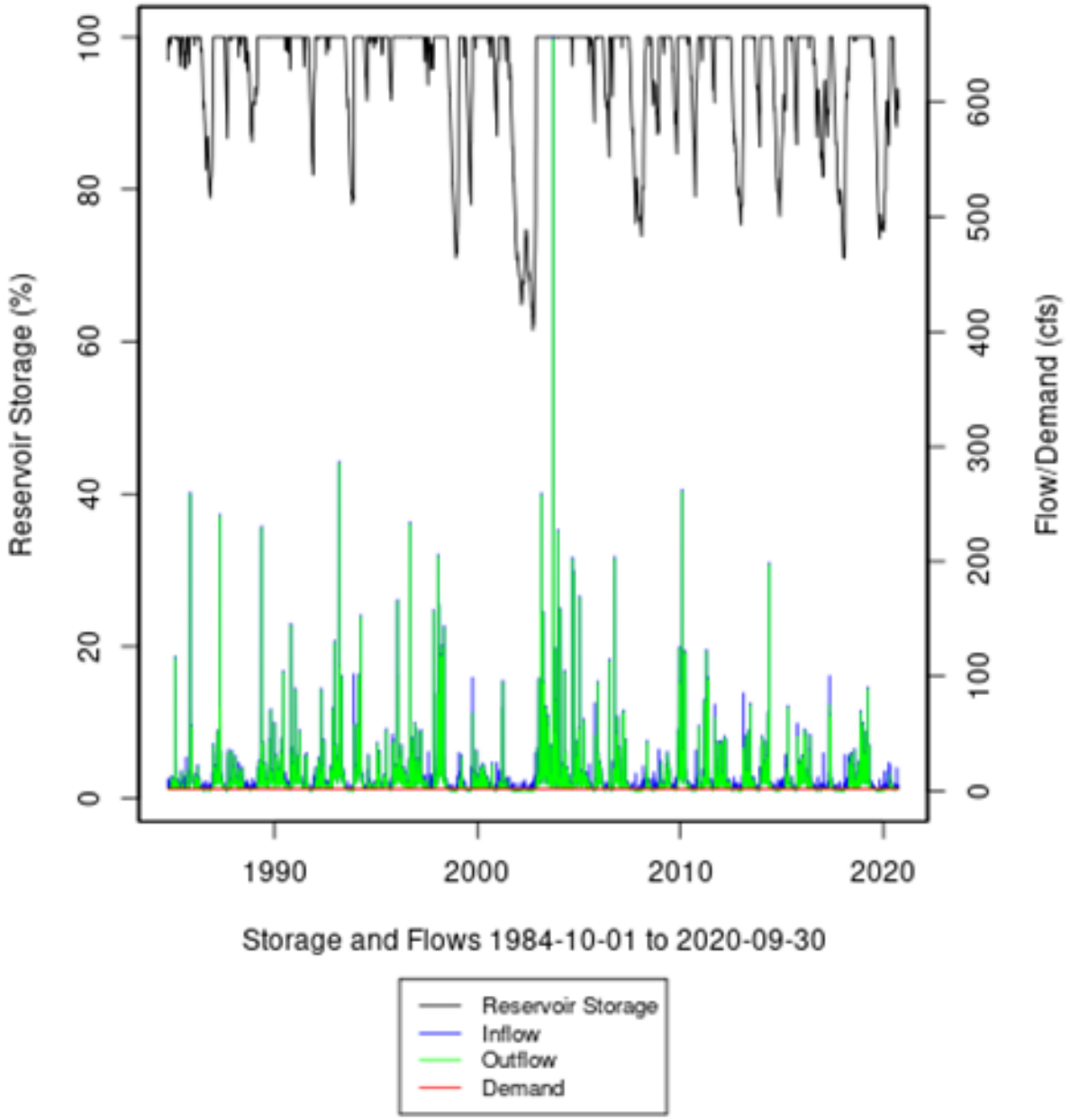
3.3.2.2. Reservoir Storage: Current 0.0 MIF



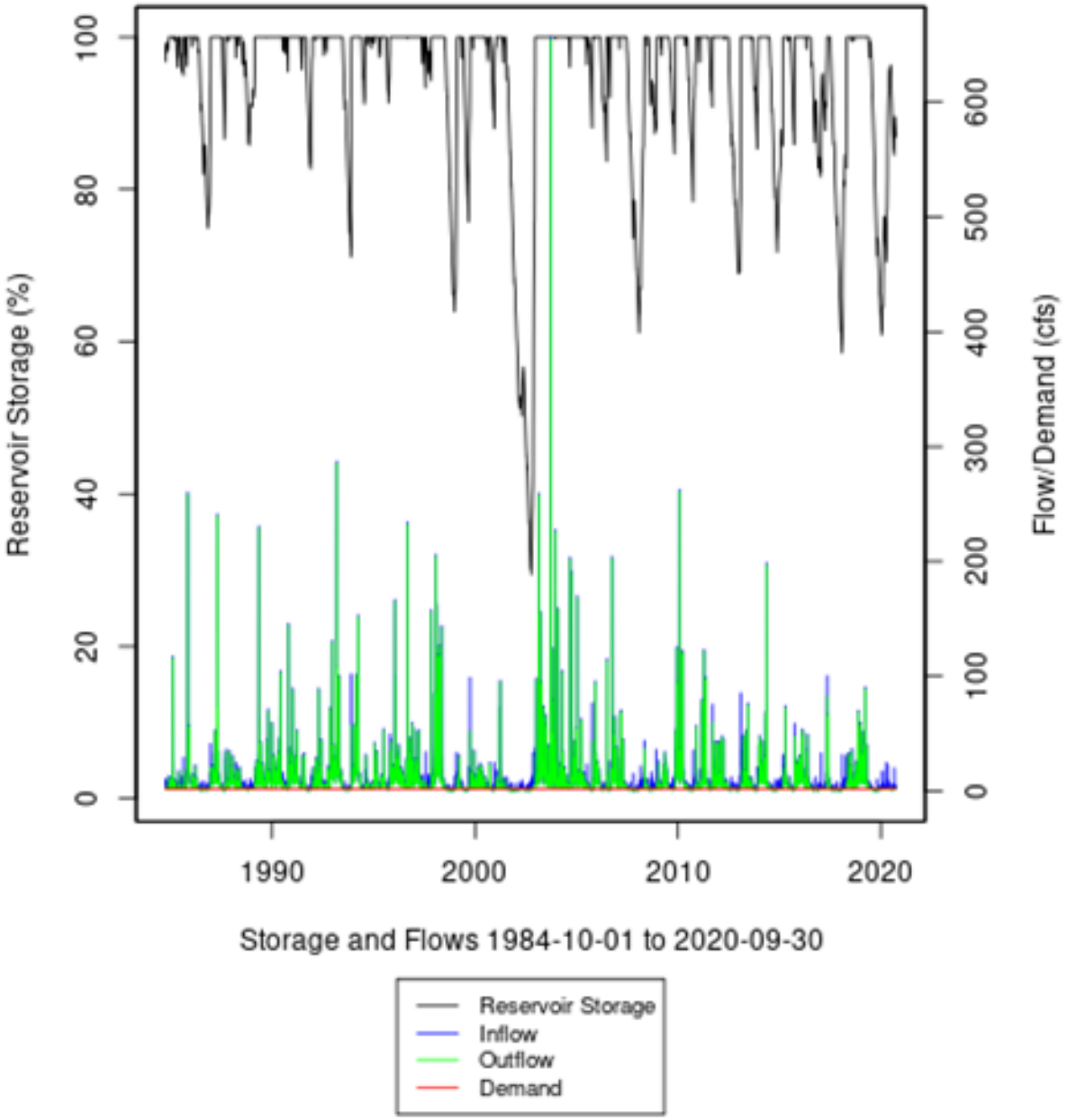
3.3.2.3. Reservoir Storage: Tiered Release w/Q30 < 80% Storage



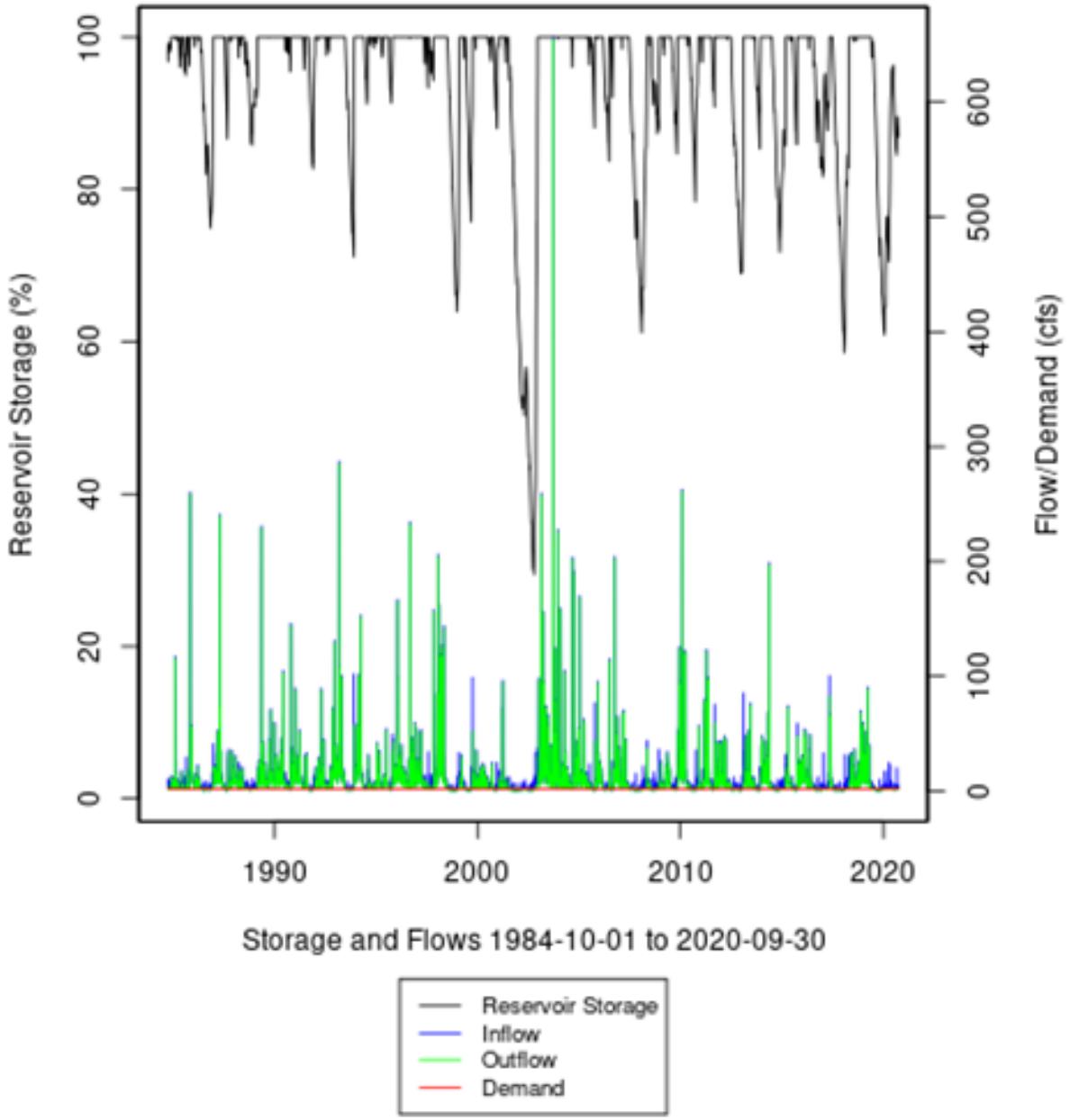
3.3.2.4. Reservoir Storage: Tiered Release w/Q30 < 80% Storage



