



SUSQUEHANNA RIVER BASIN COMMISSION

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TECHNICAL GUIDANCE FOR LOW FLOW PROTECTION RELATED TO WITHDRAWAL APPROVALS

Under Policy No. 2012-01

December 14, 2012

The following Technical Guidance for Low Flow Protection (Technical Guidance) provides supplemental information concerning the implementation of regulatory standards for flow alteration related to a water withdrawal. The Technical Guidance will be used in the review of withdrawal applications to establish limitations and conditions on withdrawal approvals issued by the Susquehanna River Basin Commission (Commission) to ensure that such withdrawals do not cause significant adverse impacts, individually or cumulatively, to the water resources of the basin during seasonal low flow periods. Further, the Technical Guidance may be used to support Commission determinations related to the approval or denial of proposed withdrawals. As guidance, the specifications for determination of low flow protection requirements and provisions for implementation presented herein are not strictly binding on the Commission.

I. BACKGROUND

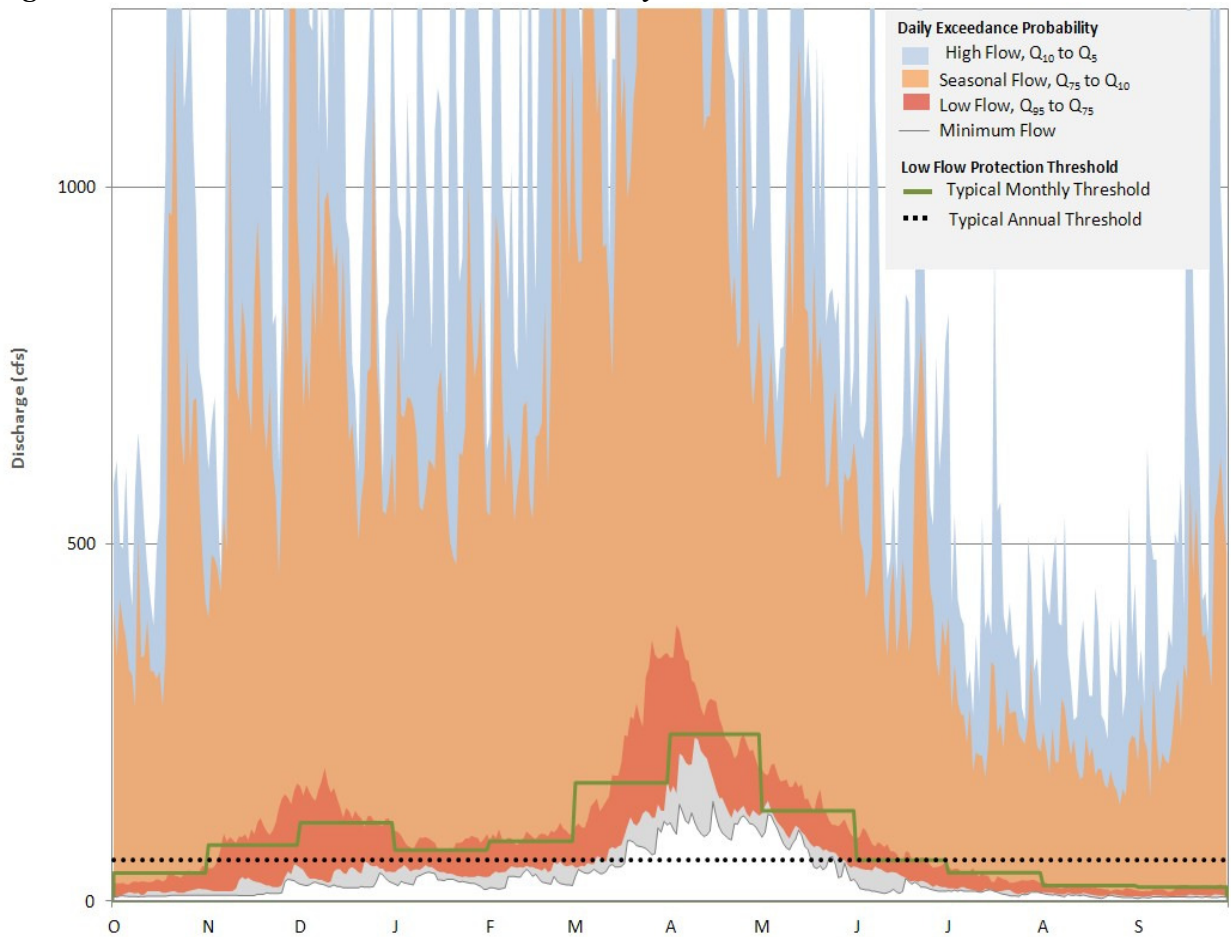
Information submitted in a water withdrawal application, and supporting technical analyses by the Commission, are used by the Commission to evaluate the proposed project and its water requirements, the sustainable yield at the proposed intake or well, and potential impacts to existing uses and water features. These efforts ensure that the targeted water source is adequate to supply the needs of the project without significant adverse impact to the water resources of the basin. This Technical Guidance provides insight into the key issues and factors evaluated in the determination of low flow protection requirements associated with withdrawal approvals to protect water quality, competing users, aquatic resources, and instream uses throughout the basin.

