Memorandum

To:	Candy McGarry, County Administrator, Nelson County	**Project:**	Nelson County Source Water Evaluation
From:	Amanda Marsh, Project Manager, CHA Consulting, Inc.	**Date:**	July 10, 2025
CHA PN:	100648	**RE:**	Dillard Creek Water Source Evaluation

Executive Summary

Nelson County is exploring Dillard Creek, which traverses the recently acquired Larkin property, as a potential surface water source to support future development. A 2024 Water and Sewer Capacity Analysis report identified a need for an additional 81,940 gallons per day (GPD) (~0.082 million gallons per day (MGD)) to meet projected demand. The key objectives of the evaluation are to evaluate Dillard Creek's capacity to serve as a reliable water source by estimating streamflow with regard to needed future water demand; identify any threatened and endangered species and migratory fish in the project area and assess potential impacts of these species on withdrawal permitting; outline permitting requirements; and estimate associated costs of water withdrawal permitting, engineering, construction, and operation.

Dillard Creek Withdrawal Evaluation

- No direct USGS gage exists on Dillard Creek; as such, the Tye River gage (USGS 02027000) was selected as a surrogate to estimate Dillard Creek flows due to its proximity and similar watershed characteristics.
- Using drainage area scaling and the Tye River gage data for the 25-year period of January 1, 2000 to December 31, 2024, the average daily flow at Dillard Creek is estimated at 8.3 MGD, with a median flow of 5.0 MGD.
- A typical DEQ Virginia Water Protection (VWP) permit 10% withdrawal limit would allow for an **average** withdrawal of 0.83 MGD.

Historic Low Flow Periods

- During typical low-flow months of July and August, **monthly average** flows would support the required 0.082 MGD withdrawal.
- During the 2002 severe drought year, creek flow was too low on 30% of days for the projected needed demand. During these days, supplemental water would be required to meet the projected demand.

Permitting

- A VWP permit will be required for intake construction and water withdrawals which will include conditions on intake design, flow monitoring, and construction as well as withdrawal limitations.

Endangered and Threatened Species

- There are threatened and endangered aquatic species possible in the project area; potential impacts are believed to be minimal but environmental agencies may require site-specific evaluations.
- A low-level dam may be necessary to ensure adequate stream depth for water withdrawals, though it could face regulatory and ecological challenges.

Preliminary Cost Estimates

- Withdrawal permitting (Application prep and DEQ fee): $40,000–$50,000
- Dam installation permitting: $50,000-$75,000

- Special studies (e.g., endangered species, archaeology): $10,000–$25,000 per study
- Intake, pump station and water treatment system engineering and construction are estimated at $6.5M with operations and maintenance costs between $150,000 - $250,000 annually.

Conclusion

- Dillard Creek appears to have sufficient flow to meet future water needs under normal conditions. However, seasonal variability, environmental constraints, potential costs, and the need for supplemental water during drought conditions must be carefully considered.

Background and Objectives

In 2024 CHA Consulting Inc. completed a Water and Sewer Capacity Analysis for the Nelson County Larkin property that showed additional water source(s) would be needed to support future residential and recreational site development included in the master plan for the site. This analysis estimated an additional 81,940 GPD (or approximately 0.082 MGD) of water is needed to support future development of the property. As a follow-up to the 2024 analysis, CHA evaluated Dillard Creek, a portion of which runs through the Larkin property, as a potential surface water source to support future development of this property.

Photograph 1. Dillard Creek on Larkin Property.

The following objectives formed the basis of the evaluation of the potential Dillard Creek surface water source:

1. Identify an appropriate United States Geological Survey (USGS) gage in the area and the associated stream flow data to project estimated Dillard Creek flows and determine if there is potential for this creek to support development of the property.
2. Identify potential intake locations and the corresponding estimated flows.
3. Determine whether endangered or threatened species or other species concerns that may be in the areas upstream and downstream of the potential withdrawal location and assess the potential impacts of any such species on potential intake location and withdrawal volumes.
4. Identify potential permit conditions that are expected to be included in a Virginia Water Protection (VWP) permit that will be required for surface water withdrawal activities including withdrawal limitations, intake construction requirements and operations and reporting requirements.
5. Estimate permitting and capital and operational costs for a withdrawal location along Dillard Creek.

USGS Gage Station Identification and Stream Flow

The project area is located southwest of Lovingston in Nelson County. There are no permanent or temporary USGS gages or stream monitoring locations on Dillard Creek that can be used to determine creek flows based on actual stream flow data. In such circumstances, the Virginia Department of Environmental Quality (DEQ) and other agencies will use stream flow from USGS gages in nearby watersheds to project flows for those streams without USGS gages. CHA identified and assessed three real-time monitoring USGS gages located in the general project area around Lovingston from the USGS National Water Dashboard interactive map (https://dashboard.waterdata.usgs.gov/app/nwd/en/).

- USGS 02027000 Tye River Near Lovingston, VA
- USGS 02027500 Piney River at Piney River, VA
- USGS 02026000 James River at Bent Creek, VA

The James River upstream of Bent Creek encompasses multiple geophysical and hydrogeological regimes, some of which are not consistent with those of Nelson County and the Dillard Creek watershed. In addition, the James River watershed is substantially larger than the Dillard Creek watershed. As such, it was determined to not be a good watershed for drainage area comparisons.