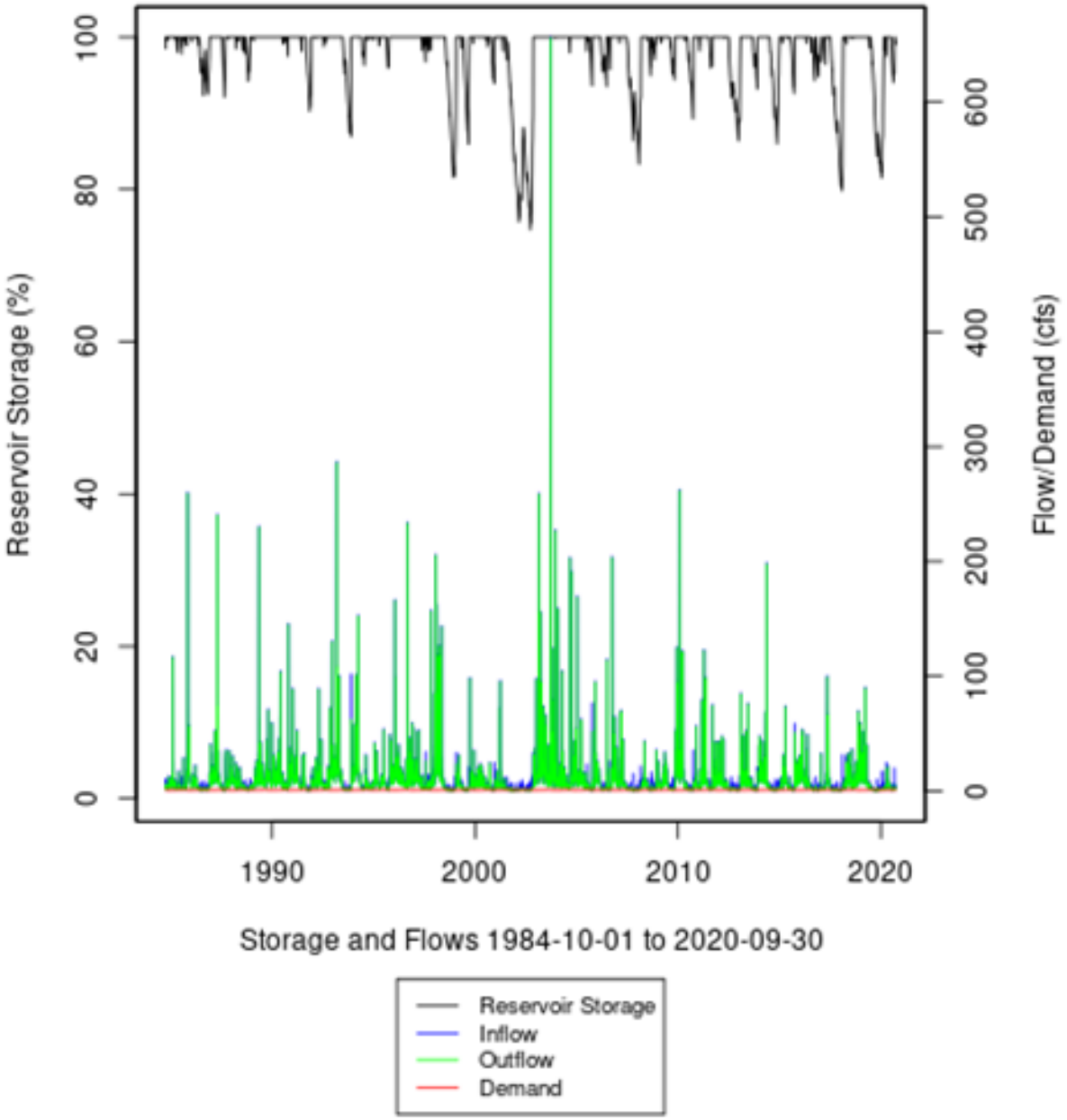
3.3.2.5. Reservoir Storage: Tiered Release w/Recharge Trigger



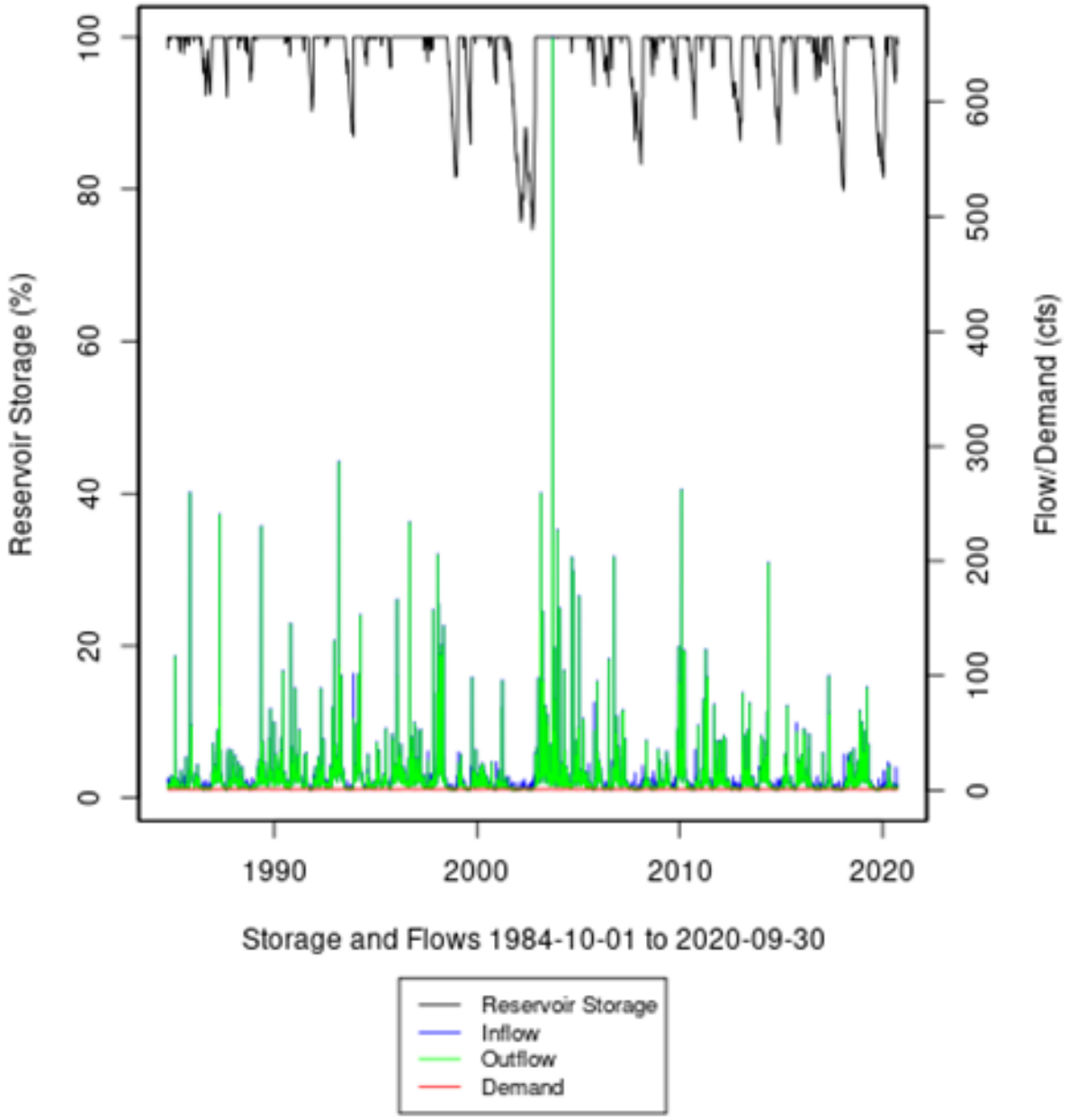
3.3.2.6. Reservoir Storage: Tiered Release w/Recharge Trigger



3.3.2.7. Reservoir Storage: 0.69 mgd w/Recharge Tiered



3.3.2.8. Reservoir Storage: 0.69 mgd w/Recharge Tiered



Cumulative Consumptive Use Plots:

3.3.2.9. Cumulative use for Current Conditions, 0.69 MGD, No Required Minimum Instream Flow.

Modeled monthly consumptive use statistics in the Beaver Creek Reservoir in cubic feet per second (cfs). Columns show the modeled non-exceedance flow percentiles and the consumptive user % due to cumulative demands. Simulated demands include all up-stream demands and demands at Crozet Beaver Creek Reservoir and all upstream point-source flows. Fields that are marked as 'n/a' indicate that the baseline flow for that time period/percentile was below the model accuracy threshold of 0.1 cfs.

Month	Min	5%	10%	25%	30%	50%	Mean
Jan (Jan%)	0.1 (-50%)	1.4 (-18%)	1.8 (-20%)	2.6 (-39%)	3.4 (-33%)	7.4 (-13%)	10.6 (-10%)
Feb (Feb%)	0.8 (+6%)	2 (-21%)	2.3 (-34%)	4 (-29%)	4.7 (-23%)	7.8 (-13%)	11.6 (-10%)
Mar (Mar%)	0.6 (-16%)	1.8 (-20%)	2.3 (-25%)	4.6 (-19%)	5.3 (-16%)	8.8 (-10%)	13.3 (-7%)
Apr (Apr%)	0.5 (-48%)	2 (-18%)	2.3 (-25%)	3.8 (-23%)	4.4 (-20%)	6.8 (-13%)	10.9 (-9%)
May (May%)	0.8 (-50%)	2.1 (-20%)	2.3 (-29%)	3.4 (-26%)	4 (-22%)	6.2 (-15%)	9.6 (-10%)
Jun (Jun%)	0.5 (-2%)	1.4 (-6%)	1.8 (-9%)	2.4 (-35%)	2.8 (-30%)	4.3 (-21%)	6.4 (-13%)
Jul (Jul%)	0.2 (-50%)	1 (-13%)	1.3 (-13%)	1.9 (-15%)	2.1 (-14%)	2.3 (-32%)	4 (-18%)
Aug (Aug%)	0.2 (-50%)	0.8 (-15%)	1 (-12%)	1.6 (-14%)	1.8 (-14%)	2.3 (-22%)	3.2 (-21%)
Sep (Sep%)	0.2 (+7%)	0.6 (-10%)	0.9 (-5%)	1.4 (-7%)	1.5 (-10%)	2.3 (-18%)	6 (-14%)
Oct (Oct%)	0.1 (-10%)	0.6 (-7%)	0.9 (-11%)	1.6 (-9%)	1.8 (-13%)	2.3 (-42%)	6 (-15%)
Nov (Nov%)	0.1 (+0%)	0.6 (-8%)	1 (-7%)	1.8 (-20%)	2.1 (-23%)	2.9 (-40%)	7.9 (-13%)
Dec (Dec%)	0.2 (-50%)	0.7 (-4%)	1.2 (-20%)	2.3 (-45%)	3.2 (-34%)	6.8 (-15%)	10.2 (-9%)

3.3.2.10. Cumulative use for Inflow-Tiered release w/30% MIF When Less Than 80% Storage

Modeled monthly consumptive use statistics in the Beaver Creek Reservoir in cubic feet per second (cfs). Columns show the modeled non-exceedance flow percentiles and the consumptive user % due to cumulative demands. Simulated demands include all up-stream demands and demands at Crozet Beaver Creek Reservoir and all upstream point-source flows. Fields that are marked as 'n/a' indicate that the baseline flow for that time period/percentile was below the model accuracy threshold of 0.1 cfs.

