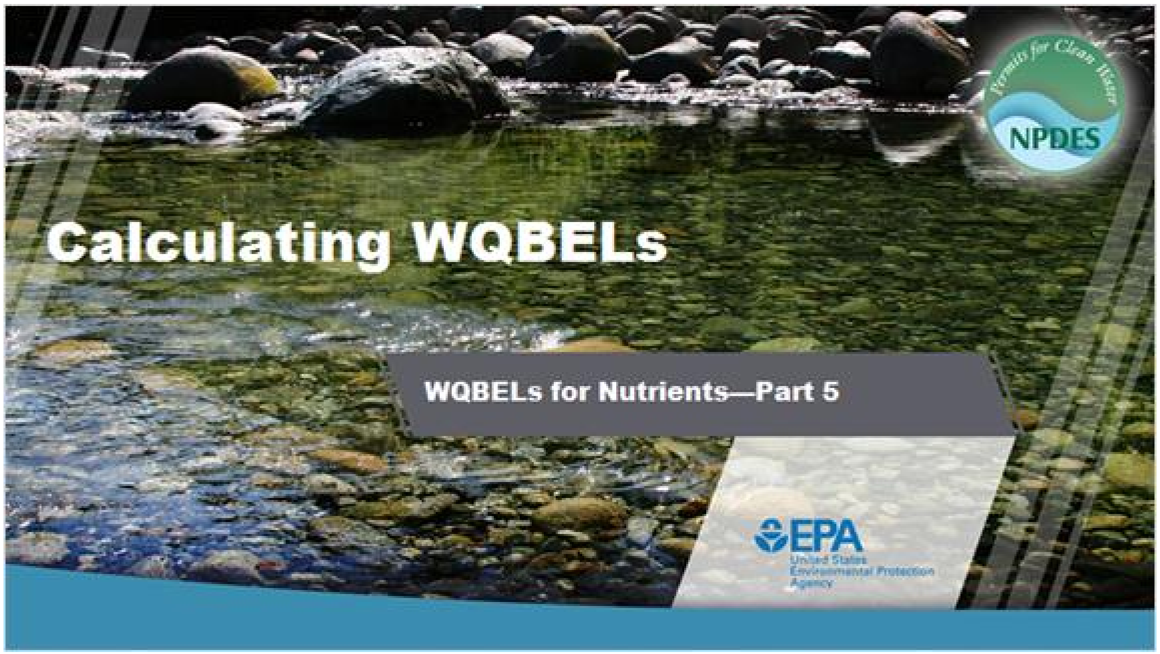
Calculating WQBELs

1. Part 5: WQBELs for Nutrients-Part 5

1.1 Calculating WQBELs



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 five 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 discuss the process of calculating water quality-based effluent limitations. 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

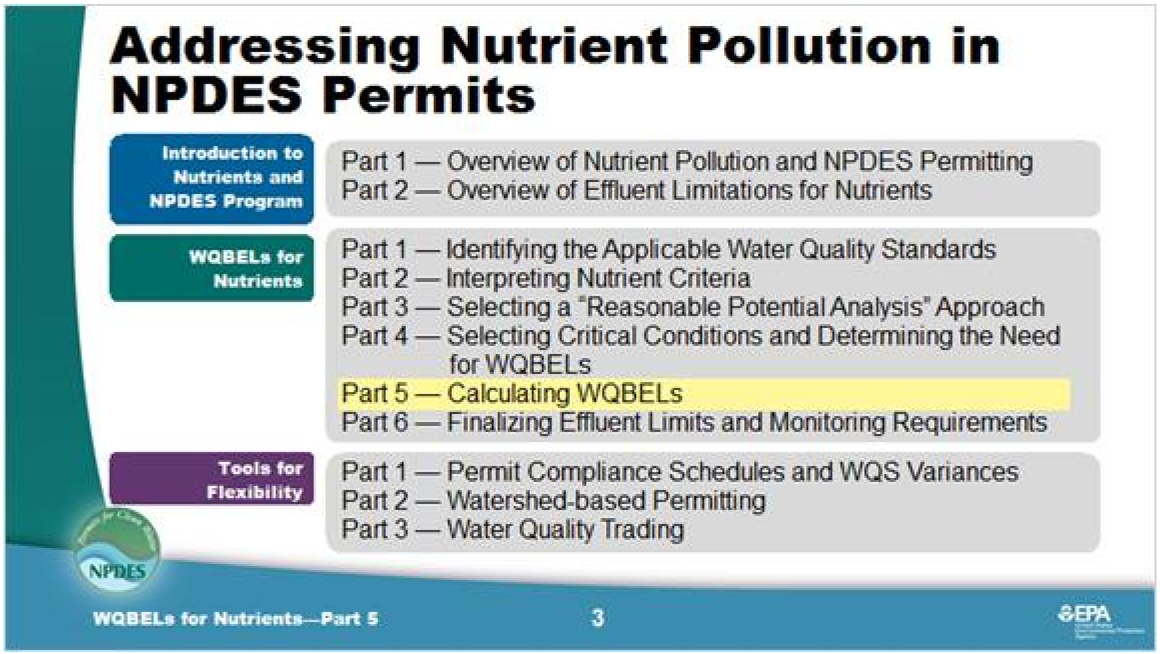
Notes:

Your speakers for this presentation are Nizanna Bathersfield and Frank Sylvester. Both speakers 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 five of the section of our training on water quality-based effluent limitations for nutrients.

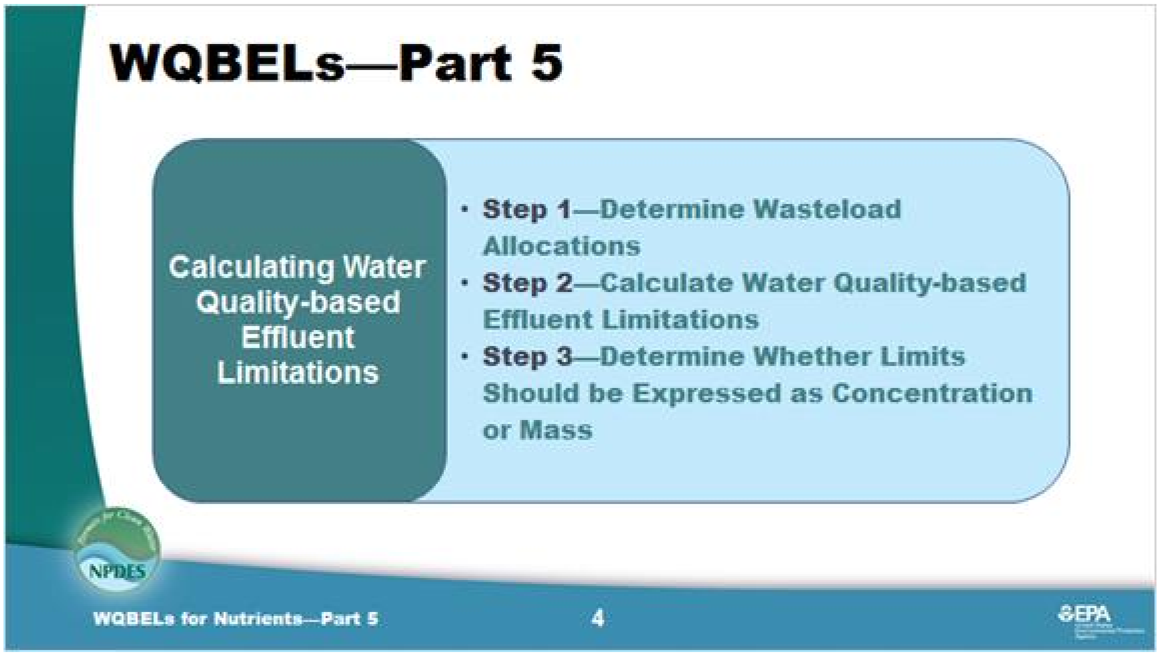
In parts one and two, we looked at how we identify the applicable water quality standards and interpret nutrient criteria in those standards in order to use them for NPDES permitting.

In parts three and four, we focused on selecting an approach to determining the need for WQBELs-our “reasonable potential analysis" approach. We also considered how we select an appropriate water quality model and model inputs and use that model for a reasonable potential analysis.

In this presentation, we will use the same water quality model and model inputs to calculate WQBELs that are derived from and comply with water quality standards.

Can you get us started, Nizanna?

1.4 WQBELs—Part 5



Notes:

I sure can, Danielle.

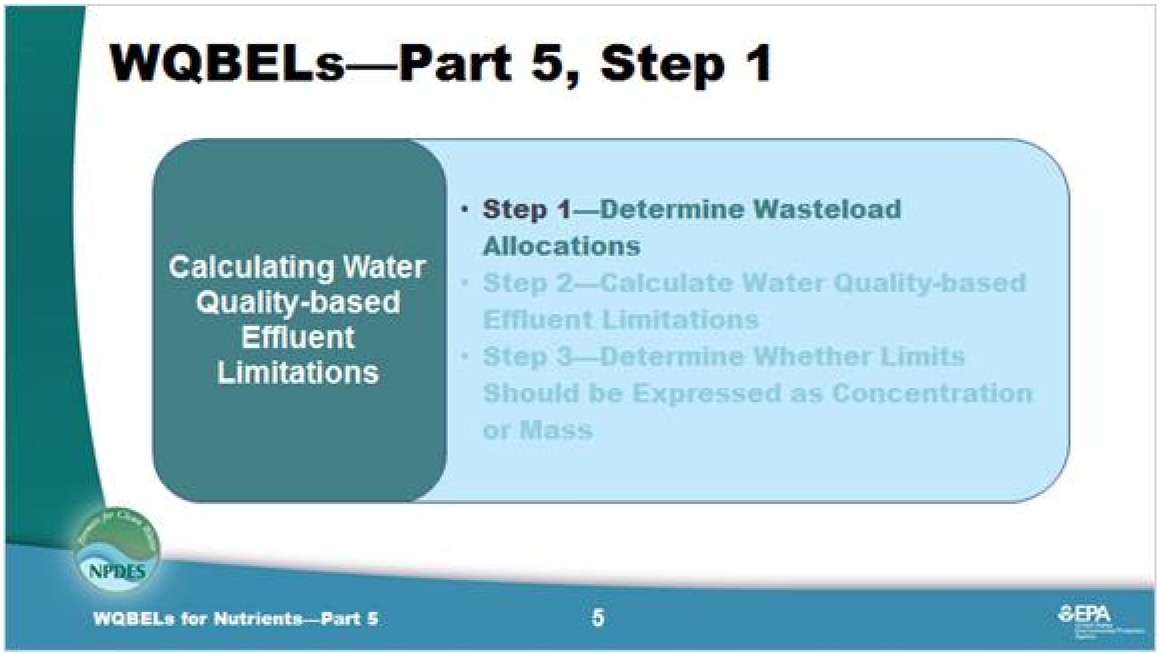
Here are the three steps that we are going to follow in calculating water quality-based effluent limitations.

First, we need to calculate wasteload allocations based on the applicable water quality criteria.

Second, we calculate water quality-based effluent limitations from the wasteload allocations.

Finally, we evaluate whether the limits should be expressed in terms of concentration, mass, or both.

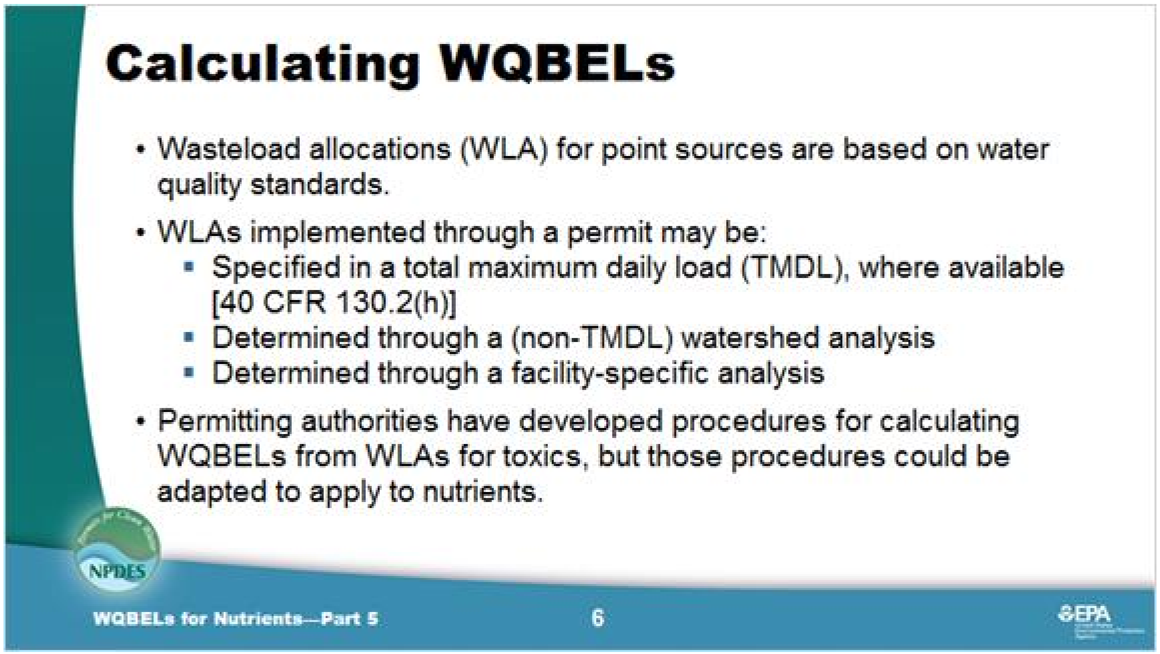
1.5 WQBELs—Part 5, Step 1



Notes:

Let's start by looking at how we determine a wasteload allocation.

1.6 Calculating WQBELs



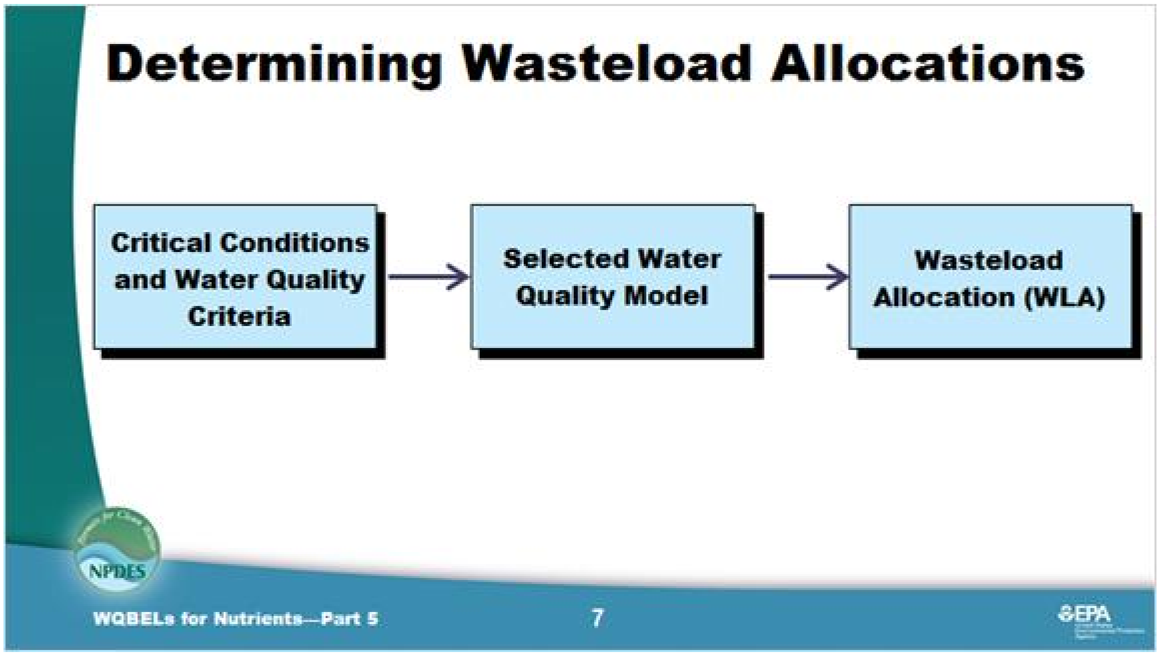
Notes:

Wasteload allocations for point sources are derived from the applicable water quality standards for the receiving water.

Wasteload allocations can be determined through a total maximum daily load, called a TMDL, through a non-TMDL watershed analysis, or through a facility-specific analysis.

Permitting authorities have developed procedures for calculating water quality-based effluent limitations from these wasteload allocations. These procedures often are based on the statistical procedures presented in EPA's *Technical Support Document for Water Quality-based Toxics Control*, otherwise known as the TSD, but they can be adapted and applied to nutrients.

1.7 Determining Wasteload Allocations



Notes:

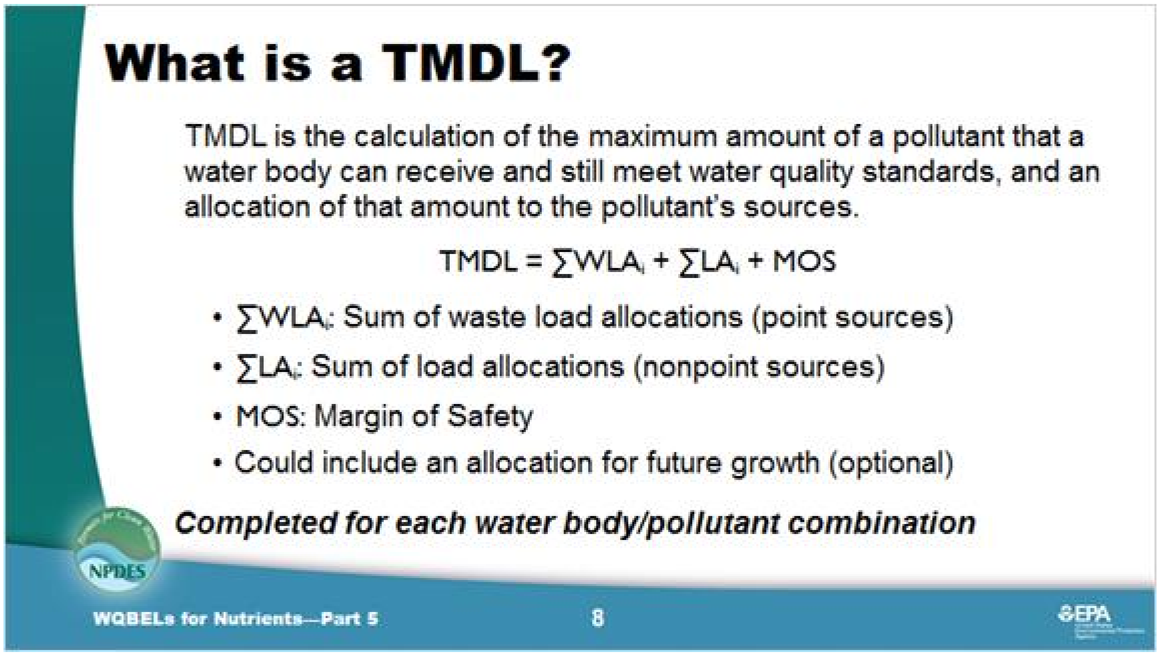
In parts three and four of this section of the training on WQBELs for nutrients, we looked at the reasonable potential analysis and used a water quality model to project the concentration or mass loading of the pollutant in the receiving water.

In this presentation, we are going to see how we can use a water quality model to calculate a wasteload allocation.

If the facility we are permitting meets the required wasteload allocation, it is controlling the pollutant to the extent necessary for water quality criteria to be attained in the receiving water under critical conditions.

Frank, can you tell us about wasteload allocations from TMDLs?

1.8 What is a TMDL?



Notes:

Absolutely, Nizanna.

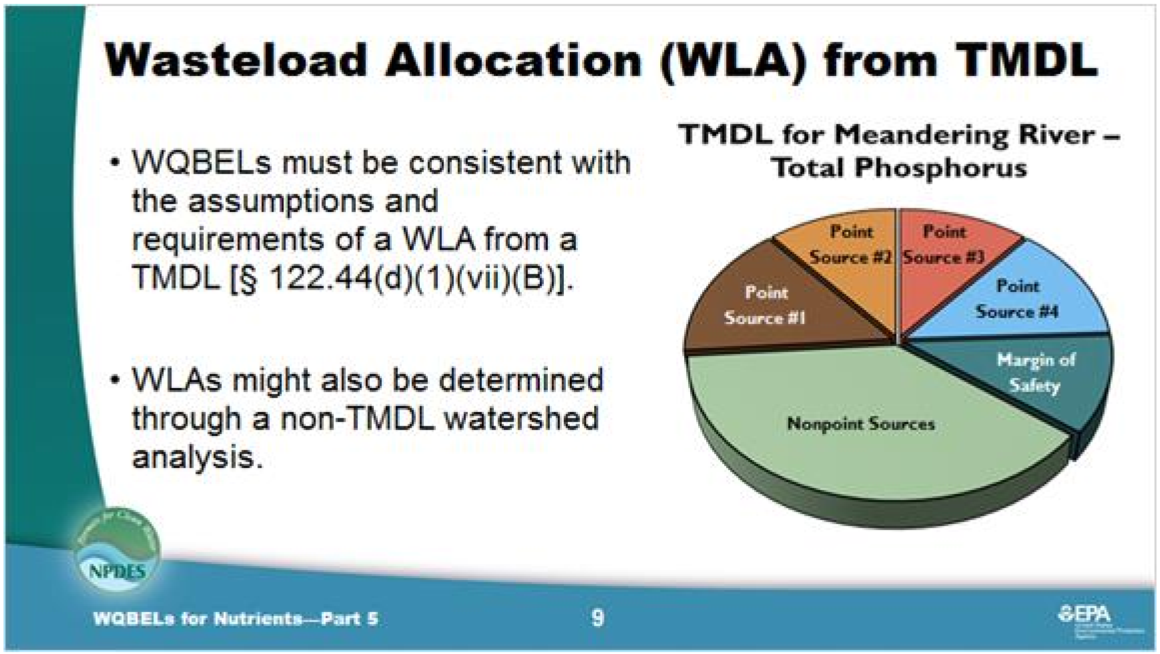
A wasteload allocation for the facility we are permitting might come from a TMDL. That TMDL might have used a water quality model to determine the loadings from various point and nonpoint sources that will allow attainment of water quality criteria.

A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. In addition, it allocates that pollutant amount among contributing sources.

EPA regulations require that a TMDL includes certain components. The first component is one or more wasteload allocations, which identify the portion of the loading capacity allocated to point sources. The second component is one or more load allocations assigned to nonpoint sources. Last but not least, TMDLs include a margin of safety. Some TMDLs also include a reserve capacity allocated for future growth.

So, if a TMDL has been developed for a pollutant for the receiving water or for a downstream water body, the wasteload allocation for the point source should already be available.

