Virtual WQS Academy

National Pollutant Discharge Elimination System (NPDES) Program Overview

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- Determine the obligations of the regulated community
- Change or substitute for any statutory provision or regulatory requirement
- Change or substitute for any Agency policy or guidance
- Control in any case of conflict between this discussion and statute, regulation, policy, or guidance

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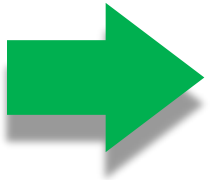
Today's Presentation

- Key Terms and NPDES Overview
- Types of Permits
- Technology-based Effluent Limitations
- Water Quality-based Effluent Limitations:
  - Standards-to-Permits Process
    - Identify Pollutants of Concern
    - Identify applicable Water Quality Standards
    - Determine Critical Conditions
    - Is there a need for a Water Quality-based Effluent Limitation?
    - Calculating a Water Quality-based Effluent Limitation
- Final Effluent Limitations

Key NPDES Terms

- All *point sources*
- Discharging *pollutants*
- Into *waters of the United States*



Must obtain an NPDES *permit* from EPA or an authorized state, territory, or Tribe

NPDES Statutory and Regulatory Framework:
CWA Section 301(a) and 40 CFR 122.1(b)

Point Source Dischargers- 40 CFR 122.2

- Any discernible, confined, and discrete conveyance, including but not limited to:
  - any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged
- *Does not include return flows from irrigated agriculture or agricultural stormwater runoff*
- *Does not include discharges incidental to the normal operation of a vessel.*

CWA Classes of Pollutants

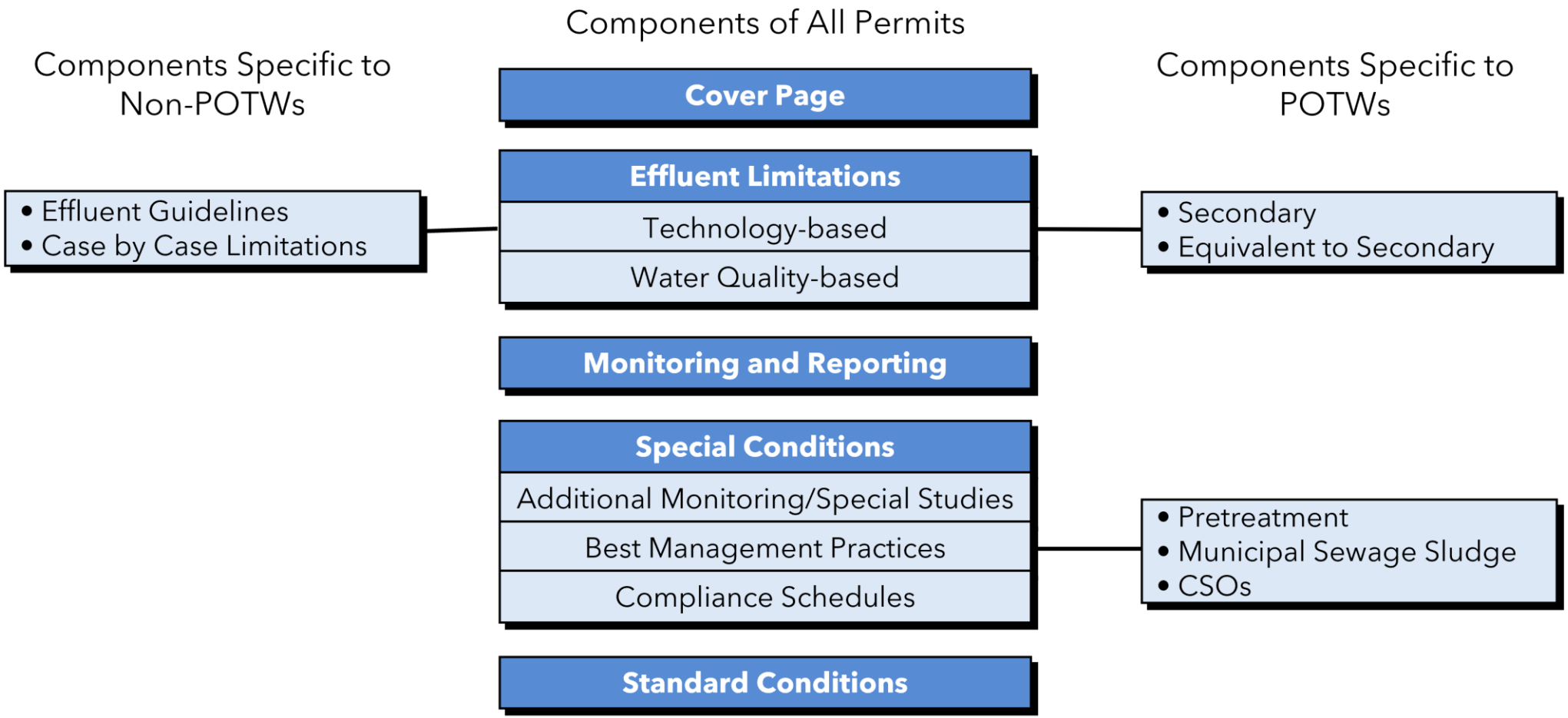
- Pollutant – defined at 40 CFR 122.2
  - Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water
- CWA Section 502(19) The term "pollution" means the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.
- Does not include sewage from vessels or certain materials related to injection wells.

Conventional Pollutants	BOD, TSS, pH, fecal coliform, and oil and grease
Toxic Pollutants	65 classes of compounds (126 priority pollutants that are heavy metals or organic compounds)
Nonconventional Pollutants	Everything else (e.g., chlorine, ammonia, nitrogen, phosphorus)

What is a Permit?

- A *NPDES permit* is a license to discharge, and limitations and requirements of a permit are enforceable.
  - issued by the **government**
  - grants permission to do something that would be **illegal** in the absence of the permit (e.g., driver's license)
- There is no right to a permit, and it is revocable for cause (e.g., reckless driving)
- A NPDES permit is issued for a term of 5 years and then expires.

Typical NPDES Permit Components



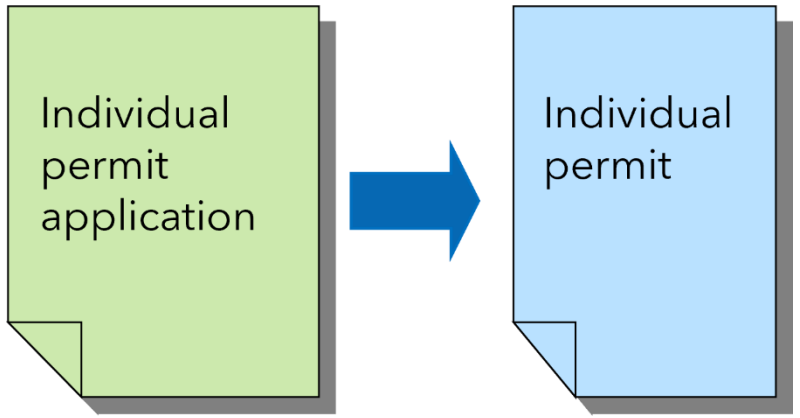
NPDES Permit Types

Individual Permit

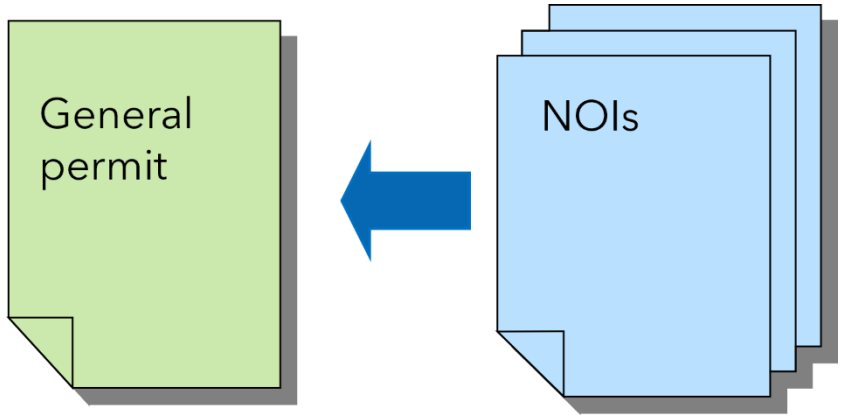
- One application submitted for each permit issued
- Appropriate where facility-specific permit conditions are needed

