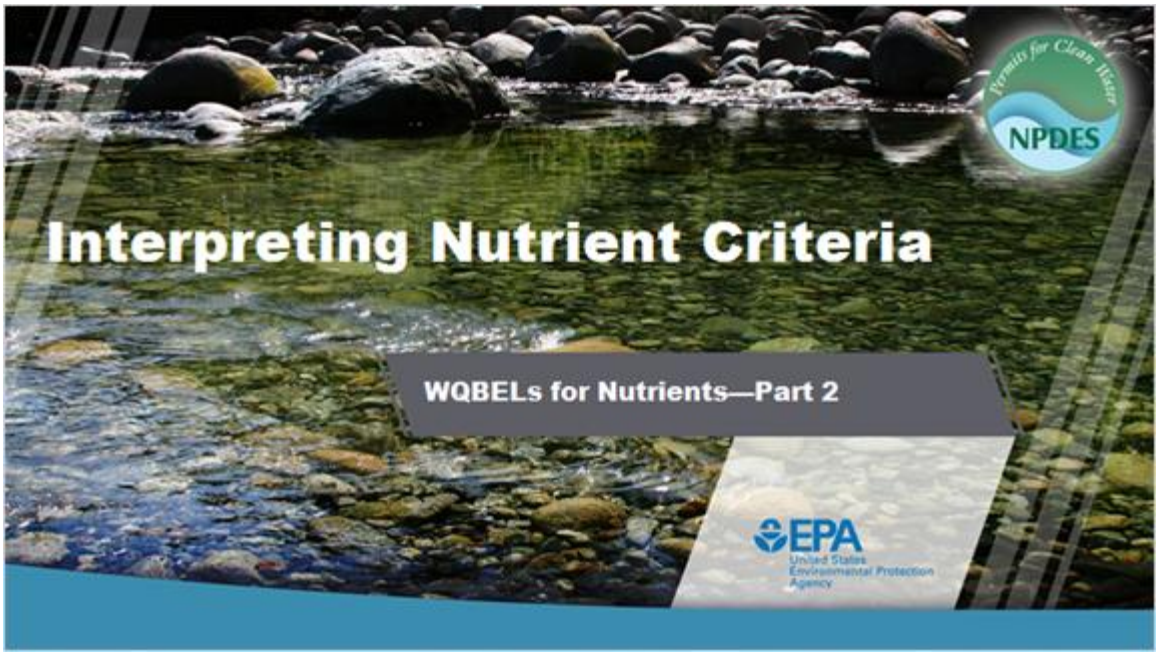
Interpreting Nutrient Criteria

1. WQBELs for Nutrients-Part 2

1.1 Interpreting Nutrient Criteria



Notes:

Welcome to this presentation on water quality-based effluent limitations for nutrients in National Pollutant Discharge Elimination System, or NPDES, permits.

This presentation is part two of a six part section of the training on establishing water quality-based effluent limitations, or WQBELs, for nutrients. This training is sponsored by the United States Environmental Protection Agency's Water Permits Division.

In this presentation, we will consider the specific issue of interpreting nutrient criteria that might be part of a state's water quality standards. Before we get started with this presentation, let's introduce our speakers, take care of a housekeeping item, and review where we are within the training series.

1.2 Presenters

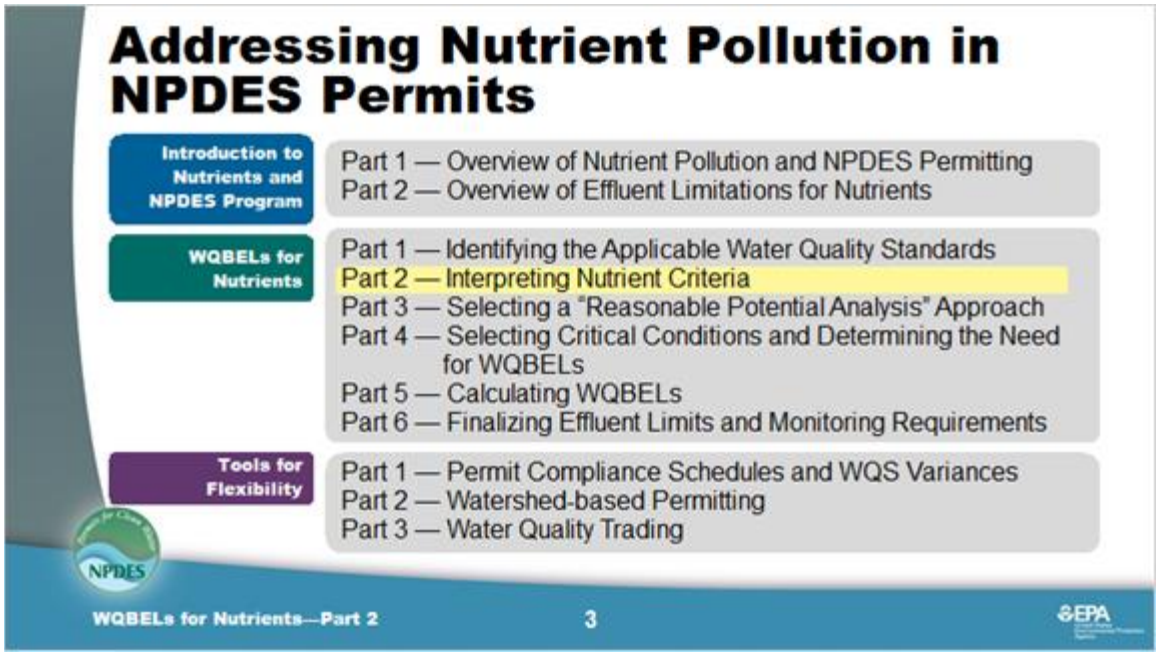
Notes:

Your speakers for this presentation are Nizanna Bathersfield and me, Danielle Stephan. We both are with the Water Permits Division of the United States Environmental Protection Agency in Washington, DC.

Now for our housekeeping item. I need to let you know that the materials used in this presentation have been reviewed by USEPA staff for technical accuracy; however, the views of the speakers are their own and do not necessarily reflect those of USEPA. NPDES permitting is governed by the existing requirements of the Clean Water Act and USEPA's NPDES implementing regulations. These statutory and regulatory provisions contain legally binding requirements. The information in this presentation is not binding. Furthermore, it supplements, and does not modify, existing USEPA policy, guidance, and training on NPDES permitting. USEPA may change the contents of this presentation in the future.

Let's take a look at where we are in the overall training series.

1.3 Addressing Nutrient Pollution in NPDES Permits



Notes:

This presentation is part two of the section of our training on water quality-based effluent limitations for nutrients.

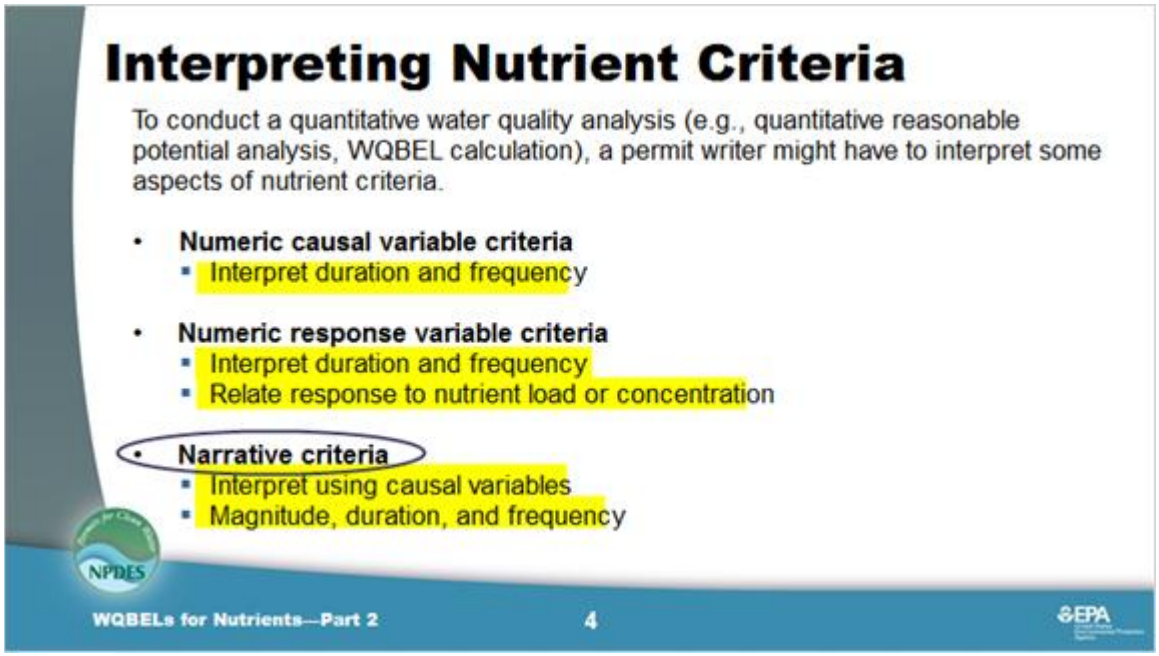
In part one, we looked at how we identify the applicable water quality standards to use when writing NPDES permits.