This Technical Guidance is a companion document for the Low Flow Protection Policy (Policy), which replaces Commission Policy No. 2003-01, *Guidelines for Using and Determining Passby Flows and Conservation Releases for Surface-Water and Ground-Water Withdrawal Approvals*, adopted in 2003. It is the Commission's ongoing duty to review its existing policies, incorporate advances in science and effectuate policy revisions, as necessary, for water resources conservation, control, utilization, and management in accordance with the best interest of the people of the basin. The water resources of the Susquehanna River Basin are vested with local, state, regional, and national interests. Present and anticipated future demands require increasing economies and efficiencies in the use and reuse of the basin's water resources. In its regulation of water withdrawals subject to review standards in 18 CFR §806.23, the Commission acknowledges the need to protect the quantity, timing, and quality of water flows required to sustain freshwater ecosystems and the livelihoods and well-being of basin residents that depend on these water resources.

As described in the Policy, a study by The Nature Conservancy (TNC, 2010¹) of the Susquehanna River and its tributaries² and related environmental flow science provides the basic tenets to limit alteration to natural flow regimes and the ecological processes they support. The principal focus of the Policy and Technical Guidance are to require low flow protection in association with approved withdrawals in order to adhere to the low flow component of the ecosystem flow recommendations. The Commission anticipates that, as the evidence for adequate levels of low flow protection and the related science evolves, this Technical Guidance may need to be updated in accordance with adaptive management principles.

Figure 1 illustrates the contrast between a constant annual low flow protection threshold determined under the 2003 guidelines and variable monthly low flow protection thresholds determined under this Technical Guidance. The Technical Guidance provides for low flow protection conditions to be specified on a monthly or seasonal basis, to preserve natural flow variability and accommodate ecological needs, and a uniform classification of the basin's streams and rivers to apply hierarchical levels of low flow protection.

Figure 1. Constant Annual vs. Variable Monthly Low Flow Protection Thresholds



¹ The Nature Conservancy (TNC). 2010. Ecosystem Flow Recommendations for the Susquehanna River Basin: Report to the Susquehanna River Basin Commission and U.S. Army Corps of Engineers. Harrisburg, Pennsylvania.

² A table listing recommendations from this report is provided as Attachment A.

The Commission proposes to provide a comprehensive approach to meeting environmental flow protection objectives using passby flows and conservation releases for low flow protection coupled with withdrawal limits to maintain ecological limits of hydrologic alteration.

A. Passby Flows

A passby flow is generally defined as a prescribed streamflow at which withdrawals must cease. As such, it represents a minimum “hands-off” flow threshold to limit withdrawal-induced impacts during low flow events. The Commission uses passby flows for defining an operational limit in its approvals of stream withdrawals, essentially making the withdrawal interruptible at a particular flow threshold(s) during periods of low monthly streamflow.

Passby flows are associated with surface water and groundwater withdrawal approvals under 18 CFR §806.23. Passby flow requirements mandate that, while water is being withdrawn, a specified amount of water must be allowed to pass the point of withdrawal. With respect to groundwater withdrawals, the point of impact is dependent on many factors (i.e., well construction, hydrogeologic setting, geologic structure, etc.) and does not always coincide with the point of withdrawal. For groundwater withdrawals, the location of potential impacts will be evaluated when making passby flow determinations. Passby flow requirements are prescribed in the withdrawal approval and are site specific.

Surface water withdrawals from small impoundments, intake dams, continuously flowing springs, or other intake structures in streams and rivers may include conditions in the Commission’s approval that require passby flows. Groundwater withdrawals that may cause a significant adverse impact to streamflow or other surface water features, such as springs, wetlands, lakes and ponds, may include conditions that require passby flows. Significant adverse impacts to surface water features may be evaluated through project-specific information and testing (well construction, hydrogeologic setting, groundwater availability analysis, packer testing, well construction, constant-rate testing, and other factors as appropriate). Evaluation of test data and site-specific information can often be used to reasonably predict that significant adverse impacts may occur and, therefore, the absence of an observed direct impact by groundwater pumping to a surface water feature during the limited duration constant-rate aquifer testing does not preclude the potential for a passby flow requirement.

B. Conservation Releases

Reservoirs and other large impoundments can capture low, seasonal, and high flows and completely alter the natural flow regime of a receiving stream. A conservation release is defined as a prescribed quantity of flow from an impoundment structure that must be continuously maintained downstream of the impoundment for low flow protection. Conservation releases are intended to prevent water quality degradation and adverse lowering of streamflow levels downstream of the impoundment, thereby protecting aquatic resources and other water uses. Conservation releases maintain specified flow requirements from storage, not only during periods of low flow, but throughout the life of the reservoir, including periods when the reservoir is replenishing its storage during refilling.