Nelson County is the location of the headwaters of the Tye River, and the portion of the river measured by the gage referenced above has a much smaller drainage area and streamflow and more

representative of the hydrogeology of Dillard Creek than the downstream gage on the James River. The gage on the Tye River is also closer to the project site than the gage on the Piney River which is located further west. In addition, it appears DEQ utilized the Tye River gage for Dillard Creek flow projections for the development of the Nelson County Sewage Treatment Plant's VPDES permit, indicating agency acceptance of this data set for flow determinations. As such, the Tye River Near Lovingston, VA (02027000) gage was selected for review of the stream data since it is closer to the project area and is believed to provide more representative data.

The Piney River watershed is similar to the Tye River watershed's geophysical and hydrogeological regimes but is located further from Dillard Creek than the Tye River gage. As such, the Piney River gage data was used as a secondary data source for comparison to the Tye River gage data. Table 1 summarizes the USGS gages/flow monitoring locations and streamflow data for the Tye River and Piney River gages.

Table 1. USGS Gage in Nelson County on the Tye River.

Waterbody Name	Gage Identification	Latitude/ Longitude	Drainage Area (square miles)	Average Daily Streamflow Data	cfs/ Square Mile	Comments
Tye River	USGS 02027000 Tye River Near Lovingston, VA	37°42'55"N 78°58'55"W	93.0	103 MGD (160 cfs)	1.72	Real-time data(1) (10/1/1938 -to 4/9/2024)
Piney River	USGS 02027500 Piney River at Piney River, VA	37°42'08"N 79°01'40"W	47.7	61.4 MGD (95 cfs)	1.99	Real-time data(2) (10/1/1949 -to 9/30/2015)

(1) Used daily mean flows from USGS gage data from https://waterdata.usgs.gov/va/nwis/rt to calculate.

(2) Used statistics included from the USGS StreamStats application for this gage.

Dillard Creek Withdrawal Location

Flows in surface water bodies are influenced by several factors including the amount of watershed drained. In general, stream flows are expected to be the greatest in the downstream sections of the County where watershed areas are larger; however, the location of the potential withdrawal is limited to the location of the newly acquired property owned by the County. Thus, the evaluation was limited to this section of Dillard Creek on the property.

Dillard Creek Flow Evaluation Approach

The data from the Tye River reference gage can be extrapolated to provide estimated flow data for the Dillard Creek project location. The data extrapolation accounts for the additional drainage area of the reference gage, and the formula used is:

$$Q_{ungaged} = \underline{A_{ungaged}} / A_{gaged} * Q_{gaged}$$

where

$Q_{ungaged}$:	Flow at the ungaged location
Q_{gaged}:	Flow at surrogate USGS gage station
$A_{ungaged}$:	Drainage area of the ungaged location
A_{gaged}:	Drainage area at surrogate USGS gage station

The drainage area for the Dillard Creek withdrawal location along US-29 (Thomas Nelson Highway) near Lovingston was calculated and was compared to the watershed at the Tye River reference USGS Gage. Twenty-five years of data from January 1, 2000 through December 31, 2024 from the Tye River gage were used to project flows for the Dillard Creek withdrawal location since this period is considered to be more representative of current climatic and stream flow conditions than the entire data set beginning in 1938. This 25-year period also includes recent major drought periods. DEQ may select a different timeframe for the development of VWP permits required for the installation and operation of an intake, but it is not anticipated that this will have a significant impact on their calculations.

The drainage area at the Tye River Near Lovingston, VA gage is 93.0 square miles while the drainage area at the Larkin Property just north of Thomas Nelson Highway (US 29) was determined to be ~7.3 square miles using the USGS StreamStats application. The section of Dillard Creek represents approximately 8% of the Tye River watershed at the Tye River Near Lovingston, VA gage location. Using a drainage area comparison approach frequently used by Virginia regulatory agencies, the flow at the County line is assumed to be approximately 8% of the flow at the selected gage location. Figure 1 shows the location of the drainage area for the gages and drainage areas for the Tye River, Piney River, and the potential intake location on Dillard Creek.