1.9 Wasteload Allocation (WLA) from TMDL

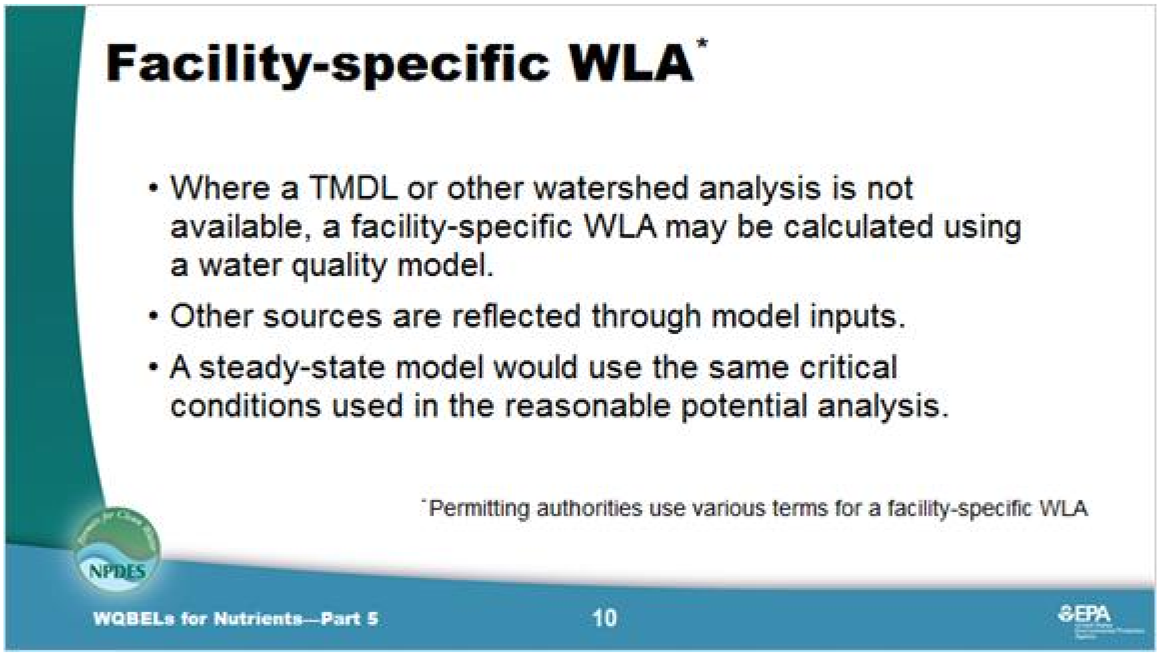


Notes:

The NPDES regulations require that water quality-based effluent limitations be consistent with the assumptions and requirements of a wasteload allocation that is assigned to the point source through a TMDL.

Note also that a watershed analysis could be completed even where a TMDL is not required. While such an analysis would not have the regulatory standing of a TMDL or be subject to the same requirements, it can provide wasteload allocations as a basis for water quality-based effluent limitations.

*1.10 Facility-specific WLA**



Notes:

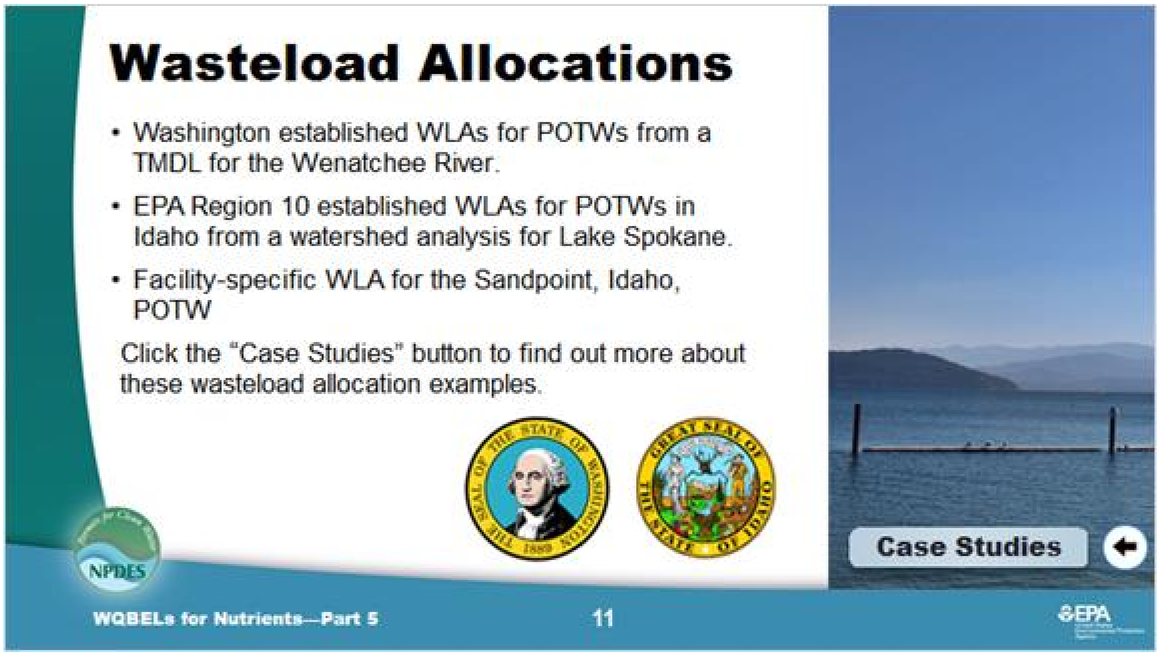
Next, let's walk through what to do where there is no TMDL or watershed analysis, or that analysis is only for a downstream water body.

In those cases, we need to develop a facility-specific wasteload allocation.

A facility-specific wasteload allocation is the maximum amount of the pollutant that may be discharged while still protecting water quality. Permit writers would consider the local water quality criterion as well as any available dilution or mixing zones. Permitting authorities might have various terms for what we are calling a facility-specific wasteload allocation in this training.

To calculate a facility-specific wasteload allocation, we use a water quality model. In this training, we apply a steady-state model and can use the same critical conditions that we selected for the reasonable potential analysis.

1.11 Wasteload Allocations



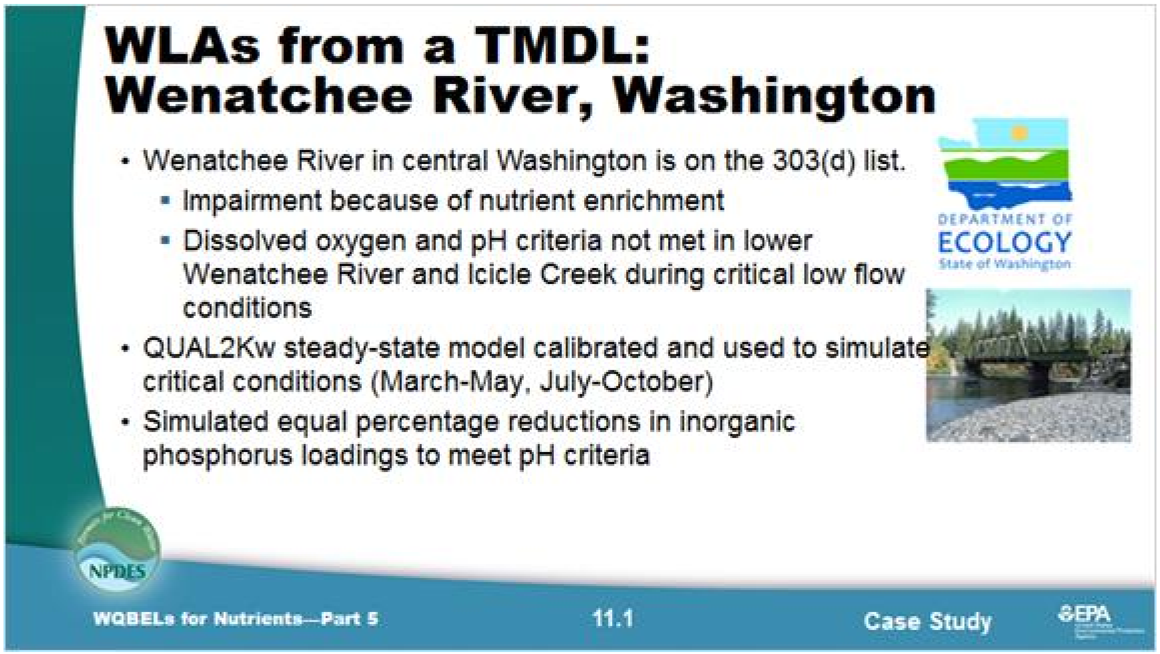
Notes:

This presentation includes case studies of wasteload allocation development from a TMDL for the Wenatchee River in Washington, a watershed analysis for Lake Spokane, and a facility-specific analysis for a POTW in Idaho.

If you would like to view these case studies, click the "Case Studies" button at the bottom of the slide.

Otherwise, click the "Next" button to skip the case studies.

1.12 WLAs from a TMDL: Wenatchee River, Washington



Notes:

The Wenatchee River, in central Washington, was listed on Washington's 1998 303(d) list because of nutrient enrichment. Effects of this enrichment included non-attainment of pH and dissolved oxygen water quality criteria. This occurred during critical low-flow conditions in both the lower Wenatchee River and Icicle Creek, a tributary.

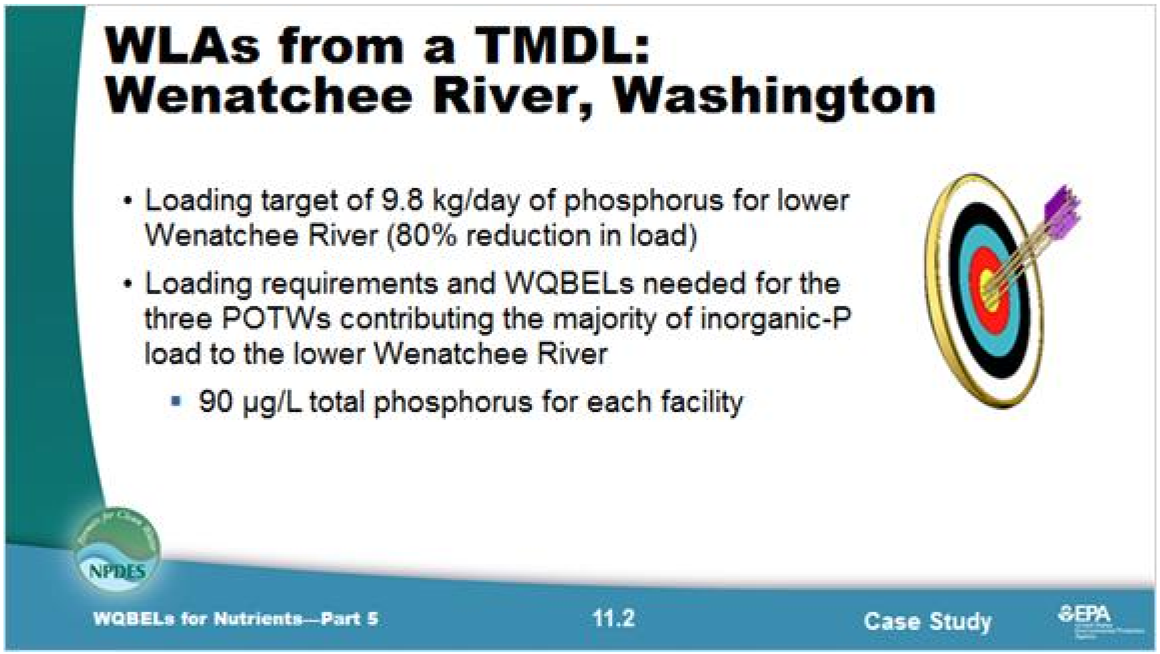
The critical periods are March through May and July through October. These months are when the river has relatively low stream flows. The critical period is interrupted as a result of increased stream flows from snowmelt that occurs from late May to early July.

Washington collected data to confirm the influence of phosphorus on these response criteria and to support a water quality model for purposes of completing a TMDL.

The state used a Washington version of QUAL2K as its model and collected data to calibrate the model. They applied the model to the critical low flow periods.

The model was used to simulate reductions in inorganic phosphorus load from all point and nonpoint sources by an equal percentage to meet the most limiting response variable criteria, which were criteria for pH.

1.13 WLAs from a TMDL: Wenatchee River, Washington

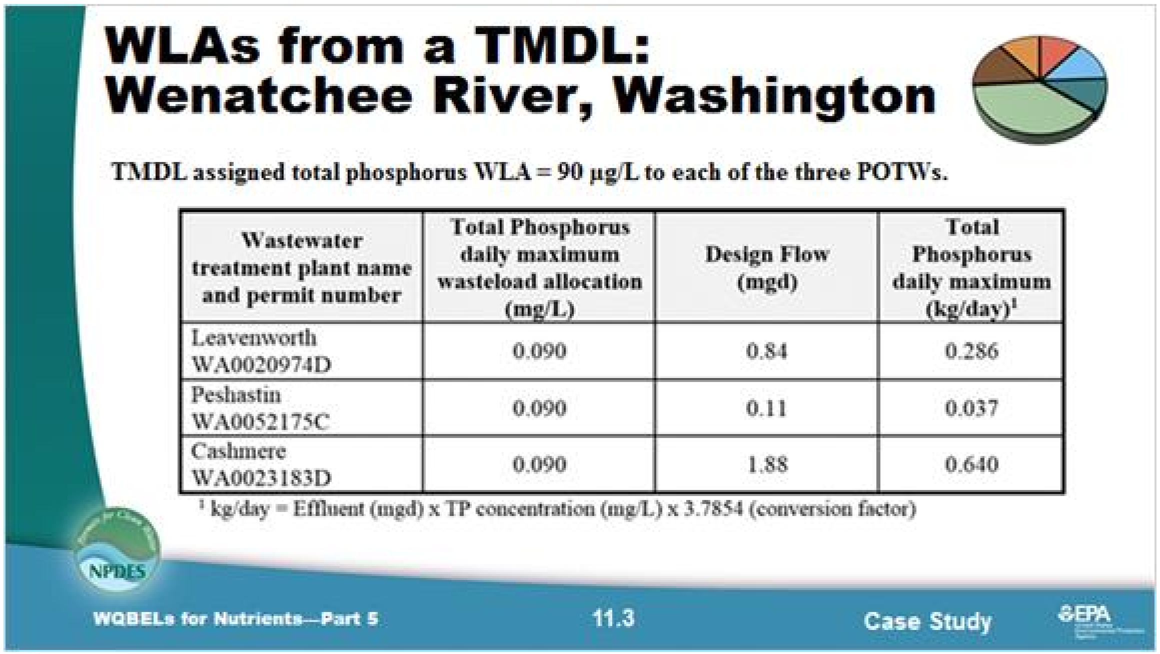


Notes:

The resulting total phosphorus target was a load of 9.8 kg/day from all sources, which represented an approximate 80% reduction in overall loading.

The TMDL concluded that three publicly-owned treatment works that contribute 55% of the inorganic phosphorus loading to the lower Wenatchee River would need WQBELs based on a maximum daily discharge concentration of 90 µg/L of total phosphorus. These three POTWs are in Leavenworth, Peshastin, and Cashmere.

1.14 WLAs from a TMDL: Wenatchee River, Washington



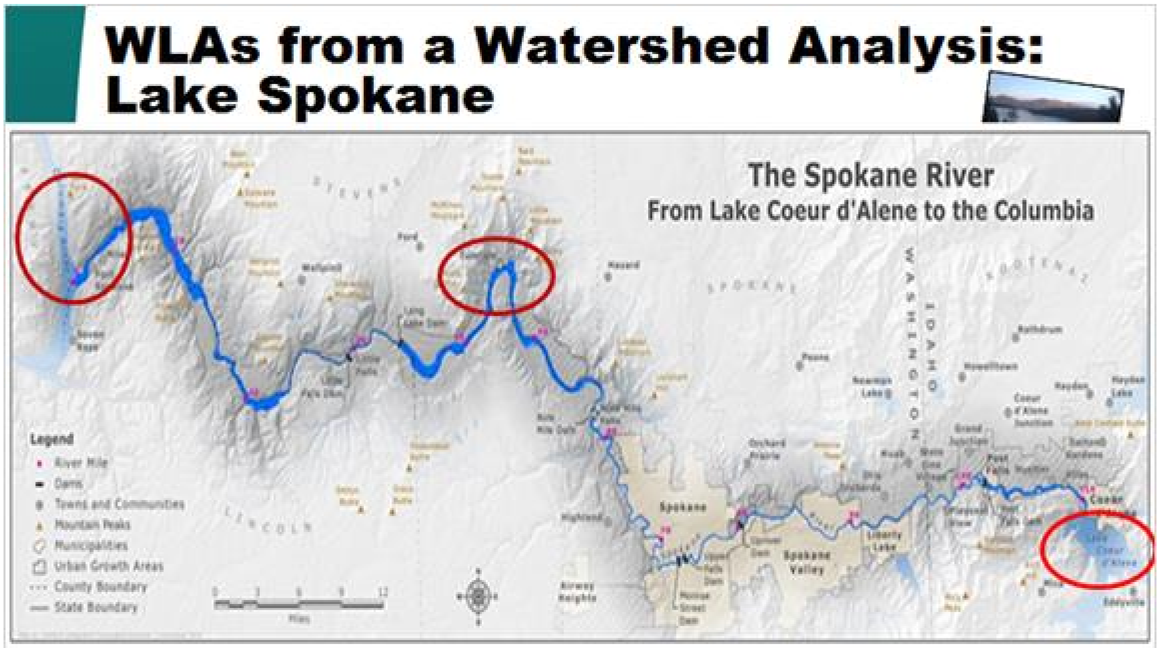
Notes:

The TMDL assigned a total phosphorus wasteload allocation of 90 µg/L to the three POTWs.

Based on each POTW's design flow, the 90 µg/L concentration was converted to a mass requirement in kilograms per day.

You can see the loading requirements in this table.

1.15 WLAs from a Watershed Analysis: Lake Spokane, Washington



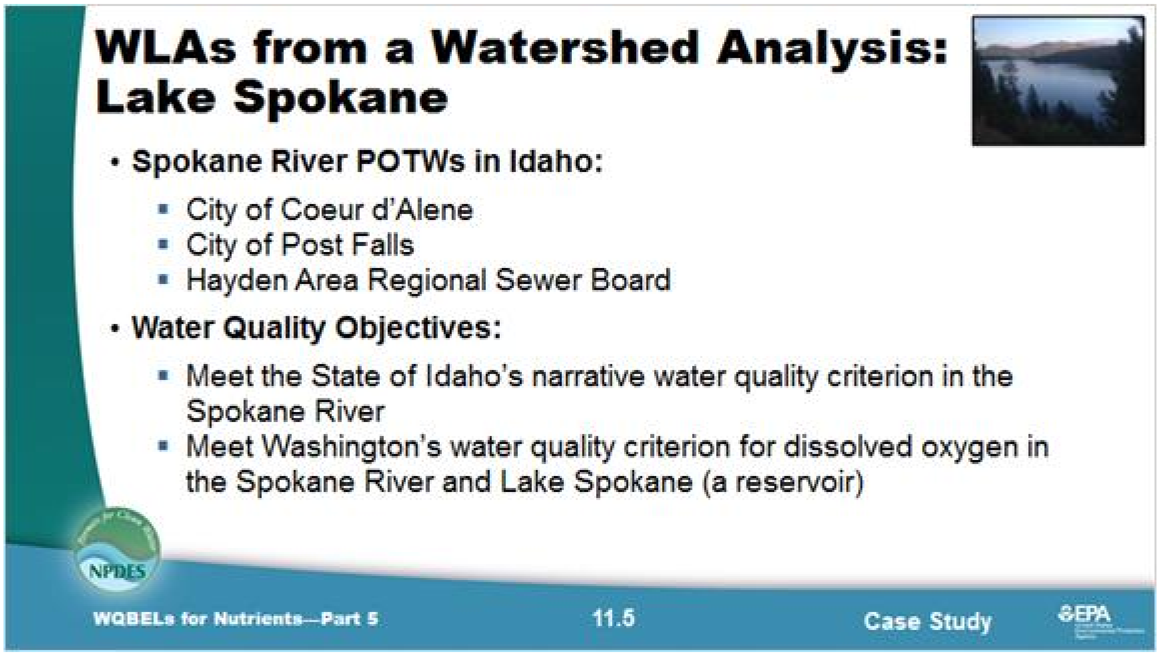
Notes:

For our next example, we will stay in Washington, but turn to the Spokane River.
The Spokane River drains the northern part of Lake Coeur d'Alene in the Idaho panhandle and flows into Washington where it empties into the Columbia River at Franklin D. Roosevelt Lake, approximately 111 miles downstream. Midway down the river is Lake Spokane.

Idaho's water quality standards have a narrative criterion that addresses excess nutrients. It requires that "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths that impair designated beneficial uses."

The dissolved oxygen criteria in Washington's water quality standards include a requirement that "For lakes, human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural condition."

1.16 WLAs from a Watershed Analysis: Lake Spokane, Washington

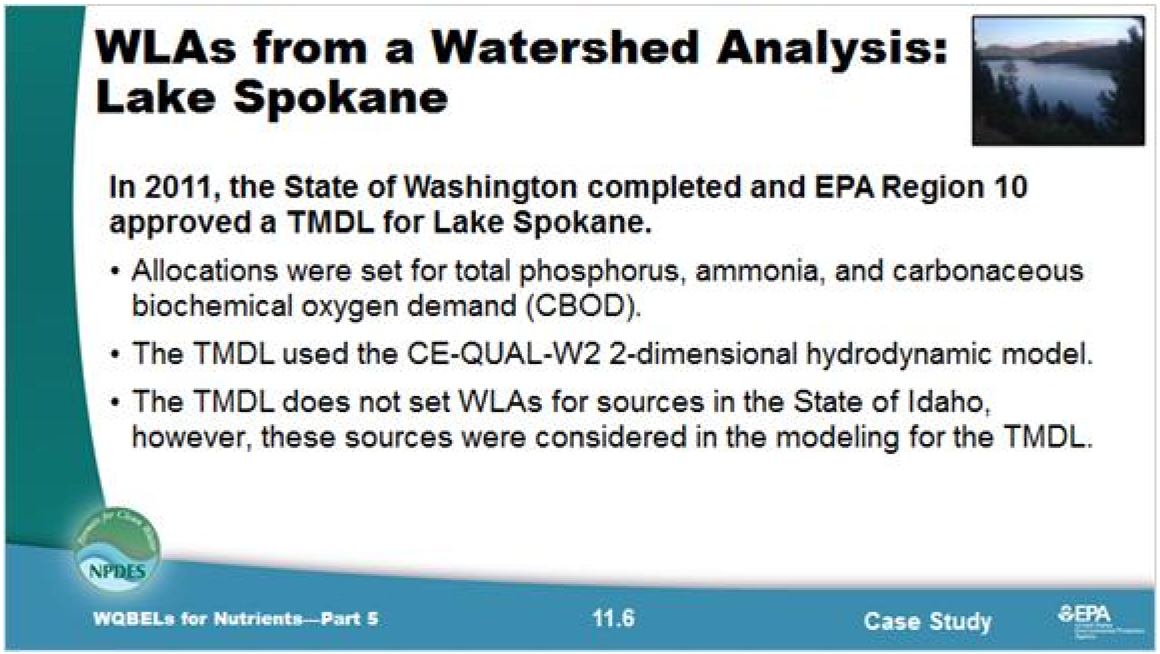


Notes:

If you have viewed the presentation entitled "WQBELs-Part 1: Identifying the Applicable Water Quality Standards," you might recall that we discussed protection of downstream water bodies and considered the Spokane River and Lake Spokane as an example.

EPA Region 10 was issuing NPDES permits to three POTWs in Idaho that discharge to the Spokane River. In developing the permit conditions for nutrients for these permits, the Region needed to consider both the Idaho narrative water quality criterion for the Spokane River and Washington's water quality criterion for dissolved oxygen in downstream Lake Spokane.