Month	Min	5%	10%	25%	30%	50%	Mean
Jan (Jan%)	0.1 (-70%)	0.5 (-71%)	0.8 (-67%)	2.3 (-46%)	2.3 (-54%)	6.4 (-25%)	9.7 (-17%)
Feb (Feb%)	0.3 (-66%)	1.4 (-43%)	2 (-44%)	2.3 (-58%)	3.5 (-42%)	6.9 (-24%)	10.7 (-17%)
Mar (Mar%)	0.2 (-70%)	1.6 (-29%)	2 (-35%)	3.2 (-44%)	4.3 (-33%)	8 (-18%)	12.5 (-13%)
Apr (Apr%)	0.5 (-48%)	1.7 (-31%)	1.9 (-38%)	2.3 (-53%)	3.3 (-40%)	5.9 (-24%)	10.1 (-15%)
May (May%)	0.7 (-53%)	1.7 (-35%)	1.9 (-41%)	2.3 (-50%)	2.8 (-45%)	5.3 (-27%)	8.8 (-17%)
Jun (Jun%)	0.3 (-46%)	1.3 (-14%)	1.6 (-19%)	2.2 (-40%)	2.3 (-42%)	3.3 (-39%)	5.7 (-24%)
Jul (Jul%)	0.2 (-65%)	1 (-9%)	1.4 (-5%)	1.7 (-21%)	1.8 (-24%)	2.3 (-33%)	3.5 (-28%)
Aug (Aug%)	0.2 (-62%)	0.7 (-27%)	1 (-11%)	1.6 (-12%)	1.7 (-18%)	2.1 (-30%)	2.9 (-30%)
Sep (Sep%)	0.1 (-66%)	0.5 (-26%)	0.8 (-8%)	1.5 (-2%)	1.6 (-7%)	2.1 (-27%)	5.5 (-21%)
Oct (Oct%)	0 (-70%)	0.3 (-59%)	0.5 (-49%)	1.4 (-23%)	1.6 (-23%)	2.3 (-42%)	5.2 (-26%)
Nov (Nov%)	0 (-70%)	0.3 (-61%)	0.5 (-53%)	1.2 (-47%)	1.6 (-41%)	2.3 (-52%)	7.1 (-22%)
Dec (Dec%)	0.1 (-70%)	0.2 (-70%)	0.4 (-71%)	2.2 (-47%)	2.3 (-52%)	5.6 (-30%)	9.2 (-18%)

3.3.2.11. Cumulative use for Tiered Release Based on Inflows w/Recharge Trigger to Vary Maximum Release

Modeled monthly consumptive use statistics in the Beaver Creek Reservoir in cubic feet per second (cfs). Columns show the modeled non-exceedance flow percentiles and the consumptive user % due to cumulative demands. Simulated demands include all up-stream demands and demands at Crozet Beaver Creek Reservoir and all upstream point-source flows. Fields that are marked as 'n/a' indicate that the baseline flow for that time period/percentile was below the model accuracy threshold of 0.1 cfs.

Month	Min	5%	10%	25%	30%	50%	Mean
Jan (Jan%)	0.2 (+0%)	1.5 (-8%)	1.6 (-30%)	2.1 (-51%)	2.3 (-54%)	6.5 (-24%)	9.9 (-16%)
Feb (Feb%)	0.8 (+6%)	1.6 (-35%)	1.9 (-47%)	2.3 (-58%)	3 (-51%)	6.7 (-25%)	10.6 (-17%)
Mar (Mar%)	0.7 (+0%)	1.6 (-29%)	2 (-36%)	3.1 (-45%)	4.2 (-34%)	8 (-19%)	12.5 (-13%)
Apr (Apr%)	0.9 (+0%)	1.7 (-32%)	1.9 (-38%)	2.4 (-51%)	3.1 (-44%)	5.8 (-26%)	10 (-16%)
May (May%)	1.5 (+0%)	1.7 (-36%)	1.9 (-42%)	2.4 (-48%)	2.7 (-48%)	5.1 (-30%)	8.7 (-18%)
Jun (Jun%)	0.6 (+6%)	1.5 (+0%)	1.6 (-19%)	2.2 (-40%)	2.3 (-42%)	3.3 (-39%)	5.7 (-23%)
Jul (Jul%)	0.5 (+0%)	1.1 (+0%)	1.5 (+1%)	1.7 (-21%)	1.8 (-24%)	2.3 (-34%)	3.5 (-27%)
Aug (Aug%)	0.4 (+0%)	0.9 (+0%)	1.2 (+0%)	1.6 (-12%)	1.7 (-18%)	2.1 (-30%)	2.9 (-28%)
Sep (Sep%)	0.2 (+7%)	0.7 (+1%)	0.9 (+3%)	1.5 (+1%)	1.6 (-7%)	2.1 (-28%)	5.5 (-21%)
Oct (Oct%)	0.1 (+0%)	0.6 (+1%)	1 (-1%)	1.6 (-11%)	1.7 (-20%)	2.3 (-42%)	5.3 (-25%)
Nov (Nov%)	0.1 (+0%)	0.7 (+0%)	1 (+0%)	1.6 (-28%)	1.8 (-35%)	2.3 (-52%)	7.2 (-21%)
Dec (Dec%)	0.3 (+0%)	0.7 (-2%)	1.5 (-5%)	1.9 (-56%)	2.2 (-55%)	5.2 (-35%)	9 (-20%)

3.3.2.12. Cumulative use for Current Demands (0.69 mgd) with Recharge-Tiered MIF

Modeled monthly consumptive use statistics in the Beaver Creek Reservoir in cubic feet per second (cfs). Columns show the modeled non-exceedance flow percentiles and the consumptive user % due to cumulative demands. Simulated demands include all up-stream demands and demands at Crozet Beaver Creek Reservoir and all upstream point-source flows. Fields that are marked as 'n/a' indicate that the baseline flow for that time period/percentile was below the model accuracy threshold of 0.1 cfs.

Month	Min	5%	10%	25%	30%	50%	Mean
Jan (Jan%)	0.2 (+0%)	1.5 (-8%)	1.7 (-28%)	2.6 (-40%)	3.4 (-34%)	7.4 (-14%)	10.6 (-10%)
Feb (Feb%)	0.8 (+6%)	1.8 (-31%)	2 (-43%)	3.9 (-31%)	4.7 (-24%)	7.7 (-14%)	11.6 (-10%)
Mar (Mar%)	0.7 (+0%)	1.7 (-27%)	2.2 (-28%)	4.5 (-21%)	5.2 (-18%)	8.8 (-11%)	13.2 (-7%)
Apr (Apr%)	0.9 (+0%)	1.8 (-28%)	2.3 (-27%)	3.8 (-24%)	4.4 (-21%)	6.8 (-14%)	10.9 (-9%)
May (May%)	1.5 (+0%)	1.8 (-32%)	2.2 (-33%)	3.3 (-28%)	3.9 (-23%)	6.1 (-16%)	9.5 (-10%)
Jun (Jun%)	0.6 (+6%)	1.5 (+0%)	1.7 (-15%)	2.6 (-29%)	2.8 (-30%)	4.2 (-23%)	6.4 (-14%)
Jul (Jul%)	0.5 (+0%)	1.1 (+0%)	1.5 (+1%)	1.8 (-17%)	2 (-17%)	2.4 (-29%)	4 (-18%)
Aug (Aug%)	0.4 (+0%)	0.9 (+0%)	1.2 (+0%)	1.6 (-12%)	1.7 (-16%)	2.2 (-26%)	3.2 (-20%)
Sep (Sep%)	0.2 (+7%)	0.7 (+1%)	0.9 (+3%)	1.5 (+1%)	1.6 (-7%)	2.2 (-21%)	6 (-14%)
Oct (Oct%)	0.1 (+0%)	0.6 (+1%)	1 (-1%)	1.6 (-11%)	1.7 (-19%)	2.6 (-36%)	5.9 (-16%)
Nov (Nov%)	0.1 (+0%)	0.7 (+0%)	1 (+0%)	1.7 (-27%)	1.9 (-32%)	3.1 (-36%)	7.9 (-13%)
Dec (Dec%)	0.3 (+0%)	0.7 (-2%)	1.5 (-5%)	2.1 (-49%)	3.1 (-35%)	6.9 (-15%)	10.2 (-10%)

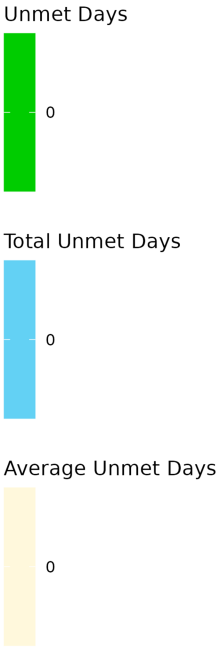
3.3.3. Analysis of Potential Conservation/Unmet Demand at the River Intake:

The following grids are data plotting tools that help visualize data as magnitudes of color intensity. These depict the number of days with required conservation demand reductions or unmet demands for each month of the simulation (due to drought triggers or demands exceeding allowable withdrawal at the intake based on the cumulative conditions in the watershed and the flow-by rules in effect). The cells show the amount of reductions/unmet demand for each month [Number of Unmet Days & Amount (MGD)]. Hydrographs are shown for the period of the simulation with greatest reduction/unmet demand.