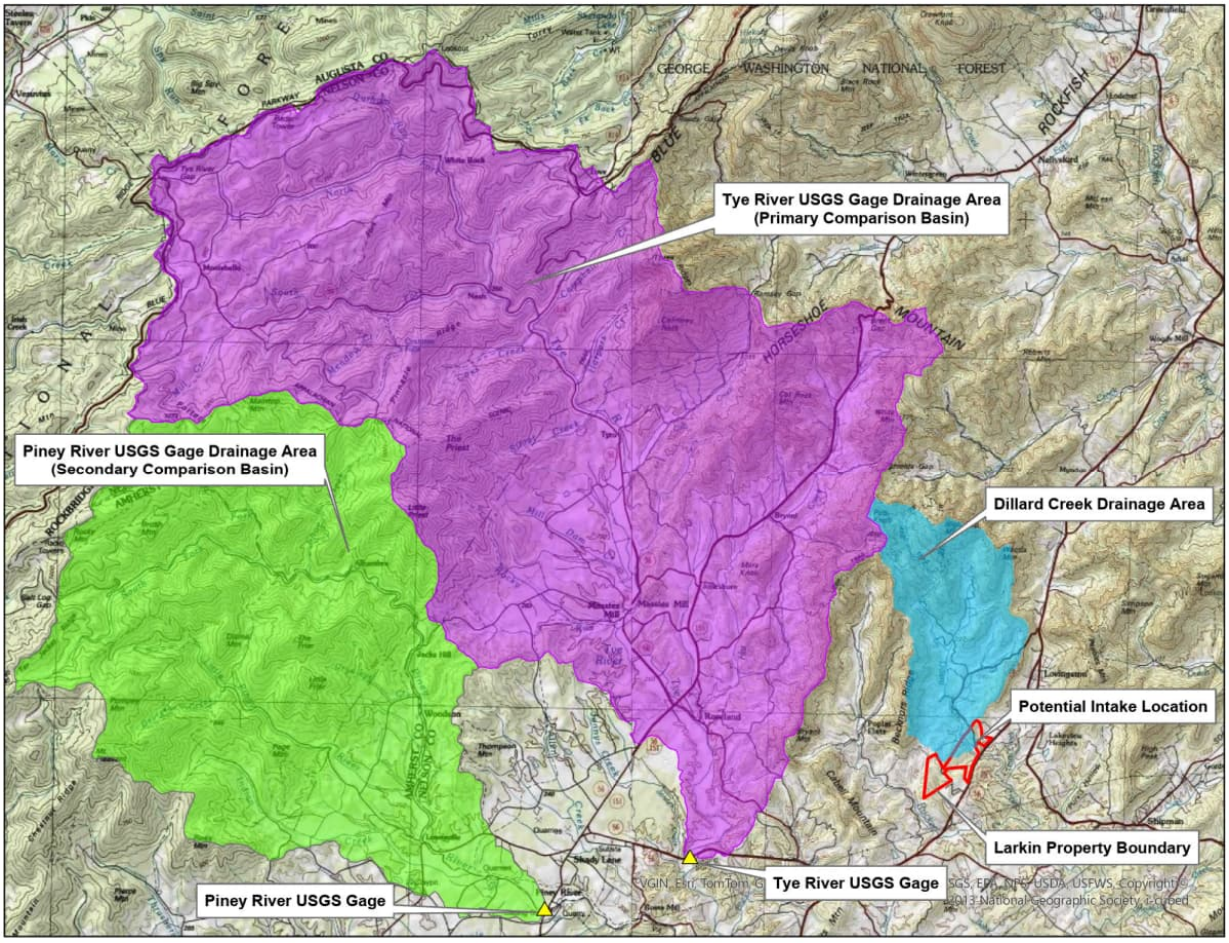

Figure 1. USGS Gages and Drainage Areas and Drainage Area of Potential Intake Location on Dillard Creek.

Projected Flows for Dillard Creek

The sections below analyze the data with consideration to average flows over a long-term period, monthly flow distribution over a long-term period, daily volume frequency flow distribution projections, and potential withdrawals during historic drought conditions.

Average Flows

The average flow data for the Tye River gage 25-year period was used in conjunction with the watershed size ratio to estimate average flows in Dillard Creek ($Q_{ungaged}$). For that 25-year period, there are 9,132 data points representing the average daily flow for the Tye River gage. The results are shown in the table below.

Table 2. Estimated Average Daily Streamflow for the Tye River Reference Location.

Stream	USGS Gage ID	A_{gaged} (Tye River Drainage Area)	$A_{ungaged}$ (Dillard Creek Drainage Area)	Q_{gaged} (Average Daily Tye River Flow)	$Q_{ungaged}$ (Estimated Average Dillard Creek Flow)
Tye River	02027000 Tye River Near Lovingston, VA	93 sq. miles	7.3 sq. miles	103 MGD (160 cfs)	8.3 MGD (12.8 cfs)

Notes: 1. Tye River flow based on the last 25-year period.
2. Dillard Creek flows at the reference location near US 29.

As depicted, the **average** estimated flow at Dillard Creek is 8.3 MGD. Assuming a typical 10% flow withdrawal limitation in a VWP withdrawal permit, the **average** available withdrawal at this location is estimated at 0.83 MGD.

Using this estimated Dillard Creek flow information, a median flow can also be determined (the median value of a set of numbers is the value at which half of the numbers in the set are below it, and the other half are above it). The **median** estimated flow in Dillard Creek is 5.0 MGD. The corresponding 10% withdrawal volume based on **median** creek flow is 0.50 MGD, and the minimum withdrawal volume was estimated at 0.003 MGD. The estimated streamflow depicted in Table 2 does not account for monthly or seasonal variations. These monthly and seasonal variations are described in the sections below.