1.17 WLAs from a Watershed Analysis: Lake Spokane, Washington



Notes:

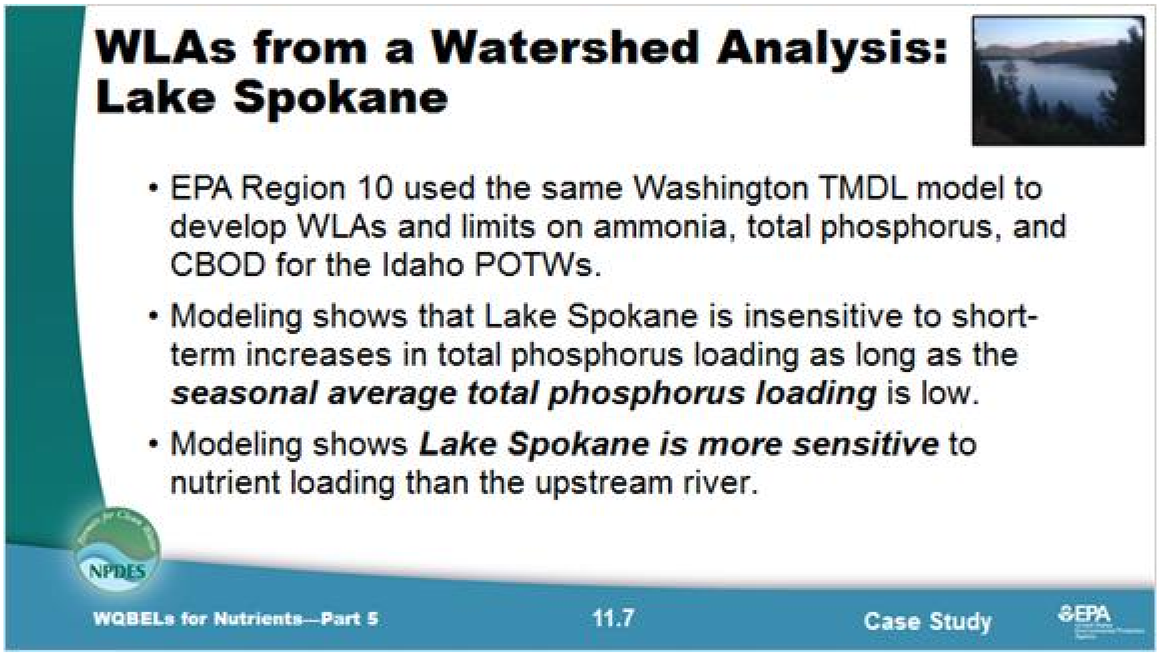
In 2011, Washington completed, and EPA Region 10 approved, a TMDL for Lake Spokane to address the dissolved oxygen impairment in the lake.

The TMDL set allocations for three parameters: total phosphorus, ammonia, and carbonaceous biochemical oxygen demand, or CBOD.

The TMDL was based on the results of a hydrodynamic model that looked at the multiple sources of pollutants and their impacts on Lake Spokane.

It is important to note that while the TMDL did not assign wasteload allocations to Idaho sources, these sources were factored into the TMDL modeling.

1.18 WLAs from a Watershed Analysis: Lake Spokane, Washington

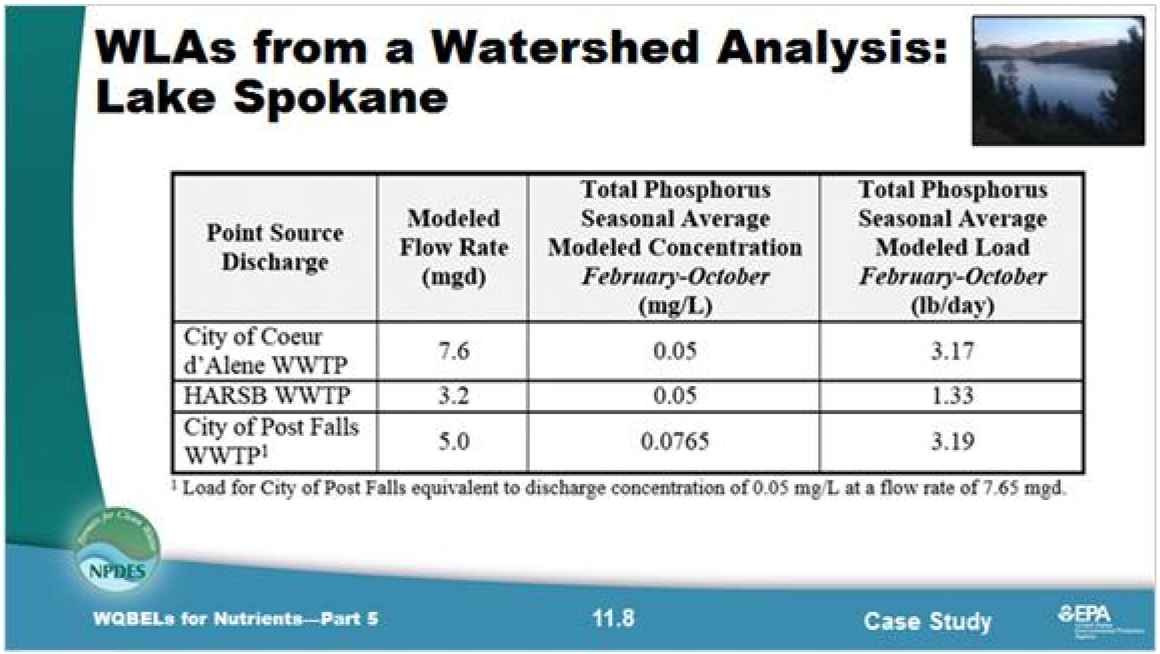


Notes:

EPA Region 10 then used the same model that was used in the Washington TMDL to determine the appropriate total phosphorus, ammonia, and CBOD limits for the Idaho POTWs. Let's focus on total phosphorus.

Looking at the results of the modeling, EPA Region 10 determined that as long as the seasonal average total phosphorus loading to Lake Spokane remains low, the lake is not sensitive to short-term increases in total phosphorus loading. This indicates that longer term averages might be appropriate. The modeling also showed that Lake Spokane is more sensitive to nutrient loading than the Spokane River upstream of the Lake. This indicates that by meeting the TMDL for the lake, upstream waters will also be protected.

1.19 WLAs from a Watershed Analysis: Lake Spokane, Washington



Point Source Discharge	Modeled Flow Rate (mgd)	Total Phosphorus Seasonal Average Modeled Concentration *February-October* (mg/L)	Total Phosphorus Seasonal Average Modeled Load *February-October* (lb/day)
City of Coeur d'Alene WWTP	7.6	0.05	3.17
HARSB WWTP	3.2	0.05	1.33
City of Post Falls WWTP[1]	5.0	0.0765	3.19

[1] Load for City of Post Falls equivalent to discharge concentration of 0.05 mg/L at a flow rate of 7.65 mgd.

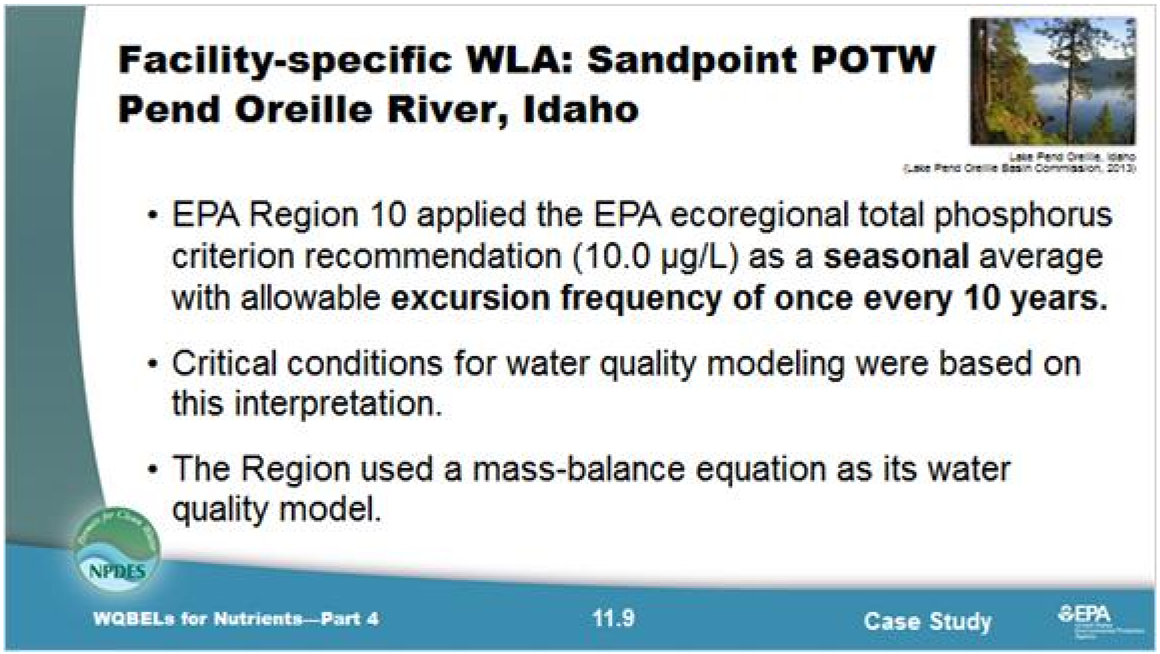
Notes:

This slide shows the seasonal average total phosphorus wasteload allocations for the three POTWs.

The seasonal average modeled loads are based on a modeled total phosphorus concentration and a modeled flow rate.

These seasonal averages apply from February through October and are the basis for the WQBELs for total phosphorus in the facilities' NPDES permits.

1.20 Facility-specific WLA: Sandpoint POTW Pend Oreille River, Idaho



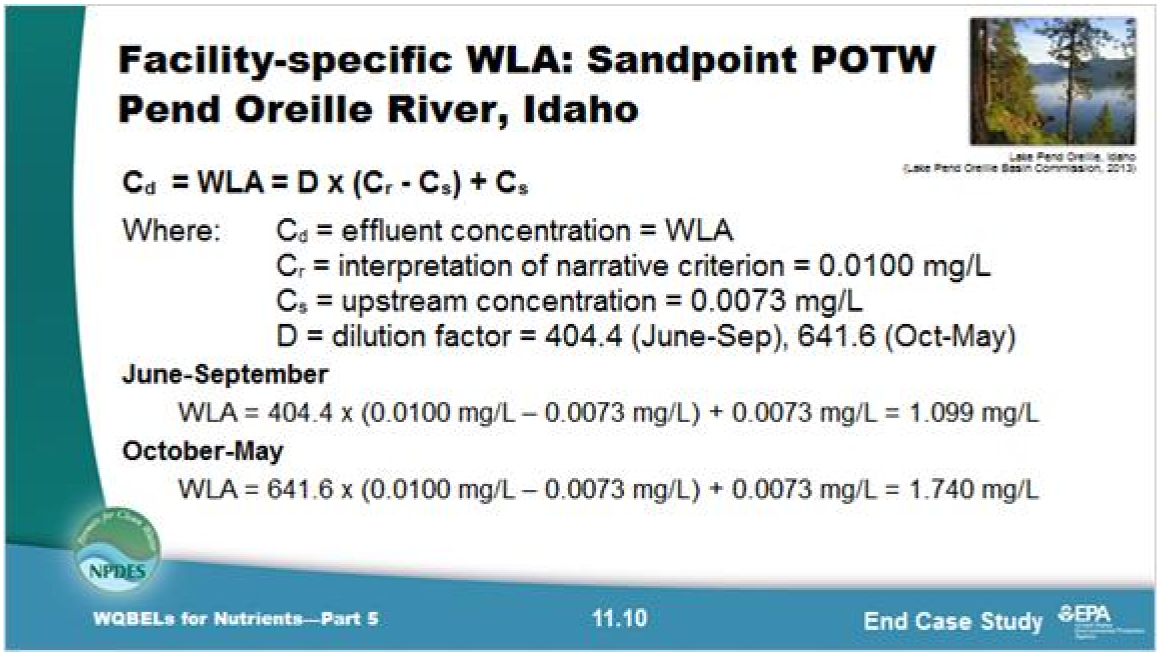
Notes:

Our final example is a facility-specific wasteload allocation calculated for a single wastewater treatment plant.

The Sandpoint POTW discharges to the Pend Oreille River in Idaho. Idaho does not have numeric nutrient criteria for the river, but it does have an applicable narrative nutrient criterion. EPA Region 10 interpreted Idaho's narrative water quality criterion using EPA's aggregate Ecoregion II total phosphorus criterion recommendation for rivers and streams of 10 µg/L. They applied this criterion as a seasonal average with an allowable excursion frequency of once every 10 years. The critical conditions used in the water quality modeling of the discharge and the river were based on this interpretation of the water quality criterion.

EPA Region 10 decided to use a mass-balance equation as its steady-state model for calculating a wasteload allocation for the Sandpoint POTW.

1.21 Facility-specific WLA: Sandpoint POTW Pend Oreille River, Idaho



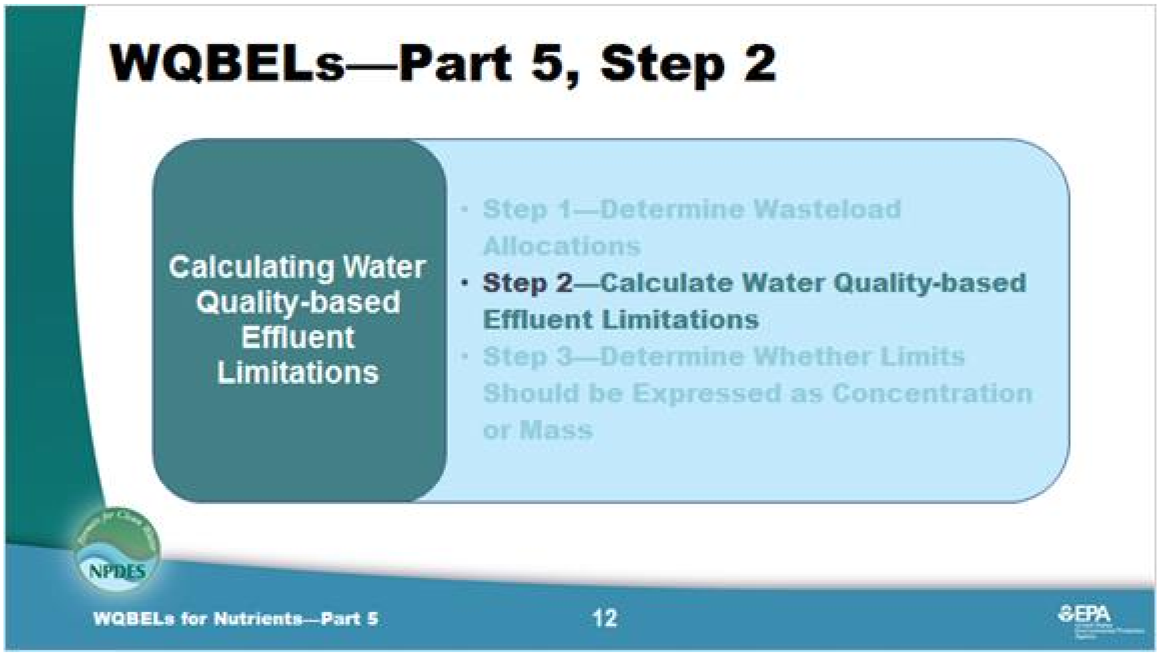
Notes:

The mass-balance equation at the top of the slide gives us the wasteload allocation needed to attain the target total phosphorus criterion in the receiving water, which is the Pend Oreille River. The equation uses the same critical conditions the Region used for its reasonable potential analysis as we described in part four of this section of the training.

There are two wasteload allocation calculations: one for the months of June through September and one for the months of October through May. Differences in the critical flow of the Pend Oreille River during the two seasons lead to different dilution factors for the two calculations.

The end results are a wasteload allocation of 1.099 mg/L for June through September and a wasteload allocation of 1.740 mg/L for October through May.

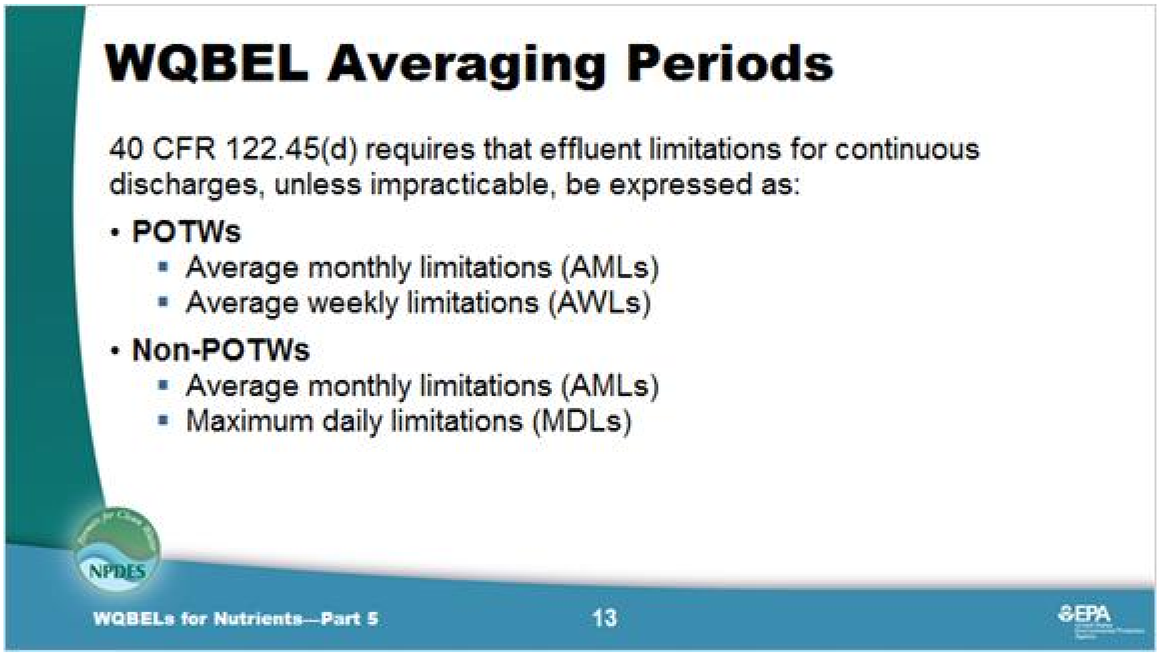
1.22 WQBELs—Part 5, Step 2



Notes:

Now that we have determined the wasteload allocations, we will move on to Step 2, where we use those wasteload allocations to calculate water quality-based effluent limitations.

1.23 WQBEL Averaging Periods



Notes:

When we are ready to calculate WQBELs from wasteload allocations, one of the things we need to keep in mind is what the NPDES regulations have to say about effluent limit averaging periods. 40 CFR 122.45(d) requires that effluent limitations for continuous discharges, unless impracticable, be expressed as average monthly and average weekly limitations for POTWs or average monthly and maximum daily limitations for non-POTWs.

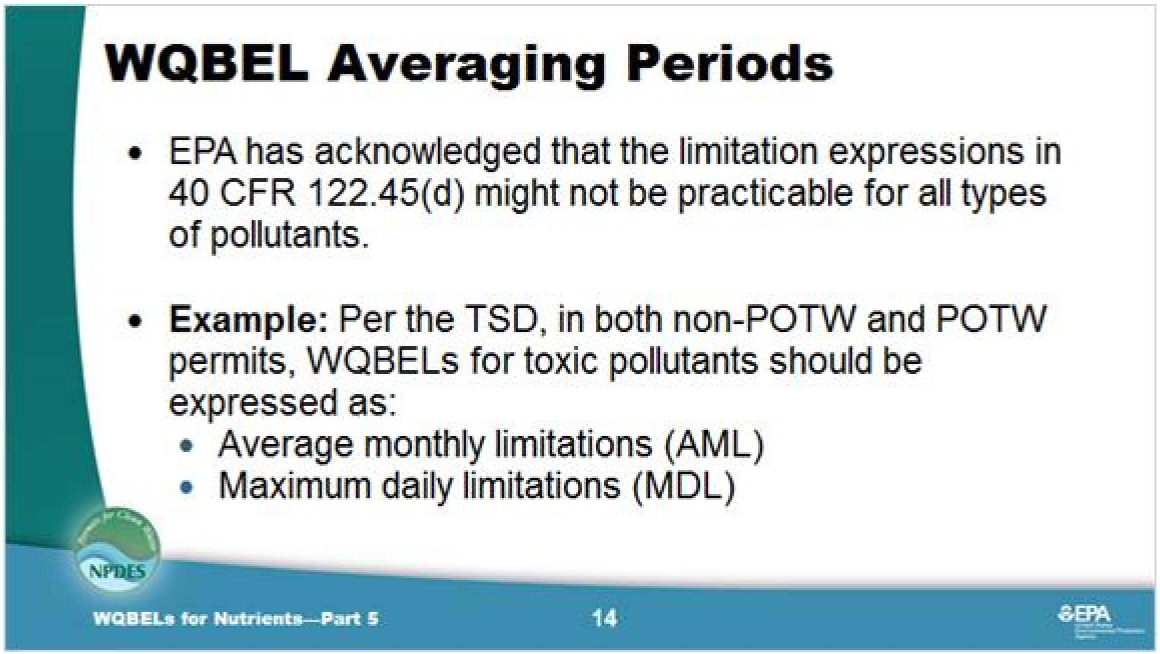
This regulation presents some potential challenges when developing effluent limits for nutrients.

First, for most pollutants, including nutrients, the averaging periods for wasteload allocations do not match the averaging periods for effluent limits required by the regulations. Therefore, for most pollutants, the permit writer will need a procedure for translating the wasteload allocations into effluent limitations.

Second, the averaging periods specified for effluent limits in the regulations might not be the most appropriate averaging periods for nutrients if the effects of nutrient pollution are long-term in nature.

We'll address both of these topics in the remainder of this presentation.

1.24 WQBEL Averaging Periods



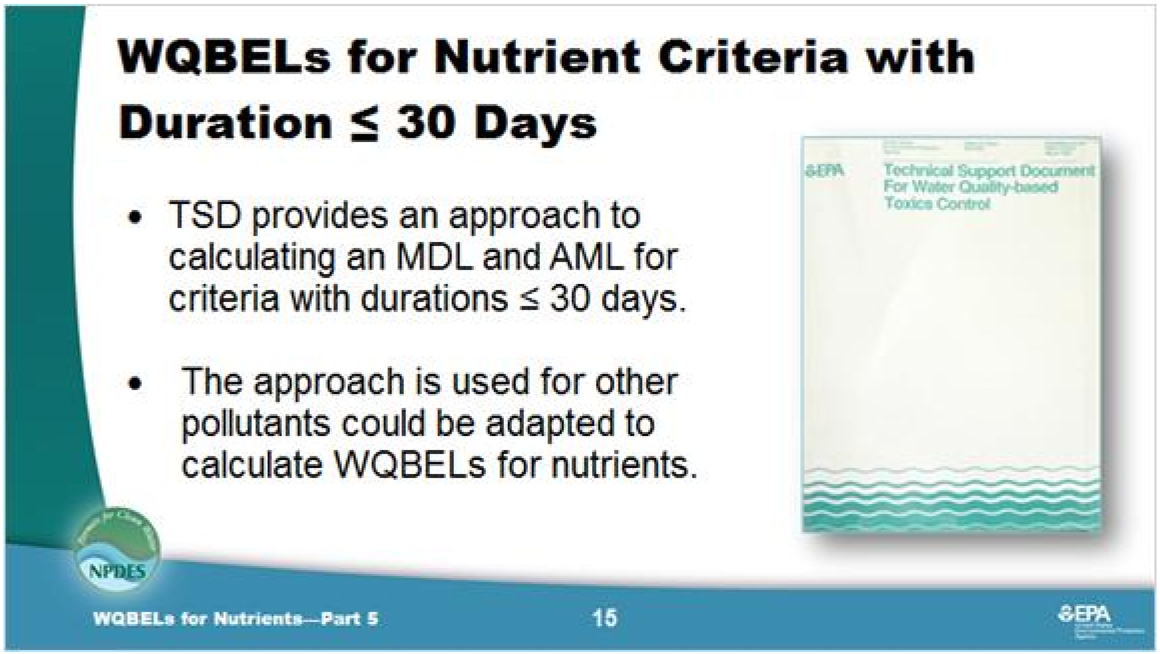
Notes:

Lucky for us, the regulations anticipated exceptions. EPA has previously acknowledged that there are cases where the "impracticable" clause of the regulation at 40 CFR 122.45(d) might kick in.

For example, EPA has said in the TSD that permit writers should calculate average monthly and maximum daily limits for toxic pollutants for both POTW and non-POTW permits. Remember, the regulation generally requires POTW permits to have average monthly and average weekly limits. But, because of the impracticability clause and guidance in the TSD, WQBELs for many pollutants are expressed as maximum daily and average monthly limits regardless of the type of facility.

This guidance is important for us because there are situations where developing WQBELs for nutrients with the averaging periods specified in the regulation also might be impracticable.