This presentation, as I mentioned previously, considers how we might need to interpret nutrient criteria that are part of the water quality standards in order to use them for NPDES permitting.

Later presentations in this section of the training will address how we determine the need for water quality-based effluent limitations for nutrients and how we calculate those limits.

Now Nizanna will begin this part of the training by discussing when we might need to interpret criteria.

1.4 Interpreting Nutrient Criteria



Notes:

Thanks Danielle!

If we plan to conduct any kind of quantitative water quality analysis, we need a numeric receiving water target for phosphorus or nitrogen.

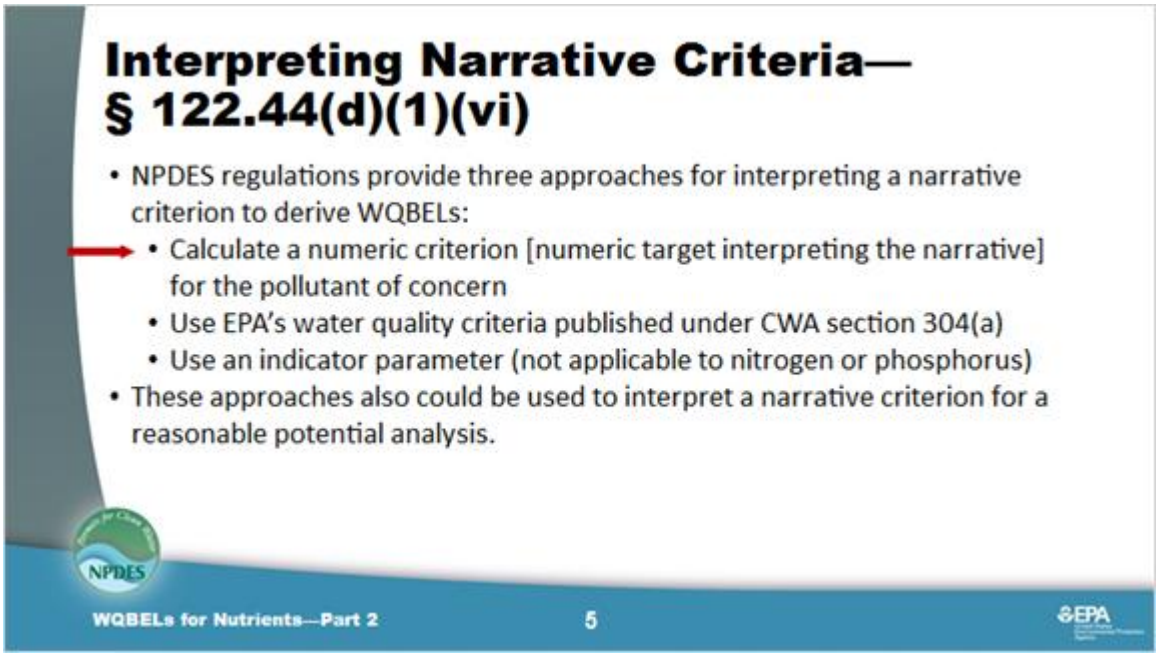
Let's think back to our discussion of nutrient criteria in Part 1 of this section of the training. There, we looked at two types of numeric criteria-criteria for causal variables and criteria for response variables. We also noted that some states currently only have narrative criteria to address nutrients. Let's consider each type of criterion that we might encounter and how we could use it in a quantitative analysis.

For numeric criteria for nitrogen or phosphorus, there is a good chance that we would need to interpret some aspect of the numeric criterion for use in a quantitative analysis. You may recall that water quality criteria typically include a magnitude, duration, and frequency. If the duration and frequency components of numeric criteria for phosphorus and nitrogen are not clearly specified, a permit writer would need to consider the data and literature underlying development of the criteria or work with water quality standards staff to determine an appropriate duration and frequency.

For numeric response variable criteria, such as dissolved oxygen and chlorophyll a, we might need to interpret the duration and frequency of the criteria for use in a quantitative analysis, if these components are not clearly specified. We will also need to relate the response variables to phosphorus and nitrogen concentrations in, or loadings to, the water body. We will look at an example of this approach in our next presentation when we talk more about water quality modeling.

To use a narrative criterion in a quantitative analysis, we would have to interpret it by developing numeric targets for nutrients that include magnitude, duration, and frequency components. For the rest of this presentation, we are going to focus on this third scenario and examine available approaches for developing numeric targets for phosphorus and nitrogen based on interpretation of a narrative criterion.

1.5 Interpreting Narrative Criteria—§ 122.44(d)(1)(vi)



Notes:

The NPDES regulation at 40 CFR 122.44(d)(1)(vi) provides specific options for interpreting a narrative water quality criterion. We want to note here that this regulation specifically addresses the situation where a permit writer is deriving water quality-based effluent limits after having already determined that there is "reasonable potential" that a narrative criterion will be exceeded.

Remember, the reasonable potential determination could have been based on a qualitative analysis, not requiring a numerical interpretation of the narrative criterion. For now, however, let's assume that we want to conduct a quantitative reasonable potential analysis and we are looking for options for how to interpret a narrative nutrient criterion to develop a numerical value to use in that analysis.

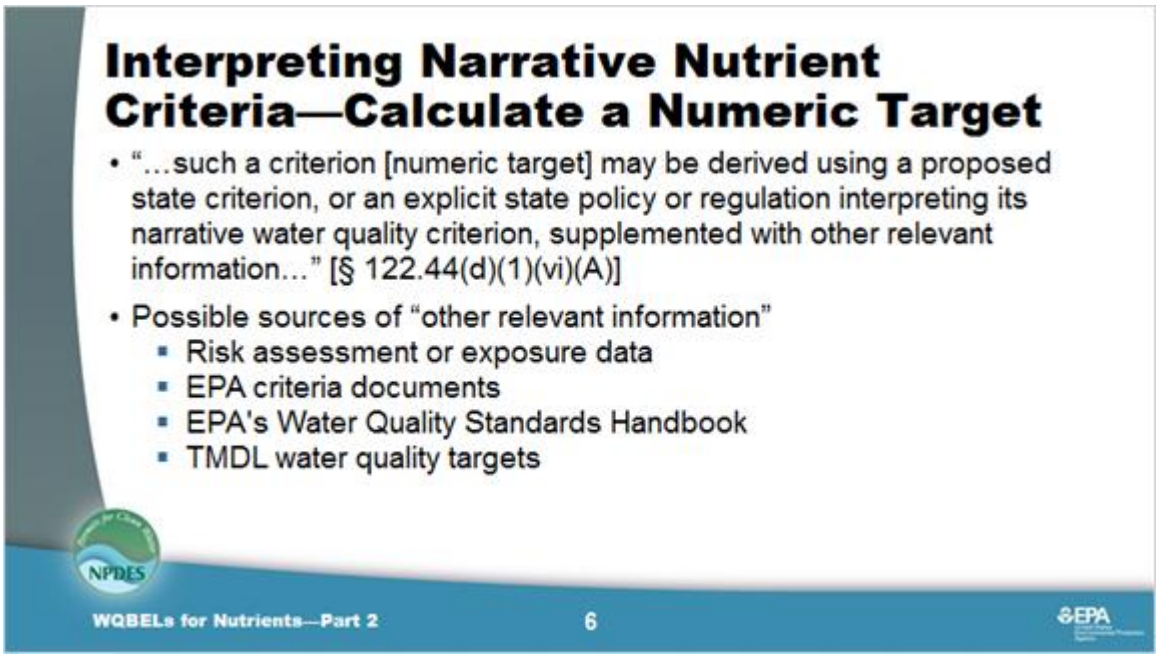
The first two of the three options in 122.44(d)(1)(vi) are relevant to our situation of interpreting a narrative nutrient criterion by setting a total phosphorus or total nitrogen target. We will look closely at these options in the remainder of this presentation.