As confirmation of the initial results of the calculated estimated flow at the Larkin property using the Tye River gage data, the Piney River average daily flow data from the StreamStats report of 95.2 cfs with its drainage area of 47.7 square miles calculates to 1.99 cfs/mile^2 as show in Table 1. Extrapolating the data for the drainage area size associated with the potential for a withdrawal on Dillard Creek on the Larkin property using the Piney River data, the estimated streamflow on Dillard Creek is 9.4 MGD (14.5 cfs). This projected flow is close to the estimate using the Tye River gage data and supports the Dillard Creek flow estimated described herein.

Monthly Flow Distribution Projections

The average daily streamflow data by month for the last 25 years was obtained for the reference gage on the Tye River and was used in conjunction with the drainage area information from the potential intake location on Dillard Creek near US-29 to determine estimated average streamflow for each month to better understand potential seasonal flow variations. These data are summarized in the table below.

Table 3. Monthly Average Streamflow for the Dillard Creek Location.

Month	Average Discharge at Tye River Near Lovingston, VA 02027000 (cfs)	Estimated Average Flow at the Dillard Creek Location (cfs)	Estimated Average Flow at the Dillard Creek Location (MGD)	10% of Average Flow at Dillard Creek (MGD)
January	192.5	15.4	9.9	1.0
February	192.4	15.4	9.9	1.0
March	215.0	17.2	11.1	1.1
April	234.8	18.8	12.1	1.2
May	203.4	16.3	10.5	1.1
June	130.3	10.4	6.7	0.7
July	70.5	5.6	3.6	0.4
August	64.9	5.2	3.4	0.3
September	129.3	10.3	6.7	0.7
October	103.5	8.3	5.3	0.5
November	168.5	13.5	8.7	0.9
December	217.0	17.4	11.2	1.1

As described previously, the **annual average** projected flow of Dillard Creek is 8.3 MGD. Using a 10% VWP permit withdrawal limit, the **average** allowable withdrawal is 0.83 MGD at the reference flow location on Dillard Creek. As shown on the table above, there are significant monthly and seasonal variations in the projected Dillard Creek flow that would change the actual withdrawal volume limits throughout the year. The projected Dillard Creek flow is lowest during the summer and fall periods. The lowest average streamflow months are July and August, followed by October. These data indicate that even during the low flow months, the **monthly average daily flow** is greater than the projected demand of 0.082 MGD.

Daily Volume Frequency Flow Distribution Projections

While the average daily flow and monthly average flow data are helpful parameters to determine the feasibility of Dillard Creek as a potential water source, it is also important to understand the frequency of low flow events that could result in a withdrawal limitation that is less than the 0.082 MGD projected water demand.

The table below summarizes the percentages of days during the last 25 years in which withdrawal volumes (10% of the estimated Dillard Creek flow) are equal to or greater than selected incremental volumes, ranging from 0.3 MGD to 5.0 MGD.

Table 4. Volume Frequency Flow Distribution Projections at the Potential Withdrawal Location.

Flow Tier	Dillard Creek Flow	10% of Flow at Dillard Creek	Percentage of Days When Dillard Creek Flows Exceed Flow Tier	Percentage of Days When Dillard Creek Flows Do Not Exceed Flow Tier
1	0.3 MGD	0.03 MGD	98.2%	1.8%
2	0.4 MGD	0.04 MGD	97.7%	2.3%
3	0.5 MGD	0.05 MGD	97.0%	3.0%
4	0.6 MGD	0.06 MGD	96.1%	3.9%
5	0.7 MGD	0.07 MGD	94.9%	5.1%
6	**0.8 MGD**	**0.08 MGD**	**93.3%**	**6.7%**
7	0.9 MGD	0.09 MGD	91.8%	8.2%
8	1.0 MGD	0.1 MGD	90.5%	9.5%
9	2.0 MGD	0.2 MGD	77.9%	22.1%
10	3.0 MGD	0.3 MGD	67.1%	32.9%
11	4.0 MGD	0.4 MGD	57.4%	42.6%
12	5.0 MGD	0.5 MGD	49.7%	50.3%

With a desired withdrawal of approximately 0.08 MGD to meet the projected demands, the flow at the Dillard Creek withdrawal location needs to be 0.8 MGD or more on a daily basis. As indicated in bold text in the table above, the average daily flow at the withdrawal location on Dillard Creek would **not** support a withdrawal of 0.08 MGD on approximately 6.7% of the days based on the past 25 years of Tye River flow data. **This represents 615 days (1.7 years) over the last 25 years.**

Potential Withdrawals During Drought Flows

During extended low flow conditions, VWP permit requirements may limit withdrawals to less than the projected 0.082 MGD demand for extended periods. Virginia has experienced a number of multi-year droughts including the 1999-2002, 2007-2008, and 2010-2012 periods (https://www.drought.gov/states/virginia). The table below summarizes the annual mean flows for those years and includes the corresponding withdrawals that would have been possible assuming the same maximum 10% withdrawal limitation.

Table 5. Flows During Historic Drought Years and Associated Potential Withdrawals.