General Permit [§ 122.28]

- One permit issued and many Notices of Intent (NOIs) for coverage submitted
- Appropriate where
  - multiple, similar sources within the same geographic area require permit coverage
  - sources have similar discharges and would require the same or similar permit conditions



50,020 facilities (June 2025)



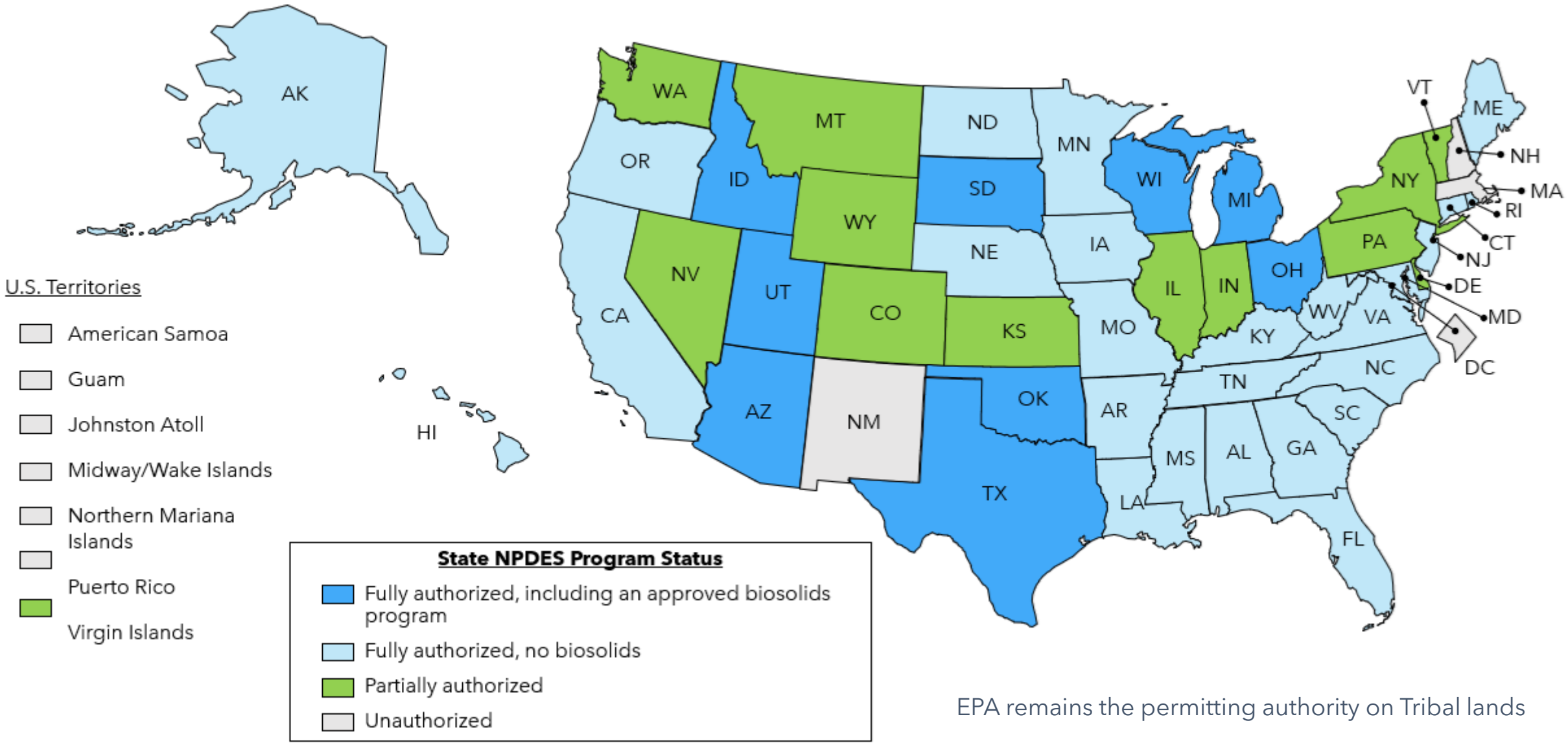
953 permits with 823,540 facilities (June 2025)

Who Administers the NPDES Program?

Under the CWA, the U.S. EPA administers the NPDES permit program unless a state, territory, or Tribal government seeks and receives authorization:

- **Request**: State/territory/Tribe [hereafter "state"] must submit a detailed request to EPA for approval [40 CFR Part 123]
- **Content**: The request must include requisite legal authority, resource commitment, and implementation procedures
- **Authority**: Upon EPA approval of the state program, *exclusive authority* for permitting transfers to the state
- **Oversight**: EPA assumes oversight role and reviews and objects to permits as necessary to assure consistency with federal requirements.

NPDES Program Authorizations
(as of December 2025)



EPA remains the permitting authority on Tribal lands

Clean Water Act Goals and Permit Limitations

Goal or Policy:	▪ Zero Discharge of Pollutants	▪ Fishable and Swimmable Waters ▪ No Toxics in Toxic Amounts
Standards:	▪ Technology	▪ Water Quality
NPDES Regulations:	▪ 40 CFR 122.44(a), (e) ▪ 40 CFR 125.3	▪ 40 CFR 122.44(d)

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CWA Technology Requirements

CWA required EPA to develop technology-based performance standards for different types of direct dischargers.

- **Publicly Owned Treatment Works** (POTW) Standards that address conventional pollutants.
  - Secondary Treatment
  - Equivalent to Secondary Treatment
- **Non-POTW Existing Source Standards** (Industrials)
  - Best Practicable Control Technology Currently Available (**BPT**)
  - Best Conventional Pollutant Control Technology (**BCT**)
  - Best Available Control Technology Economically Achievable (**BAT**)
- **Non-POTW New Source Performance Standards** (NSPS)

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Technology Standards do not consider Water Quality Effects! Evaluate available technology and treatment performance and cost for a facility

TBEL Regulations

- **Technology-based treatment standards** represent the minimum level of control that must be imposed in an NPDES permit - § 125.3(a).

- **Imposing technology-based requirements for POTWs** - § 125.3(a):
  - application of secondary treatment standards
  - equivalent to secondary treatment
  - other adjustments
- **Imposing technology-based requirements for non-POTWs** - § 125.3(c):
  - application of EPA-promulgated effluent guidelines (BPT, BCT, BAT, NSPS)
  - where effluent guidelines are inapplicable, through a case-by-case approach using Best Professional Judgment (BPT, BCT, BAT)
  - through a combination of these approaches

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Water Quality: Clean Water Act Requirements

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  - prevent future excursions of water quality standards
  - prevent or limit degradation of water quality

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- Waters Attaining Water Quality Standards
  - protect beneficial uses of the waterbody
  - prevent future excursions of water quality standards
  - prevent or limit degradation of water quality
- Waters Not Attaining Water Quality Standards
  - prevent further degradation
  - implement corrective actions (e.g., TMDLs) to restore waters and meet water quality standards