The third option presented for interpreting a narrative criterion is to use an indicator parameter. The indicator parameter approach might be useful for assessment purposes but would not be

useful for our permitting situation. For example, we could interpret a narrative criterion using a chlorophyll *a* concentration value to assess attainment of the narrative. For permitting purposes, however, we still would need to translate the narrative criterion into phosphorous or nitrogen targets to use as the basis for calculating phosphorus or nitrogen effluent limits.

So, let's look at the first two options in more detail, starting with calculating a numeric criterion, or target, for the pollutant of concern.

1.6 Interpreting Narrative Nutrient Criteria—Calculate a Numeric Target



Notes:

The first option presented in the regulation is to derive a numeric criterion-not really an official water quality criterion, like we would find in the water quality standards, but a numeric target. The regulation says that this criterion would be derived using a proposed state criterion or an explicit state policy or regulation interpreting the narrative criterion, supplemented by other relevant information.

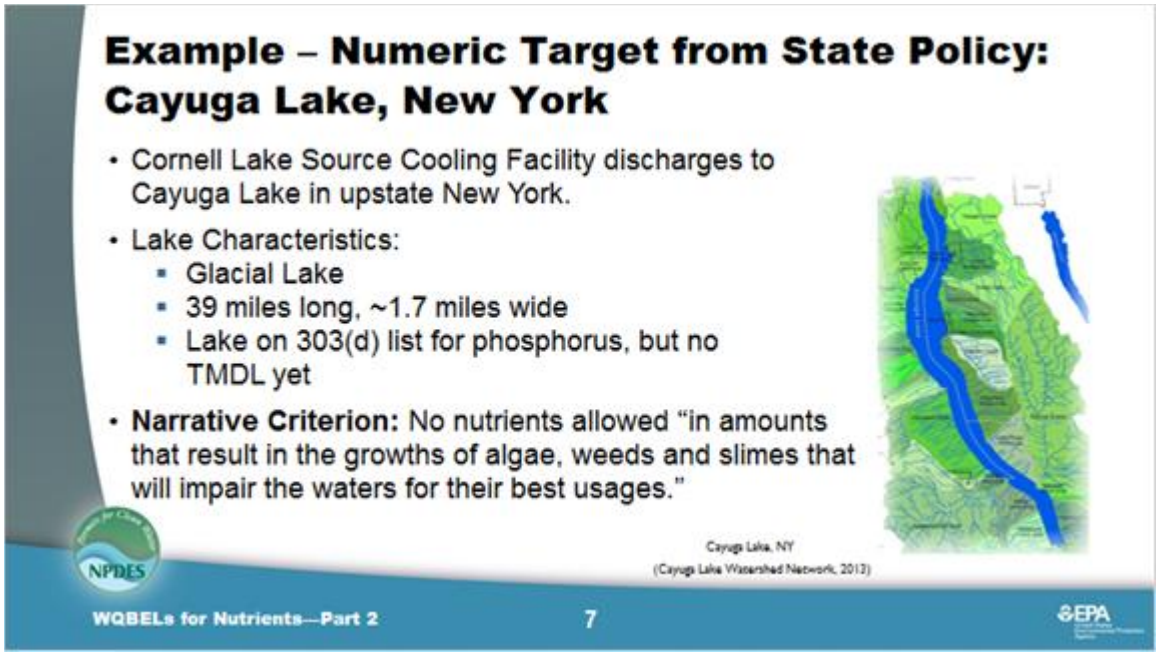
A good example of this approach that you might have seen before is when a state has a policy stating how it will interpret a narrative "no toxics in toxic amounts" criterion using whole effluent toxicity testing. A state could develop the same type of policy for nutrients and a

A good example of this approach that you might have seen before is when a state has a policy stating how it will interpret a narrative "no toxics in toxic amounts" criterion using whole effluent toxicity testing. A state could develop the same type of policy for nutrients and a narrative nutrient criterion.

Possible sources of "other relevant information" might include:

- Risk assessment or exposure data that could be used to identify the level of nutrients that could adversely impact the water body of concern,
- EPA's criteria documents-resources we will discuss further under the second option,
- EPA's W*ater Quality Standards Handbook,* which includes a discussion of narrative criteria and aquatic life criteria and their components, and
- TMDL water quality targets for nutrients developed for other, similar water bodies.

1.7 Example – Numeric Target from State Policy: Cayuga Lake, New York



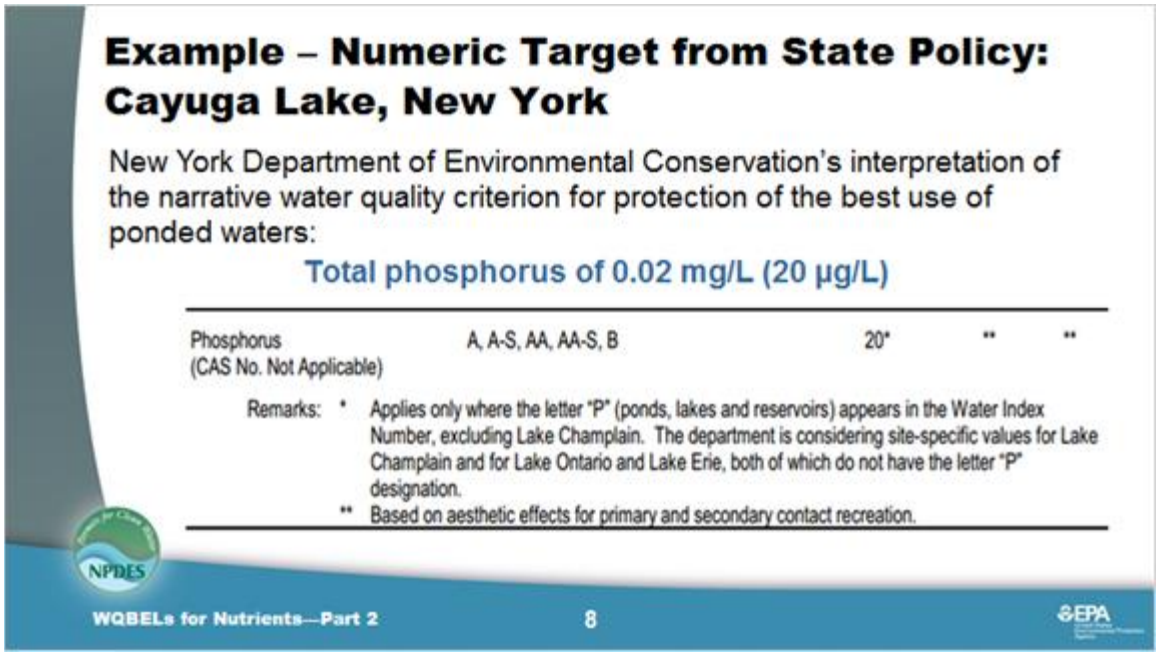
Notes:

Here is an example of numeric interpretation of a narrative criterion using this approach. In this example the permittee is the Cornell Lake Source Cooling Facility in New York.

This facility discharges into Cayuga Lake in upstate New York. In 2002, Cayuga Lake was listed as impaired, with phosphorous named as a cause of designated use impairment. A TMDL has not been developed yet.

The nutrient criterion that applies to the lake is a narrative criterion stating that no nutrients are allowed "in amounts that result in the growths of algae, weeds and slimes that will impair the waters for their best usages."