Year	Annual Mean Flow at Tye River Near Lovingston, VA 02027000 (cfs)	Estimated Flow at the Dillard Creek Location (MGD)	10% of Flow at Dillard Creek (MGD)	Days / Year When Dillard Creek Flow Would Have Been Less than 0.82 MGD[(1)]
1999	145	7.5	0.75	60
2000	100.5	5.2	0.52	0
2001	71.9	3.7	0.37	64
2002	62.9	3.3	0.33	112
2007	106.3	5.5	0.55	94
2008	95.1	4.9	0.49	71
2010	164.4	8.5	0.85	47
2011	183.7	9.5	0.95	2
2012	96.8	5.0	0.50	2

(1) This column indicates the number of days within the corresponding year that the projected demand of 0.082 MGD could not be withdrawn from Dillard Creek.

As shown on Table 5, the lowest **annual mean** flow at the Tye River gage was 2002 when the flow was 62.9 cfs. The corresponding estimated 10% of flow at Dillard Creek (MGD) is 0.33 MGD. During this 2002 drought period, withdrawals would have been limited to less than the 0.082 MGD projected demand on 112 days, or 30% percent of the year.

Extended Withdrawal Limitation Periods

In addition, the flow projections determined herein indicate that there will be days and periods of multiple consecutive days when Dillard Creek withdrawals will be less than 82,000 gpd and alternative supplemental sources may be needed. Examples of limited withdrawal periods using estimated Dillard Creek flows in the last few years include:

- During the 10/2/23 to 11/8/23 timeframe, there was insufficient creek flow for an 82,000 gpd withdrawal that extended for 38 consecutive days.
- During the 10/2/23 to 11/20/23 timeframe, there was only one day of the 50-day period that Dillard Creek flows would have allowed a withdrawal of 82,000 gpd.

Potential Intake Location Requirements

Stream flows, the stream's physical characteristics, access to the surface water, land ownership, public access and safety, and land use are all considerations for determining a potential site of a surface water intake. Proximity to developed road access is also considered to support intake construction and maintenance. The Larkin property is owned by Nelson County and is located

adjacent to Thomas Nelson Highway (US 29). A portion of Dillard Creek lies on the property owned by the County.

As noted above, several factors must be considered when attempting to locate a surface water withdrawal intake. Stream characteristics including stream depth are critical to support year-round operation of the intake and the associated 1 mm intake screens required by the Virginia Water Protection (VWP) permit. As such, water depths greater than four feet are desirable. In addition, the intake must be in close proximity to a pump station, which in turn requires enough available suitable land for the construction and operation of the pump station. For the purposes of maximizing the drainage area of the withdrawal location and the calculations of estimated flow described in the sections above, the location of the proposed intake was selected just north of Thomas Nelson Highway on the southern portion of the Larkin property. An intake location right off a roadway or highway is not unusual for water intakes, but it can pose an additional risk in the event of a traffic accident resulting in a spill of chemicals into the stream which could create contamination and subsequent water quality issues. If the location of the intake is moved to the most northern portion of the parcel along Dillard Creek, the drainage area is reduced from 7.33 square miles (previously rounded to 7.3 square miles for calculations) to 7.28 square miles. This represents a slight reduction in drainage area of less than 1%, and the corresponding decrease in estimated stream flows in Dillard Creek using this more upstream location is not significant.

In order to meet the needed water depth for the installation and operation of an intake, Nelson County may elect to request the installation of a low-level dam as part of the VWP permit application process. However, obtaining a permit for the installation of a dam may be difficult due to some of the negative consequences of dams. A dam can impact the safety of the stream increasing drowning risks, have ecological impacts such as elevating stream temperatures and decreasing dissolved oxygen concentrations, and act as a barrier to aquatic fish species that rely on migration as part of their life cycle. The potential impact on migratory fish is discussed in a section below.

Withdrawal Permitting Summary

The permitting process for a new water withdrawal intake includes the preparation of a Joint Permit Application (JPA) for the construction of the intake structure as well as for the water withdrawal. Once prepared, the JPA is submitted to the Virginia Marine Resources Commission (VMRC) who acts as a clearinghouse and distributes the application to the U.S. Army Corps of Engineers (USACE) and the DEQ for review and permitting purposes. Each agency has an opportunity to review the application and require a permit depending on the jurisdiction of that agency over the proposed activities. These agencies also distribute the application to a number of other Federal and

State agencies for review and comment; these include but are not limited to the U.S. Fish and Wildlife Service, the Department of Wildlife Resources, and the Department of Conservation and Recreation. As part of the permitting process, the proposed project will be advertised in a newspaper of local distribution to provide an opportunity for public comment.

For a new intake on Dillard creek, it is anticipated that DEQ will issue a VWP Permit for both the intake construction and water withdrawals. In addition to the DEQ VWP Permit, it is expected that the USACE will issue a construction permit with standard requirements applicable to intake construction activities. Due to a recent regulatory change, VMRC does not have jurisdiction in this part of Virginia and is not expected to issue a permit for an intake on Dillard Creek.

Summary of Potential VWP Permit Conditions

DEQ issues, administers, and enforces water withdrawal permits. If the withdrawal is approved, DEQ will issue a VWP permit with conditions that typically include intake construction requirements as well as water withdrawal operations and reporting requirements that are applicable throughout the permit term. These requirements typically include limitations on withdrawal volumes as a function of stream flows as well as requirements for intake screen size and face velocity.