Conservation releases required by the Commission are only associated with surface water withdrawal approvals under 18 CFR §806.23 if the surface water withdrawal is being drafted from, or augmented from, a large impoundment. Member state approvals of impoundments intended to be used as water supply sources commonly include permit conditions that require conservation releases. Upon review, the Commission may find these releases to be acceptable as sufficient for low flow protection. Any releases from large impoundments should, at minimum, exceed the 7-day, 10-year low flow (7Q10) threshold for protection of downstream water quality from water withdrawals during drought flows. (The 7Q10 flow has typically been used as a design flow for dilution of effluent discharged from wastewater treatment facilities.) The Commission’s “Consumptive Use Mitigation Plan” references the low flow standard contained in its Comprehensive Plan, which states that flows to the Chesapeake Bay should not be diminished below the 1-in-20 monthly average flows in each of the months of August, September, and October. Conservation releases imposed by the Commission will support these flow goals throughout the basin.

Inflow, storage, outlet infrastructure, and other site-specific constraints may prohibit implementing standard monthly or seasonal low flow protection conditions, described in Section IV, that are to be maintained year-round. Therefore, conservation releases required in an approval related to a withdrawal from a large impoundment should be determined on a case-by-case basis, with the goal of evaluating and balancing downstream needs with available storage and sustainable yield. Recommendations will be developed in coordination with the appropriate resource agencies of the member jurisdiction.

II. FACTORS USED IN THE PASSBY FLOW AND CONSERVATION RELEASE DETERMINATION PROCESS

In its review of water withdrawal applications and associated passby flow and conservation release determinations, the Commission considers hydrologic characteristics of the proposed source, the requested withdrawal quantity (as a peak day and maximum instantaneous rate), cumulative water use, potentially affected water uses and aquatic resources, and related factors as applicable. The following describes some of the factors and concepts used in the passby flow and conservation release determination process.

A. Aquatic Resource Classes

For purposes of reviewing applications for water withdrawals, streams and rivers in the Susquehanna River Basin are placed in one of six possible classes in an effort to apply the appropriate level of protection to each surface water feature in the basin. The Aquatic Resource Class (ARC) of a stream at the proposed point of withdrawal or point of impact for groundwater withdrawals is a fundamental factor in the passby flow and conservation release determination process. The objective of having the resource classes is to generally recognize smaller stream systems and their potential sensitivity to water withdrawals and, accordingly, require higher levels of low flow protection.

The criteria for assigning streams to an ARC are listed in Table 1. The approach leverages the existing Northeast Aquatic Habitat Classification System (NEAHCS) River and

Stream Size Classification criteria³ based on ranges of drainage area. The result is a uniform, streamlined approach to classifying streams and rivers in the Susquehanna River Basin for use in determining standard low flow protection requirements.

Table 1. Aquatic Resource Class* Criteria

ARC	Description	Drainage Area (square miles)	Total Stream Length (miles)	Percent Composition
1	Headwaters	<=10	40,421	81
2	Creeks	>10 <50	4,357	10
3	Small Rivers	>=50 <200	2,139	4
4	Medium Tributary Rivers	>=200 <1,000	1,300	3
5	Medium Mainstem Rivers	>=1,000 <5,000	467	1
6	Large Rivers	>=5,000	582	1

* For planning purposes, maps showing generalized ARC stream designations in the Susquehanna River Basin and its six major hydrologic subbasins are provided as Attachments C1 through C7.

ARC 1 represents headwaters in the Susquehanna River Basin that are most vulnerable to potential impacts from withdrawals due to their extremely small drainage area size. Streamflow in headwaters is highly variable and may be ephemeral or intermittent in dry months. These headwaters have the lowest water quantity available to support withdrawals of any type and can be remote and surrounded by undisturbed lands that would be sensitive to the physical disturbance associated with accessing water. ARC 1 streams include many of the Susquehanna River Basin's highest quality surface waters in terms of water quality, designated and existing uses, and ability to support multiple ecological functions. These surface waters often have high biological value and many support various life stages of naturally reproducing trout that could be vulnerable to potential impact from withdrawals. The biotic communities commonly occurring in ARC 1 streams are often comprised of native species and are structurally and functionally intact.

ARC 2 represents creeks in the Susquehanna River Basin that may be sensitive to potential impacts from withdrawals due to their small size, variable streamflow, and low flows in dry months. Streamflow is typically perennial; however, these creeks have limited water quantity available to support moderate to large withdrawals. Some creeks may be remote and surrounded by undisturbed lands that would be sensitive to the physical disturbance associated with accessing water. ARC 2 streams include some of the Susquehanna River Basin's highest quality surface waters in terms of water quality, designated and existing uses, and ability to support multiple ecological functions. These surface waters can have high biological value and may support various life stages of naturally reproducing trout that could be vulnerable to potential impact from withdrawals.

ARC 3 represents small rivers in the Susquehanna River Basin that may be less sensitive to potential impacts from withdrawals due to their moderate size, position in the landscape, and streamflow volumes. These streams may have floodplain terraces that may be suitable for water

³ Attachment B shows stream size classes in the eastern United States region according to the NEAHCS, as derived from the Northeast Association of Fish and Wildlife Agencies (NEAFWA) aquatic habitat map (2008) by The Nature Conservancy Eastern Conservation Science Office.

supply infrastructure. While nonnative species may be present in ARC 3 streams, the structural and functional integrity of biological communities commonly remain intact.

ARC 4 represents medium tributary rivers in the Susquehanna River Basin that are often less sensitive to potential impacts from withdrawals due to their moderate size, position in the landscape, and perennial streamflow volumes. Medium tributary rivers may support warm water or cool water fish assemblages. These streams also have more expansive floodplain terraces that may be suitable for water supply infrastructure. While nonnative species may be present in ARC 4 streams, the structural and functional integrity of biological communities often remain intact.