1.25 WQBEL Averaging Periods



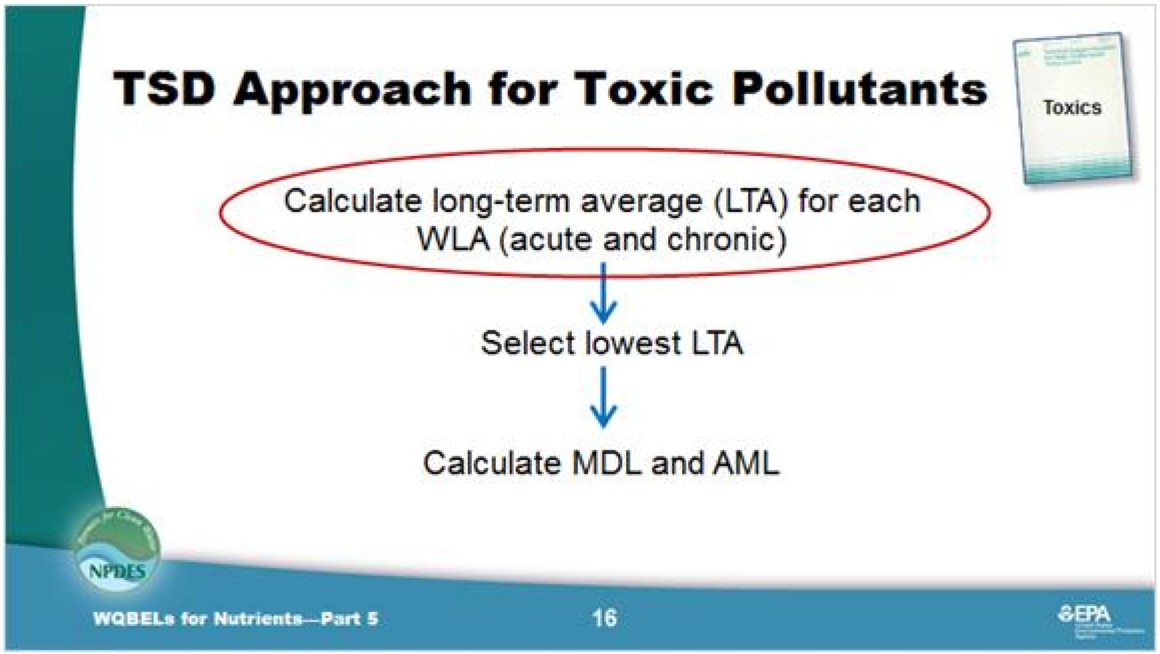
Notes:

The TSD guidance on calculating limits is appropriate to apply not just to toxics, but more generally when implementing criteria with durations of 30 days or less.

There are also cases where we might have numeric nutrient criteria or numeric interpretations of a narrative nutrient criterion with a duration of 30 days or less. With that in mind, let's review the TSD approach, consider how it might be adapted to calculating WQBELs for nutrients, and work through some example calculations.

Nizanna, can you start walking us through the TSD approach?

1.26 WQBEL Averaging Periods



Notes:

I'd be happy to, Frank.

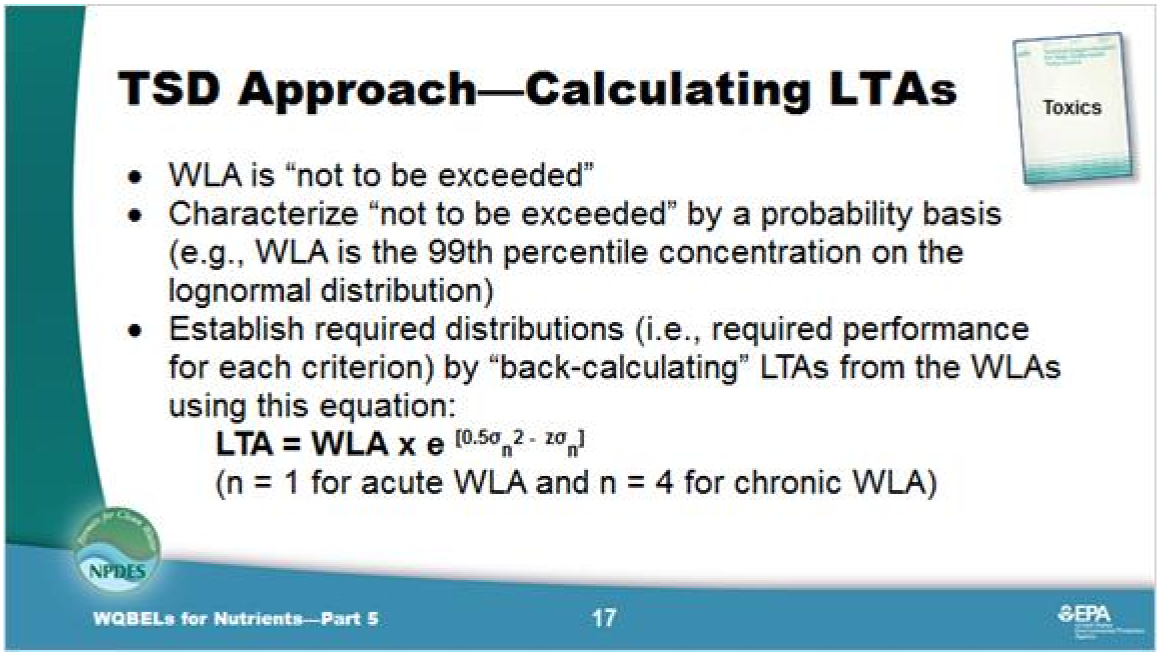
Here is an outline of the TSD's approach to calculating WQBELs for toxic pollutants from wasteload allocations.

In this slide, we are assuming that we are dealing with criteria for protection of aquatic life, which typically include both acute and chronic criteria.

Let's look at the three steps for moving from WLAs to WQBELs.

First, we need to calculate the required long-term average effluent concentration from each of the calculated WLAs.

1.27 WQBEL Averaging Periods



Notes:

To determine the required long-term average concentration, we assume a lognormal distribution of pollutant data, as we did in our reasonable potential analysis, unless we have enough data to make some other characterization.

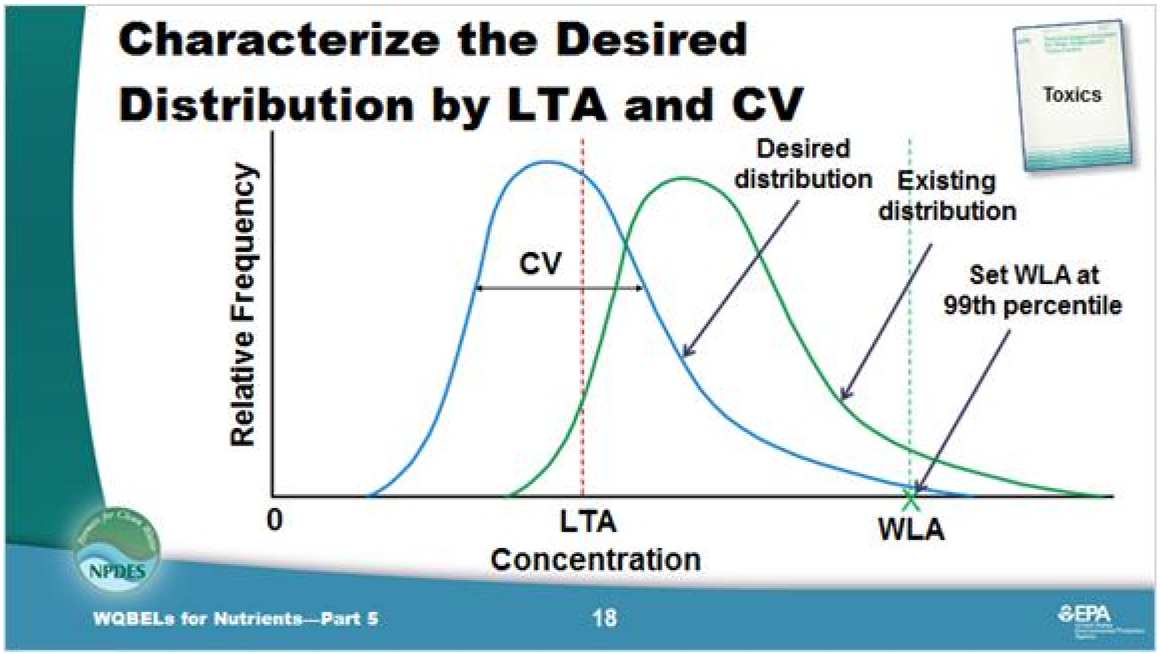
We treat the wasteload allocation as a concentration on the lognormal distribution that is not to be exceeded. By doing so we ensure that the water quality achieved by the calculated WQBELs will be derived from and comply with the applicable water quality standards.

Now, we cannot set the wasteload allocation at a value that will never be exceeded, because the tail of the distribution is asymptotic. In other words, as the concentration keeps increasing, the likelihood of higher concentrations occurring approaches, but never quite reaches, zero.

So, we can assume that the wasteload allocation is an upper bound value on the lognormal distribution. For example, we can make it the 99th percentile, 95th percentile, or another upper-bound percentile specified by the permitting authority.

Then we establish a long-term performance requirement for the facility by calculating the long-term average of the lognormal distribution using the equation shown on the slide.

1.28 WQBEL Averaging Periods



Notes:

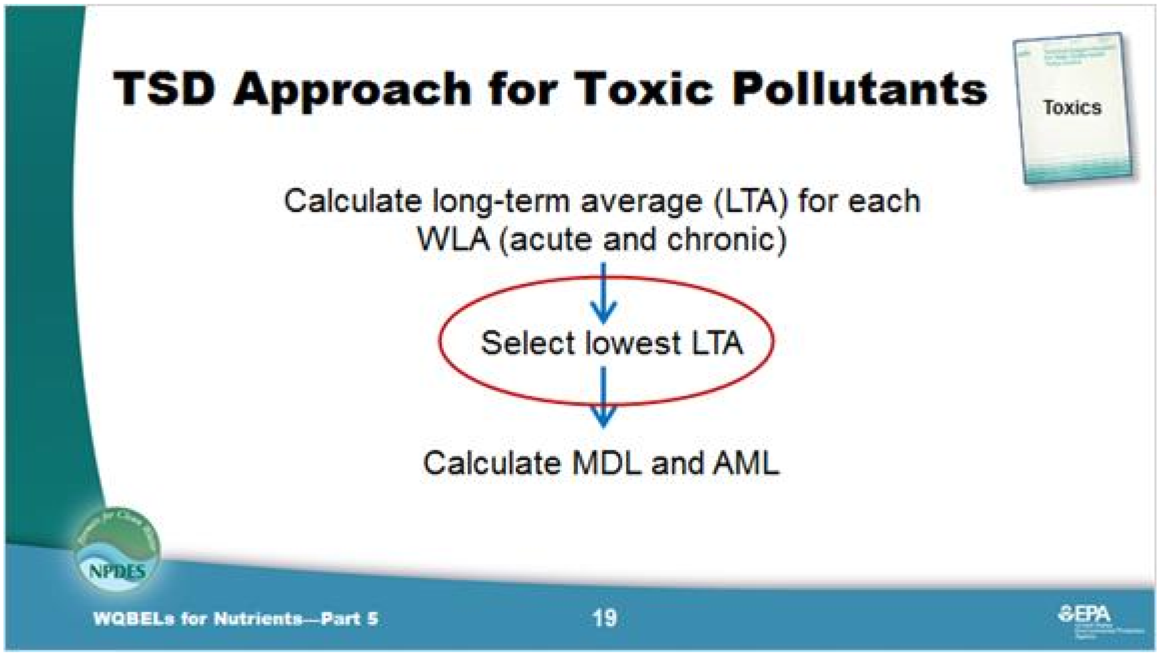
In this example, we are setting the wasteload allocation at the 99th percentile on the lognormal distribution. You can see on the slide, however, that the wasteload allocation is not at the tail end of the curve, where it should be if it is the 99th percentile concentration.

That means we need to reposition the lognormal distribution of effluent concentrations so that the 99th percentile lines up with the wasteload allocation. In effect, we are requiring the facility to perform in a manner that assures that 99% of the time its effluent concentration is less than the WLA.

Because we know that most effluent data follows a lognormal distribution, we can use that information to calculate the relationship between the wasteload allocation, at the 99th percentile, and the long term average, at the 50th percentile. The only additional piece of information we need is the coefficient of variation, or CV, which tells us how wide or narrow our curve will be.

We will need to do these calculations for all applicable criteria. For toxics, there are generally two: acute and chronic.

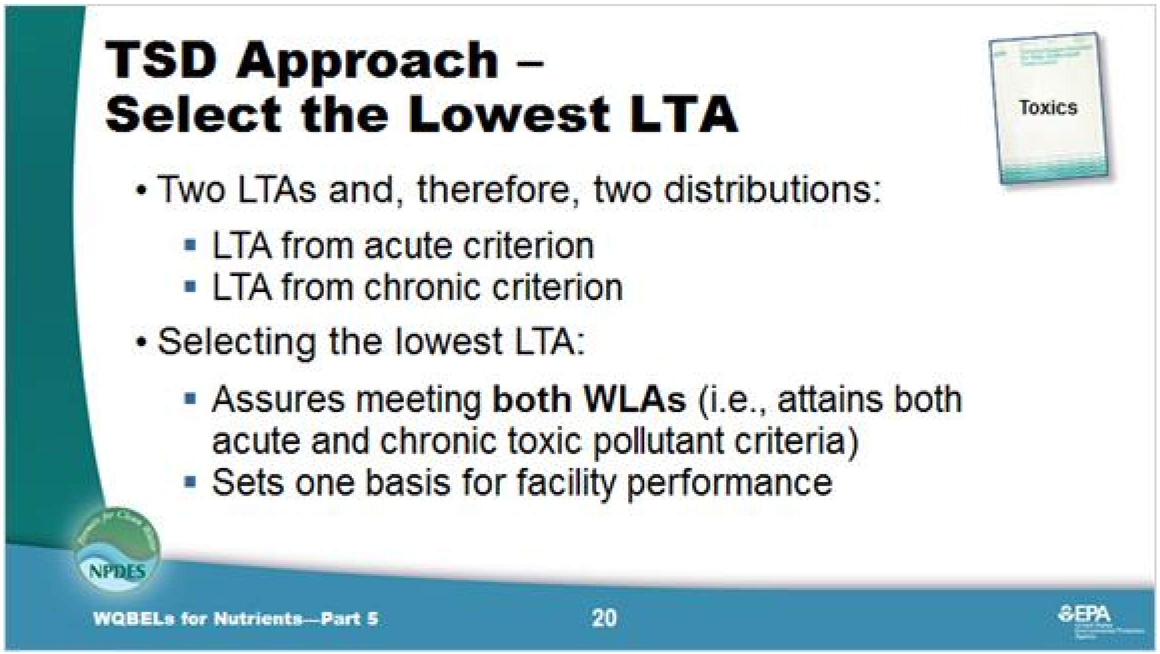
1.29 WQBEL Averaging Periods



Notes:

And that leads us to our next step, Nizanna, which is to select the lowest long-term average to serve as the basis for our WQBEL calculations.

1.30 TSD Approach – Select the Lowest LTA

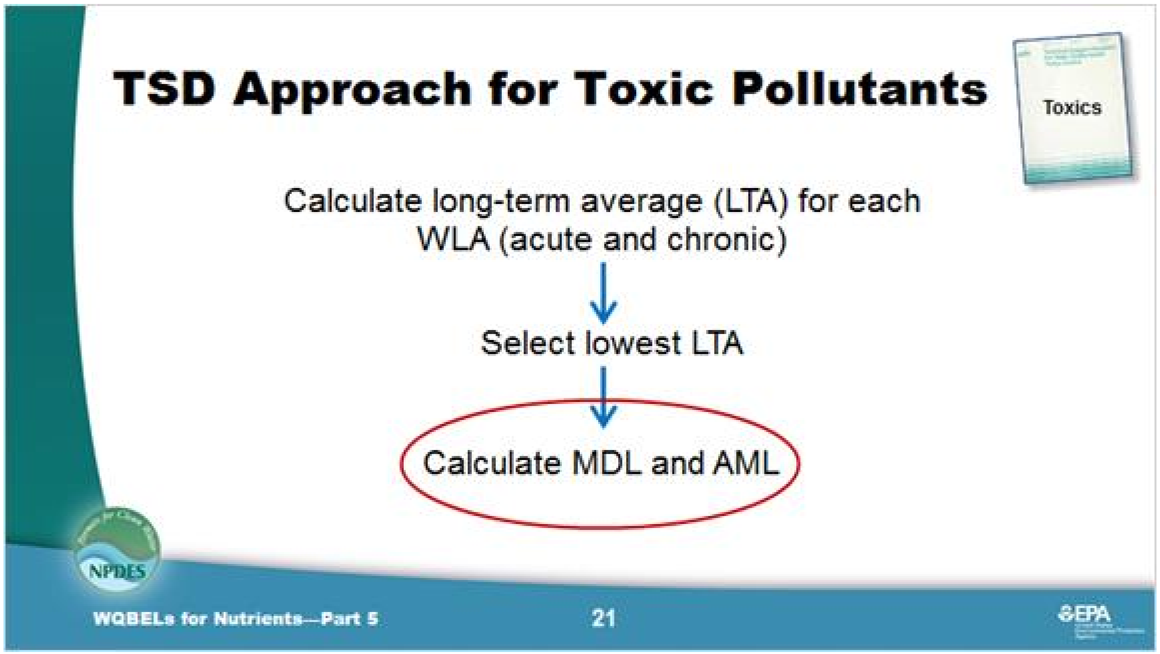


Notes:

Let's assume that we are addressing a toxic pollutant where we have both an acute aquatic life and a chronic aquatic life criterion. We calculate two long-term averages, which represent two possible effluent concentration distributions.

The lowest of these two long-term averages represents facility performance, or effluent quality, that would assure attainment of both the acute and the chronic criteria. The permit writer could use this long-term average as the basis for effluent limitations. The facility could also use that long-term average as the basis for designing its effluent controls.

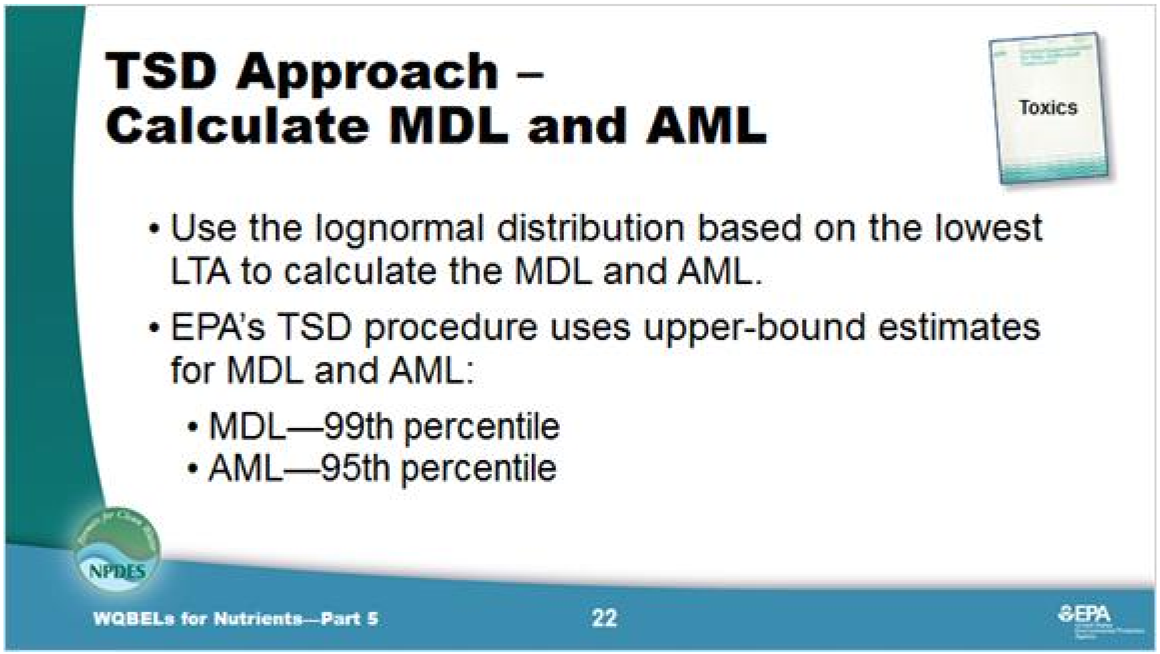
1.31 WQBEL Averaging Periods



Notes:

Now that leaves us one last step: actually calculating the maximum daily and average monthly limits.

1.32 TSD Approach – Calculate MDL and AML

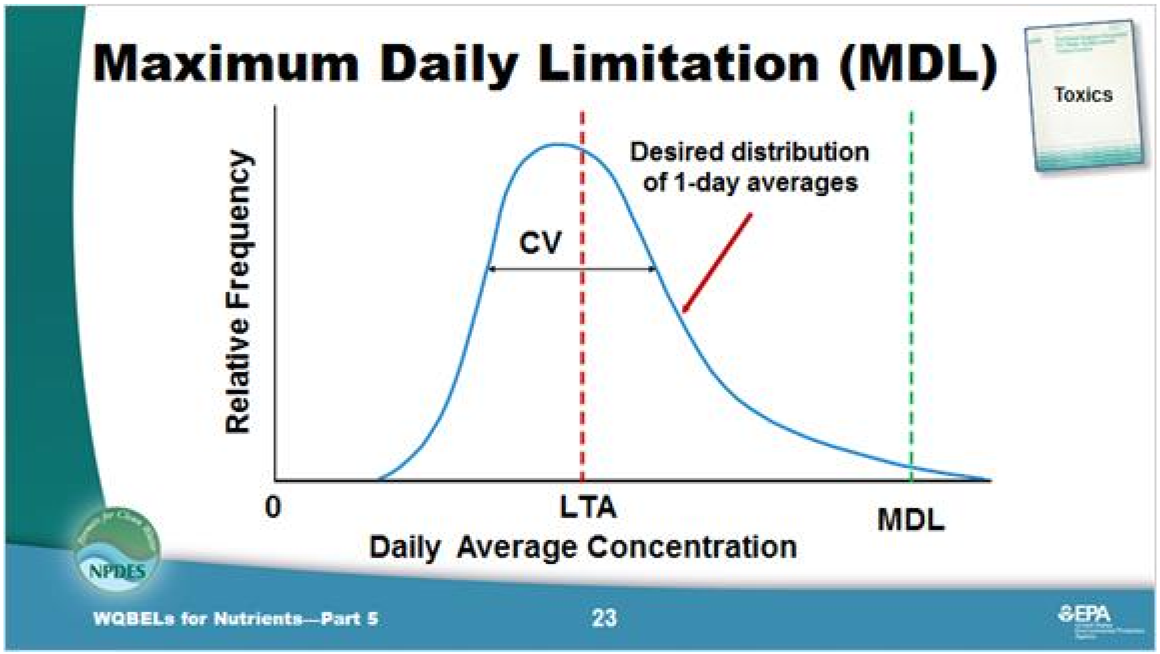


Notes:

The TSD procedure sets both the MDL and AML at upper-bound values on curves derived from the lowest LTA. It recommends setting the MDL at the 99th percentile on the distribution of daily values and the AML at the 95th percentile on the distribution of monthly average values.

To simplify the calculations, the TSD provides tables for determining the MDL and AML from the long-term average.