1.8 Example – Numeric Target from State Policy: Cayuga Lake, New York

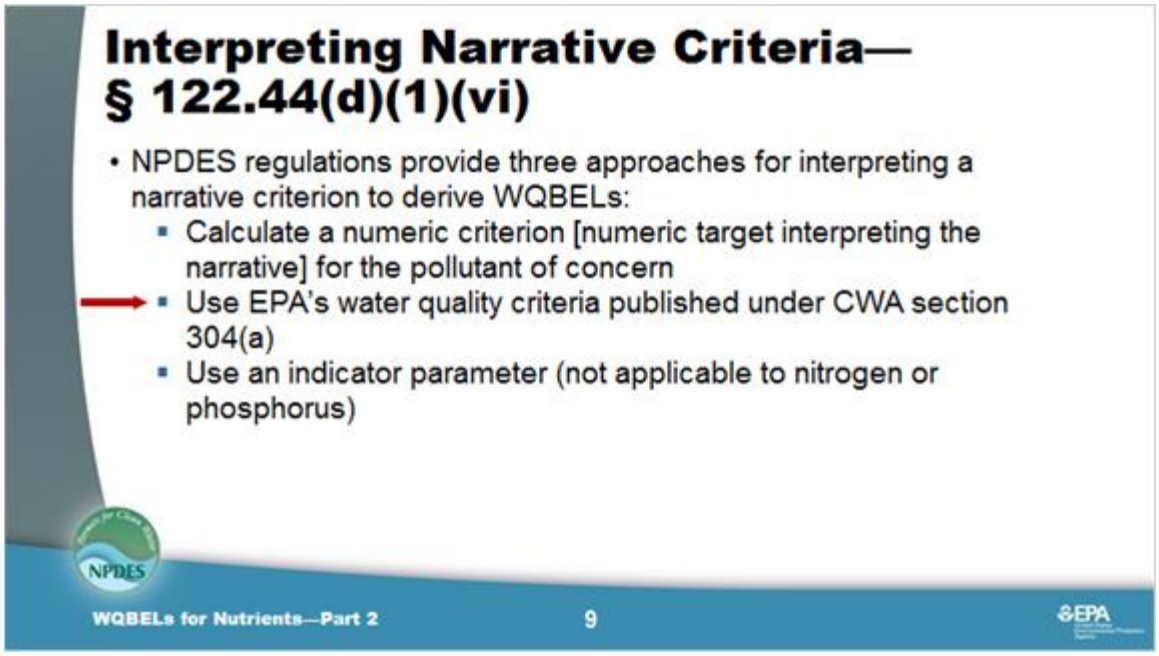


Notes:

The New York State Department of Environmental Conservation (or DEC) has a water quality guidance value for total phosphorus of 0.02 mg/L. This value is not a numeric criterion adopted as part of New York's water quality standards; however, it serves as the DEC's interpretation of the narrative water quality criterion for protection of the best use of ponded waters.

To determine this value, DEC employed a survey of lakes in New York, Vermont, and Minnesota, which evaluated the correlation of chlorophyll *a* and secchi depth to total phosphorous. DEC assumed a moderate nuisance level at an exceedance frequency of 10%, a number that also corresponded to the boundary between mesotrophic and eutrophic.

1.9 Interpreting Narrative Criteria— § 122.44(d)(1)(vi)



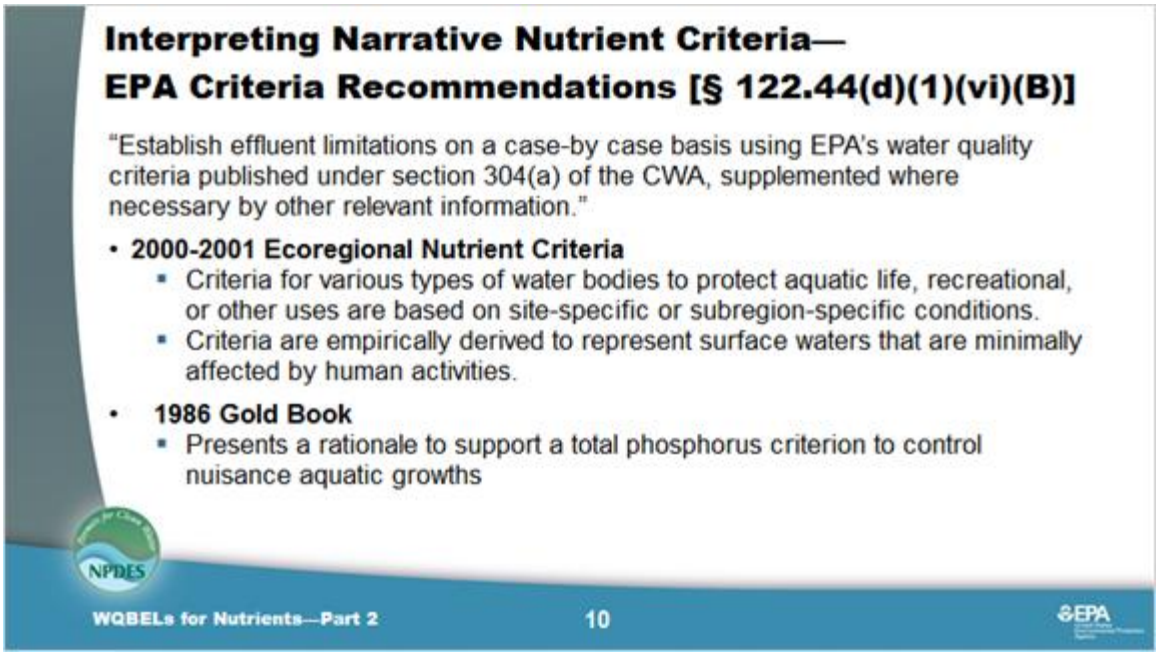
Notes:

Nizanna has just walked you through the first option in 40 CFR 122.44(d)(1)(vi).

In the second option, the regulations say that EPA's published water quality criteria under section 304(a) of the Clean Water Act may be used for interpreting a narrative criterion, supplemented where necessary by other relevant information.

Let's look at how that option could be applied when addressing nutrients.

1.10 Interpreting Narrative Nutrient Criteria— EPA Criteria Recommendations [§ 122.44(d)(1)(vi)(B)]



Notes:

What sources of information are available under this second option?

In 2000 and 2001, EPA published nutrient criteria for 14 ecoregions of similar geographic characteristics across the 48 contiguous states.

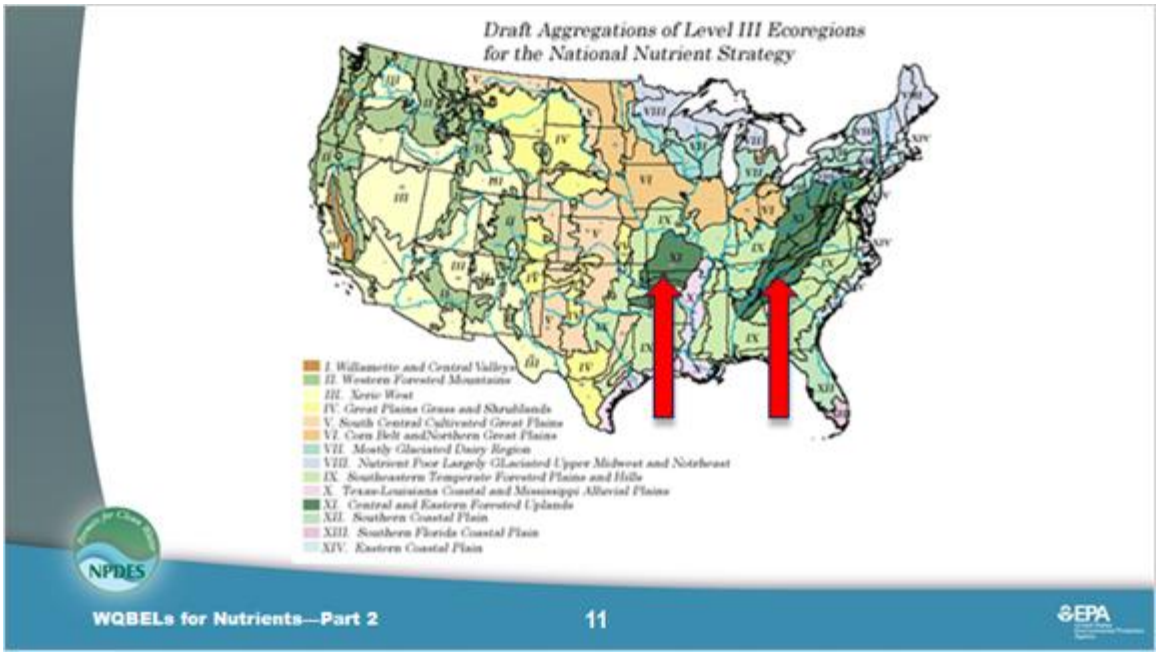
The ecoregional nutrient criteria are intended to protect aquatic life, recreational, and other uses on a site-specific basis. These criteria are based on reference conditions representing surface waters that are minimally affected by human activities.