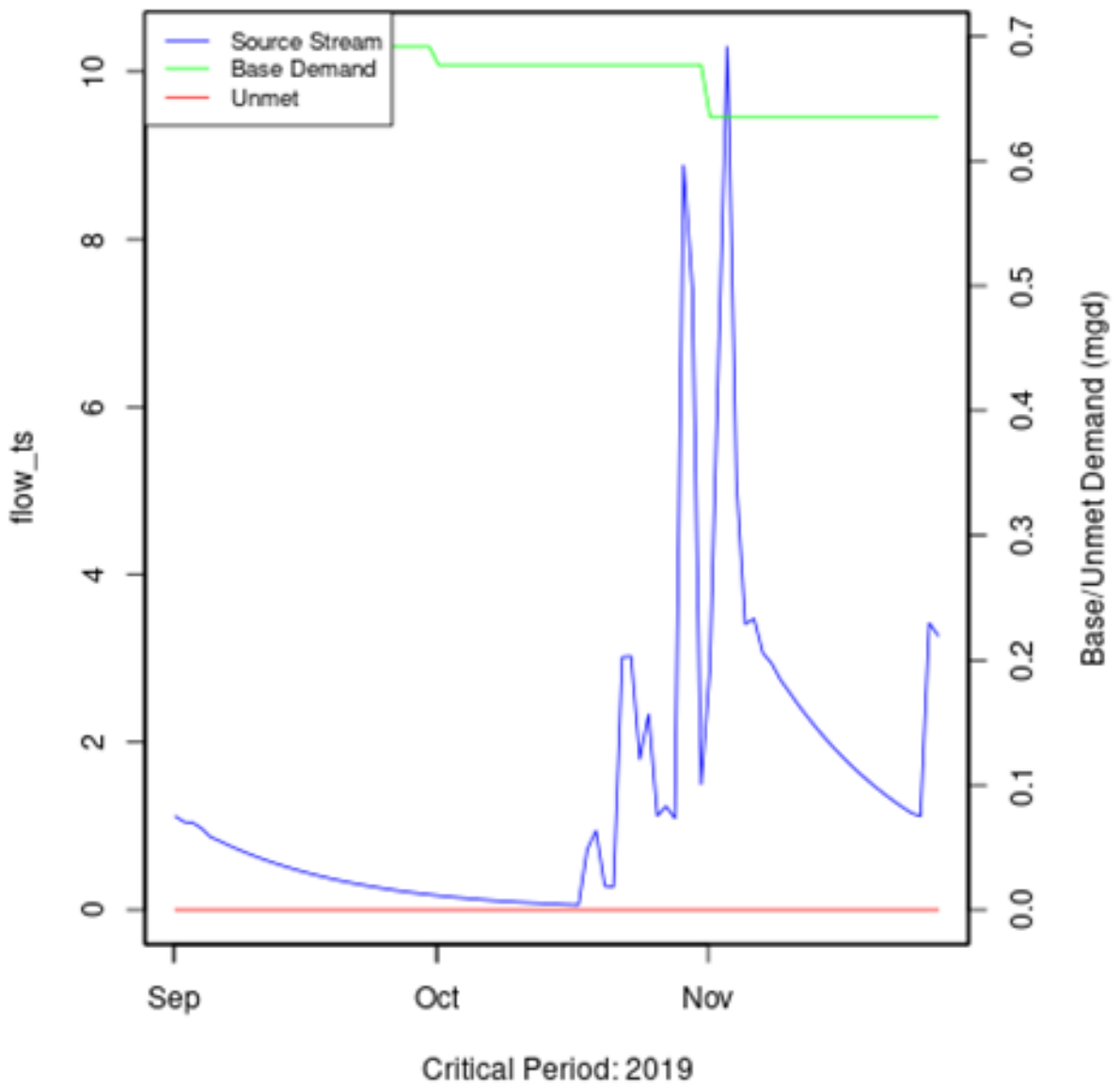
3.3.3.1. Drought reduction/Unmet Demand: Current 0.0 MIF

Unmet Demand Heatmap

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	Avg
1985	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1986	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1987	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1988	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1989	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1990	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1991	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1992	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1993	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1994	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1995	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1996	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1997	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1998	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1999	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2000	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2001	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2002	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2003	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2004	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2005	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2006	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2007	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2008	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2009	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2010	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2011	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2012	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2013	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2014	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2015	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2016	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2017	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2018	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2019	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2020	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	
Avg	0	0	0	0	0	0	0	0	0	0	0	0		



3.3.3.2. Hydrograph: Current 0.0 MIF



[1] "No local facility impoundment for Current 0.0 MIF"

3.3.3.3. Drought reduction/Unmet Demand: Tiered Release w/Q30 < 80% Storage

Unmet Demand Heatmap

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	Avg
1985	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1986	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1987	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1988	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1989	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1990	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1991	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1992	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1993	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1994	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1995	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1996	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1997	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1998	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1999	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2000	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2001	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2002	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2003	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2004	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2005	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2006	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2007	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2008	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2009	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2010	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2011	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2012	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2013	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2014	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2015	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2016	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2017	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2018	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2019	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2020	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	
Avg	0	0	0	0	0	0	0	0	0	0	0	0		

Unmet Days

0

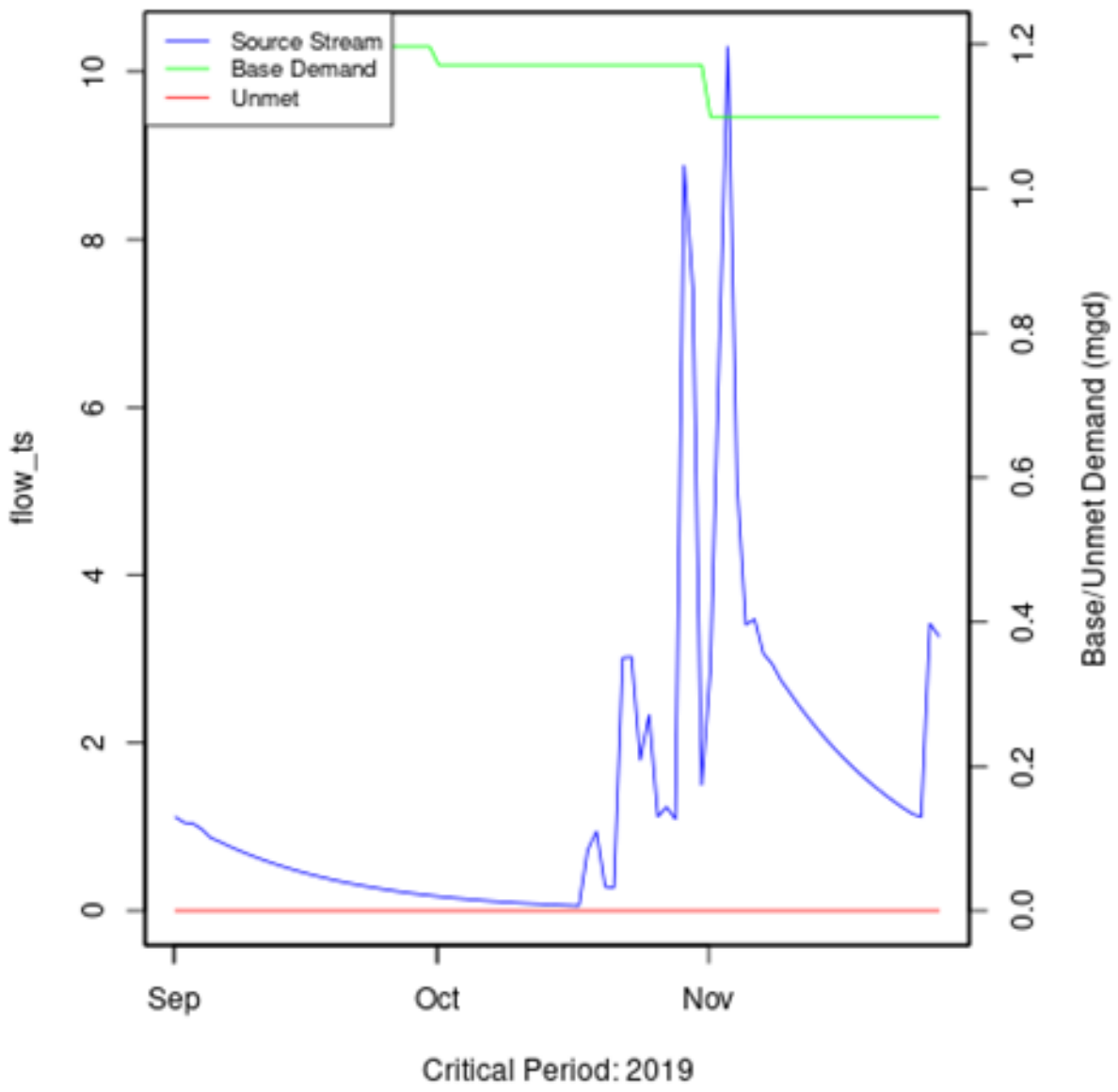
Total Unmet Days

0

Average Unmet Days

0

3.3.3.4. Hydrograph: Tiered Release w/Q30 < 80% Storage



[1] "No local facility impoundment for Tiered Release w/Q30 < 80% Storage"

3.3.3.5. Drought reduction/Unmet Demand: Tiered Release w/Recharge Trigger

Unmet Demand Heatmap

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	Avg
1985	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1986	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1987	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1988	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1989	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1990	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1991	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1992	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1993	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1994	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1995	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1996	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1997	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1998	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1999	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2000	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2001	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2002	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2003	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2004	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2005	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2006	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2007	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2008	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2009	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2010	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2011	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2012	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2013	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2014	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2015	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2016	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2017	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2018	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2019	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2020	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	
Avg	0	0	0	0	0	0	0	0	0	0	0	0		

Unmet Days

0

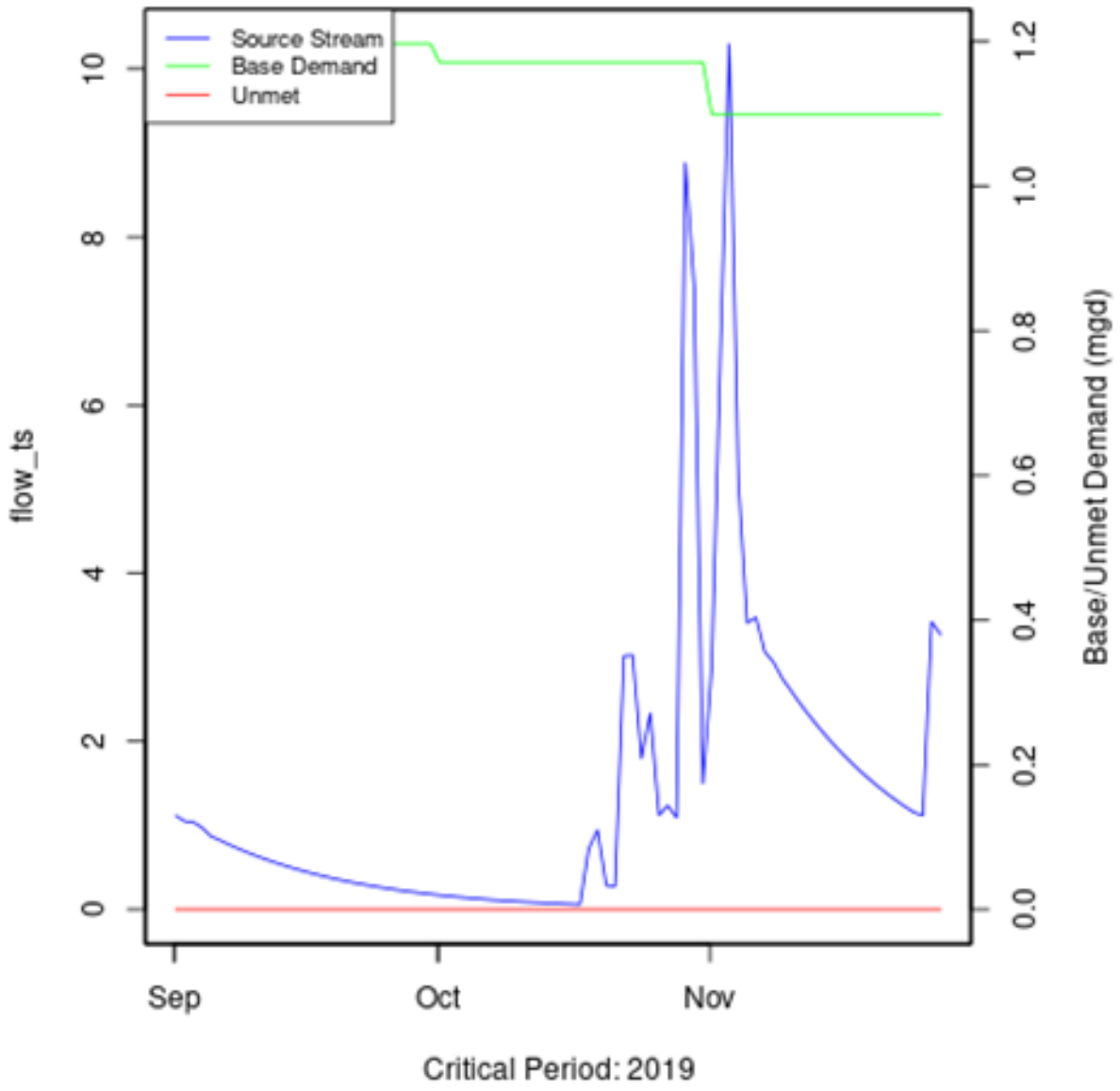
Total Unmet Days

0

Average Unmet Days

0

3.3.3.6. Hydrograph: Tiered Release w/Recharge Trigger



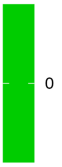
[1] "No local facility impoundment for Tiered Release w/Recharge Trigger"