1.33 Maximum Daily Limitation (MDL)



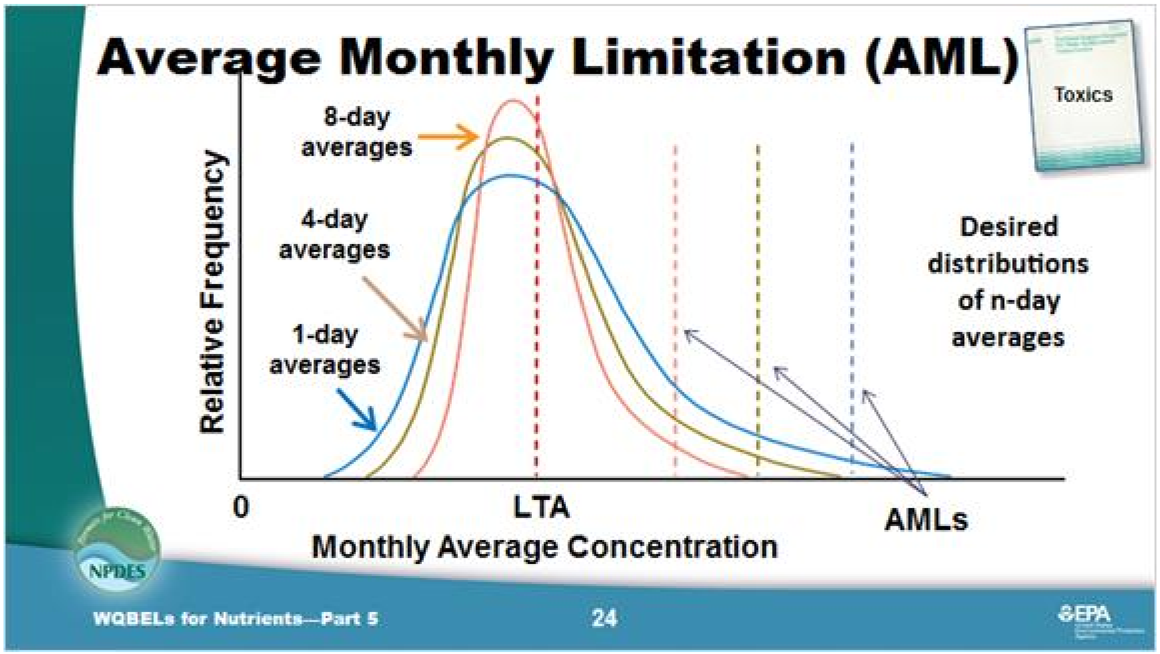
Notes:

This slide shows the MDL as an upper-bound value on a lognormal distribution of 1-day average concentrations. If we follow the TSD recommendations for toxic pollutants, we will set the MDL at the 99th percentile.

By placing the MDL at an upper-bound value on the desired lognormal distribution curve, we are requiring that almost any randomly collected daily sample must be at or below this MDL value. As long as the facility is operating its treatment system so that it performs at or better than the performance described by this “desired” curve, the statistics indicate that the facility should be able to meet the MDL.

Frank, what about average monthly limits? Do these behave differently?

1.34 Average Monthly Limitation (AML)



Notes:

Well, Nizanna, let's take a look.

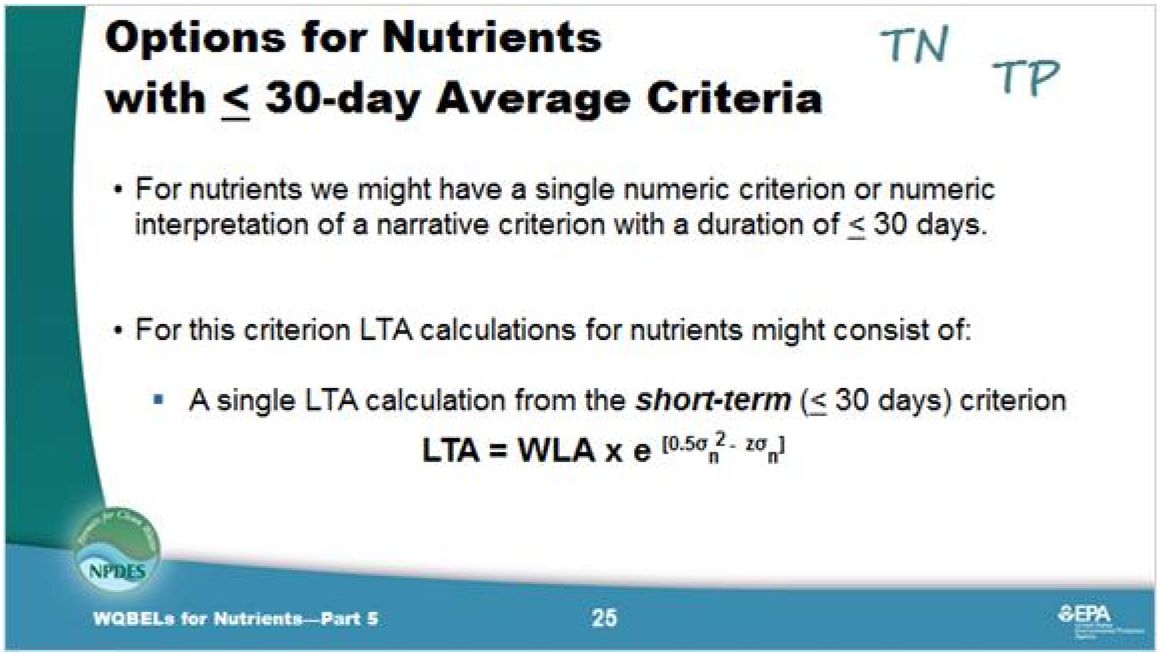
This slide shows the AML as an upper-bound value on a lognormal distribution of monthly averages. The TSD recommends setting the AML at the 95th percentile for toxic pollutants. By comparison, you just mentioned that the TSD recommends setting the MDL at the 99th percentile for toxics pollutants.

Notice that the number of samples used to calculate the monthly average can affect the shape of the curve. If the AML is based on only one sample per month, the curve looks like the curve we used to calculate the MDL.

As we increase the number of samples per month, the curve becomes more narrow and the AML is closer to the long-term average.

Just as with the MDL, as long as the facility is operating its treatment system so that it performs at or better than the performance described by the desired curve, the statistics indicate that the facility should be able to meet the AML.

1.35 Adaptations for Nutrients



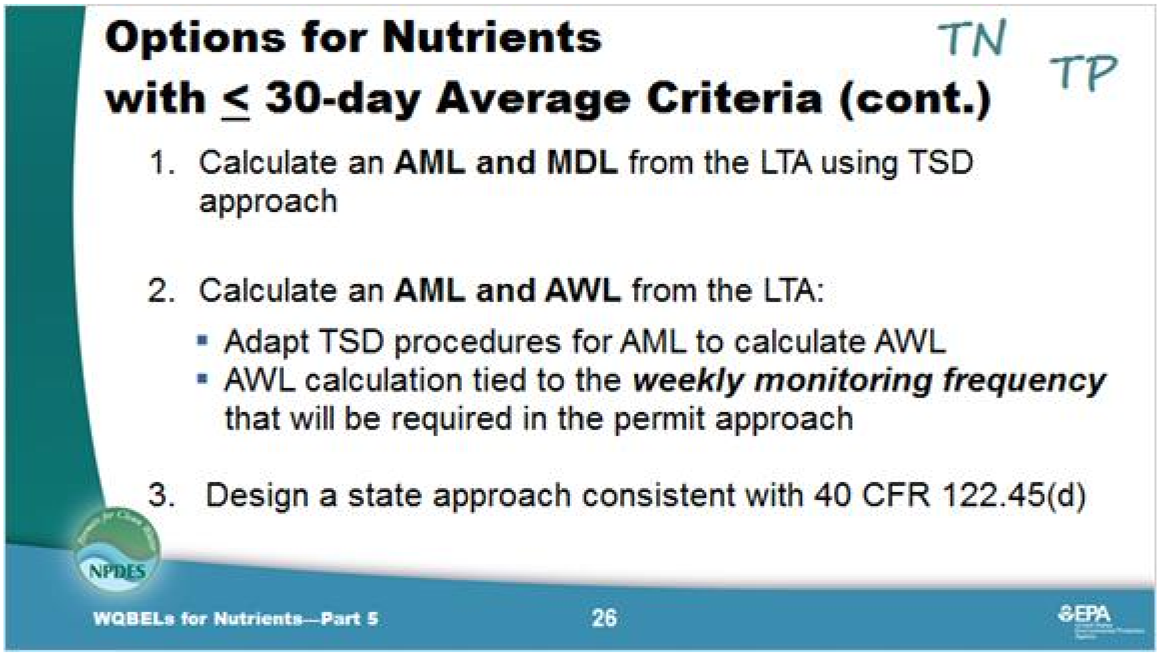
Notes:

Now, let’s consider how the TSD’s recommended procedures could be adapted for nutrients.

Instead of having acute and chronic wasteload allocations, for nutrients we are likely to have no more than a single, short-term wasteload allocation.

For short-term nutrient criteria, we could use the same equation used for toxic pollutants to calculate a long-term average, but adapted to the duration of the nutrient criterion.

1.36 Adaptations for Nutrients



Notes:

Once we have established the long-term average, we can easily use the TSD procedures to calculate an AML or MDL.

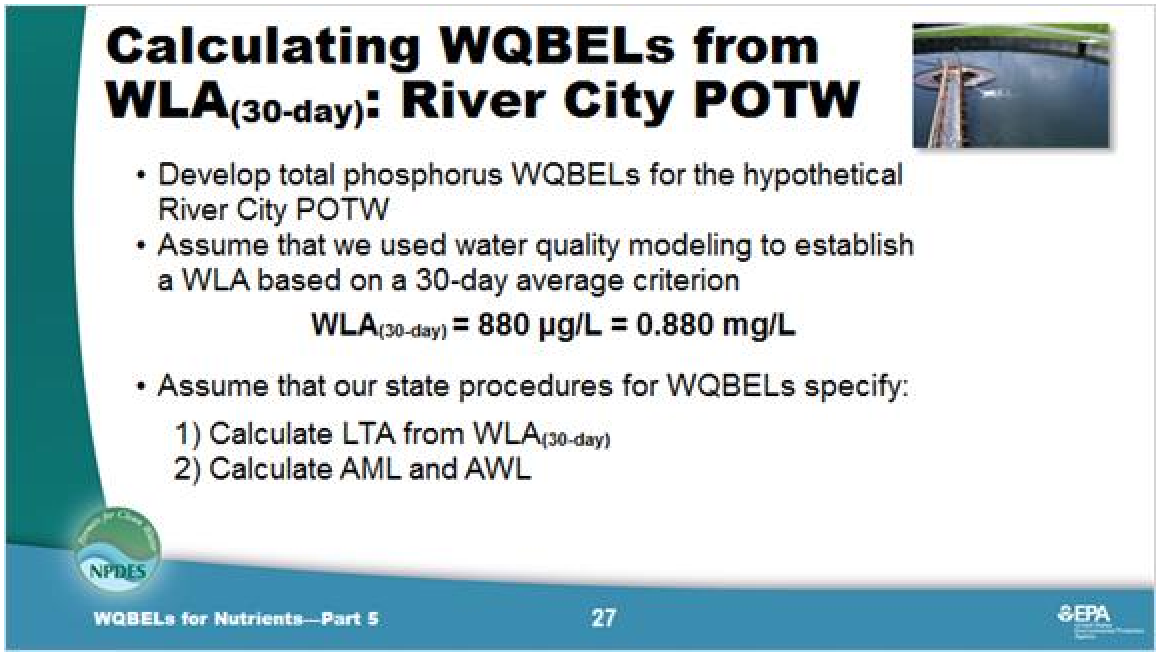
But remember, 40 CFR 122.45(d) generally requires that limits for POTWs be expressed as average monthly and average weekly limits.

So a second option is to adapt the TSD procedures for the AML to calculate an average weekly limitation, or AWL. Adapting these procedures is straightforward. We would consider the minimum weekly monitoring frequency rather than the monthly monitoring frequency in our calculations. In the next few slides, we will look at a hypothetical example of how this approach might work.

Finally, a state always has the option of developing its own procedures for calculating WQBELs as long as they are consistent with 40 CFR 122.45(d).

Frank, can you start us off with how adapting the TSD procedures might work?

1.37 Calculating WQBELs from WLA(30-day): River City POTW



Notes:

I sure can.

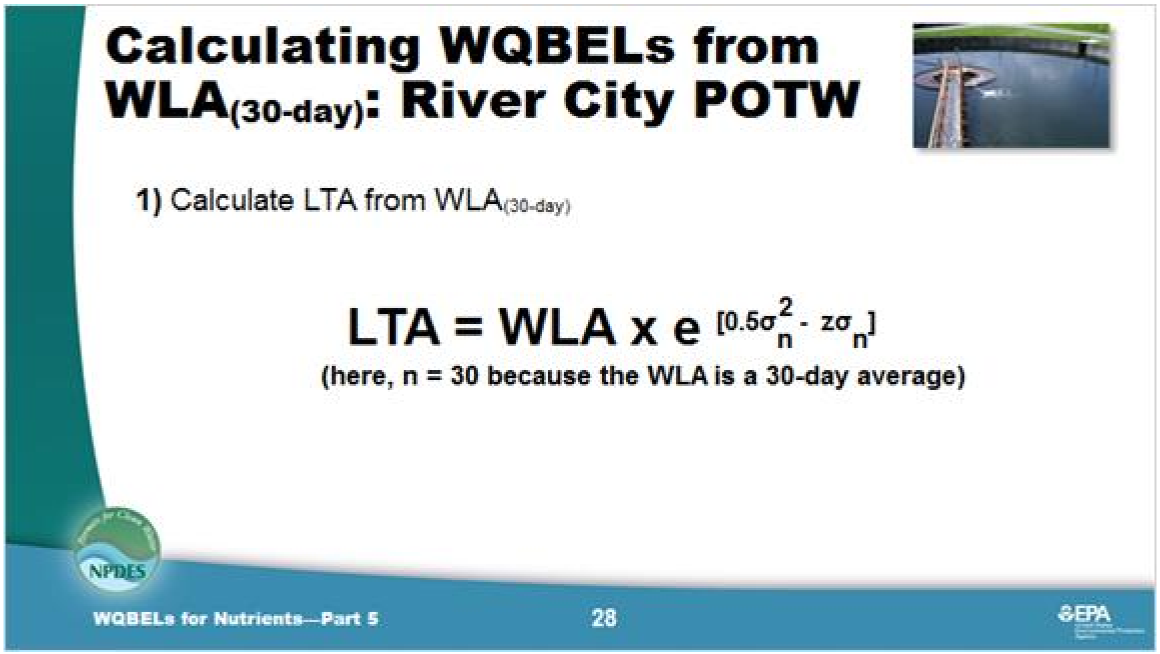
Here is a hypothetical example that demonstrates how we might adapt the TSD procedures to calculate an AML and AWL from a 30-day average criterion.

Assume that we have conducted water quality modeling to arrive at a 30-day wasteload allocation of 0.880 mg/L for the River City POTW. This wasteload allocation will ensure attainment of the 30-day average criterion that applies in the receiving water.

Based on our state procedures for calculating WQBELs, we will first determine the long term average effluent concentration we need to reliably achieve the wasteload allocation.

From that long-term average, we can then calculate the AML and AWL.

1.38 Calculating WQBELs from WLA(30-day): River City POTW



Notes:

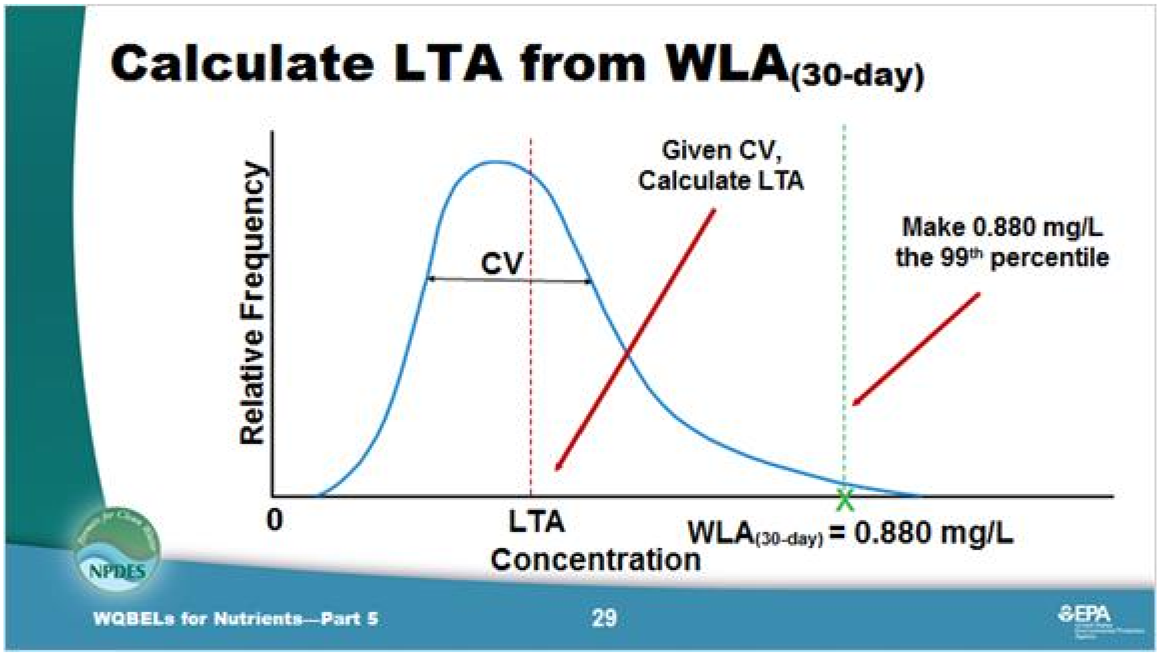
Based on our state procedures, here is our equation for calculating the long-term average from the wasteload allocation.

If you are familiar with the TSD, you can see the equation is taken from the TSD procedures.\

The only difference is the value of "n," which is the number of days represented by the wasteload allocation. For example, a wasteload allocation for a chronic criterion is a 4-day average, so n equals 4.

Here, we have a 30-day average, so n equals 30.

1.39 Calculate LTA from WLA(30-day)



Notes:

That's right, Frank.

Remember, our water quality model gave us a 30-day average wasteload allocation of 0.880 mg/L of total phosphorus.

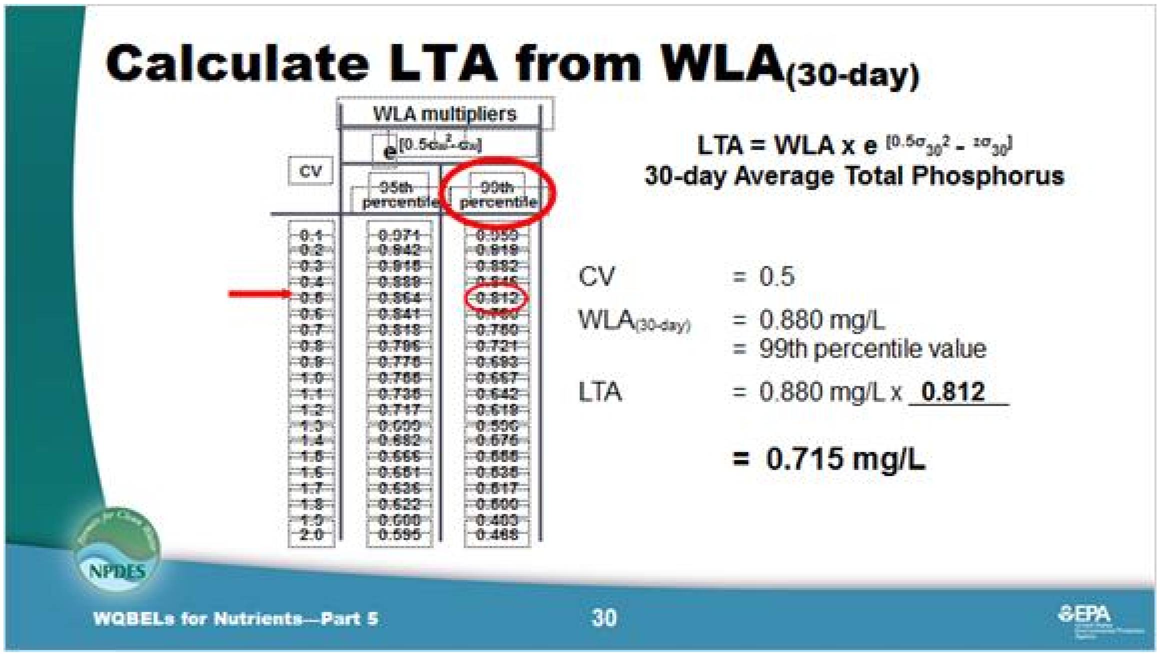
Based on the facility's current performance, it would frequently exceed this wasteload allocation.

But we want the facility to perform so that the effluent concentration is below the wasteload allocation 99 percent of the time.

We need to establish a long-term average that will move the curve to the left so that the wasteload allocation of 0.880 mg/L is the 99th percentile concentration. In other words, we are requiring the facility to perform in a manner which assures that 99% of the time its 30-day average effluent concentration is less than 0.880 mg/L.

Based on the characteristics of the lognormal distribution, we can calculate the relationship between the wasteload allocation and the long-term average.

1.40 Calculate LTA from WLA(30-day)



Notes:

The TSD provides tables that include the calculated multipliers for determining the long-term average from a wasteload allocation on the basis of a lognormal distribution.

In this slide, we have adjusted the table from the TSD to account for the fact that we have a 30-day wasteload allocation.

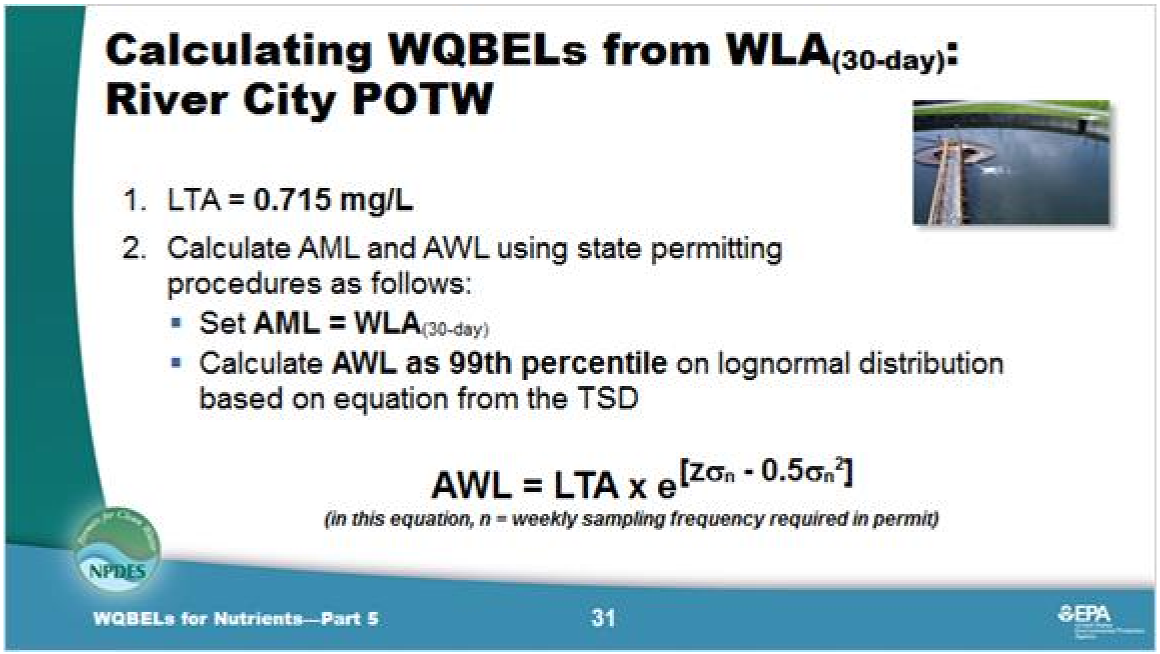
Notice that the multiplier is dependent on both the coefficient of variation of the data (the CV) and the percentile at which we fix the wasteload allocation. The TSD recommends using a CV of 0.6 where there are less than 10 data points, but state permitting procedures may specify a different default CV to use if you can't calculate one. Assume that we have calculated a CV of 0.5 for the River City POTW's total phosphorus effluent data.

If we fix the wasteload allocation of 0.880 mg/L at the 99th percentile and use our CV of 0.5, the table gives us a multiplier of 0.812. In other words, the long-term average is the wasteload allocation times 0.812.