In addition, back in 1986 EPA included in its Gold Book a rationale that could be used to support a total phosphorus criterion to control nuisance aquatic growths.

Links to both the ecoregional criteria and the Gold Book are available in the Resources tab of this presentation.

Now let's take a look a closer look at both of these resources.

1.11 Draft Aggregations of Level III Ecoregions for the National Nutrient Strategy



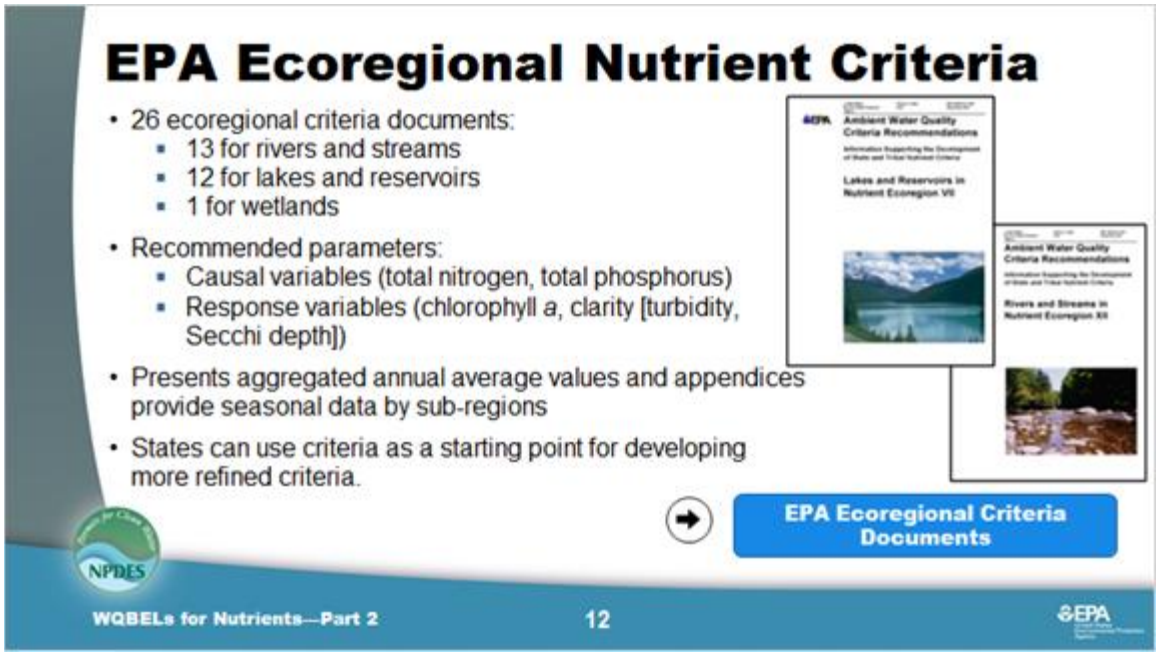
Notes:

First, let's discuss the ecoregional nutrient criteria.

Ecoregions are defined as regions of relative homogeneity in ecological systems. They depict areas within which the mosaic of ecosystem components (biotic and abiotic, as well as terrestrial and aquatic) is different than adjacent areas in a holistic sense. Geographic phenomena such as soils, vegetation, climate, geology, land cover, and physiology that are associated with spatial differences in the quantity and quality of ecosystem components are relatively similar within each ecoregion.

This slide shows a map of the level III ecoregions of the contiguous 48 states. Notice that most ecoregions, such as Ecoregion XI, are not contiguous and cover more than one geographical area of the country.

1.12 EPA Ecoregional Nutrient Criteria



Notes:

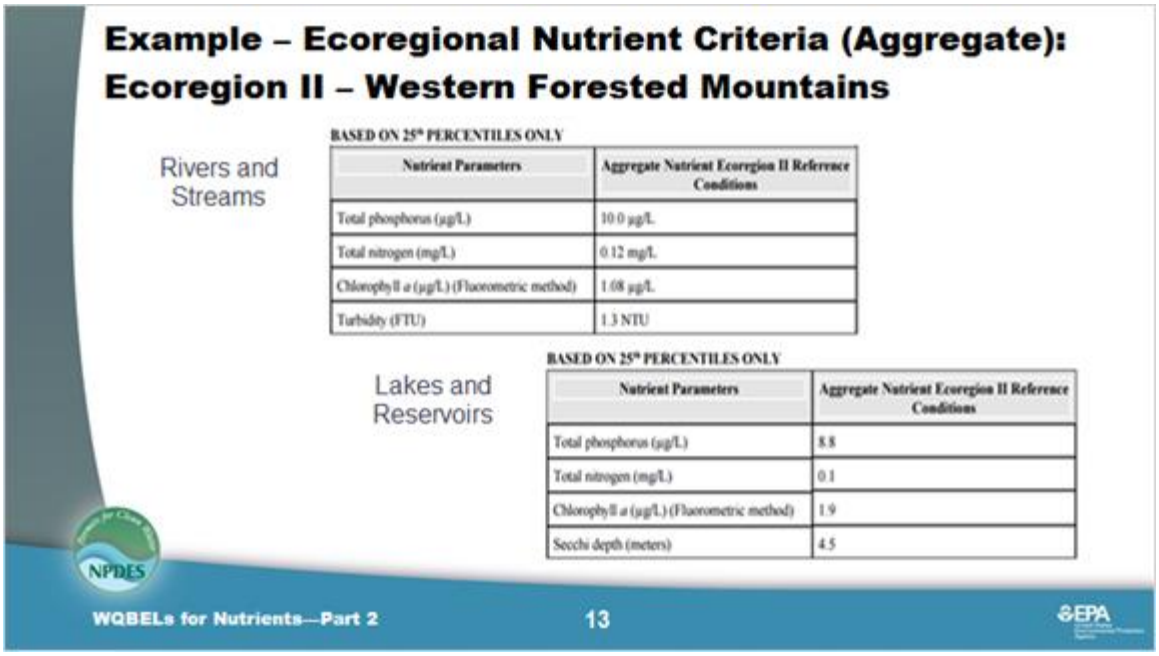
There are 26 ecoregional criteria documents. These documents cover rivers and streams in 13 ecoregions, lakes and reservoirs in 12 ecoregions, and wetlands in 1 ecoregion.

The criteria include both causal variables (total phosphorus and total nitrogen) and response variables (chlorophyll *a* and a measure of clarity, generally turbidity).

The values presented up front in the documents are annual average values aggregated across the ecoregion. Appendices provide seasonal data for the sub-regions that make up the ecoregion.

The ecoregional criteria documents were published as starting points for states to use in order to develop more refined criteria. Refining criteria involves modifying the ecoregional criteria to reflect conditions at a smaller geographic scale than an ecoregion, such as a subecoregion, the state, or a specific class of water bodies. Steps in this process might include grouping data or performing data analyses at these smaller geographic scales as well as further consideration of other tools for criteria development, such as published literature or models.

1.13 Example – Ecoregional Nutrient Criteria (Aggregate): Ecoregion II - Western Forested Mountains



Notes:

Here is an example of EPA's ecoregional criteria for rivers and streams and lakes and reservoirs. These criteria are for Ecoregion II, the Western Forested Mountains. You can see that there are total phosphorus, total nitrogen, chlorophyll *a,* turbidity, and Secchi depth criteria. Again, the criteria are based on reference conditions in the ecoregion. In this case, the criteria are derived based on the 25th percentile of available data for water bodies across the ecoregion.

Now let's consider some examples of how EPA's ecoregional criteria have been used in NPDES permits.