3.3.3.7. Drought reduction/Unmet Demand: 0.69 mgd w/Recharge Tiered

Unmet Demand Heatmap

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals	Avg
1985	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1986	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1987	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1988	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1989	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1990	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1991	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1992	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1993	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1994	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1995	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1996	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1997	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1998	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
1999	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2000	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2001	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2002	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2003	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2004	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2005	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2006	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2007	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2008	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2009	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2010	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2011	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2012	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2013	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2014	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2015	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2016	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2017	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2018	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2019	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
2020	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	
Avg	0	0	0	0	0	0	0	0	0	0	0	0		

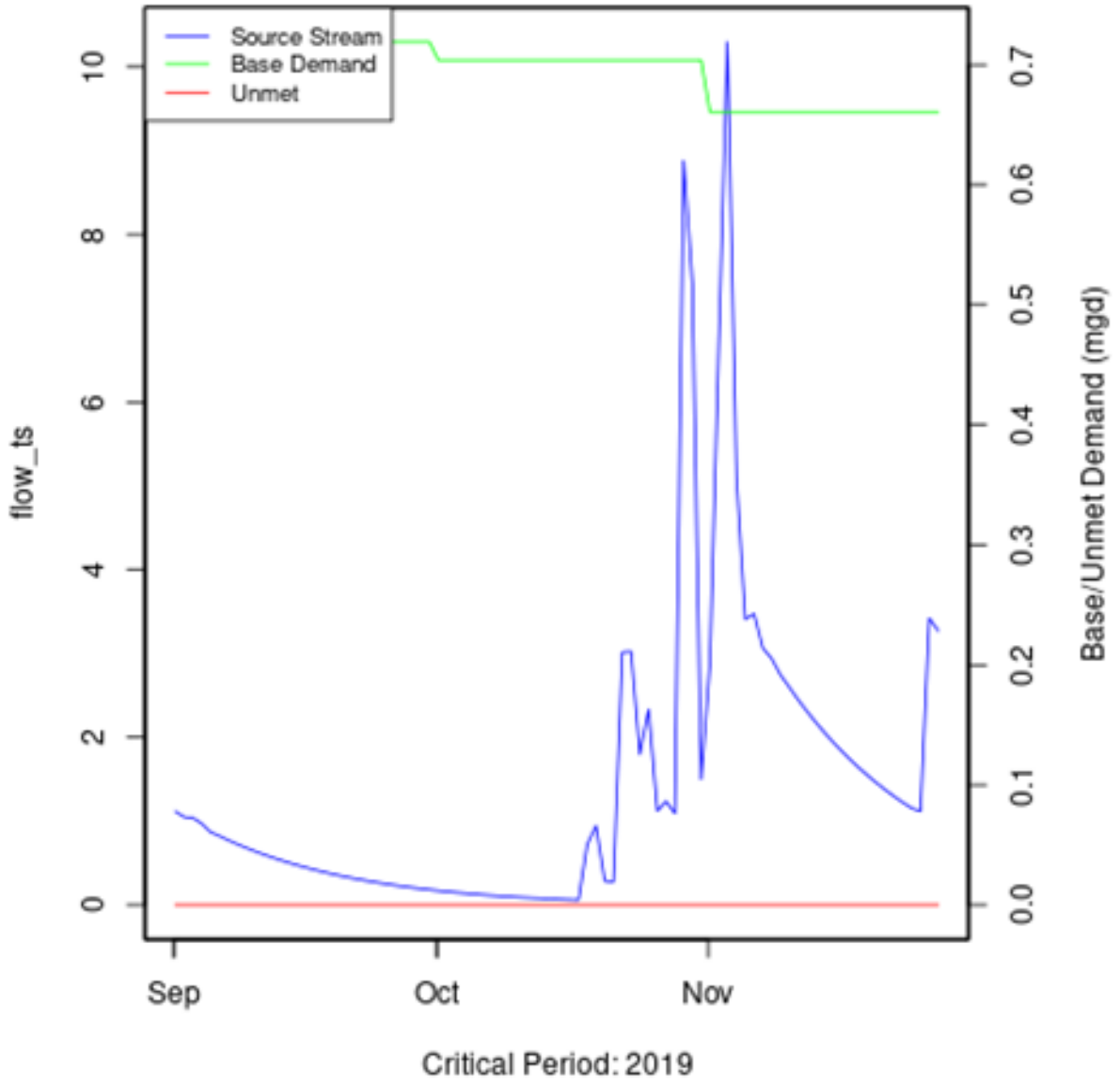
Unmet Days



Total Unmet Days

Average Unmet Days

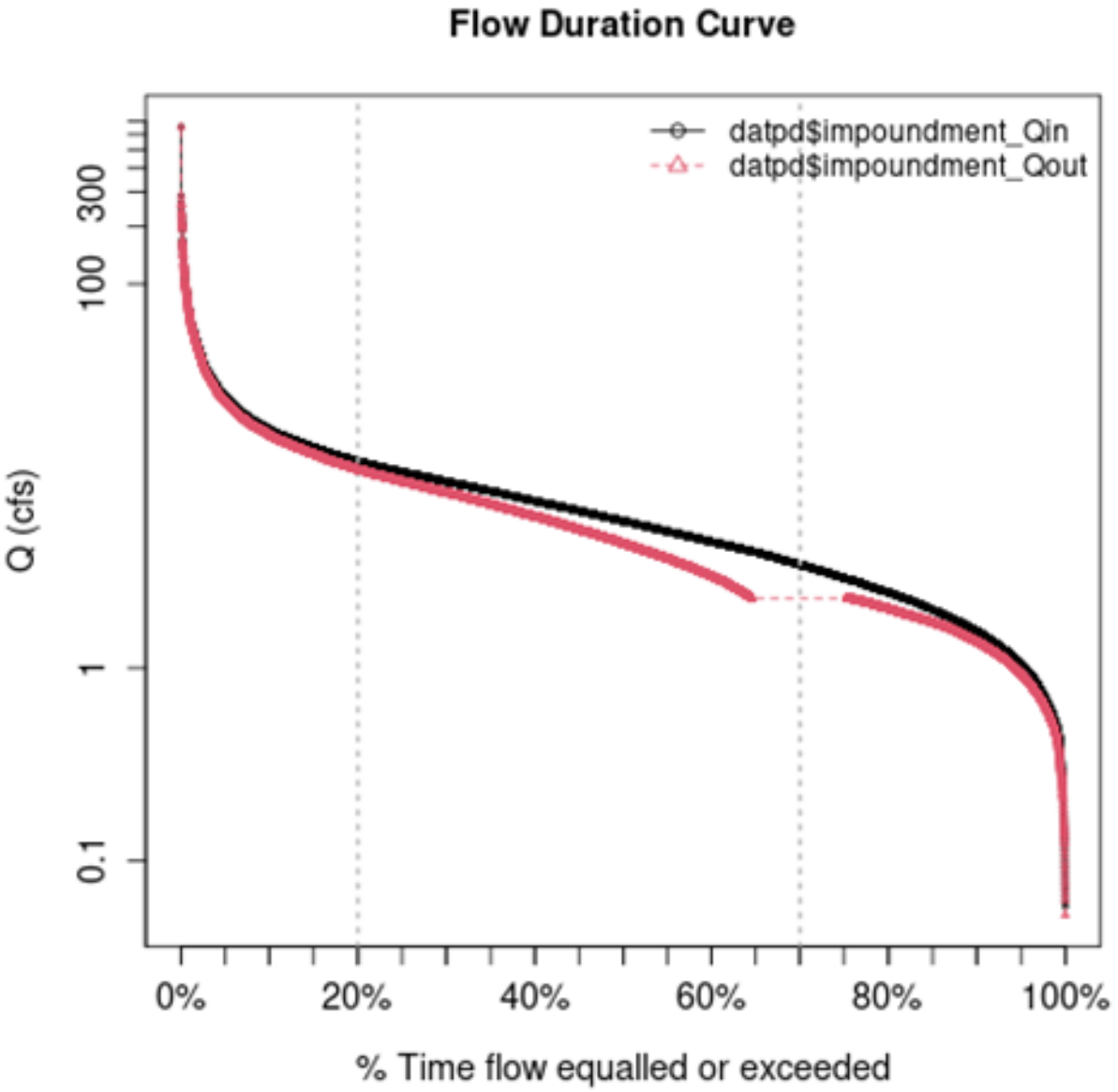
3.3.3.8. Hydrograph: 0.69 mgd w/Recharge Tiered