WQBELs Regulations

40 CFR 122.44(d)

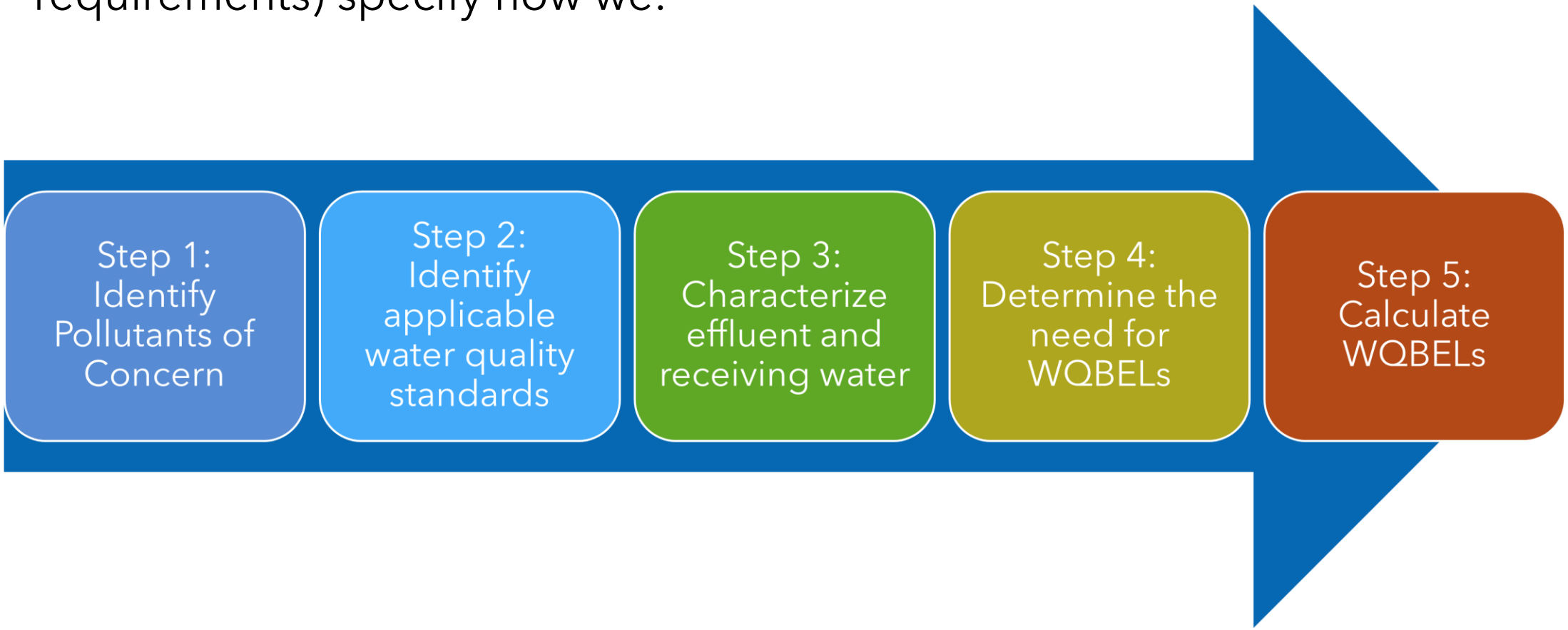
- Each NPDES permit **shall include** . . . any requirements in **addition to or more stringent** than promulgated effluent limitations guidelines or standards under sections 301, 304, 306, 307, 318 and 405 of CWA necessary to:

  1) Achieve water quality standards established under section 303 of the CWA, including State narrative criteria for water quality.

  (i) Limitations must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which the Director determines are or may be discharged at a level **which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard**, including State narrative criteria for water quality.

WQBELs: Standards to Permits

- Water quality standards and implementing procedures (including NPDES requirements) specify how we:



Step 1: Identify Pollutants of Concern

- **Pollutants of concern** (POCs) are any pollutants or pollutant parameters that:
  - permit writer has reason to believe are or may be **discharged by the facility**, and;
  - could **affect or alter** the physical, chemical, or biological condition of the receiving water
- **POCs** can be those:
  - with an applicable **TBEL**
  - with a wasteload allocation from a **TMDL or watershed analysis**
  - identified as needing **WQBELs** in the previous permit
  - **identified as present** in the effluent through monitoring
  - *otherwise expected to be present in the discharge*

Step 2: Identify Applicable Standards

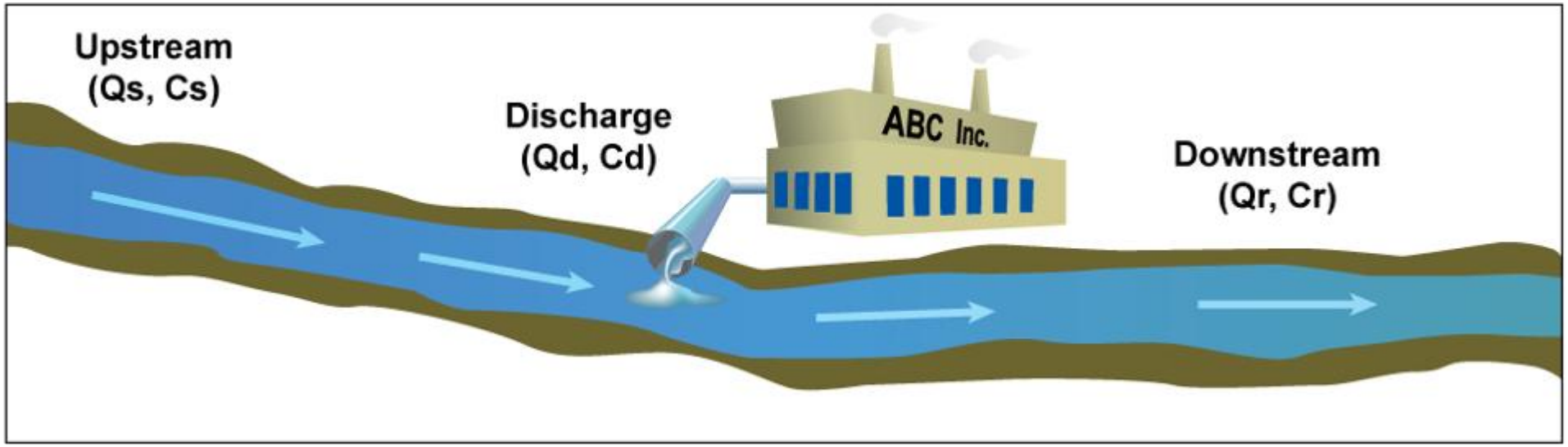
Permit writer's task:

- Identify the specific **receiving water segment**
- Determine all numeric and narrative **water quality criteria** applicable to the receiving water segment for the **pollutants of concern**
- Identify any **implementation policies** associated with applicable standards and criteria
- Consider whether **downstream criteria** may also be applicable to the discharge.

Step 3: Characterize Effluent and Receiving Water

- **Determine whether dilution or mixing zones are allowed by state water quality standards**
  - Evaluate applicability for each pollutant of concern and determine allowance or mixing zone requirements.
  - Determine the appropriate model to incorporate dilution or mixing
- **Identify Critical Conditions**
  - Often specified in WQS implementing policies
  - May varying based upon when impacts are expected to occur (seasonality or wet/dry weather)
  - Effluent Flow and Pollutant Concentrations
    - Use application and monitoring data
  - Receiving Water Flow and Ambient Concentrations
    - Use stream gauge data or low flow tools
    - Use available stream monitoring data

Steady State Model



Mass-Balance Equation:

$$Q_sC_s + Q_dC_d = Q_rC_r$$

- Q_s= Critical upstream flow
- C_s= Critical upstream pollutant concentration
- C_d= Critical effluent pollutant concentration
- Q_d= Critical effluent flow
- Q_r= Sum of Q_s and Q_d
- C_r = Sum of C_s and C_d

Step 4 - Determining the Need for WQBELs

Water Quality-Based Effluent Limitations (40 CFR 122.44(d)(1)(ii))

When determining whether a discharge causes, **has the reasonable potential to cause**, or contributes to an in-stream excursion above a narrative or numeric criteria within a State water quality standard, the permitting authority shall use procedures which account for:

- **existing controls** on point and nonpoint sources of pollution
- **the variability** of the pollutant or pollutant parameter in the effluent
- **the sensitivity** of the species to Whole Effluent Toxicity testing (when applicable)
- where appropriate, the **dilution of the effluent** in the receiving water

EPA has developed a process found in a Technical Support Document (**TSD**), but state procedures vary widely…must account for the factors above. The TSD was developed for toxic pollutants and may not be appropriate for other pollutants.