1.14 Example – Ecoregional Nutrient Criteria: Pend Oreille River, Idaho

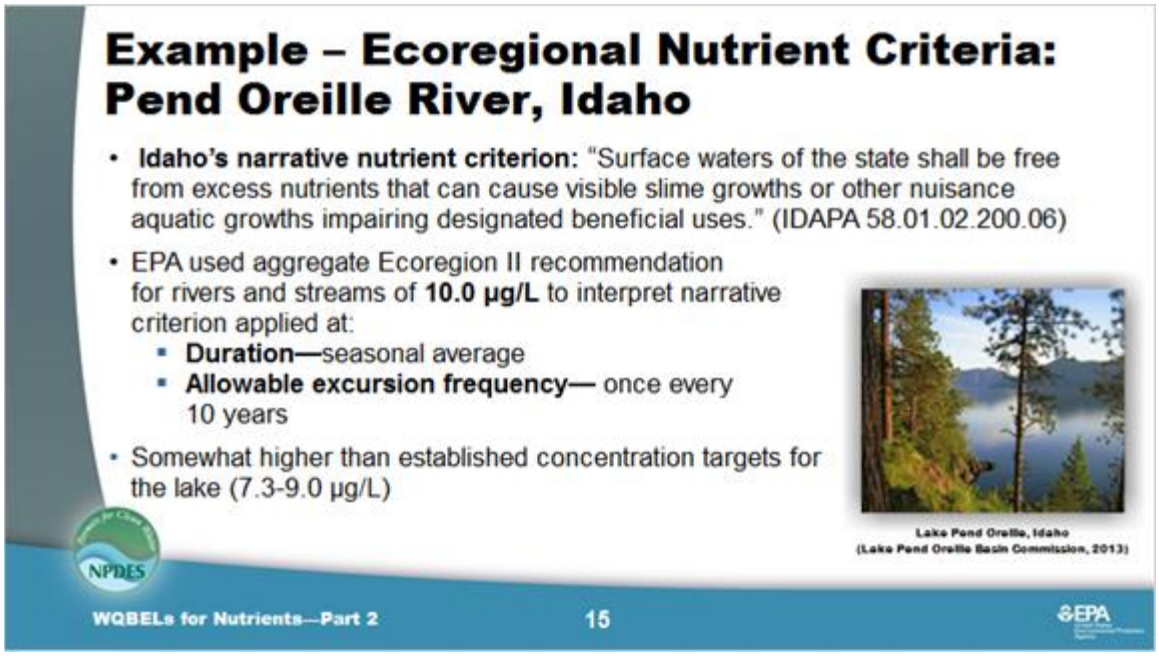
Notes:

If you viewed part one of this section of the training on water quality-based effluent limits for nutrients, you might have looked at the case study. The case study included a discussion of EPA Region 10's permit for the City of Sandpoint, Idaho. Recall the EPA Region 10 is the permitting authority for the state of Idaho, as the state has not yet been authorized to administer the NPDES program. The Sandpoint POTW discharges to the Pend Oreille River just downstream of the outlet from Lake Pend Oreille and there is a gradual transition from lake to river.

A total phosphorus TMDL was completed for the lake in 2002. The river had been listed on EPA's 303(d) list of impaired waters for total phosphorus, but was de-listed in 2010. Additionally, modeling results indicated that the discharge had the potential for significant water quality effects.

Consequently, EPA Region 10 issued an NPDES permit for the Sandpoint POTW that set limits aimed at protection of the vulnerable, slow-moving river downstream of the lake.

1.15 Example – Ecoregional Nutrient Criteria: Pend Oreille River, Idaho



Notes:

Idaho has a narrative nutrient criterion, but no numeric criterion for total phosphorus. To assess the need for water quality-based effluent limitations on phosphorus in the Sandpoint POTW permit, EPA Region 10 decided to interpret Idaho's narrative nutrient criterion and conduct a quantitative reasonable potential analysis.

The Region decided to use 10.0 µg/L, EPA's Aggregate Ecoregion II recommendation for total phosphorus for rivers and streams, as the basis for interpreting the narrative criterion that applies to the Pend Oreille River.

This decision was based on several lines of evidence:

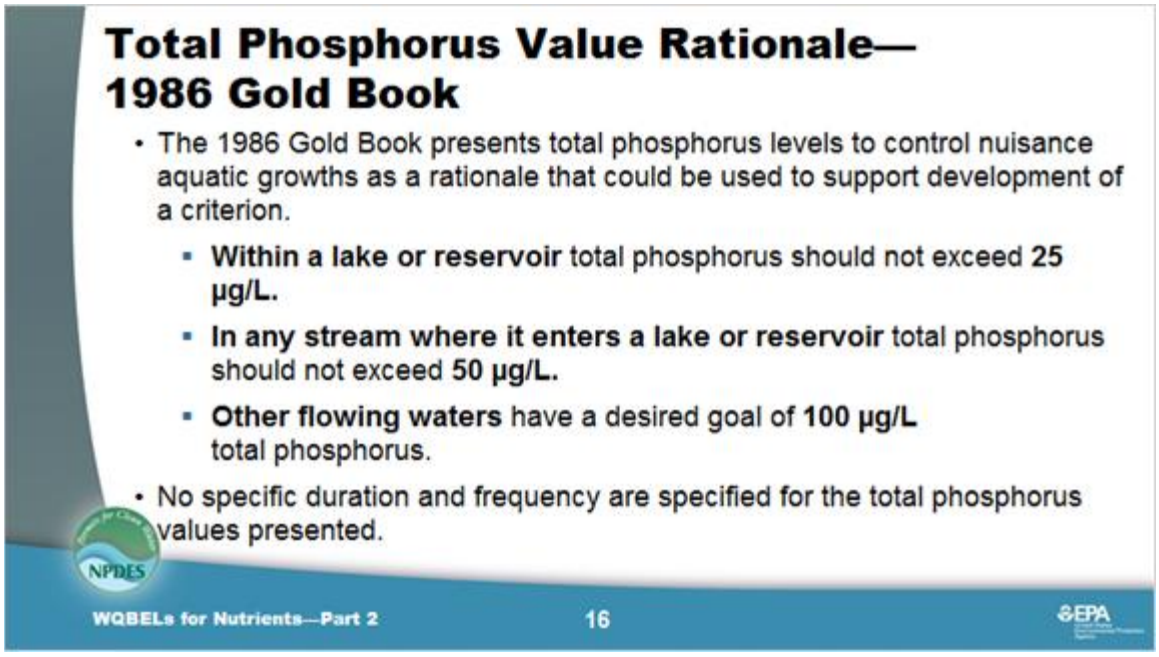
- The receiving water is sensitive to nutrients, as evidenced by the TMDL for the upstream lake and the vulnerability of the river to the effects of nutrient pollution.
- The total phosphorus target from the lake TMDL is 9.0 µg/L.
- The average eutrophic zone target set for Lake Pend Oreille in a Border Nutrient Load Agreement signed by Montana and Idaho is 7.3 µg/L.
- The ecoregional criterion of 10 µg/L is higher than either of the lake total phosphorus targets, but is a reasonable concentration target given that lakes generally are more

sensitive to nutrients than rivers. For example, EPA's total phosphorus criterion for lakes in the same aggregate ecoregion is 8.8 µg/L.

EPA Region 10 also had to determine the appropriate duration and frequency to use when applying the 10 µg/L criterion to the Pend Oreille River. They applied the ecoregional criterion as a seasonal average and set an allowable excursion frequency of once every 10 years, which is typical for water quality-based permitting. The duration and frequency decisions are consistent with statements in the ecoregional criteria document stating that "EPA does not recommend identifying nutrient concentrations that must be met at all times, rather a seasonal or annual averaging period…is considered appropriate. However these seasonal or annual central tendency measures should apply each season or year, except under extraordinary circumstances."

Now, let's turn it over to Nizanna to discuss the Gold Book in more detail.