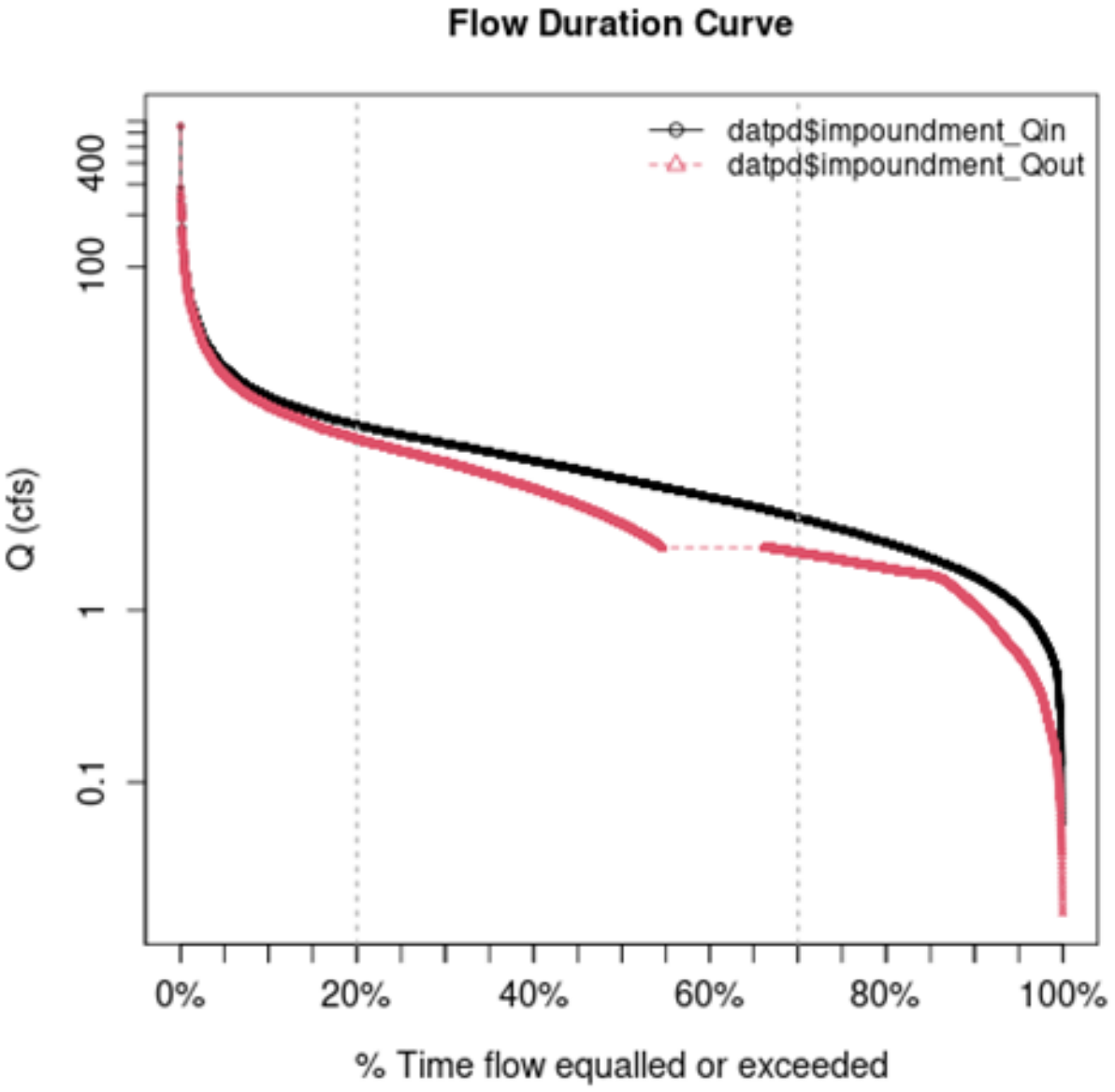
[1] "No local facility impoundment for 0.69 mgd w/Recharge Tiered"

3.3.4. Additional Model Flow Plots:

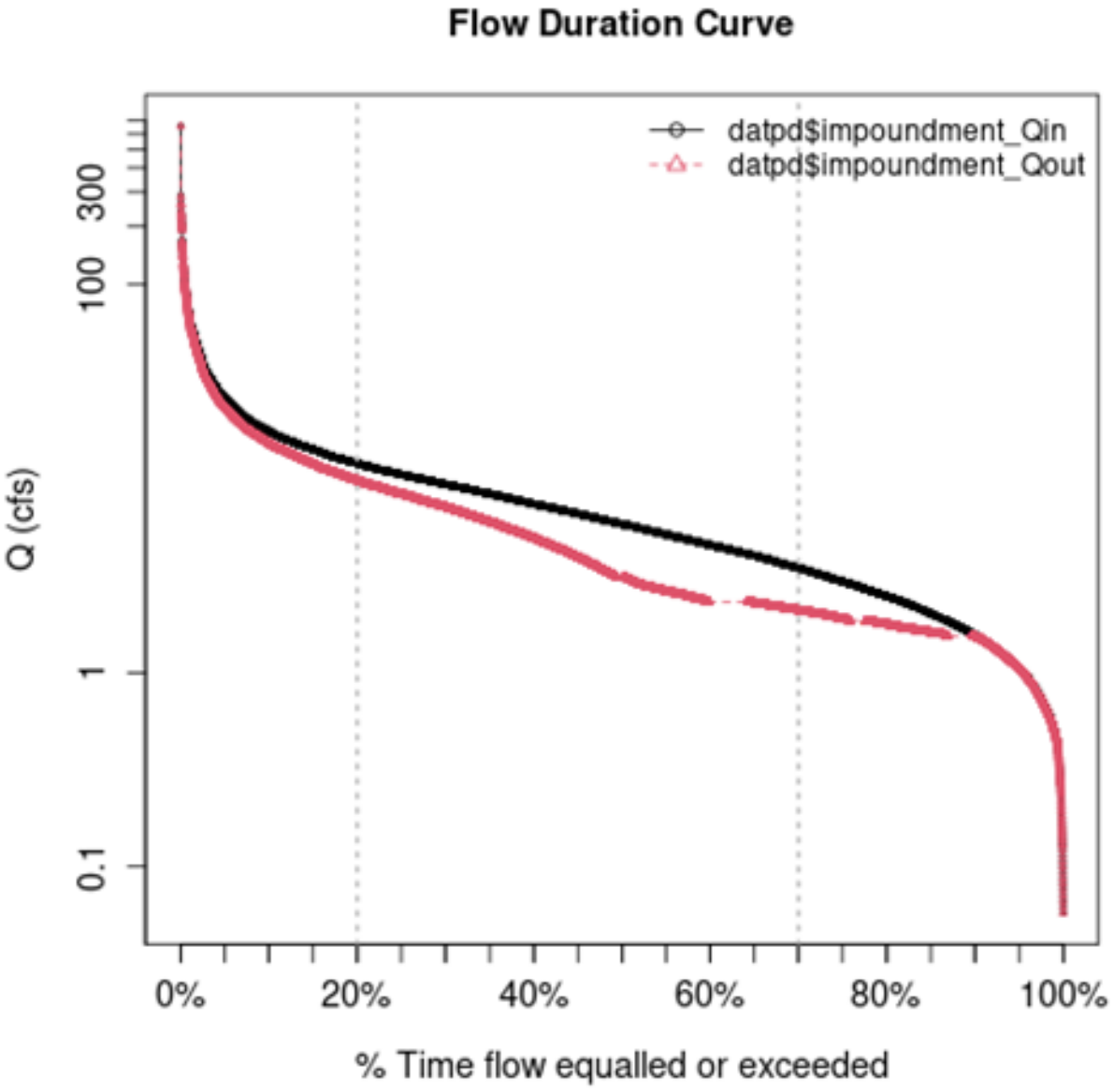
3.3.4.1. Current 0.0 MIF:



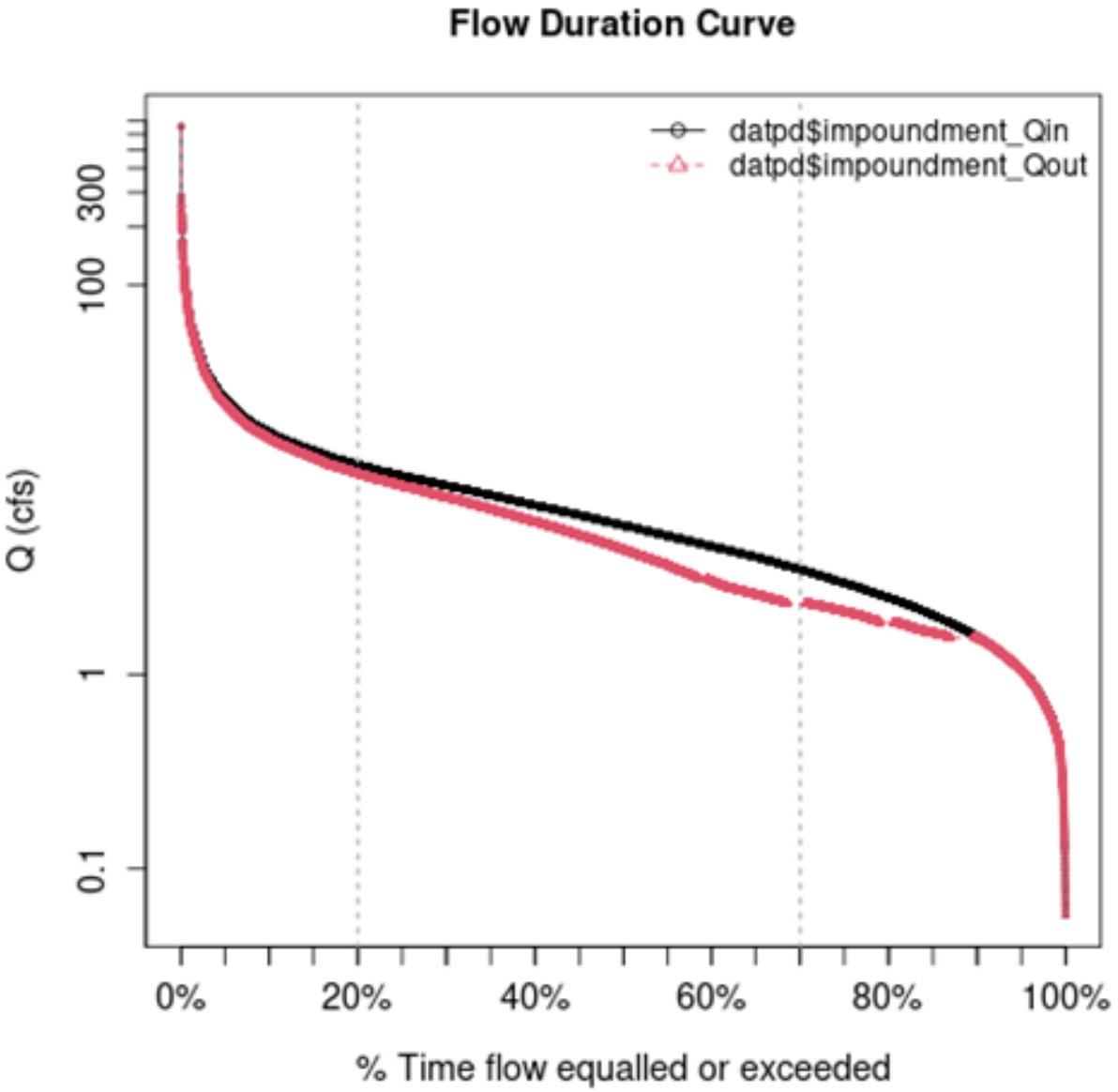
3.3.4.2. Tiered Release w/Q30 < 80% Storage:



3.3.4.3. Tiered Release w/Recharge Trigger:



3.3.4.4. 0.69 mgd w/Recharge Tiered:



4. VAHydro Model:

4.1. Appendix B - VAHydro

The comprehensive VAHydro hydrologic model is used by the DEQ Office of Water Supply to evaluate instream and off-stream beneficial uses for non-tidal surface water withdrawals throughout Virginia. This model also simulates streamflow with inputs such as precipitation, climate, land use, and topography, as well as local data collected through DEQ water supply planning and reporting programs, which includes all known withdrawals and discharges, as well as operational rules of Virginia Water Protection (VWP) permits and major hydrologic features such as reservoirs.

The VAHydro model is built on the rainfall-evaporation-runoff (RER) time-series from the Chesapeake Bay Model Phase 6[2]. The VAHydro model simulates conditions from 1984-2014 in the Chesapeake Bay watershed drainage, and 1984-2005 in the rivers flowing outside of the Chesapeake Bay watershed. The VAHydro model features high-resolution hydrologic subsections called "river segments" (over 600 river segments in total), roughly the size of HUC 10 hydrologic units, with additional high-resolution segments added for VWP modeling projects as needed.