We multiply the wasteload allocation by this multiplier to get a long-term average of 0.715 mg/L.

What do we do next, Frank?

1.41 Calculating WQBELs from WLA(30-day): River City POTW



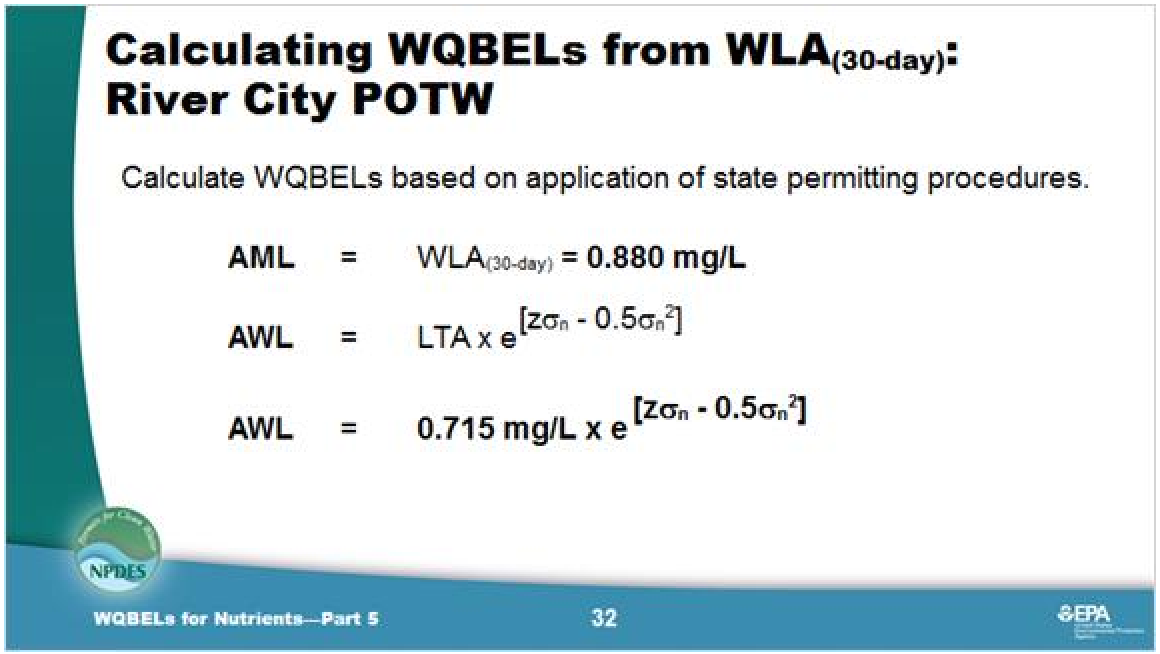
Notes:

Well Nizanna, our hypothetical state procedures for determining the AML say that we set the AML equal to the 30-day average wasteload allocation.

We can use the TSD statistical procedures to calculate an AWL from the long-term average we just calculated in the previous slide.

In the AWL calculation, the “n” is set equal to the number of samples we will require per week.

1.42 Calculating WQBELs from WLA(30-day): River City POTW

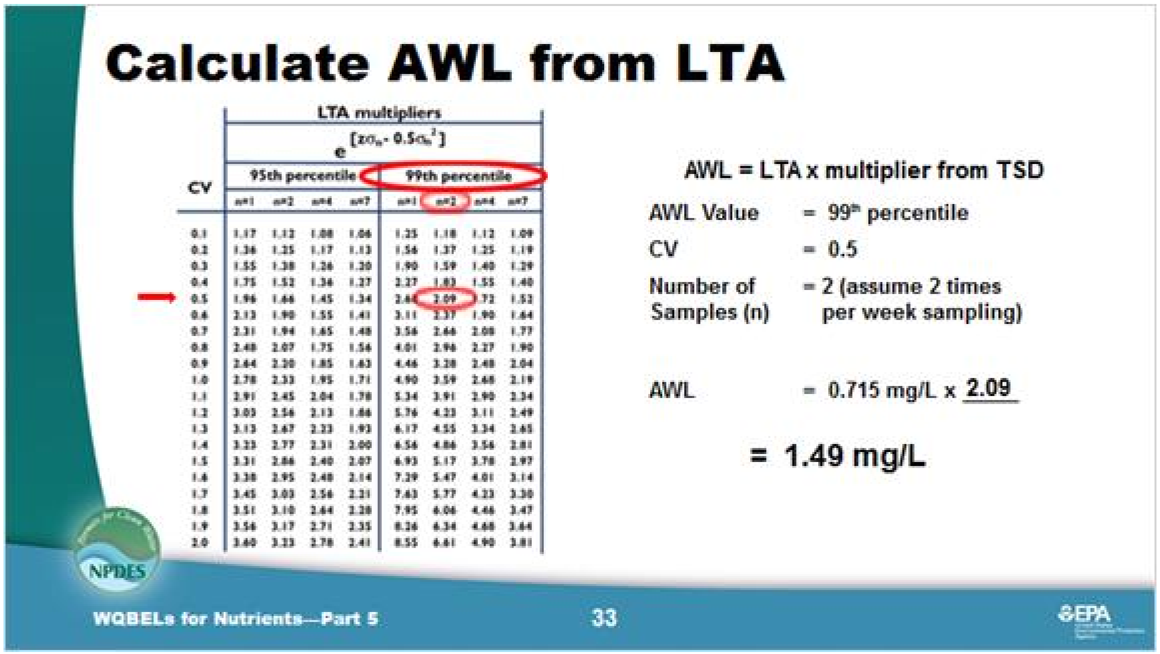


Notes:

So, that leaves us with an AML equal to the wasteload allocation of 0.880 mg/L.

Our AWL will be the calculated long-term average of 0.715 mg/L times a multiplier based on the procedures from the TSD.

1.43 Calculate AWL from LTA



Notes:

Here is the table for calculating the AWL. It is similar to the TSD table for calculating an AML.

The multipliers were determined using the equation at the top of the table.

To determine the appropriate multiplier, we need to know the CV and the desired percentile value for the AWL.

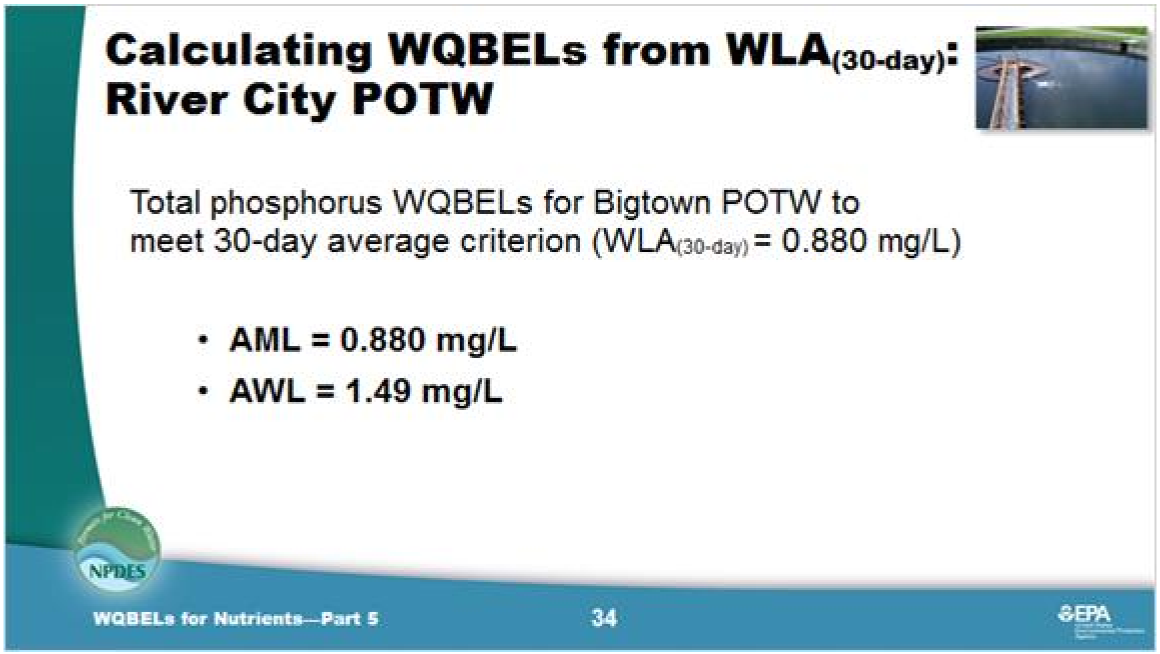
In addition, we need to know the minimum number of daily samples per week we will require the permittee to collect and average together to determine its average weekly concentration.

We are setting the AWL at the 99th percentile in accordance with our hypothetical state procedures. Our calculated CV was 0.5, and we are basing the calculation on a monitoring frequency of 2 samples per week.

That makes the multiplier 2.09.

We multiply the long-term average of 0.715 mg/L by 2.09 and get an AWL of 1.49 mg/L.

1.44 Calculating WQBELs from WLA(30-day): River City POTW

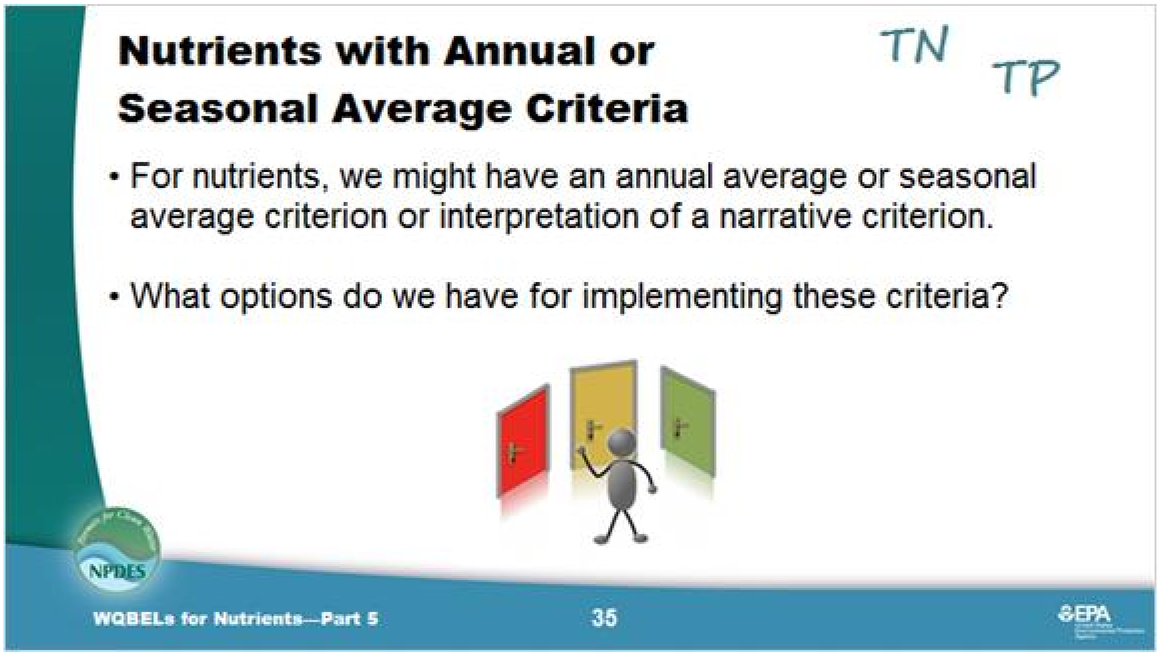


Notes:

Now we have determined both an AML and an AWL.

So, here is a summary of the WQBELs for the River City POTW based on the 30-day average criterion for total phosphorus.

1.45 Adaptations for Nutrients



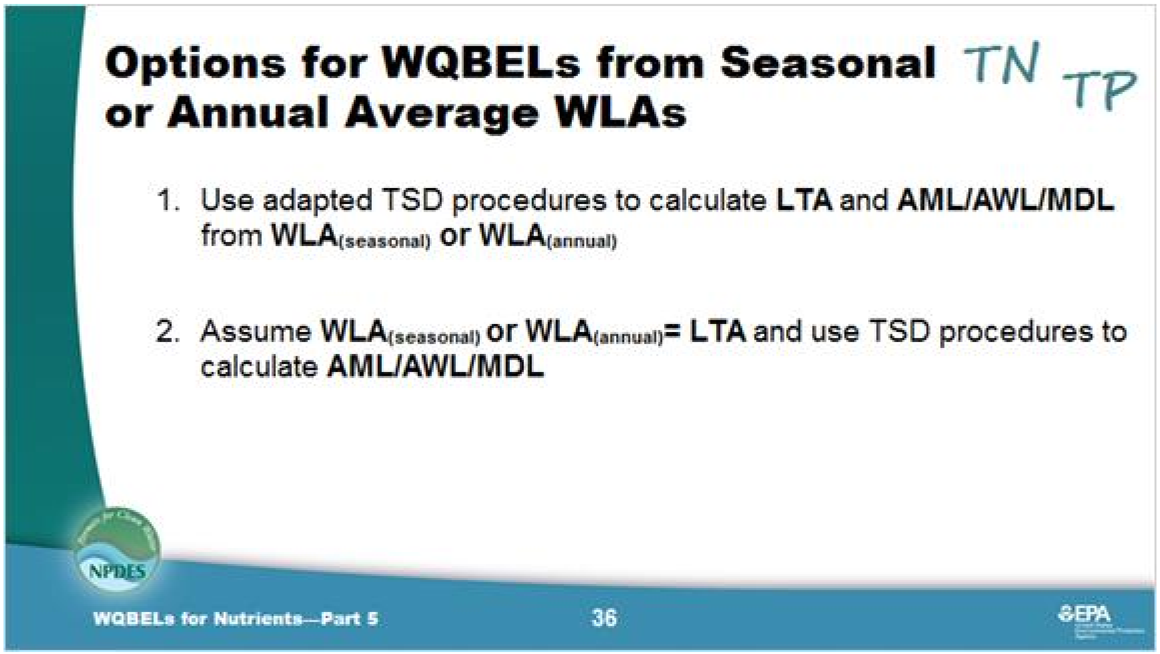
Notes:

Up to this point, we have considered how the TSD's recommendations could be adapted to apply to nutrient criteria with durations of 30 days or less.

Some states, however, use seasonal or annual average numeric criteria or interpretations of a narrative criterion.

What options do we have for implementing these criteria?

1.46 WQBELs from Annual or Seasonal Average Criteria and WLAs

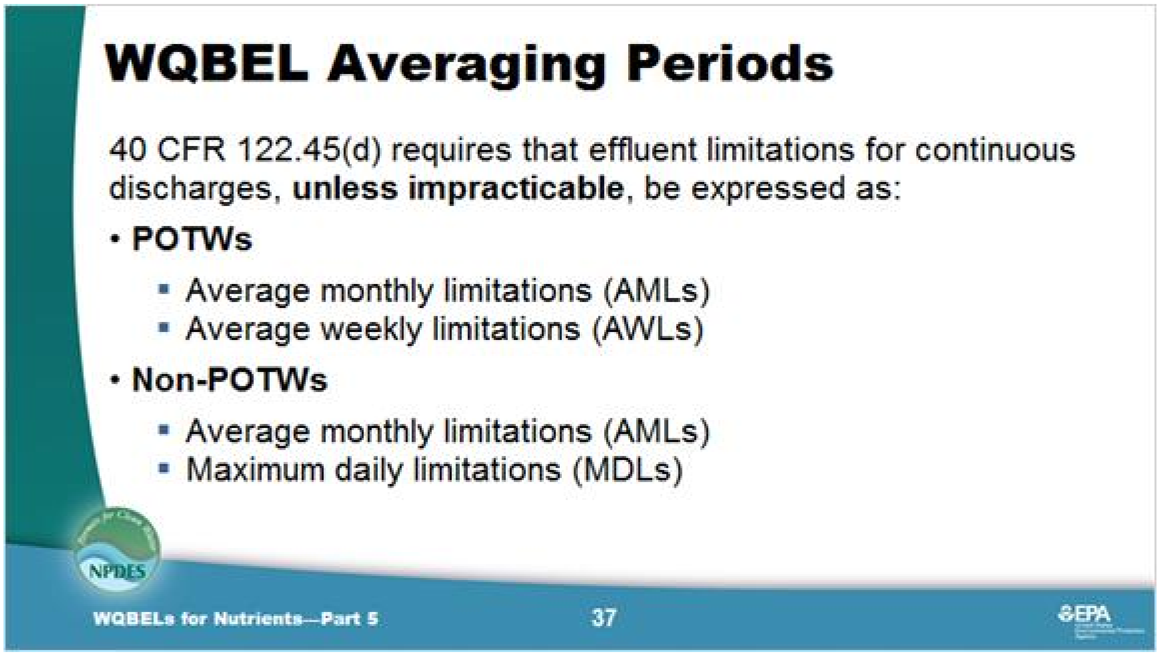


Notes:

First, we could adapt the TSD procedures to calculate a long-term average from the seasonal or annual average wasteload allocation, just as we did with the 30-day average wasteload allocation that applied in the River City POTW example. We could then use the TSD statistics to calculate an AML, AWL, or MDL from the long-term average.

A second option would be to assume that the seasonal or annual average wasteload allocation is the required long-term average and then use the TSD to calculate the appropriate effluent limits.

1.47 WQBEL Averaging Periods



Notes:

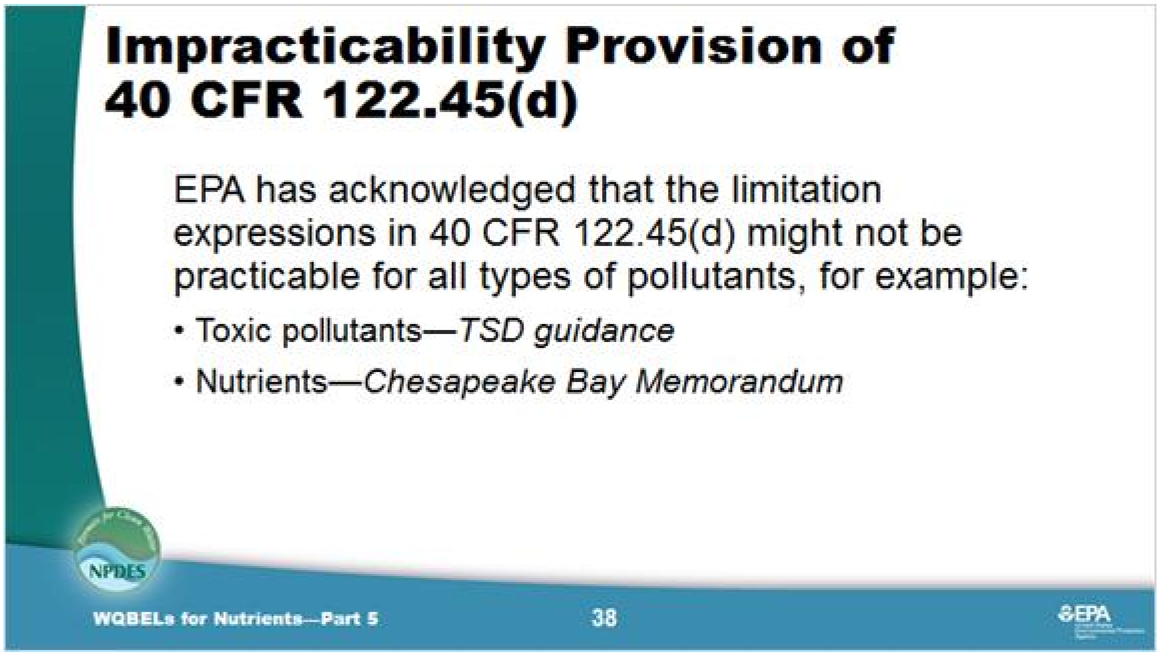
But wait! Remember this slide?

We said that 122.45(d) presents two challenges. The first challenge was that, for most pollutants, including nutrients, the averaging periods of the wasteload allocations do not match the required averaging periods for effluent limits. We addressed this challenge by using or adapting procedures from the TSD to translate wasteload allocations into WQBELs.

However, that still leaves us with the second challenge. The averaging periods specified for effluent limits in the regulations might not be the most appropriate averaging periods. This is especially true when the effects of the pollutant are from long-term average concentrations or mass loadings, as is often the case with nutrients.

As it turns out, EPA addressed this second challenge in acknowledging that there are cases where the “impracticable” clause of the regulation might apply.

1.48 Impracticability Provision of 40 CFR 122.45(d)



Notes:

That's right, Frank.

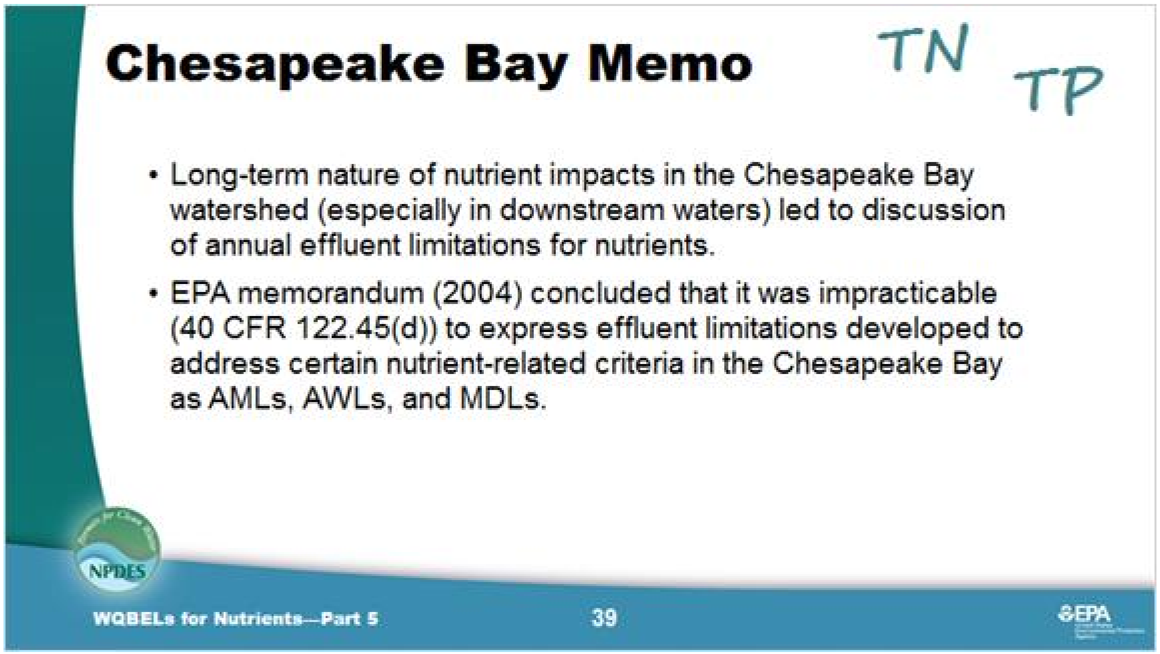
For example, we already have seen that the TSD recommends calculating average monthly and maximum daily water quality-based limits for toxic pollutants for all types of facilities.

EPA said in the TSD that, for POTWs as well as non-POTWs, permit writers should calculate average monthly and maximum daily (rather than average weekly) water quality-based limits for toxic pollutants. EPA indicated that calculating an average weekly limit rather than a maximum daily limit is impracticable because it could average out peak toxic concentrations and miss the discharge's potential for causing acute toxic effects.

Similarly, in a memorandum on nutrient limits for discharges affecting the Chesapeake Bay, EPA indicated that there are situations where setting water quality-based effluent limits for nutrients with averaging periods specified in the regulation might also be considered impracticable.

Let's take a closer look at the memo, which you can find under the Resources tab to the left of your screen.