1.16 Total Phosphorus Value Rationale—1986 Gold Book



Notes:

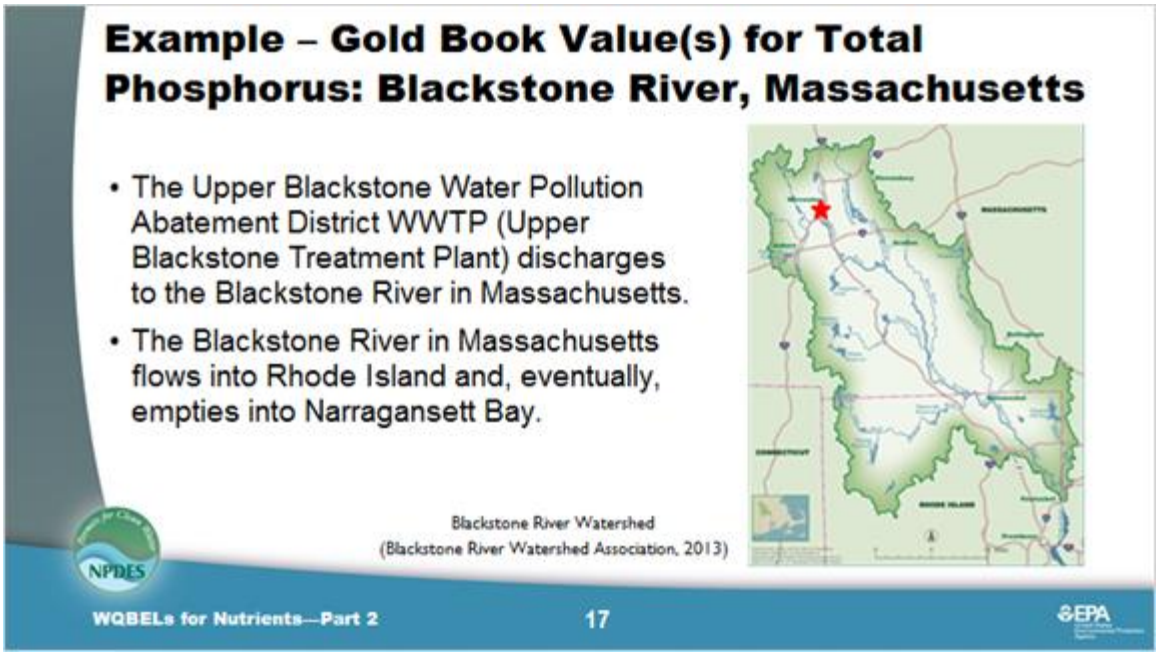
Those were great examples Danielle!

Now, let's turn to another possible source from EPA for interpreting a narrative nutrient criterion.

Earlier we discussed the fact that EPA's 1986 Gold Book included a rationale for a total phosphorus value to control nuisance aquatic growths. The Gold Book values to protect a lake or reservoir are 25 µg/L within the lake or reservoir itself and 50 µg/L in any stream at the point where it enters any lake or reservoir. In addition, there is a goal of 100 µg/L total phosphorus in flowing waters that do not discharge directly into lakes or reservoirs.

These values were used in a permit issued by EPA Region 1 as concentrations applied with short-term average durations and a low frequency of excursion.

1.17 Example – Gold Book Value(s) for Total Phosphorus: Blackstone River, Massachusetts

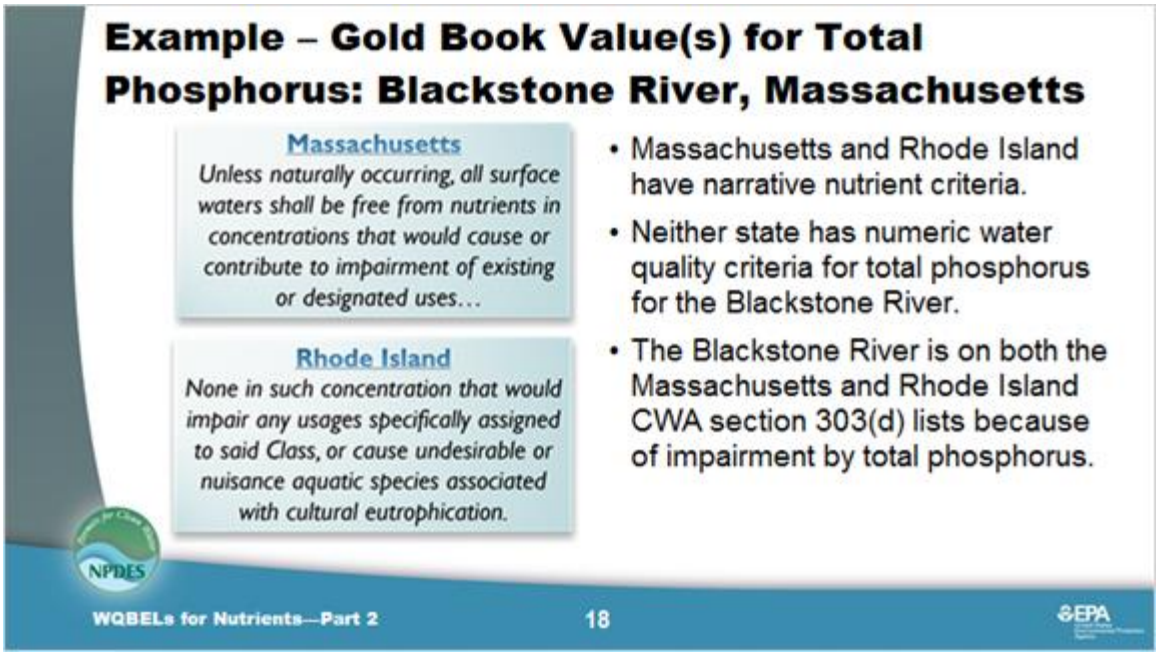


Notes:

Remember that EPA Region 1 is the permitting authority for the state of Massachusetts, as the state has not yet been authorized to administer the NPDES program. EPA Region 1 considered the potential impacts of the discharge from the Upper Blackstone Water Pollution Abatement District Wastewater Treatment Plant on the downstream water quality in Narragansett Bay when issuing the NPDES permit for the treatment plant. From now on, we'll just call the facility the Upper Blackstone Treatment Plant.

The Upper Blackstone Treatment Plant is authorized to discharge a flow of 56.0 million gallons per day to the Blackstone River in Massachusetts. The Blackstone River in Massachusetts flows into Rhode Island and eventually empties into Narragansett Bay.

1.18 Example – Gold Book Value(s) for Total Phosphorus: Blackstone River, Massachusetts



Notes:

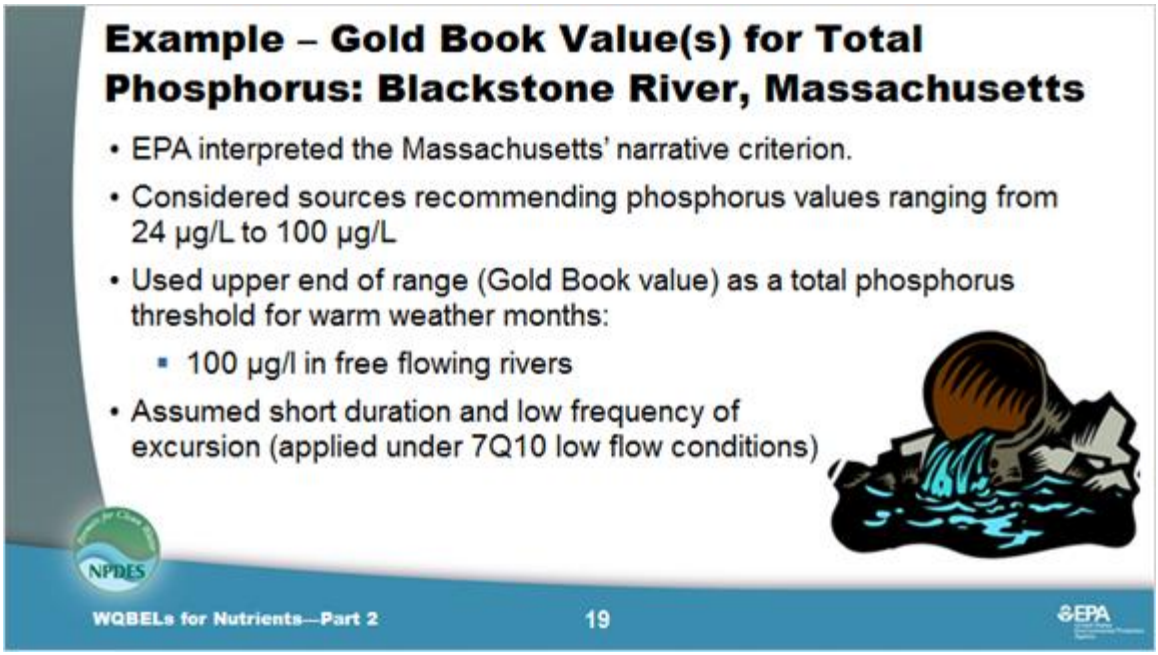
The Region looked at the potential impact of the discharge from the Upper Blackstone Treatment Plant on both the immediate receiving water, the Blackstone River, and the downstream Narragansett Bay.