4.2. Cumulative Impact Analysis (CIA)

DEQ assesses water supply sustainability through Cumulative Impact Analysis (CIA). CIA is a modeling and analysis approach that takes into account the varied hydrologic processes occurring throughout a river network (including meteorological and human water use). By simulating a daily water balance for every individual river segment within a watershed, DEQ is able to evaluate the potential "cumulative impact" of all streamflow changes occurring upstream and downstream of any location within the river system, as well as the downstream impact of a specific proposed or permitted surface water withdrawal.

The goal of the following analysis is to estimate the potential impacts of the proposed water withdrawal upon existing beneficial uses, including both in-stream and off-stream uses. In addition, cumulative impacts from all existing withdrawals are included in the evaluation.

4.2.1. Glossary of Cumulative Impact Modeling Terms

- 30 Day Low Flow (l30): Describes the lowest consecutive 30 day average daily streamflow over the simulation period. This metric is a representation of a short-term, or acute drought.
- 90 Day Low Flow (l90): Represents the lowest consecutive 90 day average daily streamflow over the simulation period. This would represent a prolonged drought.
- Base Demand / Requested Demand: The demand simulated for a facility/intake prior to any reductions due to conservation, depleted storage, or adherence to Minimum Instream Flow operational rules (MIF). In this document, *Base Demand* is expressed as *MGY*, and Requested Demand is given in *MGD*.
- CFS: Cubic Feet Per Second, a common unit of measuring stream flow.
- Consumptive Use Fraction (CU): This is calculated as a fraction of modeled Flow, so it is CU = 1.0 - (Flow / Flow_Baseline), where Flow_Baseline = (Flow + WD - PS), and WD and PS are the total cumulative withdrawals and point source discharges above the point in the stream. In other words, for calculating baseline flow, we take modeled outflow from the river, add the withdrawals back in, and

[2] Chesapeake Bay Program Phase 6 Model.

subtract the point source in order to estimate a baseline flow balance. This almost always ends up being a higher number than the modeled Flow out, so it tells us the fraction of baseline flow that is consumed. Occasionally there are water transfers and point sources from groundwater, or point sources that cross watershed boundaries that can make the CU fraction in some watersheds negative, i.e. Flow > Flow_Baseline.

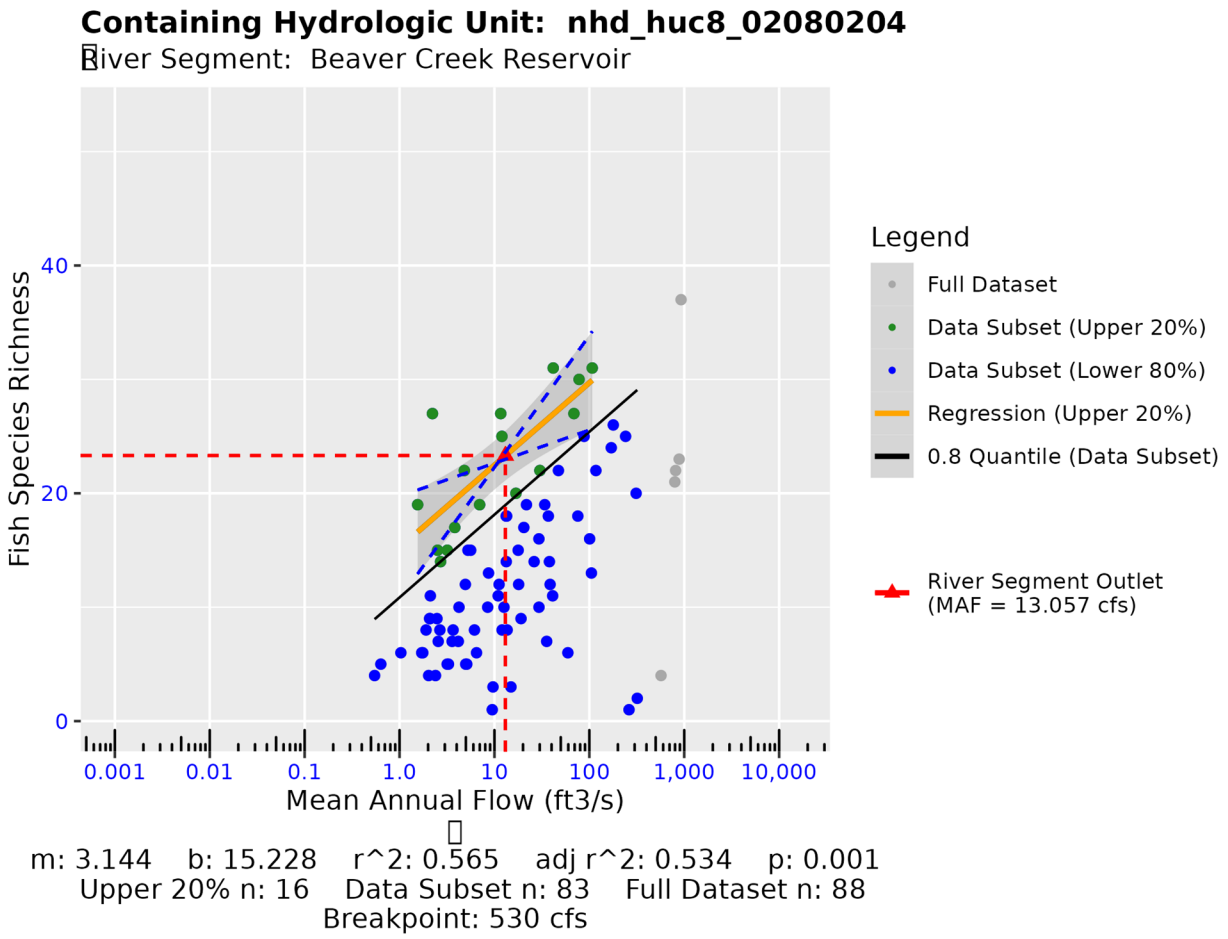
- Cumulative Withdrawal: The amount of water withdrawn by all intakes in a given river segment sub-watershed, and all upstream sub-watersheds. See also: *Cumulative Withdrawal*.
- Days of Storage Remaining: For reservoir models, the quotient of the volume of water in a reservoir divided by the daily rate of withdrawal, calculated at each time step of the entire simulation period.
- Maximum 30 day potential drought reduction/Unmet Demand (MGD): The largest difference between *Requested Demand* and *Withdrawal Met* that results during a continuous 30-day simulation period.
- MGD: Millions of Gallons per Day, a common unit of measuring withdrawal and discharge.
- MGY: Millions of Gallons per Year, a common unit for expressing annual facility demand.
- Minimum Days of Storage Remaining: The minimum simulated *Days of Storage Remaining* in a reservoir.
- Point Source: Water returned to the stream as treated wastewater.
- Withdrawal: The amount of water withdrawn by a single facility, or the total amount of water withdrawn within a single simulated river segment sub-watershed. See also: *Cumulative Withdrawal*.
- Withdrawal Met: The amount of requested demand that was met, on average, throughout the entire simulation period.
- Drought Reduction/Unmet Demand: The difference between *Base Demand* and *Withdrawal Met*, on average, throughout the entire simulation period.

5. Appendix A - Ecological Impacts Assessment:

5.1. Elfgen:

In response to a need for better environmental flow metrics, DEQ has developed a new framework for characterizing relations between streamflow and aquatic organism species richness. Part of an evolving approach to managing environmental flows for maintaining aquatic life; this methodology builds on existing minimum instream flow approaches, allowable withdrawals as a percentage of flow, and extensive flow-habitat studies. For the first time this new framework may allow quantification of potential species loss resulting from flow change and may offer an improved understanding of aquatic life risk variability due to geographic location, stream size and local scale.

This new flow-ecology framework referred to as "elfgen" (*pronounced elf-jen*) derives its name from Ecological Limit Function (ELF) generation (*ELF-gen*). In order to calculate river segment-level richness change, elfgen is first used to produce ELFs, or relations between stream flow and species richness at the HUC 8 scale (See plot below). This is achieved using long term datasets for both ecological and hydrologic data. Ecological data (Fish species richness) is sourced from the VAHydro-EDAS dataset. Hydrologic data (Average Annual Flow) is sourced from the National Hydrography Dataset Plus. The Richness Change values presented in the table below are derived from this flow-ecology relation.



ewpageEstimates for richness change are presented both as an absolute number of species (Richness Change (abs)) and as a percentage of the total number of species present (Richness Change (%)). Richness change calculations are derived from the

estimated percent total consumptive use[3]. Note: elfgen methodology only applicable for watersheds < 800 cfs mean annual flow.

Description	Current 0.0 MIF	Tiered Release w/Q30 < 80% Storage	Tiered Release w/Recharge Trigger	0.69 mgd w/Recharge Tiered
Consumptive Use (%)	11	19	19	11
Cumulative Withdrawal (MGD)	0.66	1.15	1.15	0.69
Richness Change (abs)	-0.37	-0.66	-0.66	-0.38
Richness Change (%)	-1.58	-2.85	-2.85	-1.64

[3] Kleiner et al: https://onlinelibrary.wiley.com/doi/full/10.1111/1752-1688.12876 & Rapp et al: https://onlinelibrary.wiley.com/doi/full/10.1111/1752-1688.12877

6. Appendix C - Nearby Users Table:

	Location	Sub-Watershed	MP Type	MP Name	MP 5-yr Avg Use (MGY)	Facility Name	Facility 5-yr Avg Use (MGY)	Facility 2040 Use (MGY)	Tiered Release w/Recharge Trigger: base_demand_mgy
1	Upstream	Beaver Creek Reservoir	intake	BEAVER CREEK RESERVOIR	252.56	CROZET WTP	252.56	282.48	419.97
2	Upstream	Mechums River at SFR Confluence	intake	#1 Irrigation Pond (pump station location)	14.80	OLD TRAIL GOLF CLUB	14.80	0.00	16.33

Attachment B – Default Water Conservation Conditions

Mandatory Non-essential Water Use Restrictions
Virginia Drought Assessment and Response Plan

The following non-essential water uses will be prohibited during periods of declared drought emergencies. Please note the exceptions that follow each prohibited use. These prohibitions and exceptions will apply to uses from all sources of water and will only be effective when the Governor of Virginia or the Virginia Drought coordinator declares a Drought Emergency. Water use restrictions shall not apply to the agricultural production of food or fiber, the maintenance of livestock including poultry, nor the commercial production of plant materials, *provided that best management practices are applied to assure the minimum amount of water is utilized.*

1. ***Unrestricted irrigation of lawns is prohibited.***

   - Newly sodded and seeded areas may be irrigated to establish cover on bare ground at the minimum rate necessary for no more than a period of 60 days. Irrigation rates may not exceed one inch of applied water in any 7-day period.

   - Gardens, bedding plants, trees, shrubs, and other landscape materials may be watered with handheld containers, handheld hoses equipped with an automatic shutoff device, sprinklers or other automated watering devices at the minimum rate necessary but in no case more frequently than twice per week. Irrigation should not occur during the heat of the day.

   - All allowed lawn irrigation must be applied in a manner to assure that no runoff, puddling, or excessive watering occurs.

   - Irrigation systems may be tested after installation, routine maintenance, or repair for no more than ten minutes per zone.

2. ***Unrestricted irrigation of golf courses is prohibited.***

   - Tees and greens may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary.

   - Localized dry areas may be irrigated with a handheld container or handheld hose equipped with an automatic shutoff device at the minimum rate necessary.