Determine the Receiving Water Concentration Under Critical Conditions

For steady-state modeling under **critical conditions**, the permit writer estimates:

- a single **receiving water concentration**
- to compare to each applicable **water quality criterion**
- to determine whether **reasonable potential** to exceed the criterion exists

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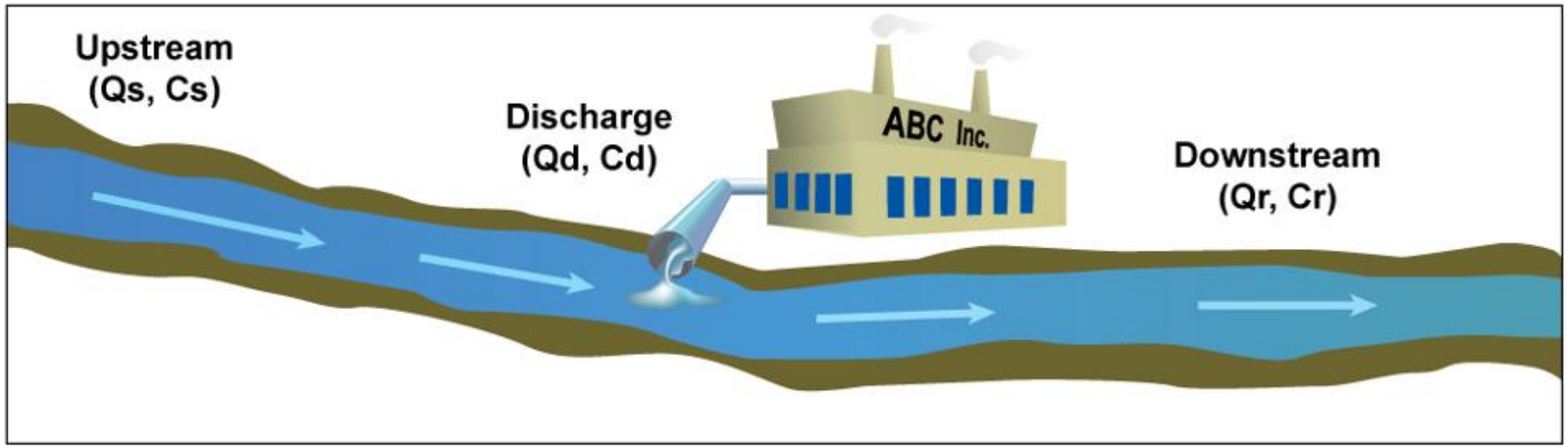
Let's take a look at the EPA TSD process.

Reasonable Potential Analysis – *Steady-State, Complete Mixing Under Critical Conditions*



Determine the pollutant concentration of Pollutant X (the pollutant of concern) in the waterbody downstream of the discharge:

$$Q_s C_s + Q_d C_d = Q_r C_r \quad \Rightarrow \quad C_r = \frac{Q_s C_s + Q_d C_d}{Q_r}$$

Mass Balance Equation

Determining a Critical Value for C_d

Examine data for ABC Incorporated

- Number of samples **(N) = 6**
- Concentrations of Pollutant X:

$C_d(1)$ = 1.2 mg/L	**$C_d(2)$ = 0.92 mg/L**
$C_d(3)$ = 0.87 mg/L	**$C_d(4)$ = 1.3 mg/L**
$C_d(5)$ = 0.74 mg/L	**$C_d(6)$ = 1.0 mg/L**

- Maximum Observed Effluent Concentration **= 1.3 mg/L**

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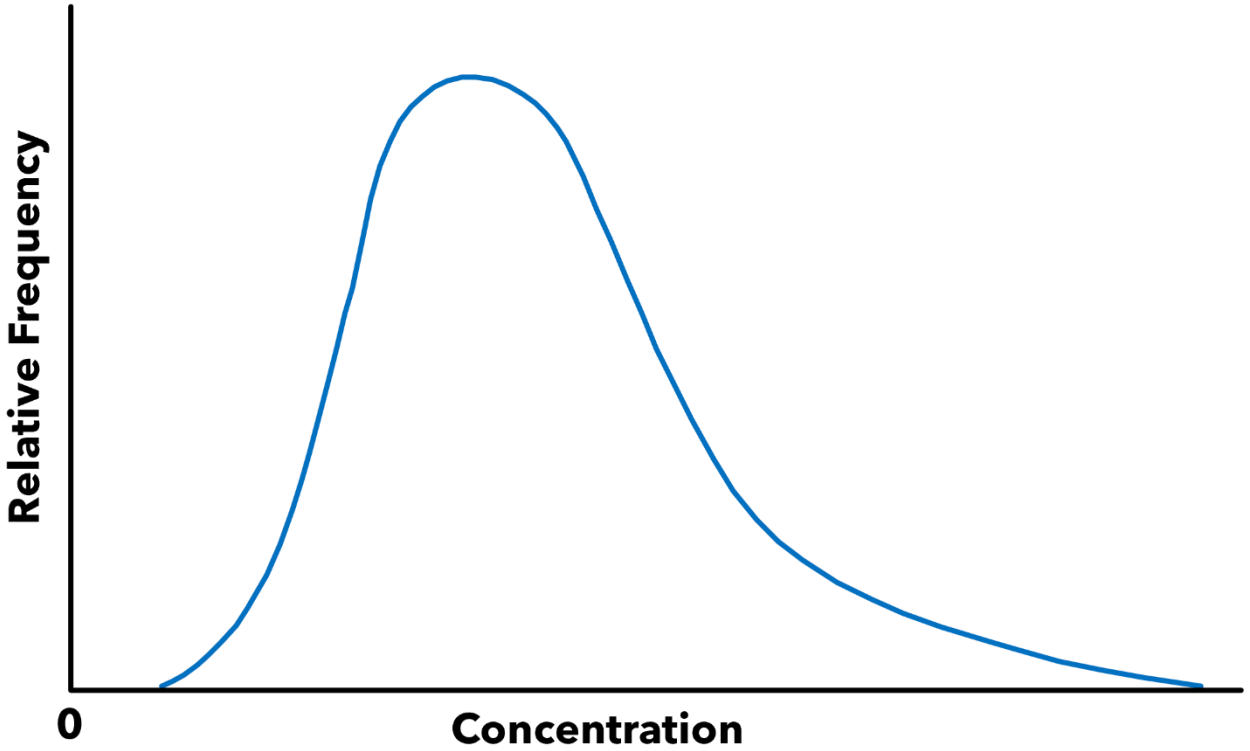
Question: *Would this C_d represent the "critical" condition?*

Follow permitting authority procedures to determine the critical value for C_d

- permitting authority regulation, policy, or guidance
- EPA's *Technical Support Document for Water Quality-based Toxics Control* (TSD)
  - uses a ***statistical analysis***
  - assumes effluent data follow a ***lognormal distribution***

Defining a Lognormal Distribution

EPA facility studies show lognormal distributions of daily pollutant concentrations



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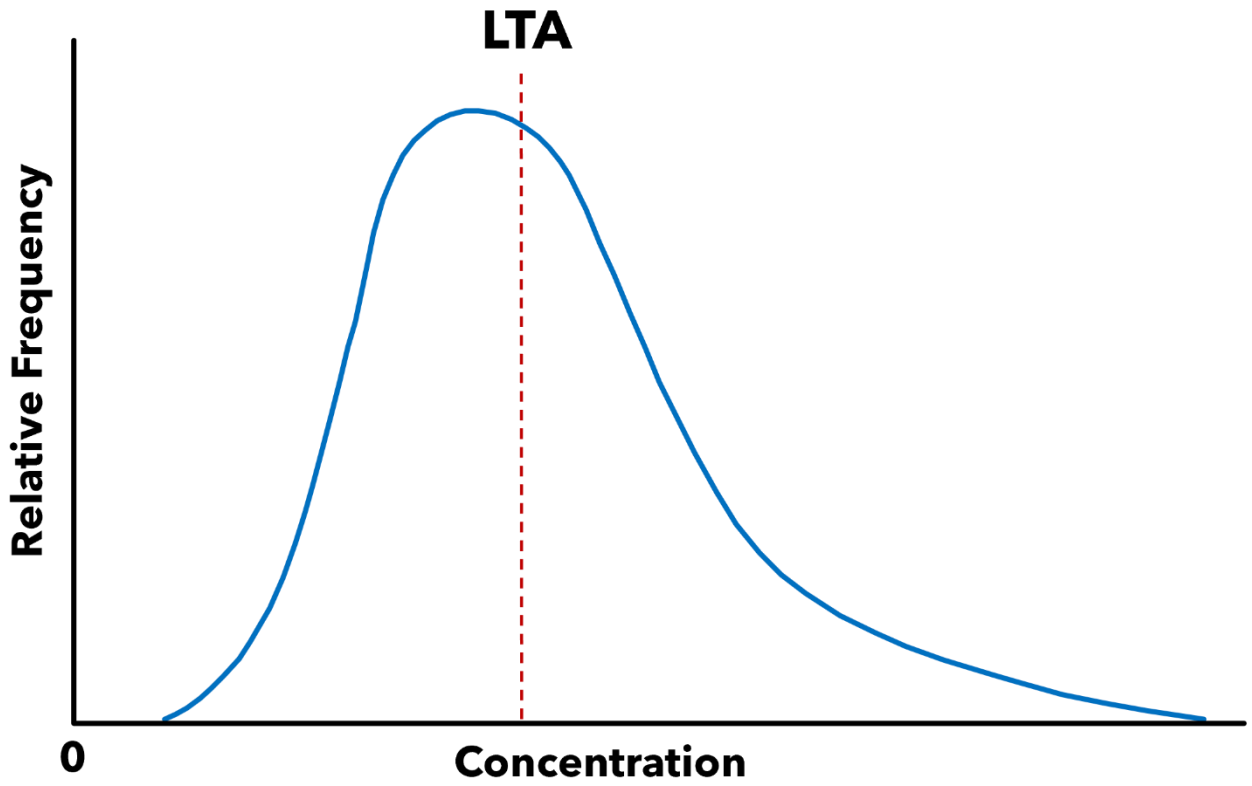