ARC 5 represents medium mainstem rivers in the Susquehanna River Basin that are less sensitive to potential impacts from withdrawals due to their moderate to large size and streamflow volumes. Stream channels are often complex and may include complex margins, islands, and backwater habitats. Medium mainstem rivers may support diadromous and migratory resident fish assemblages. These surface waters are generally surrounded by a variety of land uses from forests to agriculture to urban, and often support multiple water withdrawals and uses. These rivers typically have expansive floodplain terraces suitable for water supply infrastructure. Rivers in ARC 5 function as the receiving waters of large volumes of water draining from the lands and streams upgradient in the watershed, and as such, offer some of the largest capacity for human and industrial use.

ARC 6 represents large rivers in the Susquehanna River Basin that are least sensitive to potential impacts from withdrawals due to their large size and streamflow volumes, and are the preferred location for large withdrawals. Stream channels are complex and include complex margins, islands, and backwater habitats. Flow regimes may be influenced by flood control and hydropower operations. Large rivers have diadromous and migratory resident fish assemblages. These surface waters are surrounded by a variety of land uses from forests to agriculture to urban, and support significant numbers and quantities of water withdrawals and uses. The large rivers have expansive floodplain terraces suitable for water supply infrastructure. Rivers in ARC 6 function as the receiving waters of large volumes of water draining from the lands and streams upgradient in the watershed, and as such, offer the largest capacity for human and industrial use.

B. Hydrologic Analyses and Flow Statistics

Historical flow data collected at continuous streamflow gaging stations that are sufficient in quality and quantity are fundamental to performing hydrologic analyses and the accurate calculation of flow statistics. Data used to compute flow statistics are typically from daily mean flow records at stream gages operated by the U.S. Geological Survey (USGS) in the Susquehanna River Basin or neighboring basins. For flow statistics to be considered reliable indicators of hydrologic conditions, a minimum of 10 recent years of record is typically required with representative wet, normal, and dry periods sufficiently represented.

Flow duration curves are commonly used to statistically characterize streamflow data. Flow duration curves are comprised of daily mean flow values measured over a specified time interval and show the percent of time specified discharges were exceeded during that period. For example, a 5 percent exceedance probability represents a high flow that has been exceeded only

5 percent of all days in the flow record. Conversely, a 95 percent exceedance probability would characterize low flow conditions in a stream because 95 percent of all daily mean flows in the record are greater than that amount. Although flow duration and low flow frequency statistics are commonly computed on an annual basis, they can also be computed on a seasonal or monthly basis, as is specified in the passby flow and conservation release determination process. The daily streamflow data used to calculate the annual flow statistics are simply limited to the specific season or month of interest.

Flow statistics, including percent exceedance values, will be determined at the point of withdrawal or point of impact for groundwater withdrawals according to accepted hydrologic practices. Reference stream gages⁴ used to determine low flow statistics at a project site should be unregulated, of a similar drainage area size compared to the project site (ideally within the one-third to threefold range) (Ries and Friesz, 2000⁵), of similar physiographic province and geology, of similar mean annual precipitation and evapotranspiration, and ideally located on the same stream or on a nearby stream, if possible. Accepted procedures for calculating flow duration and low flow frequency statistics include USGS Scientific Investigation Report 2008–5126 (Risley, Stonewall and Haluska, 2008⁶). Best professional judgment will be used in evaluating the balance between selection of gages with very similar drainage areas and those with more varied drainage areas that better represent watershed and hydrologic characteristics. The Commission will identify additional references and tools that it has determined to be acceptable for hydrologic analyses and calculation of flow statistics (e.g., USGS’s Pennsylvania Baseline Streamflow Estimator).

For ungaged streams, best professional judgment will be used in selecting an appropriate USGS stream gage that could be used for estimating flow statistics for ungaged streams in the Susquehanna River Basin. The selection process will identify gages that best represent watershed and hydrologic characteristics, based on similar basin characteristics, which may include drainage area, precipitation, physiography, geology, and land use. Regional regression-based tools and equations may also prove useful in estimating flow statistics for ungaged streams with unique basin characteristics or located in gaps within the gage network in the Susquehanna River Basin.

While the project sponsor may calculate passby flows and conservation releases based on this process, Commission staff reserves the right to compute flow statistics using accepted methodologies and to determine appropriate passby flows and conservation releases based upon the results of its analyses.

C. Cumulative Water Use Assessment

The assessment of water availability for a proposed withdrawal at a given location is fundamentally dependent on the selected benchmark flow statistic(s) and defined threshold(s) for unacceptable hydrologic alteration or impact that fixes the amount of water and the existing

⁴ A list of potential reference stream gages for computing flow statistics for streams and rivers in the Susquehanna River Basin is provided as Attachment D.

⁵ Ries III, K.G. and J.P. Friesz. 2000. Methods for Estimating Low-Flow Statistics for Massachusetts Streams: U.S. Geological Survey Water-Resources Investigations Report 2000-413, 81 p.