   - Greens may be cooled by syringing or by the application of water with a handheld hose equipped with an automatic shutoff device at the minimum rate necessary.

   - Fairways may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary not to exceed one inch of applied water in any ten-day period.

- Fairways, tees, and greens may be irrigated during necessary overseeding or resodding operations in September and October at the minimum rate necessary. Irrigation rates during this restoration period may not exceed one inch of applied water in any seven-day period.

- Newly constructed fairways, tees and greens and areas that are re-established by sprigging or sodding may be irrigated at the minimum rate necessary not to exceed one inch of applied water in any seven-day period for a total period that does not exceed 60 days.

- Fairways, tees, and greens may be irrigated without regard to the restrictions listed above so long as:

    - The only water sources utilized are water features whose primary purpose is stormwater management;

    - Any water features utilized do not impound permanent streams;

    - During declared Drought Emergencies these water features receive no recharge from other water sources such as ground water wells, surface water intakes, or sources of public water supply; and,

    - All irrigation occurs between 9:00 p.m. and 10:00 a.m.

- All allowed golf course irrigation must be applied in a manner to assure that no runoff, puddling, or excessive watering occurs.

- Rough areas may not be irrigated.

3. ***Unrestricted irrigation of athletic fields is prohibited.***

- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at a rate not to exceed one inch per application or more than a total of one inch in multiple applications during any ten-day period. All irrigation water must fall on playing surfaces with no outlying areas receiving irrigation water directly from irrigation heads.

- Localized dry areas that show signs of drought stress and wilt (curled leaves, foot-printing, purpling) may be syringed by the application of water for a cumulative time not to exceed fifteen minutes during any twenty four hour period. Syringing may be accomplished with an automated irrigation system or with a handheld hose equipped with an automatic shutoff device at the minimum rate necessary.

- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. during necessary overseeding, sprigging or resodding operations at the minimum rate necessary for a period that does not exceed 60 days. Irrigation rates during this restoration period may not exceed one inch of applied water in any seven-day period. Syringing is permitted during signs of drought stress and wilt (curled leaves, foot-printing, purpling).

- All allowed athletic field irrigation must be applied in a manner to assure that no runoff, puddling, or excessive watering occurs.

- Irrigation is prohibited on athletic fields that are not scheduled for use within the next 120-day period.

- Water may be used for the daily maintenance of pitching mounds, home plate areas and base areas with the use of handheld containers or handheld hoses equipped with an automatic shutoff device at the minimum rate necessary.

- Skinned infield areas may utilize water to control dust and improve playing surface conditions utilizing handheld containers or handheld hoses equipped with an automatic shutoff device at the minimum rate necessary no earlier than two hours prior to official game time.

4. ***Washing paved surfaces such as streets, roads, sidewalks, driveways, garages, parking areas, tennis courts, and patios is prohibited.***

   - Driveways and roadways may be pre-washed in preparation for recoating and sealing.

   - Tennis courts composed of clay or similar materials may be wetted by means of a hand-held hose equipped with an automatic shutoff device at the minimum rate necessary for maintenance. Automatic wetting systems may be used between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary.

   - Public eating and drinking areas may be washed using the minimum amount of water required to assure sanitation and public health.

   - Water may be used at the minimum rate necessary to maintain effective dust control during the construction of highways and roads.

5. ***Use of water for washing or cleaning of mobile equipment including automobiles, trucks, trailers, and boats is prohibited.***

   - Mobile equipment may be washed using handheld containers or handheld hoses equipped with automatic shutoff devices provided that no mobile equipment is washed more than once per calendar month and the minimum amount of water is utilized.

   - Construction, emergency, or public transportation vehicles may be washed as necessary to preserve the proper functioning and safe operation of the vehicle.

   - Mobile equipment may be washed at car washes that utilize reclaimed water as part of the wash process or reduce water consumption by at least 10% when compared to a similar period when water use restrictions were not in effect.

   - Automobile dealers may wash cars that are in inventory no more than once per week utilizing handheld containers and hoses equipped with automatic shutoff devices, automated equipment that

utilizes reclaimed water as part of the wash process, or automated equipment where water consumption is reduced by at least 10% when compared to a similar period when water use restrictions were not in effect.

- Automobile rental agencies may wash cars no more than once per week utilizing handheld containers and hoses equipped with automatic shutoff devices, automated equipment that utilizes reclaimed water as part of the wash process, or automated equipment where water consumption is reduced by at least 10% when compared to a similar period when water use restrictions were not in effect.

- Marine engines may be flushed with water for a period that does not exceed 5 minutes after each use.

6. ***Use of water for the operation of ornamental fountains, artificial waterfalls, misting machines, and reflecting pools is prohibited.***

   - Fountains and other means of aeration necessary to support aquatic life are permitted.

7. ***Use of water to fill and top off outdoor swimming pools is prohibited.***

   - Newly built or repaired pools may be filled to protect their structural integrity.

   - Outdoor pools operated by commercial ventures, community associations, recreation associations, and similar institutions open to the public may be refilled as long as:

     - Levels are maintained at mid-skimmer depth or lower;

     - Any visible leaks are immediately repaired;

     - Backwashing occurs only when necessary to assure proper filter operation;

     - Deck areas are washed no more than once per calendar month (except where chemical spills or other health hazards occur);

     - All water features (other than slides) that increase losses due to evaporation are eliminated; and

     - Slides are turned off when the pool is not in operation.

   - Swimming pools operated by health care facilities used in relation to patient care and rehabilitation may be filled or topped off.

   - Indoor pools may be filled or topped off.

   - Residential swimming pools may be filled only to protect structural integrity, public welfare, safety, and health and may not be filled to allow the continued operation of such pools.

8. ***Water may be served in restaurants, clubs, or eating-places only at the request of customers.***

Attachment C: VWP PERMIT CONSTRUCTION STATUS UPDATE FORM

Attached to VWP Individual Permit Number 22-2318

[DATE]

[PERMIT ACTION]

Date (check one):

☐ June____, _____

☐ December _____, _____

VWP Individual Permit Number: 22-2318

Project Name and Location: Crozet Water Supply Project located at 1525 Browns Gap Turnpike Charlottesville VA, 22901

Status within each authorized surface water impact location, as identified on "Impact Map", dated and received October 5, 2023 with the joint permit application: (check one of the following status options for each impact number/location. Attach additional sheet(s) if needed.)

Authorized impact number	Construction activities not started	Construction activities started	Construction activities started but currently not active	Does this impact involve culvert(s)[1]?	Construction activities complete[2]

[1] Provide spot elevations of the stream bottom within the thalweg at the beginning and end of the pipe or culvert, extending to a minimum of 10 feet beyond the limits of the impact, with completion of all culvert installations.

[2] If all construction activities and compensatory mitigation requirements are complete, the permittee completes and signs the Termination Agreement section below within 30 days of last authorized activity and/or compensation completion. A completed and signed Agreement serves as Notice of Project Completion (9VAC25-210-180 H).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

Authorized Signature: _____

Print Name: _____

Title: _____ Phone: _____

Date: _____ Email: _____

TERMINATION AGREEMENT BY CONSENT – PROJECT COMPLETION

Permittee Name: _____

Permittee Mailing Address: _____

Permittee Phone: _____

I hereby consent to the termination of coverage for VWP Individual Permit Number 22-2318.

"I certify under penalty of law that all activities and any required compensatory mitigation authorized by a VWP permit have been completed. I understand that by submitting this notice of termination that I am no longer authorized to perform activities in surface waters in accordance with the VWP permit, and that performing activities in surface waters is unlawful where the activity is not authorized by a VWP permit, unless otherwise excluded from obtaining a permit. I also understand that the submittal of this notice does not release me from liability for any violations of this VWP permit."

Permittee Signature: _____

Impact Construction Status Table Continued (if needed)

Additional Page [#] of [#]					
Authorized impact number	**Construction activities not started**	**Construction activities started**	**Construction activities started but currently not active**	**Does this impact involve culvert(s)[1]?**	**Construction activities complete[2]**

Attachment D: MONTHLY VWP PERMIT INSPECTION CHECKLIST

An inspection of all permitted impact areas, avoided waters and wetlands, and permanently preserved waters, wetlands and upland areas must be conducted at least once every month during active construction activities. Maintain this record on-site and available for inspection by DEQ staff.

Project Name	**VWP Permit #**	**Inspection Date** 5/15/2019
Inspector Name & Affiliation	**Phone # & Email Address**	

I certify that the information contained in this report is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

_____ _____

Signature of Inspector Date

	In Compliance?				
PERMIT REQUIREMENT	**Yes**	**No**	**Not Applicable**	**Location, Description, Notes & Corrective Action Taken (use additional note space below if needed)**	**Date Completed**
Surface water impacts are limited to the size and locations specified by the permit. No sedimentation impacts and no impacts to upland preservation areas have occurred[1].	☐	☐	☐		
Within 50 feet of authorized activities, all remaining surface waters and mitigation (preservation) areas that are inside the project area are clearly flagged or marked to prevent unpermitted impacts.	☐	☐	☐		
Authorized temporary impact areas have been restored to original contours, stabilized, and planted or seeded with original wetland vegetation type within 30 days of completing work in each area.	☐	☐	☐		
E&S controls consistent with the Virginia ESC Handbook are present and maintained in good working order.	☐	☐	☐		
Exposed slopes/stream banks have been stabilized immediately upon completion of work in each impact area, in accordance with the Virginia ESC Handbook.	☐	☐	☐		
Heavy equipment is placed on mats/ geotextile fabric when working in temporary wetland impact areas. Equipment and materials removed immediately upon completion of work.	☐	☐	☐		
Construction activities are not substantially disrupting the movement of aquatic life.	☐	☐	☐		
New instream pipes and culverts on <5% slope have been installed to maintain low flow conditions and are countersunk at both ends as follows: ≤ 24" diameter: countersunk 3" > 24" diameter: countersunk 6" or more. Any variations were approved in advance by DEQ.	☐	☐	☐		
Time-of-year restrictions are being adhered to.	☐	☐	☐		

[1] If unauthorized impacts have occurred, you **must** email or fax a copy of this report to DEQ within 24 hours of discovery. Email: vro.vwp@deq.virginia.gov.

	In Compliance?				
PERMIT REQUIREMENT	**Yes**	**No**	**Not Applicable**	**Location, Description, Notes & Corrective Action Taken (use additional note space below if needed)**	**Date Completed**
For stream channelization or relocation, work in surface waters is being performed in the dry, with all flows diverted until the new channel is stabilized.	☐	☐	☐		
Water quality monitoring is being conducted during permanent stream relocations.	☐	☐	☐		
Streams and wetlands are free from any sheen or discoloration that may indicate a spill of oil, lubricants, concrete or other pollutants.[2]	☐	☐	☐		

Inspection Notes

[2] Any fish kills or spills of fuels or oils shall be reported to DEQ immediately upon discovery at 540-574-7800. If DEQ cannot be reached, the spill or fish kill shall be reported to the Virginia Department of Emergency Management (VDEM) at 1-800-468-8892 or the National Response Center (NRC) at 1-800-424-8802. Any spill of oil as defined in § 62.1-44.34:14 of the Code of Virginia that is less than 25 gallons and that reaches, or that is expected to reach, land only is not reportable, if recorded per § 62.1-44.34:19.2 of the Code of Virginia and if properly cleaned up.