- **Long-term Average (LTA)**: for a continuous random variable, the value at which the area under the distribution curve to the left of the value equals the area under the distribution curve to the right of the value

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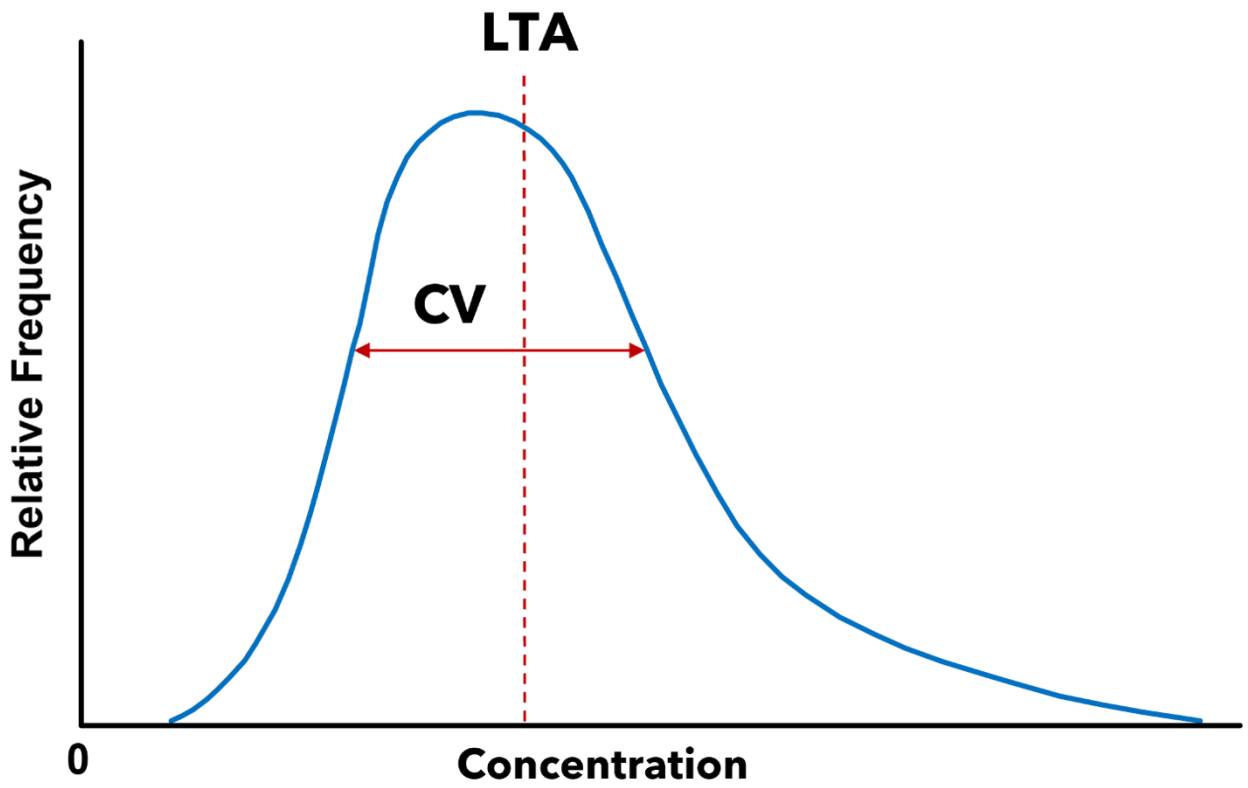

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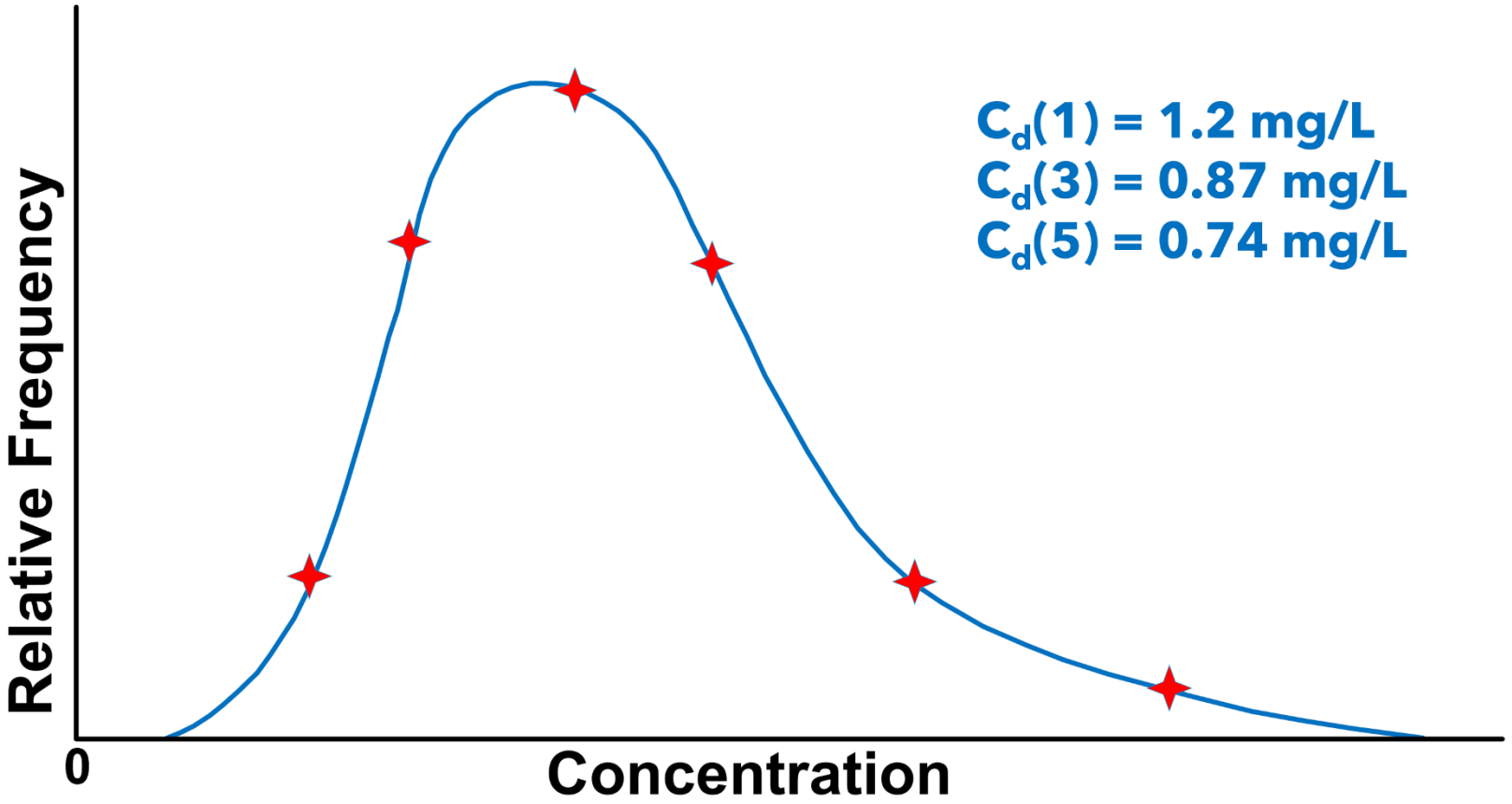
- **Coefficient of Variation (CV)**: a statistical measure of the relative variation of a distribution or set of data calculated as the standard deviation divided by the mean

Lognormal Distribution – Our Data

So, what would a graph of this data look like on a lognormal distribution?