⁶ Risley, J.C., A. Stonewall, and T. Haluska. 2008. Estimating Flow-Duration and Low-Flow Frequency Statistics for Unregulated Streams in Oregon: U.S. Geological Survey Scientific Investigations Report 2008-5126, 23 p.

users, both upstream and downstream from the proposed withdrawal location. Upstream users that have approved withdrawal limits and operate interrupted withdrawals as flows approach critical thresholds, and users that return the full amount of water withdrawn in close proximity to their point of withdrawal, generally do not conflict with a proposed withdrawal. However, consumptive uses and withdrawals that are not returned near the point of withdrawal or above the point where an impact assessment is made contribute to the accumulated demands on water resources. Similarly, an existing downstream user may have certain flow requirements (i.e., for wastewater or mine drainage assimilation) that may, during low flows, constrain upstream use. In these instances, passby flows or conservation releases may be used, in conjunction with withdrawal limits, for low flow protection.

Cumulative water use assessments will be conducted by Commission staff to determine when low flow protection requirements and withdrawal limits are appropriate. State, regional, and local information and planning tools that provide both reported and estimated water use data may be considered in evaluating demand. Cumulative water use is assessed as the total net water use in the drainage area upgradient of the proposed point of withdrawal in the case of surface water withdrawals, or from the point of impact on a surface water feature in the case of groundwater withdrawals, plus the proposed net withdrawal (e.g., the proposed withdrawal minus return flow in proximity to the point of withdrawal). Cumulative demand is then compared to low flow thresholds and other related factors to determine the potential for adverse cumulative impact.

The cumulative water use assessment also considers potentially impacted uses and water quality downstream of the proposed point of withdrawal or impact for groundwater withdrawals. Typically, the closest or largest downstream user, which could be either a competing withdrawal or discharge, has the greatest potential to experience adverse impacts from a proposed upstream withdrawal. Downstream uses, considered cumulatively and in combination with net upstream water use, also are compared to low flow thresholds and other related factors to determine the potential for adverse cumulative impact.

D. *De Minimis* Withdrawals

Some withdrawals are sufficiently small in rate and quantity that the impacts on streamflows and the ecosystems they support are negligible during all or certain months of the year. A proposed withdrawal, evaluated both individually and cumulatively, that is considered by the Commission to be too low in magnitude to have any appreciable effect on instream flows is not subject to passby flow, conservation release, or other low flow protection requirements unless as otherwise determined by the Commission. The proposed withdrawal, at the point of withdrawal for surface water withdrawals or point of impact for groundwater withdrawals, will be compared to a specified percentage of a monthly benchmark flow value to determine the *de minimis* withdrawal threshold for that month. *De minimis* withdrawal thresholds are stepped by ARC as shown in the table below:

Table 2. *De minimis* Withdrawal Thresholds by Aquatic Resource Class

ARC 1	ARC 2	ARC 3	ARC 4	ARC 5	ARC 6
None	5% monthly P95	5% monthly P95	5% monthly P95	10% monthly P95	10% monthly P95

In most ARCs, the criterion will be 5 percent or more of P95 flow for that month. The criteria allow for uncertainty in estimating hydrology and increased risk of potential significant adverse impacts for smaller, more sensitive resources. All withdrawals in the smallest watersheds designated as ARC 1 will be subject to passby flows, conservation releases, or other low flow protection requirements. The criterion is increased to 10 percent or more of the monthly P95 flow for larger rivers (ARCs 5 and 6), due to decreased risk of potential adverse impacts for larger, less sensitive resources. The criterion is also increased to 10 percent or more of the monthly P95 flow for impaired waters to incentivize the use of lesser quality waters by permitting more uninterrupted withdrawals from these sources, provided uses do not prohibit recovery efforts and critical Total Maximum Daily Loads (TMDLs) can still be met.

The *de minimis* net withdrawal threshold will be assessed both individually and cumulatively to determine if, and for which months, low flow protection requirements will be imposed. In all cases, the sum of uninterruptible net withdrawals should itself be *de minimis* in order to avoid low flow protection requirements.

E. Exceptional Quality⁷ and Impaired Waters

The ARCs and other factors previously described generally provide for environmental flow-based standards for regional low flow protection. Additional considerations may be necessary to determine low flow protection requirements in certain unique settings, including both exceptional quality and impaired waters. For exceptional quality waters, these considerations should further recognize the potential increased sensitivity to withdrawals and hydrologic alteration in these sources. Exceptional water quality exists in various-sized streams throughout the basin and, as such, the Commission may afford enhanced flow protection to prevent water quality degradation injurious to the protected uses of such streams. Exceptional quality waters in headwaters and creeks may be especially sensitive to water withdrawals during critical summer low flow periods and, accordingly, should be afforded higher levels of flow protection. For impaired waters, these considerations should further recognize the overall water resource management benefits of incentivizing the use of lesser quality sources. Lesser quality waters, such as streams impaired by mine drainage, wastewater or industrial discharges, or other pollutants may be of suitable quality to satisfy a variety of water uses while allowing for lower levels of low flow protection in drainage areas of all sizes.