1.49 Chesapeake Bay Memo



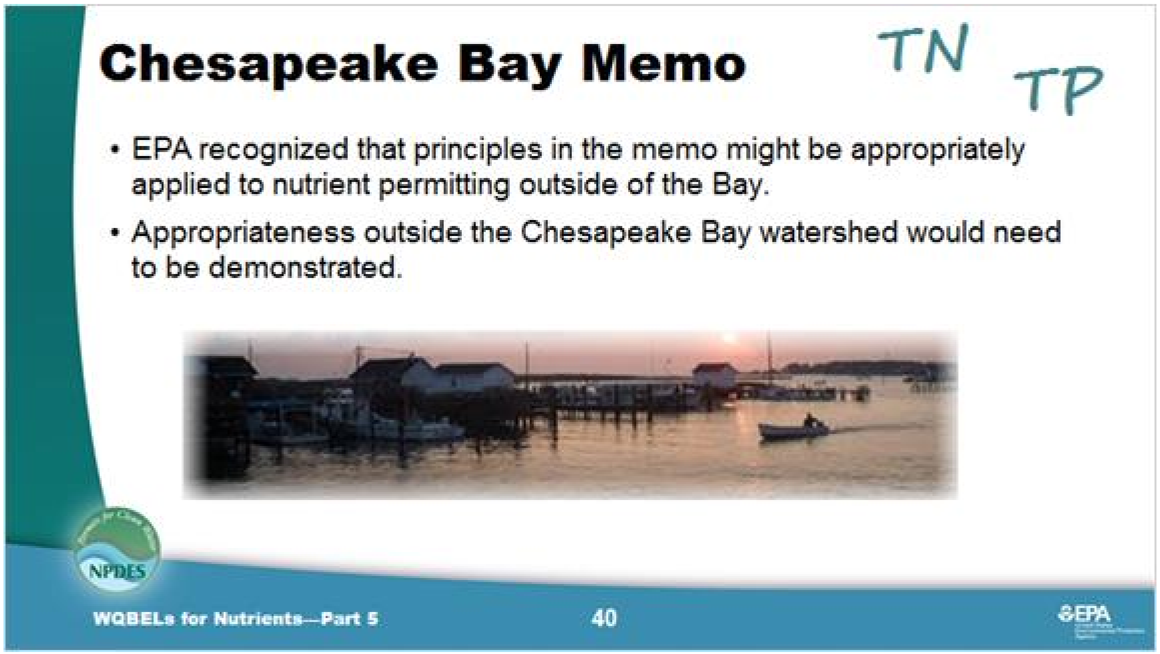
Notes:

EPA has recognized that the long-term nature of nutrient impacts, particularly in downstream waters, leads to discussion of whether or not it is appropriate for effluent limitations to be expressed as annual averages.

A 2004 memorandum from the Office of Wastewater Management at EPA Headquarters addresses this issue and, in so doing, refers back to the impracticability clause in 40 CFR 122.45(d).

It concludes that it is impracticable to express effluent limitations developed to address certain nutrient-related criteria in the Chesapeake Bay as AMLs, AWLs, and MDLs.

1.50 Chesapeake Bay Memo



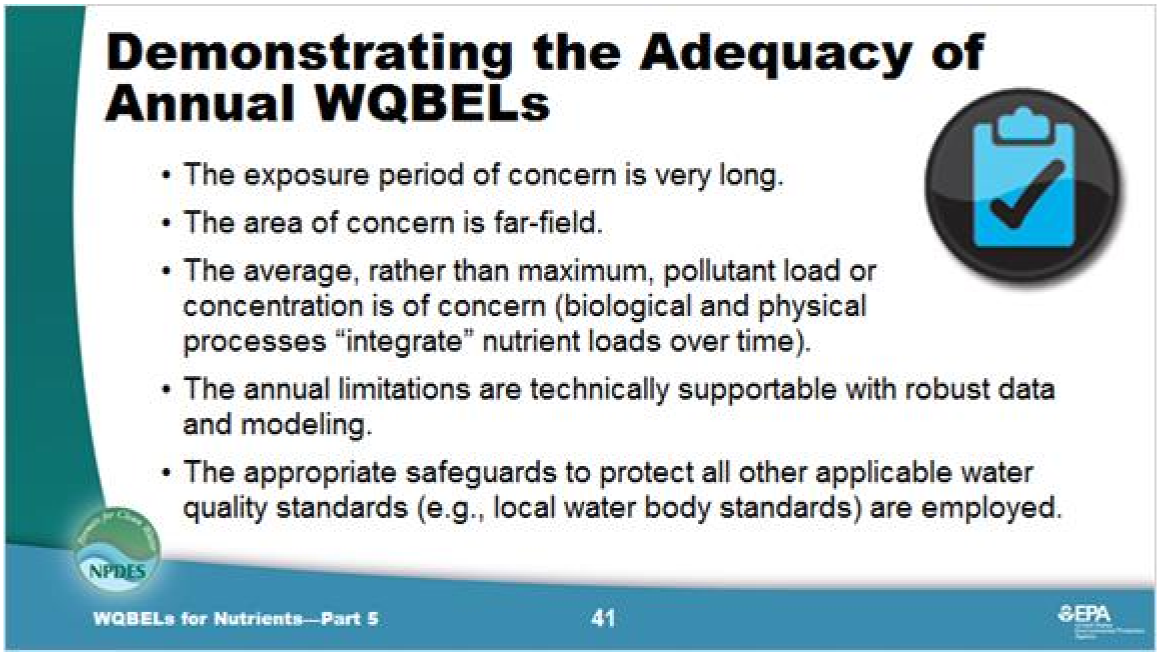
Notes:

For purposes of our discussion, it is important to note that the memorandum recognized that the principles it laid out might also be appropriately applied to permitting for nutrient discharges affecting other water bodies in a similar way.

The permitting authority must demonstrate that it is appropriate to apply the principles of the memorandum in watersheds outside of the Chesapeake Bay.

Frank, what would a permitting authority likely have to show?

1.51 Demonstrating the Adequacy of Annual WQBELs

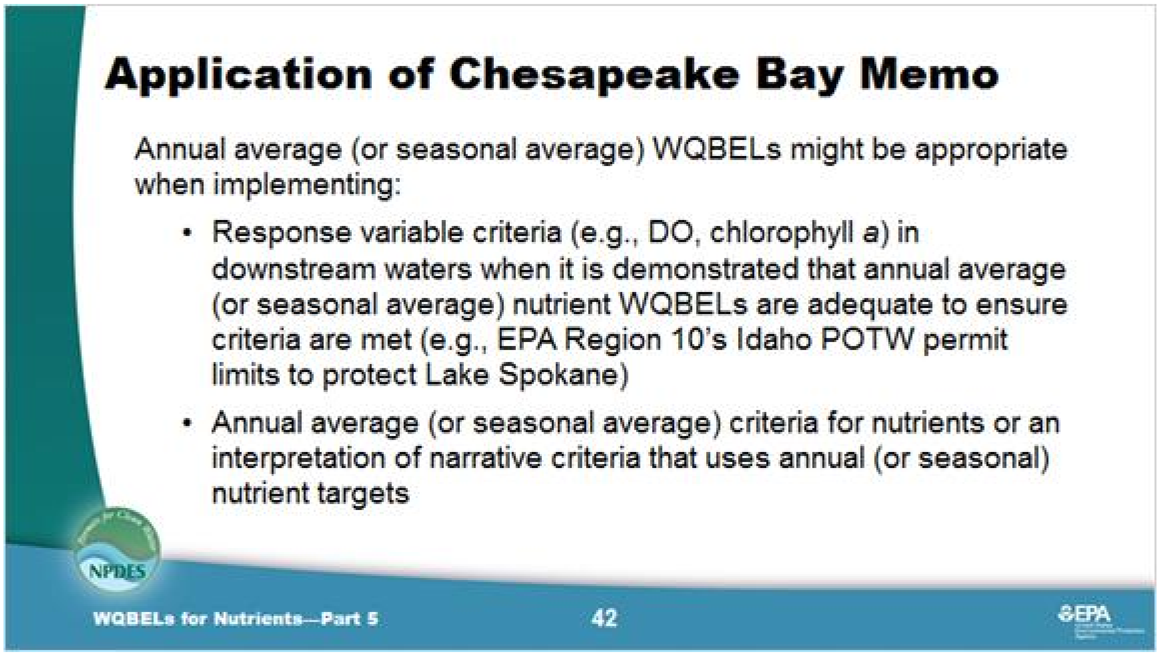


Notes:

Well, factors that would go into making such a demonstration include:

- A very long exposure period;
- A far-field area of concern;
- Integration of pollutant loads over time so that an average, rather than maximum, pollutant load or concentration is of concern;
- Robust modeling that supports the annual or seasonal limits to meet the downstream criteria; and
- Appropriate safeguards to ensure that all other water quality standards are met, including local water quality standards that might include criteria expressed as short-term averages.

1.52 Application of Chesapeake Bay Memo



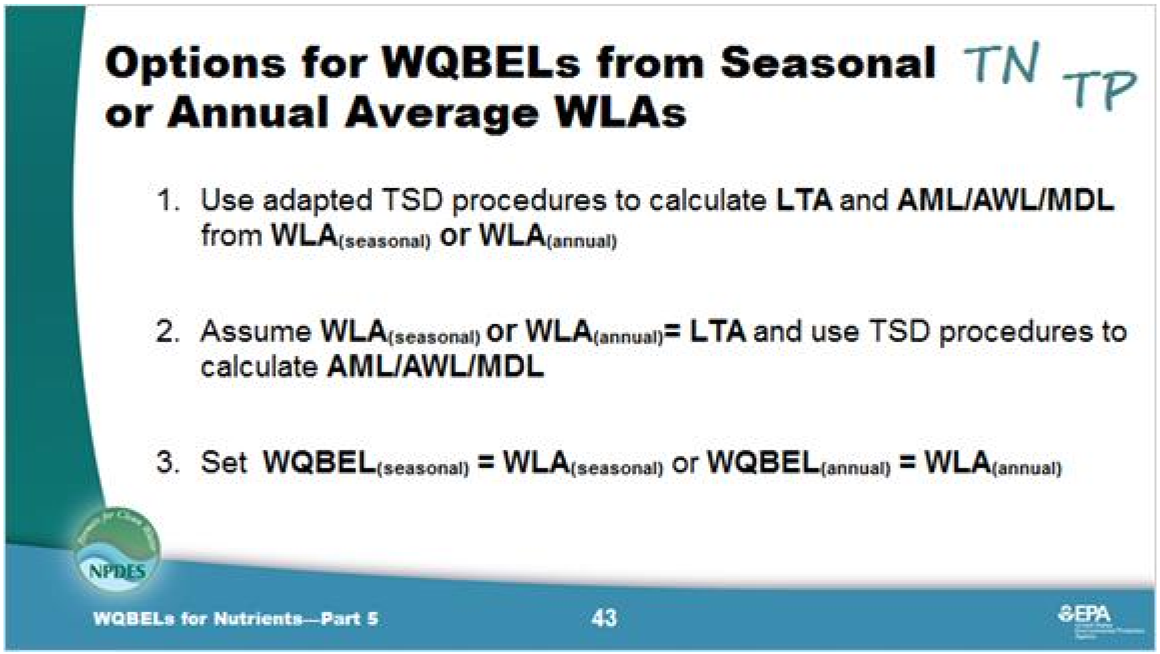
Notes:

Based on the conclusions of the Chesapeake Bay memorandum we can develop some general principles regarding when annual or seasonal average WQBELs might be appropriate.

First, they might be appropriate when implementing response-variable criteria in downstream waters. There would need to be a demonstration that annual or seasonal average WQBELs for nutrients are adequate to ensure that the downstream criteria are met. An example of such a demonstration is in EPA Region 10's permits for Idaho POTWs that included limits on total phosphorus to protect downstream Lake Spokane.

Second, they might also be appropriate when implementing annual or seasonal average criteria for nutrients or when implementing an interpretation of a narrative criterion that uses annual or seasonal nutrient targets. In fact, where this is the case, it might be preferable to include an annual or seasonal limit in the permit.

1.53 WQBELs from Annual or Seasonal Average Criteria and WLAs

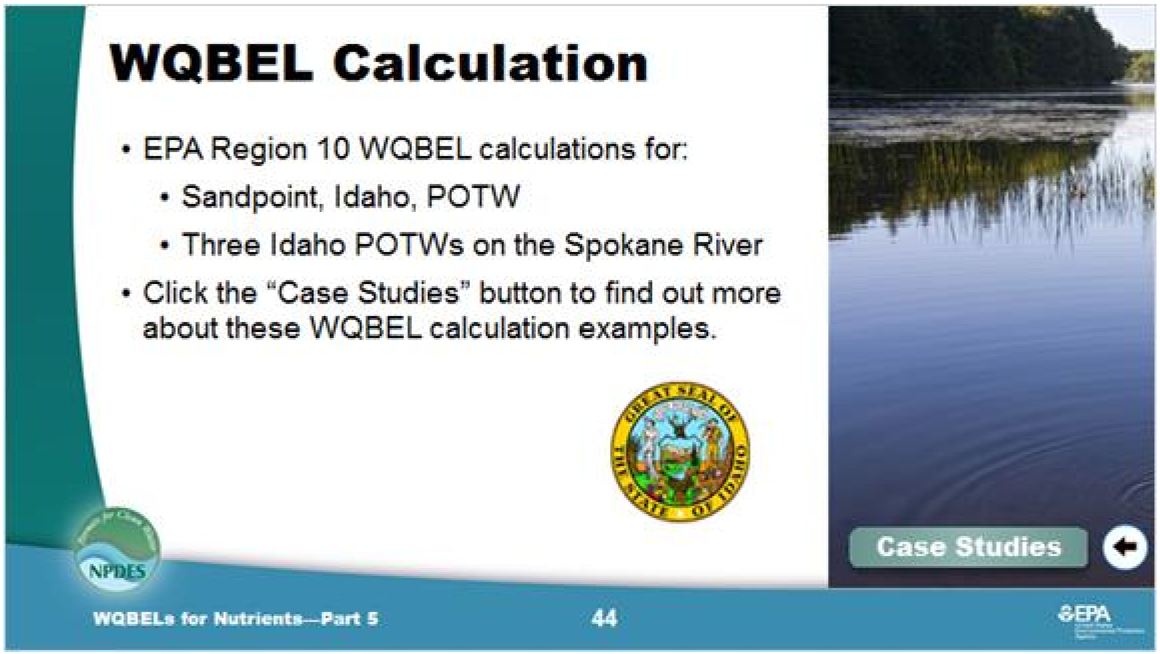


Notes:

And that, Nizanna, brings us to a third option for calculating WQBELs from seasonal or annual average wasteload allocations.

Where the applicable nutrient criterion and corresponding wasteload allocation is a seasonal or annual average, we could set the WQBEL equal to the wasteload allocation. This approach would give us a seasonal average or annual average WQBEL.

1.54 WQBEL Calculation

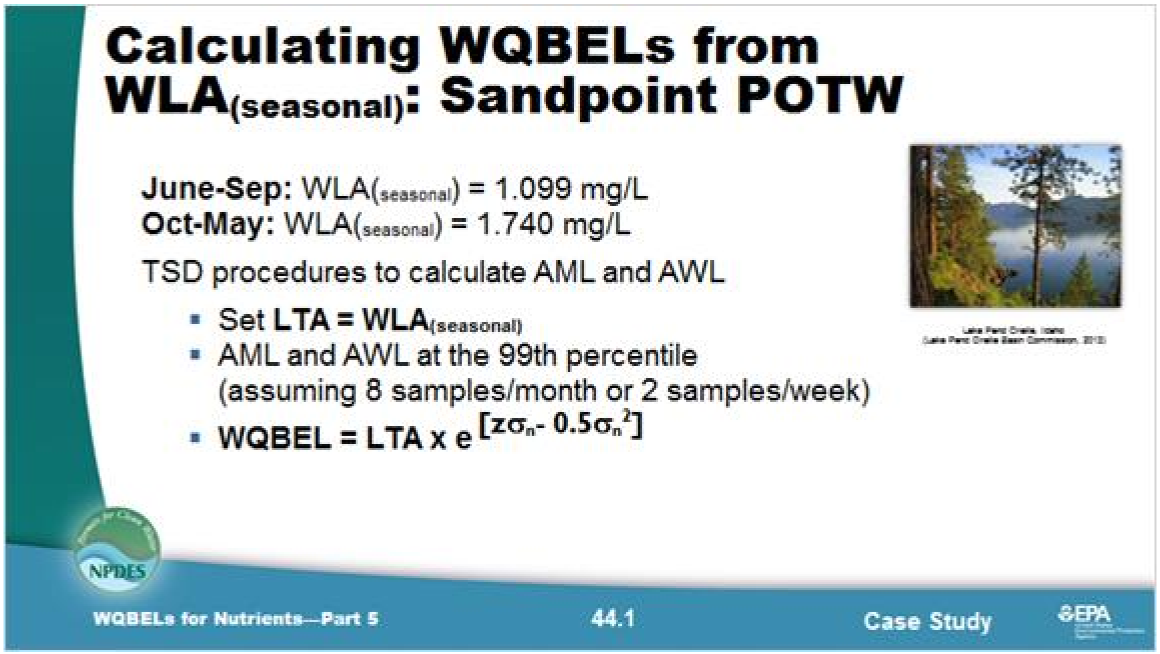


Notes:

If you would like to view case studies showing how EPA Region 10 used two different options for implementing seasonal average criteria in POTW permits, click the "Case Studies" button at the bottom of the slide. The case studies consider the Region's NPDES permits for the City of Sandpoint, Idaho, and for three other Idaho POTWs on the Spokane River.

Otherwise, click the "Next" button to skip the case studies.

1.55 Calculating WQBELs from WLA(seasonal): Sandpoint POTW



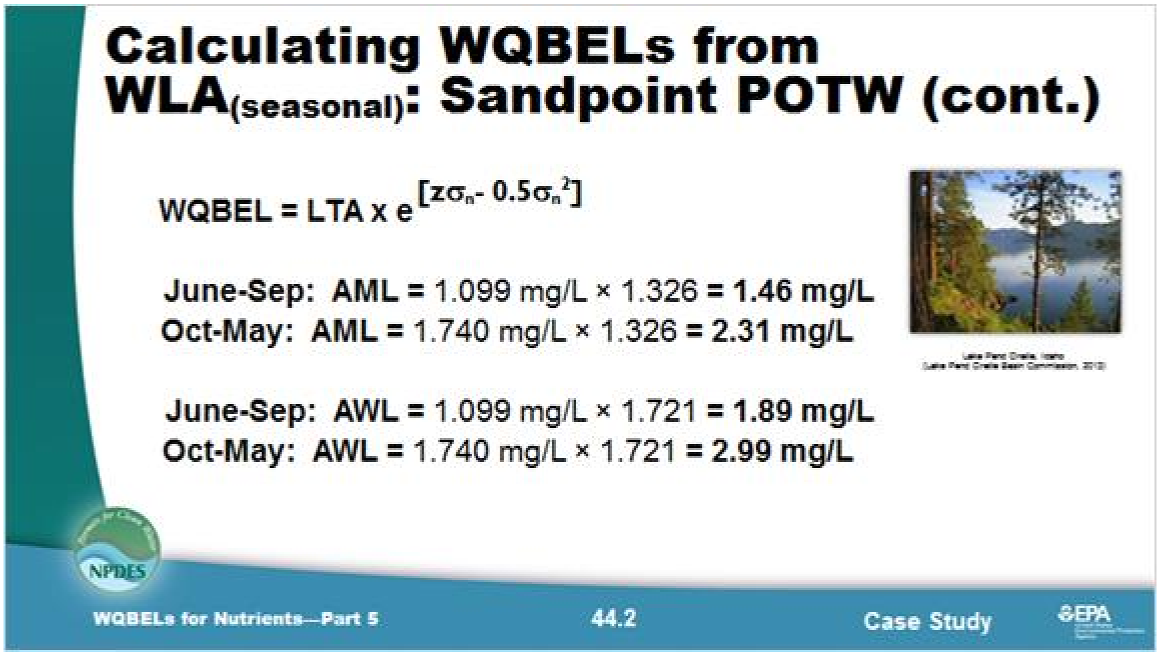
Notes:

For the first case study, we are going back to Sandpoint, Idaho, to see how EPA Region 10 calculated average monthly and average weekly limits from a seasonal average wasteload allocation.

The EPA Region calculated two wasteload allocations for the Sandpoint POTW's total phosphorus discharge to the Pend Oreille River. The seasonal average wasteload allocations were 1.099 mg/L for June through September and 1.740 mg/L for October through May.

The Region assumed that the long-term average for each season was equal to the seasonal wasteload allocation and then calculated effluent limits from each long-term average. They decided to set both the AML and the AWL at the 99th percentile on the lognormal distribution.

1.56 Calculating WQBELs from WLA(seasonal): Sandpoint POTW (cont.)



Notes:

Here are the Region's limit calculations. The two seasonal wasteload allocations for total phosphorus became the two seasonal long-term averages.

From each long-term average, they calculated an AML and an AWL for each season using the same equation we adapted from the TSD and demonstrated in our example for the River City POTW.

1.57 WLAs from a Watershed Analysis: Lake Spokane, Washington

Seasonal Limits: Spokane River Idaho POTWs

Point Source Discharge	Modeled Flow Rate (mgd)	Total Phosphorus Seasonal Average Modeled Concentration *February-October* (mg/L)	Total Phosphorus Seasonal Average Modeled Load *February-October* (lb/day)
City of Coeur d'Alene WWTP	7.6	0.05	**3.17**
HARSB WWTP	3.2	0.05	**1.33**
City of Post Falls WWTP[1]	5.0	0.0765	**3.19**

[1] Load for City of Post Falls equivalent to discharge concentration of 0.05 mg/L at a flow rate of 7.65 mgd.

NPDES

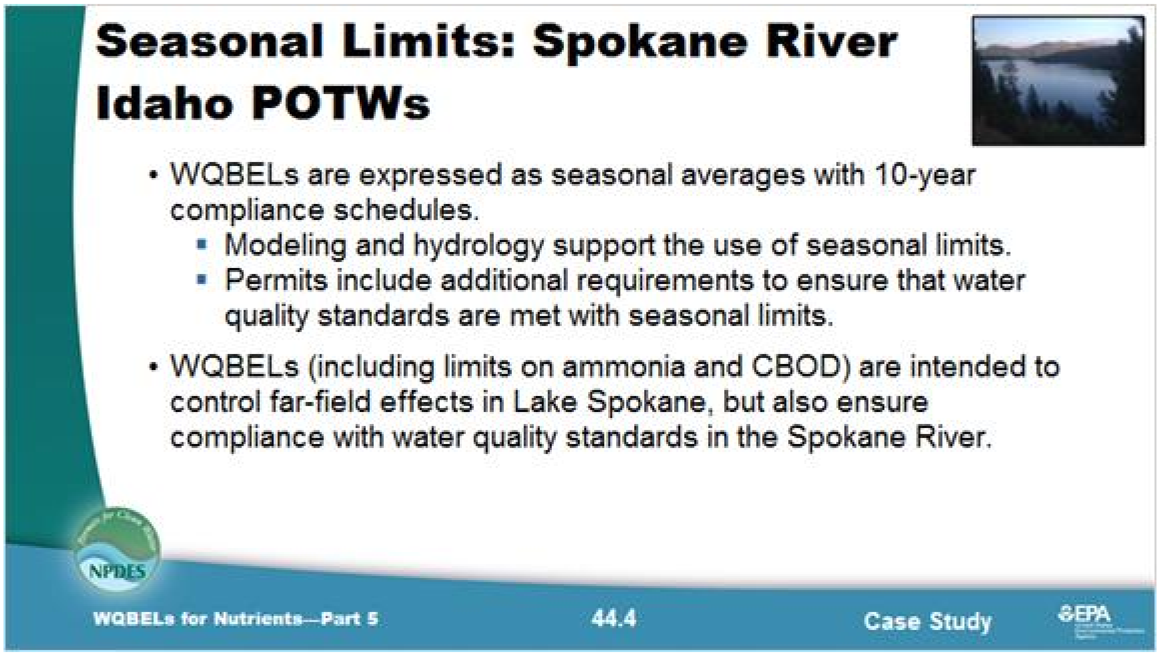
WQBELs for Nutrients—Part 5 44.3 Case Study EPA

Notes:

Our second case study returns to the example where EPA Region 10 was issuing NPDES permits to three POTWs along the Spokane River in Idaho.