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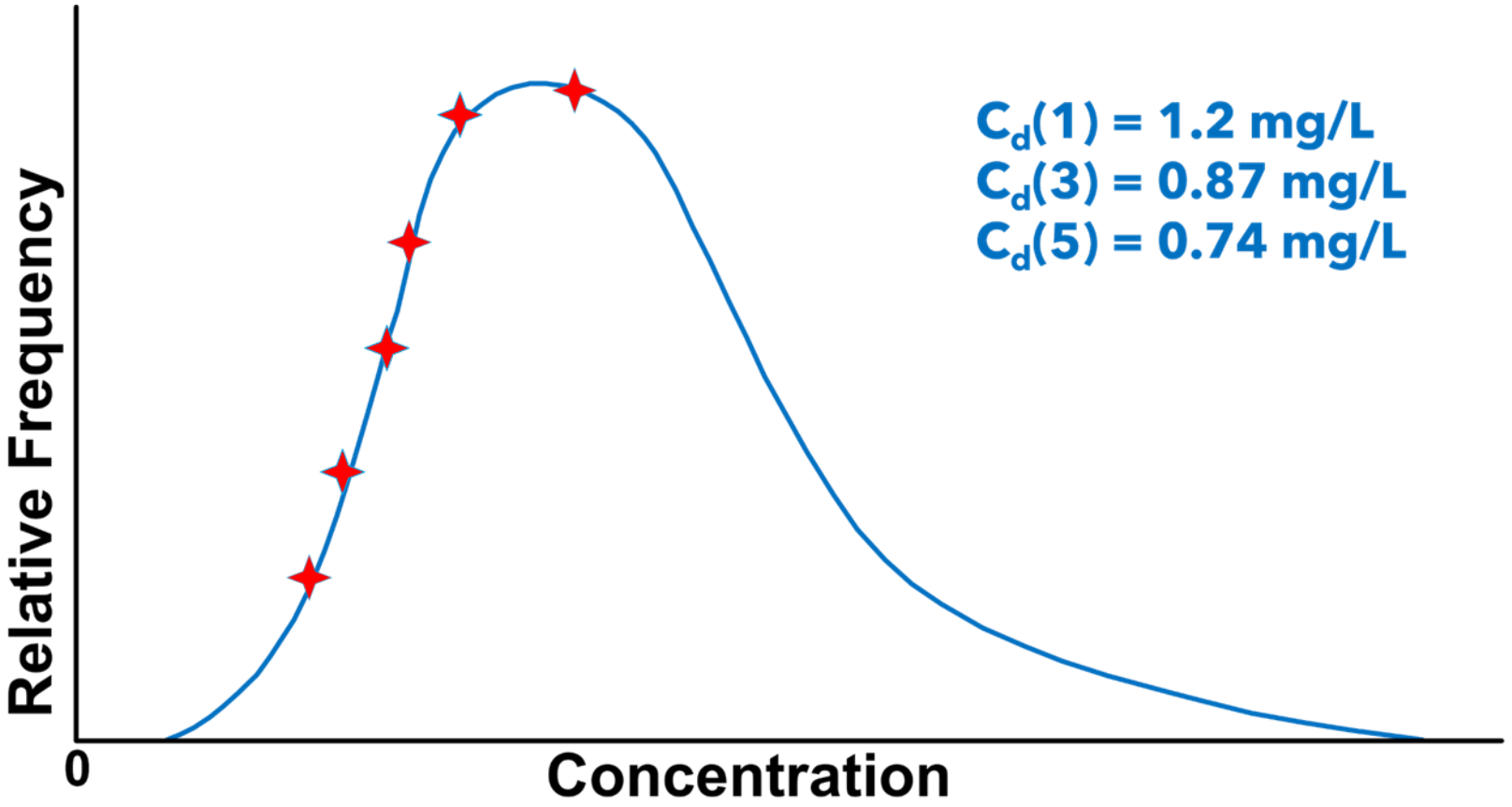

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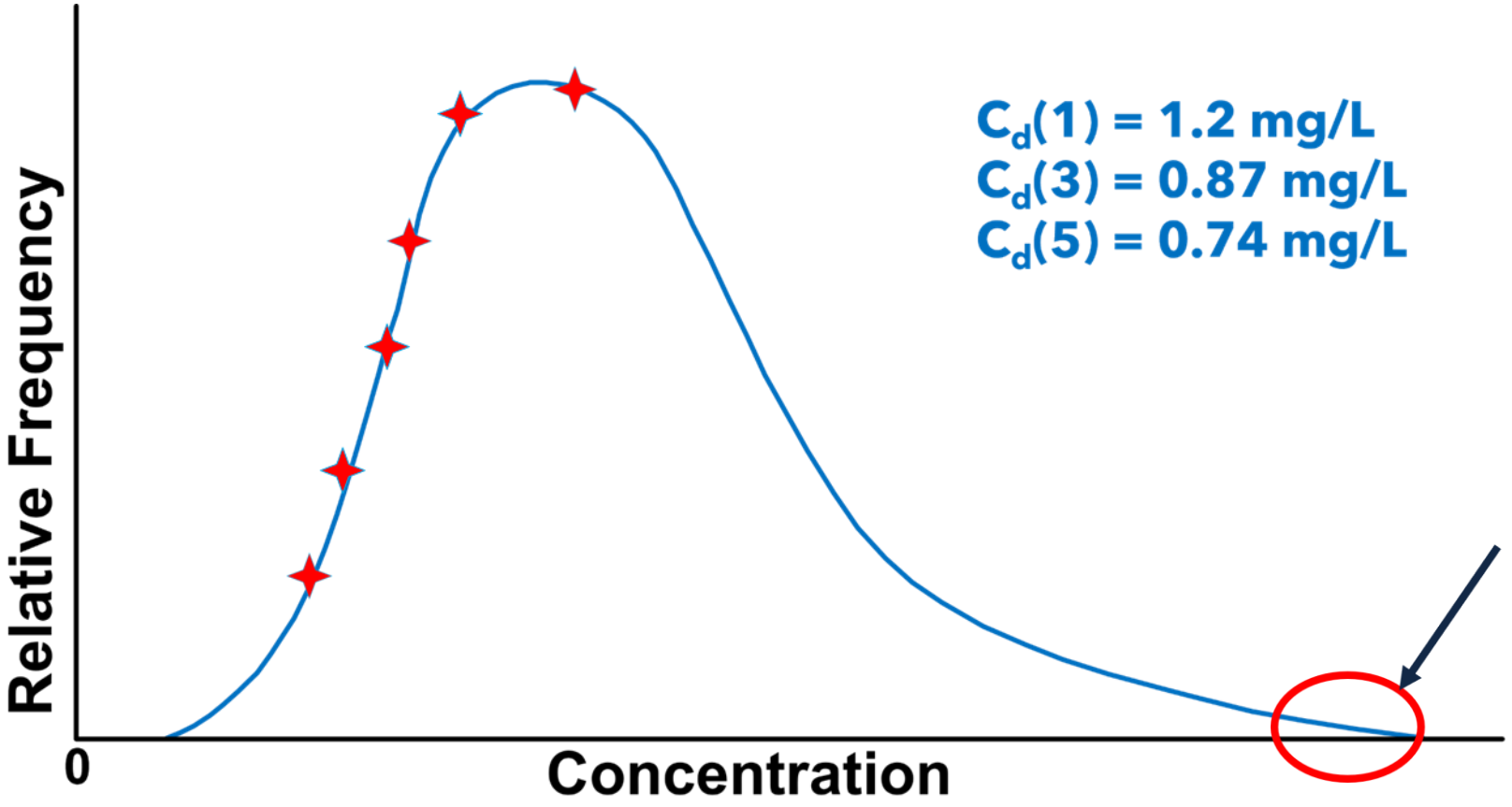