Extreme summer low flow conditions in headwaters and creeks may strongly affect aquatic habitat availability, connectivity among habitats, and water temperature. During these times, large withdrawals could potentially be detrimental to sensitive aquatic species and habitats. Proposed withdrawal sources in drainage areas less than 50 square miles will be evaluated more closely based on state stream designations, available fisheries data, and Aquatic Resource Survey data. Where exceptional quality waters or extremely sensitive taxa or habitats are identified, higher monthly percent exceedance flow values for the traditional low flow months of July, August, September, and October may be required. As described further in Section IV, the Pennsylvania-Maryland Instream Flow Study (PA-MD IFS) Method is tailored to

⁷ Examples of exceptional quality waters in the basin may include Trout Spawning (TS) waters in New York, Exceptional Value (EV) and High Quality (HQ) streams in Pennsylvania, and Tier II waters in Maryland.

determining instream flow protection levels for sensitive reproducing trout populations within the study area in non-glaciated drainage areas less than 100 square miles.

Thousands of stream miles degraded due to the widespread presence of existing or abandoned coal extraction operations account for a major share of the lesser quality waters present in the Susquehanna River Basin. The Commission adopted Resolution No. 2012-01 in March 2012, to promote the use and reuse of lesser quality water in preference to higher quality waters and, on a case-by-case basis, allow for the waiver or partial waiver of application fees for projects using water degraded by past or present mining activities. Streams impaired by mine drainage may have decreased sensitivity to withdrawals and hydrologic alteration.

Proposed withdrawals from impaired sources in drainage areas of all sizes will be evaluated based on state stream designation, specific water quality parameters, the source's capacity to support aquatic life, and beneficial attributes of the quantity of flow within the subject stream and watershed. Where withdrawals from impaired waters are determined to have overall water resource management benefits, lower monthly percent exceedance flow values may be recommended. The standard passby flow or conservation release threshold for mine drainage impaired stream withdrawals may not be less than the monthly P95 flow.

III. IMPLEMENTING LOW FLOW PROTECTION

To implement low flow protection for a surface water withdrawal or a groundwater withdrawal, the following will apply:

1. In its review of a proposed new or increased withdrawal, the Commission will consider any applicable anti-degradation provision or water quality standards of its member jurisdictions to avoid significant adverse impacts to the water resources of the basin.
2. To prevent significant adverse impact to streams during low flow conditions, new surface water withdrawals, or project modifications or renewals proposing to increase a surface water withdrawal, that exceed the *de minimis* withdrawal threshold(s) are subject to low flow protection measures in accordance with Section IV.
3. To prevent significant adverse impact to streams during low flow conditions, new groundwater withdrawals, or project modifications or renewals proposing to increase a groundwater withdrawal, determined by the Commission to have a significant adverse impact on surface water features, including streams, springs and wetlands, and that exceed the *de minimis* withdrawal threshold(s) are subject to low flow protection measures in accordance with Section IV.
4. To prevent significant adverse impact to streams during low flow conditions, the Commission will consider and apply low flow protection measures in accordance with Section IV on a case-by-case basis to existing surface water withdrawals, other than those addressed in Item 2 above, that exceed the *de minimus* withdrawal threshold(s) where: (1) a modification is proposed to physical features, operations, or consumptive use that would increase its impact on stream flows; (2) the withdrawal project was previously unregulated but becomes subject to review and approval

- pursuant to 18 CFR §806.4; (3) the withdrawal project is subject to renewal; or (4) a project approval transfer is proposed that is subject to the requirements of 18 CFR §806.6(d).
5. To prevent significant adverse impact to streams during low flow conditions, the Commission will consider and apply low flow protection measures in accordance with Section IV on a case-by-case basis to existing groundwater withdrawals, other than those addressed in Item 3 above, that exceed the *de minimus* withdrawal threshold(s) where: (1) a modification is proposed to physical features, operations, or consumptive use that would increase its impact on surface water features, including streams, springs, and wetlands; (2) the withdrawal project was previously unregulated but becomes subject to review and approval pursuant to 18 CFR §806.4; (3) the withdrawal project is subject to renewal; or (4) a project approval transfer is proposed that is subject to the requirements of 18 CFR §806.6(d).
 6. In its review of projects addressed in Items 4 and 5 above, the Commission will consider the technical feasibility, economic implications, environmental considerations, provision for water storage, flow augmentation measures, and any other pertinent factors it deems appropriate in its case-by-case determination of low flow protection requirements for such existing withdrawals.
 7. For existing withdrawal projects undergoing approval, modification, renewal, or transfer, where the application of the policy would result in the imposition of a new or modified passby flow or conservation release condition, the Commission may also establish interim operating conditions of appropriate duration on a case-by-case basis.
 8. A proposed withdrawal, evaluated both individually and cumulatively, that is considered by the Commission to be too low in magnitude to have any appreciable effect on instream flows will not be subject to passby flow, conservation release, or other low flow protection requirements unless as otherwise determined by the Commission.
 9. For purposes of compliance monitoring for low flow protection requirements, continuous streamflow monitoring should be conducted at the approved withdrawal site at a USGS stream gage elsewhere on the stream, or (if appropriate) on an ungaged stream, estimated using a valid USGS stream gage identified by the Commission. For approved withdrawals located on ungaged streams, a 48-hour buffer may be required before the withdrawal, once suspended, may be resumed to ensure adequate low flow protection.