In the next presentation in this series, we will have the opportunity to consider how the Region assessed the potential impact from the discharge of nitrogen on water quality in Narragansett Bay. For now, let's focus on the Region's assessment of the potential impacts of phosphorus discharges on the river.

Both Massachusetts and Rhode Island have water quality criteria that address nutrients, but these criteria are narrative. There are no numeric nutrient criteria for the Blackstone River, but studies show documented effects of phosphorus enrichment, and the river is on the Clean Water Act section 303(d) lists in both states for, among other things, impairment from phosphorus.

EPA Region 1 decided to interpret Massachusetts' narrative criterion in order to assess the potential impacts of the Upper Blackstone Treatment Plant's phosphorus discharges on water quality in the Blackstone River.

1.19 Example – Gold Book Value(s) for Total Phosphorus: Blackstone River, Massachusetts



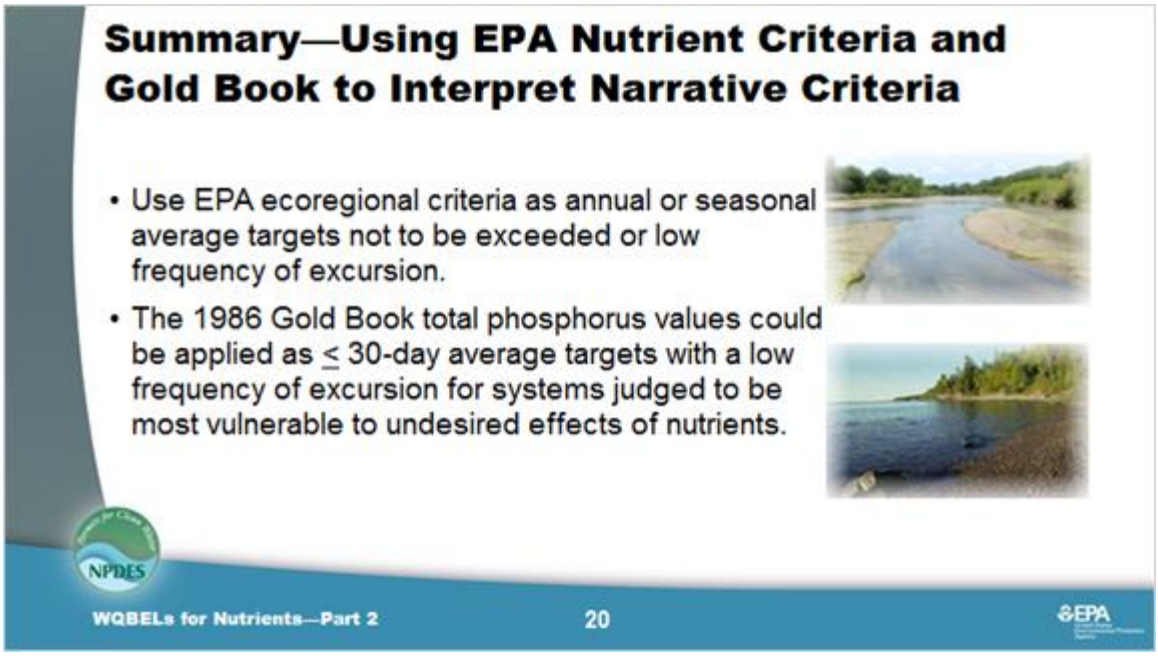
Notes:

Region 1 considered interpreting Massachusetts' narrative criterion using values ranging from 24 µg/L (the ecoregional criterion for Ecoregion XIV, Eastern Coastal Plains) to 100 µg/L (the value from the Gold Book for free-flowing rivers). Ultimately, the Region decided to apply the concentration at the upper end of that range, which was the 100 µg/L total phosphorus concentration value from the Gold Book.

The Region applied this interpretation of the narrative criterion at the 7Q10 low flow of the Blackstone River, indicating a short duration and low frequency of excursion and, therefore, a need to attain the concentration under all flow conditions. The Region based this decision on the lack of dilution-the discharge from the facility dominates the flow in the river-as well as data

indicating elevated concentrations of phosphorus upstream of the discharge, even during wet weather events.

1.20 Summary—Using EPA Nutrient Criteria and Gold Book to Interpret Narrative Criteria

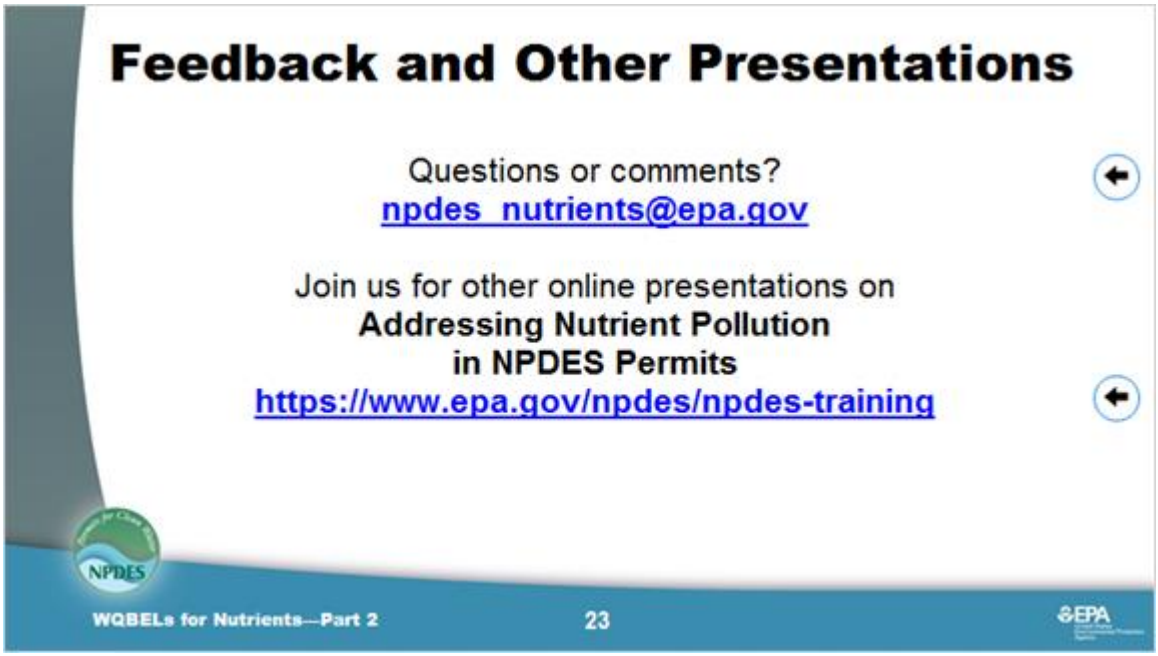


Notes:

What kind of general conclusions can we draw from how EPA criteria are expressed and these examples of how they have been applied in NPDES permits?

- First, ecoregional criteria for total phosphorus and total nitrogen could be used as annual or seasonal average values, refined as needed to reflect local conditions.
- Second, the Gold Book values for total phosphorus could be used as short-term averages (for example, 30 days or less) with low frequency of excursion in water bodies judged to be the most vulnerable to the undesired effects of high phosphorus concentrations.

1.28 Feedback and Other Presentations



Notes:

Congratulations on completing the quiz and this presentation!

If you have questions or comments on this presentation or any part of this training curriculum, you can email npdes_nutrients@epa.gov.

Remember, you will find all NPDES online training presentations, under the "Training" section of USEPA's NPDES website.

Thanks again for joining us!