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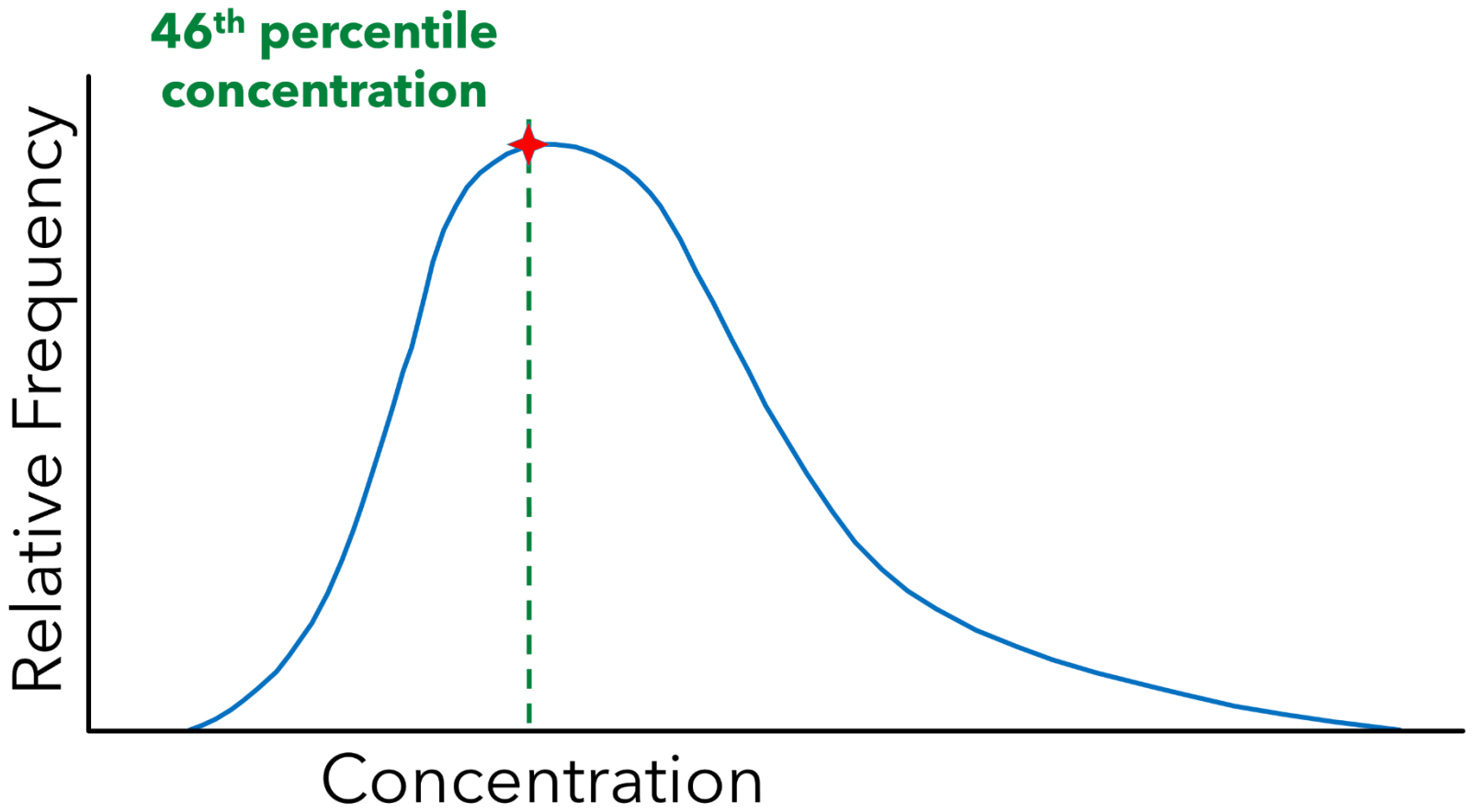
Critical Condition would be out here!

Determining a Critical Value for C_d

Statistics tell us we can be 99% confident:



The **largest** concentration **of 6 measurements** for Pollutant X

Will be greater than or equal to

the ***46th percentile*** of a lognormal distribution of all ABC Inc. effluent pollutant concentrations

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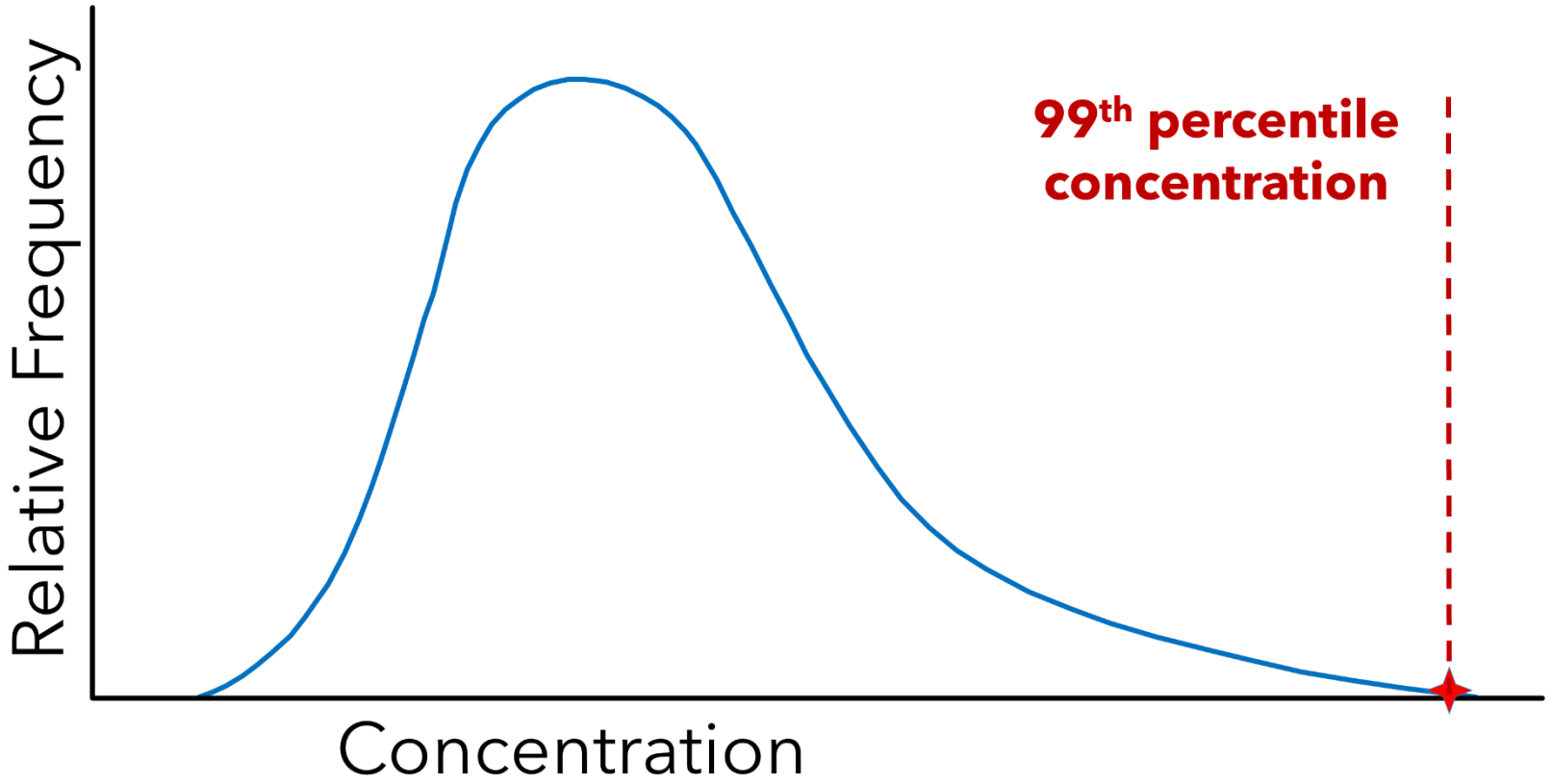