IV. PASSBY FLOW AND CONSERVATION RELEASE DETERMINATION PROCESS

To determine the appropriate passby flow or conservation release for a surface water withdrawal or an impact from a groundwater withdrawal, Commission staff will use the following process to assess each of the factors previously described.

A. Aquatic Resource Class

Classification of a proposed source based on drainage area criteria previously described (see Table 1):

1. Drainage Area Delineation – Watershed delineation and calculation of the drainage area upgradient of the proposed point of withdrawal or point of impact for groundwater withdrawals.

B. Environmental Screening

Desktop characterization of environmental resources associated with proposed withdrawal source:

1. Water use classifications;
2. Fishery designations;
3. Rare, threatened, or endangered (RTE) aquatic species;
4. Wild and scenic river designations; and
5. Impaired designations.

Aquatic Resource Survey – When deemed necessary based on established criteria, an Aquatic Resource Survey is conducted at proposed withdrawal sites to provide site-specific baseline information about aquatic resources and the supporting habitat present, inventory sensitive species, and document the presence of any RTE species. Aquatic Resource Surveys are utilized to document existing stream conditions.

C. Hydrologic Analyses

Estimation of hydrology and associated streamflow statistics at the proposed point of withdrawal or point of impact for a groundwater withdrawal:

1. Gaged Sources – Calculate monthly percent exceedance flow values using daily streamflow records for USGS stream gage located on proposed source, and transfer flow statistics to proposed source location using drainage area ratio method.
2. Ungaged Sources:
 - a. Reference Gage Analysis – Select an appropriate USGS stream gage based on similar basin characteristics (which may include drainage area, precipitation, physiography, geology, land use, etc.):
 - 1) Refer to USGS National Water Information System (NWIS) web interface.
 - 2) Refer to the table of monthly percent exceedance flow values in Attachment E or calculate monthly percent exceedance flow (Px) values using daily streamflow records for selected reference gage and transfer flow statistics to proposed source location using drainage area ratio method and applicable criteria described previously.

- b. USGS Pennsylvania Baseline Streamflow Estimator⁸.
 - c. USGS StreamStats⁹ application.
 - d. Published regional regression equations.
3. Regulated Streamflow – Stream reaches with regulated streamflow (which includes reaches downstream of a consumptive use mitigation release or conservation release) would require a case-specific analysis to relate magnitude of a proposed withdrawal to both natural and augmented streamflow and evaluate downstream flow needs.

D. Passby Flow/Conservation Release Calculation

1. Percent Exceedance Value Method – Used throughout the basin in rivers and streams of varying sizes, and based on ARC. Variability in climate, geology, and hydrology among physiographic provinces and states is accommodated for in the selection of representative reference stream gages or applicable regional regression equations used to compute the monthly percent exceedance values. The calculated monthly passby flow/conservation release values are the standard thresholds for low flow protection. Percent exceedance flow values are specified as the required monthly passby flow/conservation release values according to Table 3 below.

Table 3. Passby Flow/Conservation Release Schedule

ARC 1	ARC 2	ARC 3	ARC 4	ARC 5	ARC 6
monthly P70	monthly P75	monthly P80	monthly P85	monthly P90	monthly P95

For conservation releases, inflow, storage, outlet infrastructure, and other site-specific constraints may prohibit implementing standard monthly or seasonal low flow protection conditions that are to be maintained from storage year-round. Therefore, conservation releases required in an approval related to a withdrawal from a large impoundment may need to be determined on a case-by-case basis, with the goal of evaluating and balancing downstream needs with available storage and reservoir yield. Recommendations will be developed in coordination with the appropriate resource agencies of the member jurisdiction.

2. Pennsylvania-Maryland Instream Flow Study (PA-MD IFS) Method – The PA-MD IFS Method is tailored to determining instream flow protection levels for sensitive reproducing trout populations within the study area in non-glaciated drainage areas less than 100 square miles. Monthly passby flows and conservation releases, based on monthly habitat loss criteria, will be generated using the PA-MD IFS Method where applicable criteria are met. This method will typically be utilized within the Pennsylvania portion of the basin in cold water streams of generally 100-square-mile drainage area or less, and located within the hydrologic regions delineated on Plate 2, “Pennsylvania-Maryland Instream Flow Study: Hydrologic Regions” of Commission

⁸ Stuckey, M.H., E.H. Koerke, and J.E. Ulrich. 2012. Estimation of Baseline Daily Mean Streamflows for Ungaged Locations on Pennsylvania Streams, Water Years 1960–2008: U.S. Geological Survey Scientific Investigations Report 2012-5142, 61 p.

⁹ Ries III, K.G., J.G. Guthrie, A.H. Rea, P.A. Steeves, and D.W. Stewart. 2008. StreamStats: A Water Resources Web Application: U.S. Geological Survey Fact Sheet 2008-3067, 6 p.

Publication 191, “Instream Flow Studies, Pennsylvania and Maryland” (May 1998). This includes ARC 1 and 2 cold water trout streams and ARC 3 cold water trout streams with drainage areas generally less than 100 square miles.