The allocation to each POTW was a seasonal average load for February through October. The Region applied these seasonal average loads directly as seasonal average WQBELs.

1.58 WLAs from a Watershed Analysis: Lake Spokane, Washington



Notes:

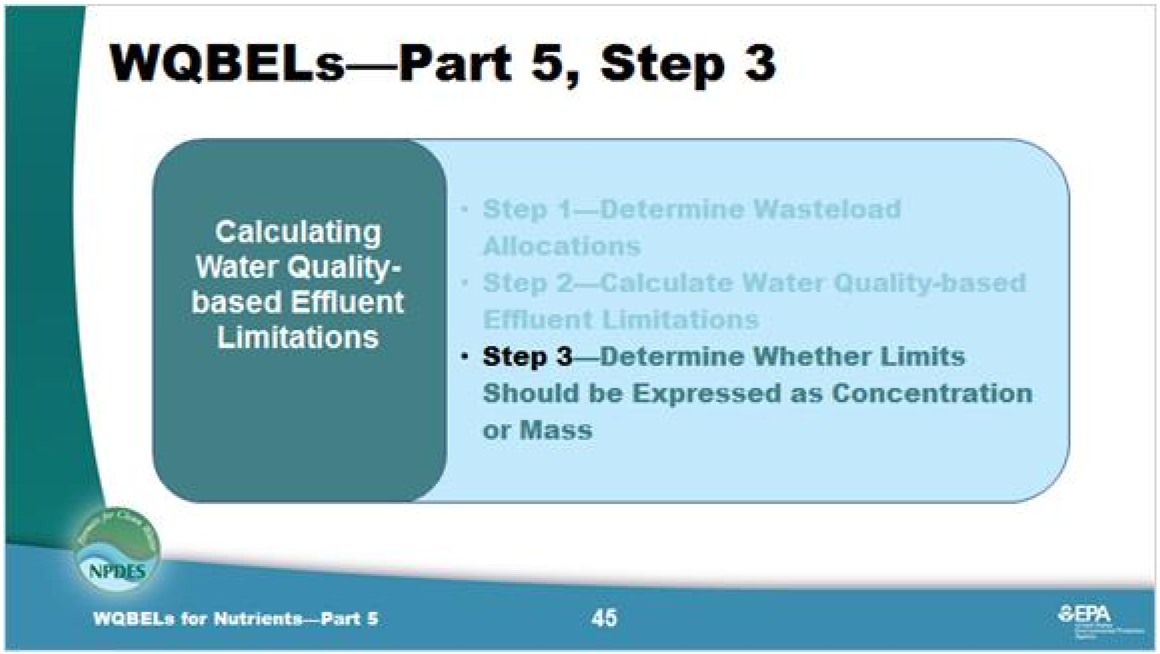
The Region was able to use the modeled loads as seasonal average effluent limits because the modeling showed that as long as the seasonal average total phosphorus loading to Lake Spokane remains low, the Lake is not sensitive to short-term increases.

In addition, the Region included other requirements in the permits to help ensure that the seasonal limits will lead to water quality standards attainment. Specifically, the permits include:

- Requirements to report monthly averages and
- Reporting on reduction measures that will be taken to ensure compliance with the seasonal average for any months where the monthly average exceeds the seasonal average limits.

The WQBELs are intended to control far-field effects. The upstream end of Lake Spokane is 42.5 miles downstream from the closest of the three Idaho POTWs. The modeling shows, however, that the effluent limits in the permits will assure attainment of dissolved oxygen criteria and narrative criteria for nutrients in the Spokane River.

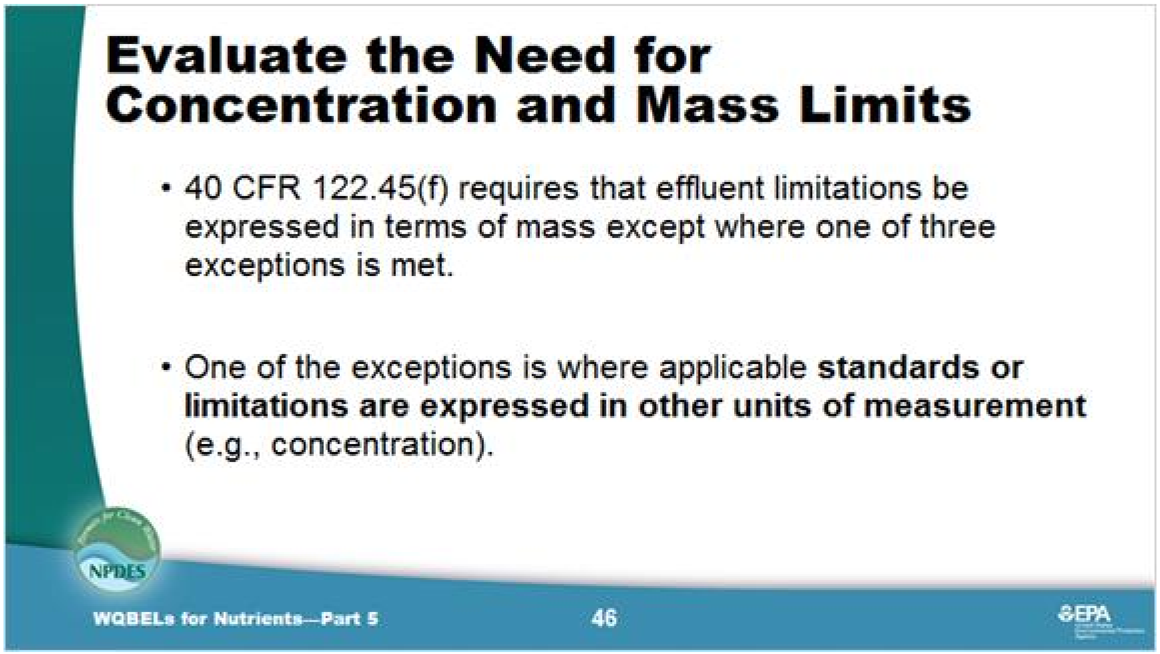
1.59 WQBELs—Part 5, Step 3



Notes:

After we have calculated WQBELs, our final step is to evaluate whether WQBELs should be expressed in terms of concentration, mass, or both.

1.60 Evaluate the Need for Concentration and Mass Limits

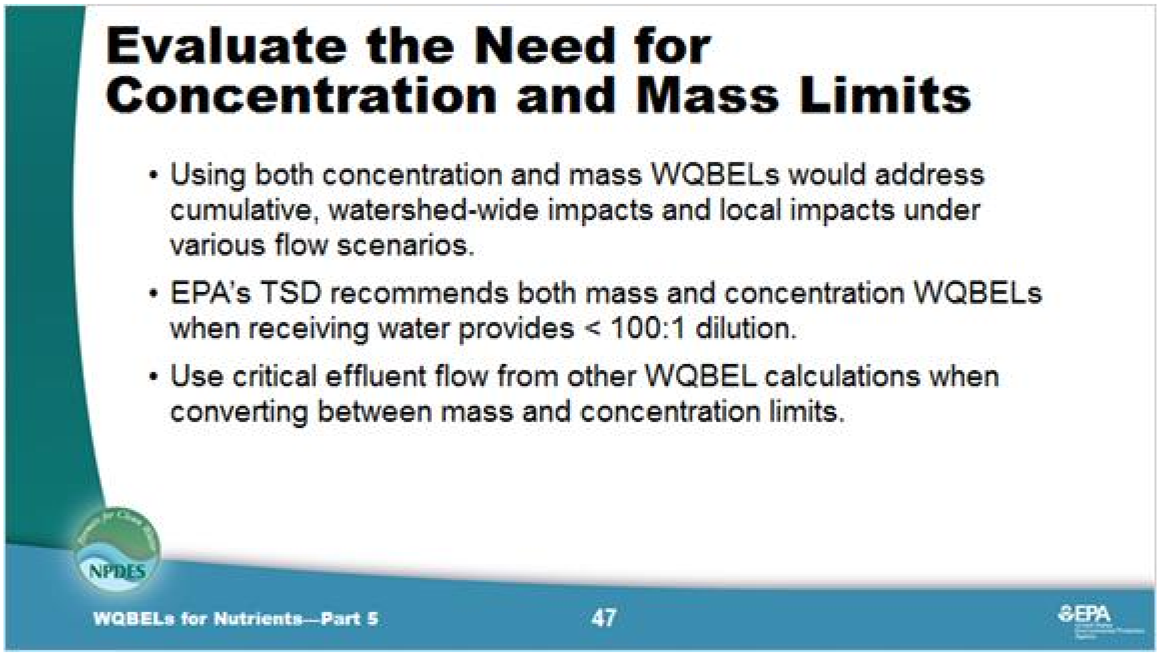


Notes:

The NPDES regulations at 40 CFR 122.45(f) require that effluent limitations be expressed in terms of mass unless one of three exceptions is met. One of the three exceptions is where applicable ***standards or limitations are expressed in other units of measurement***, such as standard units for pH.

Where you might see this come into play in calculating WQBELs for nutrients is where the applicable water quality criteria are expressed in concentration units. In this case, WQBELs derived from concentration-based criteria for nutrients can be expressed in terms of concentration.

1.61 Evaluate the Need for Concentration and Mass Limits



Notes:

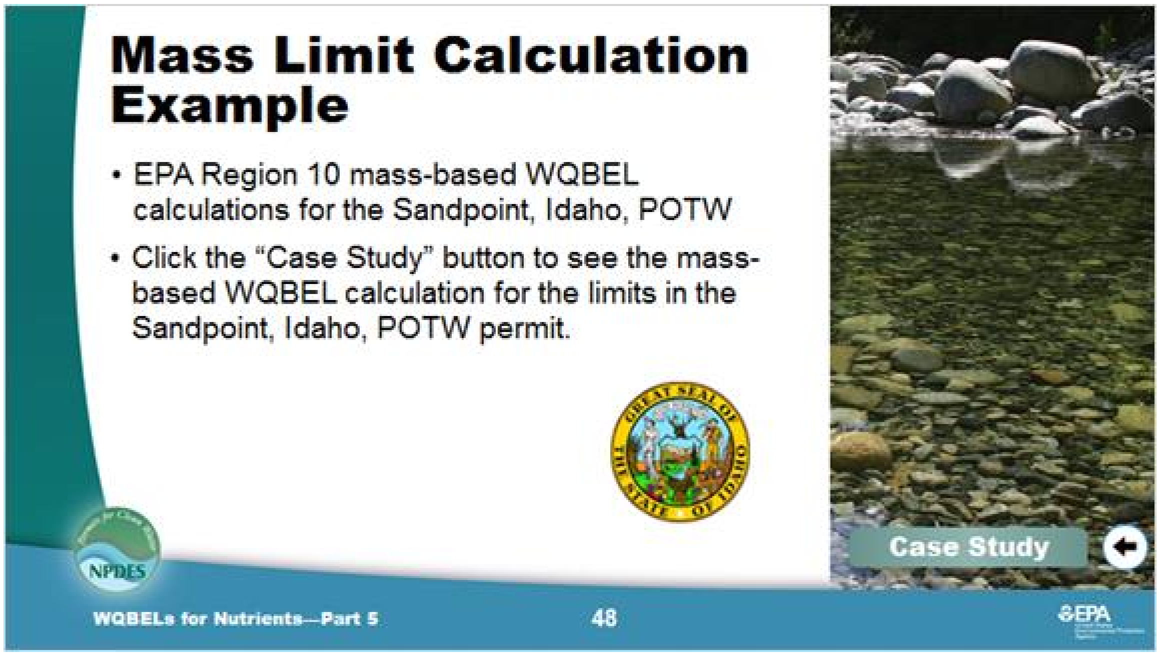
Although WQBELs could be expressed as concentration-based limits only, it might be advisable to supplement concentration limits with mass limits to make sure that we are recognizing the cumulative impacts of nutrient loading.

On the other side of the coin, mass limits alone might not assure the attainment of water quality criteria for nutrients in certain flowing waters. Concentration-based limits might be necessary to supplement mass limits and protect against localized impacts, especially where there is not significant dilution.

EPA's TSD recommends both mass and concentration WQBELs when the receiving water provides less than 100 to 1 dilution.

Calculating mass limits from concentration limits or concentration limits from mass limits requires a conversion factor and the effluent flow. In these conversion calculations, the permit writer should use the critical effluent flow that was used in other water quality calculations.

1.62 Mass Limit Calculation Example

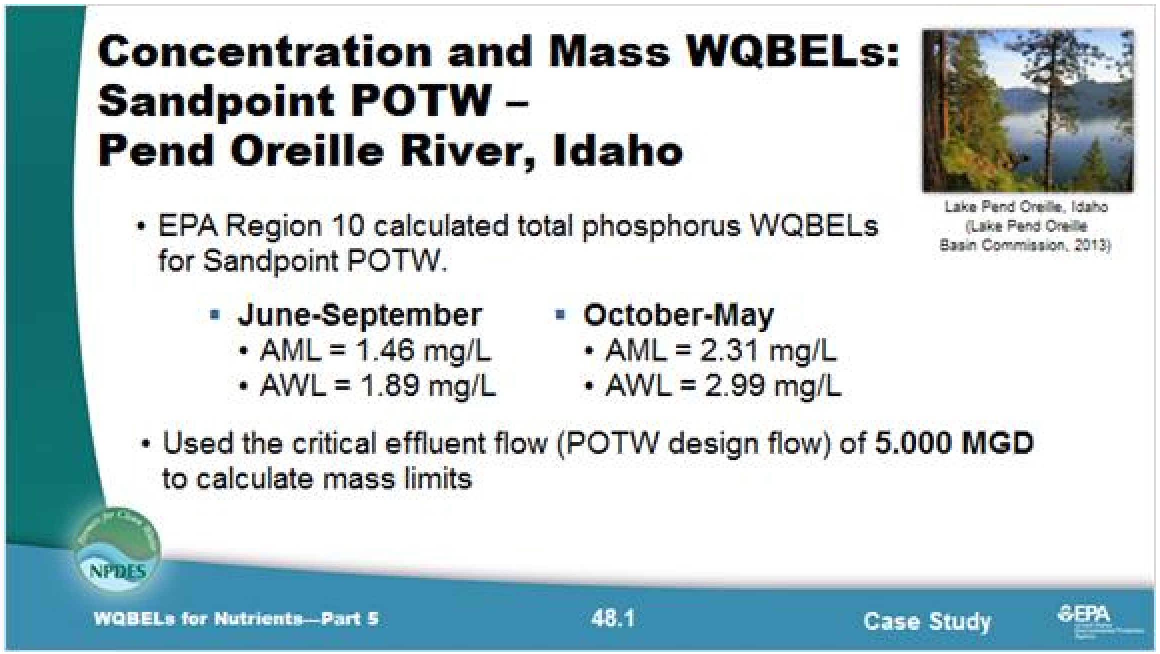


Notes:

If you would like to view an example of mass limit calculations from EPA Region 10's permit for the City of Sandpoint, Idaho, click the "Case Study" button at the bottom of the slide.

Otherwise, click the "Next" button to skip the case study.

1.63 Concentration and Mass WQBELs: Sandpoint POTW - Pend Oreille River, Idaho



Notes:

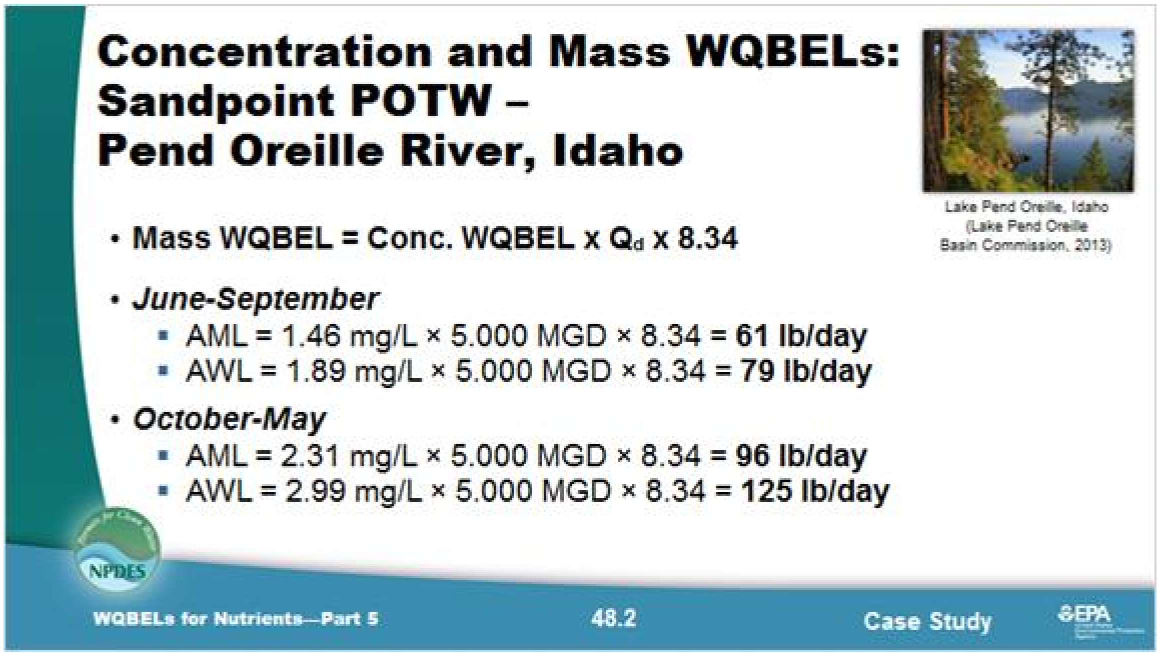
For one last time, let's return to our example of the Sandpoint POTW on the Pend Oreille River in Idaho.

The Region calculated average monthly and average weekly limits from its interpretation of Idaho's narrative nutrient criterion.

The Region also decided to calculate mass limits from these concentration values.

To do this calculation, they used the same critical effluent flow that they used in other water quality calculations. In this case, the critical effluent flow they chose was the design flow of 5 million gallons per day.

1.64 Concentration and Mass WQBELs: Sandpoint POTW - Pend Oreille River, Idaho

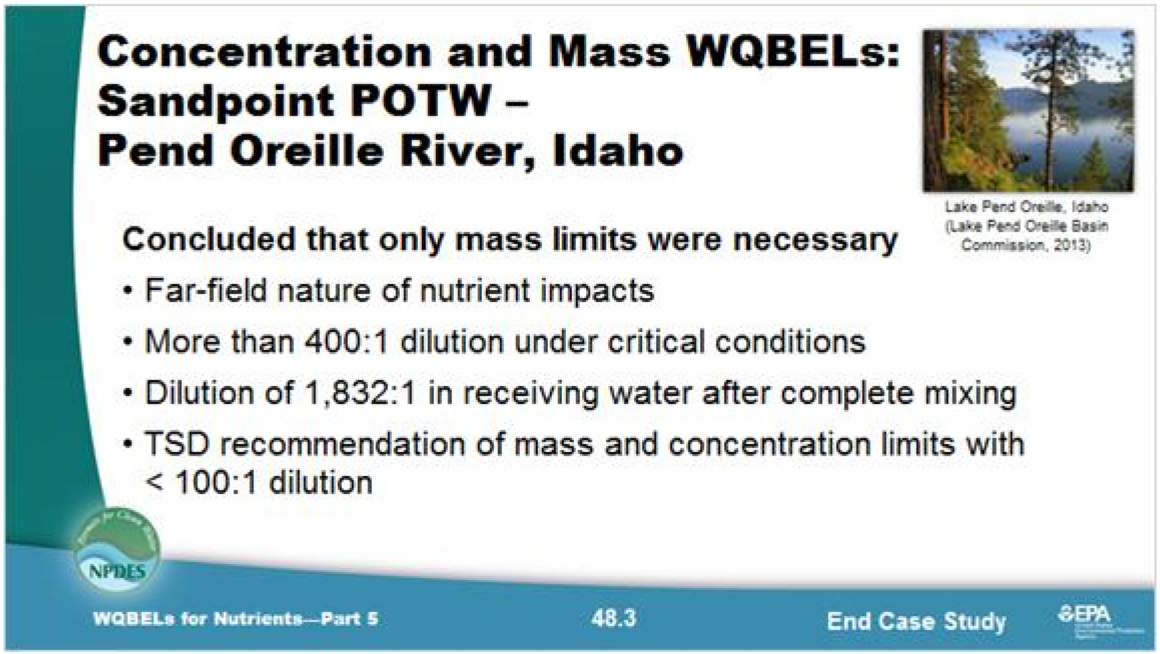


Notes:

Here are the Region’s calculations converting the concentration values into mass limits.

While NPDES permit limits may be expressed as both concentration and mass, the Region determined that concentration limits were not necessary in this permit. The limits are expressed exclusively as mass.

1.65 Concentration and Mass WQBELs: Sandpoint POTW - Pend Oreille River, Idaho



Notes:

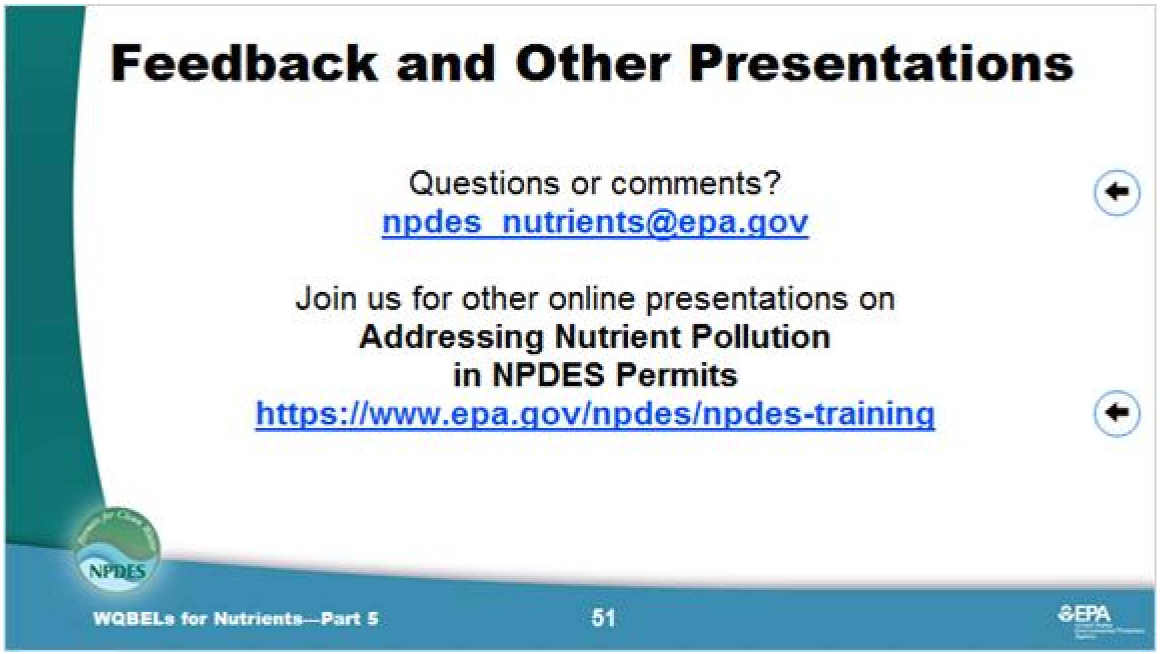
The Region explained in the permit fact sheet that the nutrient pollutants exert their impact on water quality over long distances.

The Pend Oreille River provides a dilution factor of more than 400 to 1 under critical conditions, even during the low-flow season. In addition, after complete mixing, the river provides over 1,800 to 1 dilution. These large dilution factors mean that the effluent concentration will be insignificant as long as the permittee complies with its mass limits.

Finally, the Region cited the TSD recommendation that mass and concentration limits be established for effluents discharging into waters with less than 100-fold dilution, which is not the case for the Sandpoint permit.

Based on these considerations, the Region determined that only mass limits are needed in the permit.

1.75 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!