The following sections summarize the anticipated sections of a VWP permit for the construction and operation of a new water intake. The sections include:

- Authorized Activities
- Permit Term
- Standard Project Conditions
- Stream Modifications, Including Intake/Outfall Structures
- Surface Water Withdrawals
- Water Withdrawal Monitoring, Recordation and Reporting Conditions
- Construction Monitoring and Submittals
- General Conditions

The general requirements for each of these sections are summarized herein based on as the *Virginia Water Protection Permit Program Regulation (9 VAC 25-210)* as well as a review of several other WTP facility VWP permits.

Authorized Activities

This section of the permit includes information on the activity that has been authorized by DEQ; this would include the authorization of the installation and operation of a surface water withdrawal

from the selected water body. This section will also reference the area of the temporary and permanent impacts that are authorized as part of the installation of the intake and will match the calculated areas of disturbance that were included by the County as part of the JPA. This section will also include a standard condition requiring the permittee to notify DEQ of additional impacts to surface waters as well as changes in the intake design so that the agencies may determine if the permit needs to be modified and if the changes are acceptable to the agencies.

Permit Term

The permit will include a section on the permit term. VWP permits are typically issued for fifteen (15) year terms. The permit application for reissuance of the permit must be completed 270 calendar days prior to the expiration date of the VWP permit.

Standard Project Conditions

This section will include standard text regarding the expectations that construction activities are conducted regarding standard erosion and sediment control and other best management practices to minimize in-stream impacts. This includes conditions that may require the following in addition to other conditions deemed appropriate by DEQ:

- Adhering to Time-of-Year-Restrictions recommended by the Virginia Department of Wildlife Resources if applicable;
- Beneficial uses of the stream not to be impacted by the project;
- Aquatic life movement not to be impeded by the project;
- Downstream flows to be maintained;
- Minimal adverse impacts on navigation;
- Not blocking more than half of the stream at any given time;
- Not impeding normal or expected high flows;
- Reporting any fish kills or spills of fuels or oils immediately upon discovery;
- Reporting any potentially environmentally threatening conditions within 24 hours; any changes to the conditions must be approved beforehand.;
- Conducting construction activities during periods of low flow;
- Spill prevention;
- Prevention of a violation of Virginia Water Quality Standards; and
- Reporting, notification and submittal requirements.

Stream Modifications, Including Intake/Outfall Structures, Access Roads, and Installation of Utilities

These sections of the permit include additional construction requirements that apply to the installation of an intake, access roads, and utility installation. This includes restrictions on the

disturbance and removal of stream substrate as part of the intake installation. This will include some erosion control conditions as well as restrictions on materials used. This may also include a section with conditions on the construction of an access road to the project site if needed. If utility work will be completed in surface waters, this section will include conditions on restoration of this impact post-construction and temporary excavated material storage.

Surface Water Withdrawals

This section of the permit will identify the surface water source where the intake will be located. In addition, it is expected to include the following:

- **Maximum withdrawal volumes, potentially with daily, monthly, and annual limitations;**
- **Restricting the withdrawal to a certain percentage of streamflow, often set at 10%;**
- The calculation for estimating streamflow at the intake location;
- **Requirements for the intake screen design such as screen openings not larger than 1 millimeter in width and height and the screen face intake velocities not greater than 0.25 feet per second;**
- Development and approval of a drought management plan; and
- Water withdrawal monitoring report requirements.

Water withdrawal monitoring, recordation and reporting conditions

This section of the permit will include standard text regarding monitoring and operation requirements for the intake. This includes conditions that require the following:

- Submittal of a monitoring and operations plan for approval within 180 of permit issuance. The monitoring and operations plan must include:
    - Intake procedures ensuring compliance with permit conditions;
    - Streamflow estimation procedures in accordance with permit conditions;
    - Streamflow estimation procedures in the event that the stream gauging station is damaged, disabled or discontinued; and
    - Procedures to ensure compliance with withdrawal recording, monitoring and reporting requirements.
- Pump monitoring and recording requirements;
- Daily monitoring using flow totalizer technology;
- Reporting non-compliance with withdrawal limitations within five (5) days; and
- Water withdrawal monitoring report requirements.

Construction Monitoring and Submittals

As part of the intake construction process, there are conditions for reporting and monitoring that are likely to be included in the VWP permit. This includes requirements for submitting final plans in advance of the construction activities, written notification of initiation of land disturbance, monthly site inspections reporting, semi-annual constructions status update reporting, notification to the DEQ of unauthorized impacts to surface waters, and notification of completion of construction activities.

The permit will likely include report forms for some of the reporting that is required to be completed as part of the construction monitoring.

General Conditions

Part II of the VWP permit would include the general conditions applicable to all VWP permits. The following sections summarize the anticipated general conditions of a VWP permit for the construction and operation of a new water intake.

Endangered and Threatened Species

The Virginia Department of Wildlife Resource's (DWR) Virginia Fish and Wildlife Information Service (VaFWIS) and the U.S. Fish and Wildlife Service (USFWS)'s Information for Planning and Consultation (IPaC) databases were reviewed to determine if there is the potential for any endangered and threatened (E&T) species impacts that could impact the VWP permitting and/or complicate the location of the intake in the selected waterbody or the volume and rate of withdrawals.