- a. Monthly passby flows and conservation releases will be determined using the PA-MD IFS Method and compared with monthly passby or conservation release results generated from the percent exceedance value method.
- b. Passby flows and conservation releases will be based upon designated monthly habitat loss criteria associated with ARCs as follows:
 - 1) ARC 1 – Withdrawals may not cause greater than a 5 percent loss of habitat.
 - 2) ARC 2 – Withdrawals may not cause greater than a 7.5 percent loss of habitat.
 - 3) ARC 3 – Withdrawals may not cause greater than a 10 percent loss of habitat.

These habitat loss criteria were derived from Commission Policy No. 2003-01, *Guidelines for Using and Determining Passby Flows and Conservation Releases for Surface-Water and Ground-Water Withdrawal Approvals*, Section I, developed in coordination with Pennsylvania Fish and Boat Commission staff, and translated from Pennsylvania Chapter 93 Use Designations to ARCs. Section II(E) contains additional considerations for designating monthly habitat loss criteria.

- c. In no case will the passby flow or conservation release be less than the monthly P75 for ARC 1 and 2 streams or monthly P95 for other streams.

E. *De minimis* Withdrawals

Unless a proposed net withdrawal, evaluated both individually and cumulatively, is considered by the Commission to be too low in magnitude to have any appreciable effect on instream flows, a passby flow or conservation release condition will be imposed in the approval. *De minimis* withdrawal thresholds are stepped by ARC as previously described (see Table 2).

F. Withdrawal Limits

In order to preserve natural flow variability and meet seasonal flow protection objectives, the Commission may limit a proposed withdrawal rate to a percentage of the monthly passby flow or monthly median flow. This condition may be imposed when the proposed withdrawal has the potential to affect seasonal flow variability and/or result in unacceptable levels of hydrologic alteration. In establishing such conditions, the Commission will consider the ecosystem flow recommendations contained in TNC’s “Ecosystem Flow Recommendations for the Susquehanna River Basin” (2010) or other related environmental flow protection scientific studies.

G. Special Cases and Conditions

1. Seasonal Passby Flows/Conservation Releases – Monthly flow statistics are the standard for low flow protection according to this Technical Guidance. However,

Commission staff may recommend, or a project sponsor may request, adherence to a seasonal passby flow or conservation release condition to simplify project operations and monitoring requirements. The calculated monthly passby flow/conservation release values may be grouped into successive months to develop seasonal values. Seasonal groupings will be determined based on localized monthly hydrologic variability. An example of a seasonal grouping of monthly low flow protection standards is included below:

- a. Winter Months – December, January, February
- b. Spring Months – March, April, May, June
- c. Summer/Fall Months – July, August, September, October, November

An alternate grouping of months may be appropriate for a seasonal project withdrawal (e.g., golf course), the project location in the basin (e.g., major subbasin), or a specific seasonal instream flow need (e.g., migratory fish) identified during technical review. The average of the monthly low flow protection thresholds within each seasonal grouping will be selected as the passby flow/conservation release requirement over those months.

2. Project-Specific Instream Flow Studies – Optional project-specific instream flow studies may be conducted to support the proposal of alternate monthly passby flows or conservation release requirements. The Commission will evaluate the proposed alternatives and provide recommendations for monthly low flow protection requirements that meet policy objectives. Passby flows and conservation releases, other than those derived from the guidance, may be acceptable to the Commission if an appropriate instream flow study by the project sponsor demonstrates in a clear and convincing manner that lower flows or releases will provide an acceptable level of low flow protection. The plan of study should be submitted to the Commission for review and approval prior to initiation of the study.
3. Exceptional Quality Waters – Where exceptional quality waters or extremely sensitive taxa or habitats are identified, higher monthly percent exceedance flow values for the traditional low flow months of July, August, September, and October may be required.
4. Impaired Waters – Where impaired waters, particularly mine drainage and wastewater or industrial discharges, are identified and the proposed withdrawal will not prohibit recovery efforts or prevent critical TMDLs from being met, the *de minimis* withdrawal threshold criterion may be increased to 10 percent or more of the monthly P95 flow and lower monthly percent exceedance flow values may be required.
5. Water Conservation – Approved withdrawal projects shall comply with the water conservation requirements specified in 18 CFR §806.25(b).
6. Emergencies – Prioritization of water use during extreme low flow conditions is established by the Commission pursuant to its drought emergency powers under

Section 11.4 of the Susquehanna River Basin Compact, in consultation with its member jurisdictions.

7. Agency Coordination – On a case-by-case basis and in coordination with the water resources agency of the host member jurisdiction, the Commission may determine that passby flow and conservation release criteria, other than those derived from the guidance, can be established for a withdrawal project that meet the Commission’s low flow protection objectives.
8. Adaptive Management – The Commission anticipates that, as the evidence for adequate levels of low flow protection and related science evolves, the Technical Guidance may need to be periodically updated in accordance with adaptive management principles.
9. Reservation – In accordance with 18 CFR §806.23, the Commission reserves the right to increase the passby flow or conservation release requirement for any project above the standards determined using the guidance in cases where sensitive environmental resources (i.e., wetlands, migratory fish) or water quality conditions (i.e., mine drainage remediation, TMDLs, National Pollutant Discharge Elimination System [NPDES] discharges, public water supply intakes) may be adversely impacted.