<u>DWR VaFWIS Database Review</u>

Based on the DWR's VaFWIS database search, ten (10) state and/or federally endangered and/or threatened (E/T) species were identified as known or likely to occur within a two-mile radius of the potential intake location on Tye River in Nelson County. Of these, seven (7) are terrestrial and three (3) are aquatic. The terrestrial species include three (3) bat species: the Northern Long-Eared Bat, the Little Brown Bat, and the Tri-Colored Bat. Although the intake construction itself would not impact these species, there is often tree-clearing associated with these types of construction projects on the bank of the stream. Any tree clearing may trigger time-of-year restrictions or that bat surveys be completed to determine if these bat species are absent in the project area prior to initiaitng tree clearing. The intake construction is not expected to have the potential to impact the remaining listed terrestrial species. A summary of the aquatic specis identified in the database along with an assessment of potential impacts follows.

The juvenile James Spineymussel (*Parvaspina collina*) generally have prominent spines on each valve although the adults usually lack spines. The shell is orange with a darkly pigmented band around the edges. The James spinymussel is found in a variety of substrates that are free from silt. The mussels are generally buried in the substrate. According to the VaFWIS database, the James Spineymussel has been located in Nelson County but is not present within the hydrologic unit where the intake construction would occur. As such, this potential intake is unlikely to impact this species.

The Yellow Lance (*Elliptio lanceolata*) is a bright yellow mussel with a shell more than twice as long as it is tall, reaching just over three inches in length. The species favors clean water in gravel or sandy substrates in small to medium-sized streams and smaller rivers. According to the VaFWIS database, the Yellow Lance has been located in Nelson County but is not present within the hydrologic unit where the intake construction would ocucr. As such, this potential intake is unlikely to impact this species.

The Green Floater (*Lasmigona subviridis*) is a small mussel with a thin shell and a subovate or trapezoidal shape. The shell is yellow to green with dark green rays. The species is found in small creeks and large rivers; it is intolerant of strong currents and occurs in pools and other calm waters. It prefers a gravel and sand substrate. The VaFWIS identified this species as known or likely to occur within the 2-mile radius of this project site, as it is known or likely within Nelson County and the hydrologic unit of the project site. However, the proposed project location receives consistent flow and current, and lacks any pools or calm waters that are ideal for this species. As such, this potential intake is unlikely to impact this species.

The potential for the project to impact endangered or threatened species is believed to be low. Most of the E&T species identified as part of this initial determination are not expected to reside in the project area.

U.S. Fish and Wildlife Services IPaC Database Review

Based on the USFWS IPaC database search, two (2) federally proposed threatened species were idenfitied as known or likely to occur within a two-mile radius of the potential intake location on Tye River in Nelson County: The Monarch Butterfly (*Danaus plexippus*) and the Green Floater (*Lasmigona subviridis*). As this project does not involve significant terrestrial impacts, it is unlikely to impact the Monarch Butterfly. As previously mentioned, the proposed location lacks pools and other calm waters that are ideal for Green Floaters, and as such, the potential intake is not likely to impact the species.

As part of the intake construction and VWP permitting process, agencies tasked with the protection of endangered and threatened species may idenfity protected species that have the potential to be impacts by the proposed project and the best methods to protect them if potential impacts could occur. Any such protections would be included as part of the construction and withdrawl permits associated with the potential intake.

Migratory Fish

The Department of Wildlife Resources (DWR) Virginia Fish and Wildlife Information Service (VaFWIS) also provides a list of all species suspected or known to be within a two-mile radius of the potential intake location. Certain structures or features, such as an impoundment or dam, can adversely impact migratory fish in the area. As stated previously, the installation of a dam may be needed so that the stream is deep enough at the potential intake location for the operation of the intake. As such, migratory fish should be considered when evaluating the potential water source. A summary of migratory fish found in the area and their associated migratory behaviors is summarized in the table below.

Table 6. Summary of Migratory Fish Near Potential Intake Location and Associated Behaviors

Common Name	Scientific Name	Migratory Pattern
American Eel	*Anguilla rostrata*	Adults migrate to Sargasso Sea to spawn and then die.
Brook Trout	*Salvelinus frontinalis*	Migrations are generally limited to movements into headwater streams or tributaries for spawning or short migrations to avoid temperature extremes.
Largemouth Bass	*Micropterus nigricans*	Migrate to warm water discharges of power plants in the winter; There is an upstream migration of adults in the spring, and a downstream migration in the fall.
Smallmouth Bass	*Micropterus dolomieu*	The upstream migration of adults occurs in the spring, with a downstream migration in the fall.
Common carp	*Cyprinus carpio*	This species will migrate into shallow weedy bays to spawn.
Channel Fish	*Ictalurus punctatus*	Depending on habitat, the spawners may or may not migrate into rivers or moving water at spawning time.
Flathead catfish	*Pylodictis olivary*	A spring migration and temporary departure from home range.
Creek chub	*Semotilus atromaculatus*	Many individuals show upstream spawning migration in the spring, and the males move into shallow gravel channels, runs, and riffles.
Fantail darter	*Etheostoma flabellare*	Males migrate from deeper faster riffles up to shallow, slow flowing riffles.
Eastern creek chubsucker	*Erimyzon oblongus*	Stream fish undertake a short spawning migration to headwaters in the spring and move downstream to larger creeks following spawning.

Sea lamprey	*Petromyzon marinus*	Upstream migrations occur in Virginia and Maryland between March and June.
Shorthead redhorse	*Moxostoma macrolepidotum*	Spring migration and ascend streams to spawn.
Golden shiner	*Notemigonus crysoleucas*	They migrate daily, from the littoral zone near the shoreline during day to open water at night. Migration is associated with the breeding season.
Central stoneroller	*Campostoma anomalum*	They migrate up-stream in spring to spawn; to an area with a good current and a gravel bottom.
Northern hog sucker	*Hypentelium nigricans*	They begin the upstream migration to spawning grounds when the water temperature rises above 4.4 degrees C and congregates in high gradient streams over riffles.
White sucker	*Catostomus commersonii*	They migrate during spring when water temperatures reach a minimum of 4 degrees C, and move toward headwater areas or until an impassable barrier is reached.
Rainbow trout	*Oncorhynchus mykiss*	Juveniles migrate from natal streams to a freshwater lake instead of to the ocean; Anadromous steelhead juveniles reside in fresh water for 1-4 years before migrating to the sea as smolts.

While some of the migratory patterns of these species of fish do not appear to apply to Dillard Creek due to the relatively small size of the stream and its location inland, there may need to be surveys or other studies completed to determine if these species could be impacted if a structure was installed in the creek such as a dam or impoundment.

Preliminary Cost Estimates of Water Withdrawal and Treatment System

The costs that will be incurred as part of the development of a withdrawal include both engineering costs and those costs associated with obtaining permits for the construction and operation of the intake on Dillard Creek as well as the costs for the design and construcion of the associated pump station and treatment system needed to procude potable water. The estimated costs are described below.

Engineering Cost Estimates

There are currently many unknowns about the site and the water quality of the stream that make it difficult to determine the actual engineering costs at this time; however a conservative preliminary estimate is provided for intial assessment purposes. The quality of the water is important to determine if a membrane treatment system is feasible or if a conventional treatment system will be required. A summary of the estimated engineering, construction, and operating and maintence costs are included in Table 7.

Table 7. Estimated Engineering Costs.

Activity	Estimated Cost
Engineering and Construction	$6.5M
Operating and Maintenance (annual)*	$150,000 - $250,000

*Surface water plants that are not membranes require operators onsite when running.

If there is the potential to pump water from the creek to an existing treatment system, a new treatment facility would not be required and the engineering, construcion and O&M costs depicted above could be reduced substantially. These cost reductions would be offset by the cost of installing a raw water transmission line to the existing treatment system.

Permitting Cost Estimates

As described previously, to construct and operate a surface water withdrawal on Dillard Creek, Nelson County will need to prepare and submit a Joint Permit Application (JPA) to the Virginia Marine Resource Commission (VMRC) who will distibute this permit application to the appropriate agencies for review and permitting. For an intake and withdrawal project, it is anticiapated that for the construction portion of the project, the United States Army Corps of Engineers (USACE) and Virginia Department of Envioronmental Quality (DEQ) will both issue permits. DEQ VWP permit preparation requires payment of a permit processing fee. The DEQ permit will also include the requirements and limitations for operating the withdrawal system. It is estimated to take 9 months to 1 year to receive a DEQ VWP permit and USACE contruction permit once the JPA is submitted, longer if special studies are required by regulatory agencies.

DEQ and USACE will solicit input from other state and federal agencies to support the permit development process including review and comment with regards to historic resources and endangered and threatened species. If there are concerns about either of these types of resources, the agencies may request special studies be conducted including archaeological surveys, habitat assessments and/or species surveys and relocations. These can result in additional costs as well as delays in the project schedule. The table below provides some general cost estimates for the permitting process, and these are intended for initial planning purposes only.

Table 8. Estimated Permitting Costs.

Activity	Estimated Cost
Joint Permit Application Development and Permitting Assistance (VWP)	$40,000 - $50,000
Dam installation permitting	$50,000 - $75,000
DEQ VWP Permit Application Fee (withdrawals less than 1,000,000 gallons on any day)	$10,000
Special Studies (archeaological & endangered and threatened species)	$10,000 - $25,000 (per study)

Summary of Source Limitations

The flow needed to meet the additional water needs appears to be available in Dillard Creek under most flow conditions; however, the stream itself is small and typically shallow and unless there are some naturally occurring deep areas, the installation of an intake may require a low-level dam. This may not be possible due to restrictions or prohibitions from environmental agencies due to the presence of migratory fish. The cost of the installation of an intake may be cost prohibitive. The level of treatment that may be required is unknown and could also be cost prohibitive.

In addition, the flow projections determined herein indicate that there will be days and periods of multiple consecutive days when Dillard Creek withdrawals will be less than 82,000 gpd and alternative supplemental sources may be needed. An evaluation of supplemental sources such as groundwater wells will help determine if there is sufficient availability to supplemental surface water withdrawals during low or very low Dillard Creek flow periods.