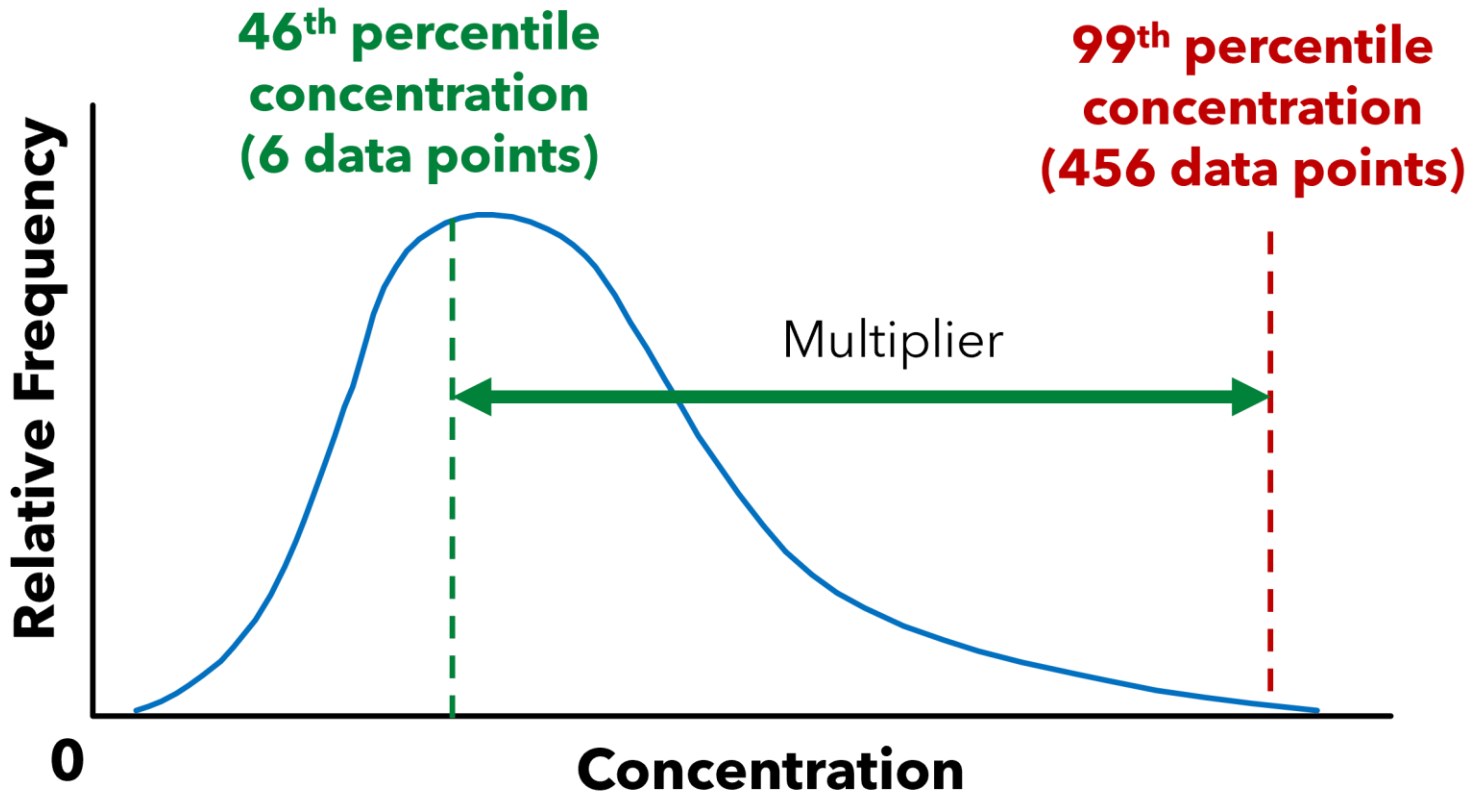
The **largest** concentration **of 456 measurements** for Pollutant X

Will be greater than or equal to

the ***99th percentile*** of a lognormal distribution of all ABC Inc. effluent pollutant concentrations

Determining a Critical Value for C_d

So, using statistics and looking at differences in concentration values between the 46th percentile and the 99th percentile for known data sets, we can come up with a multiplier that can estimate the 99th percentile when we only know the 46th percentile.



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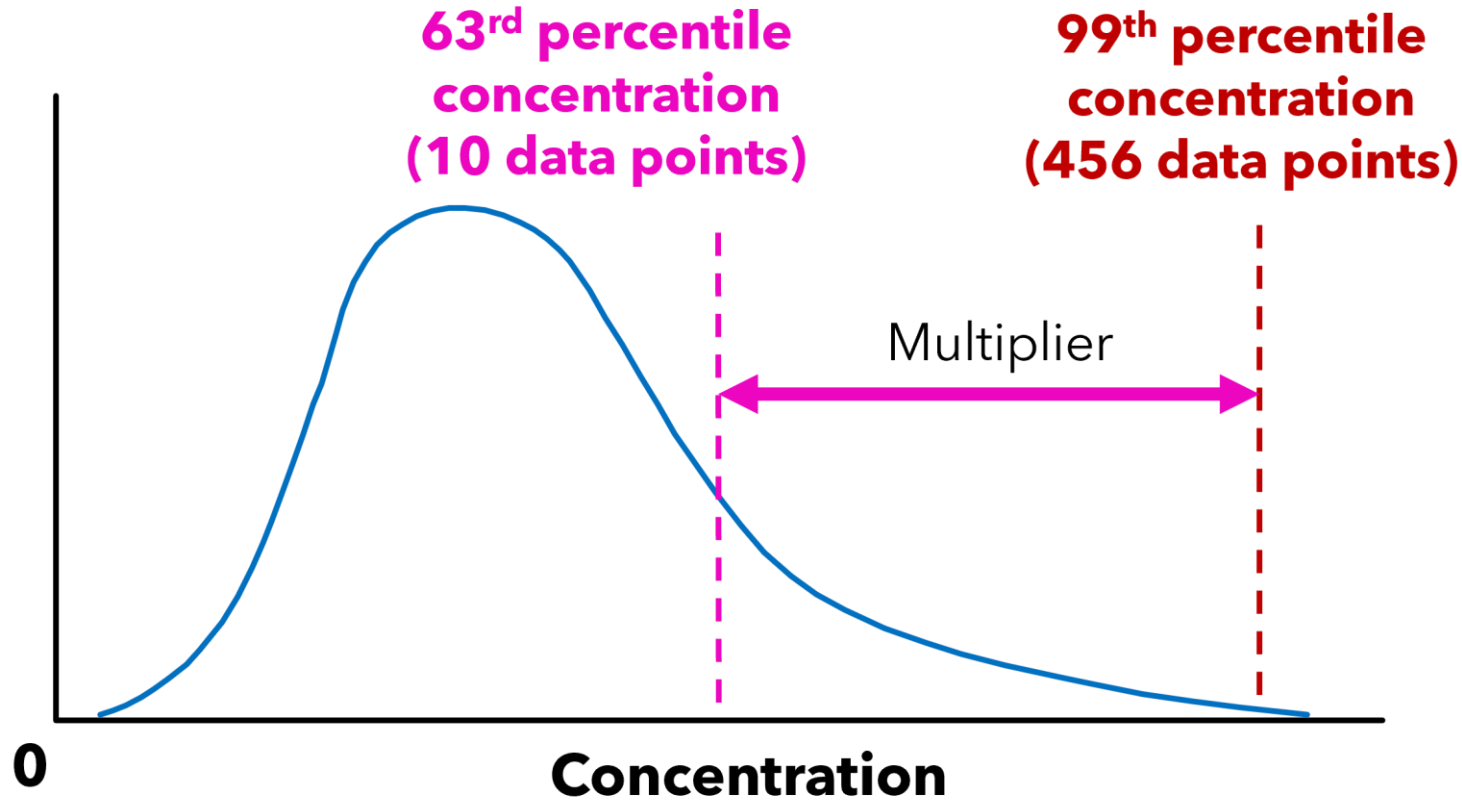

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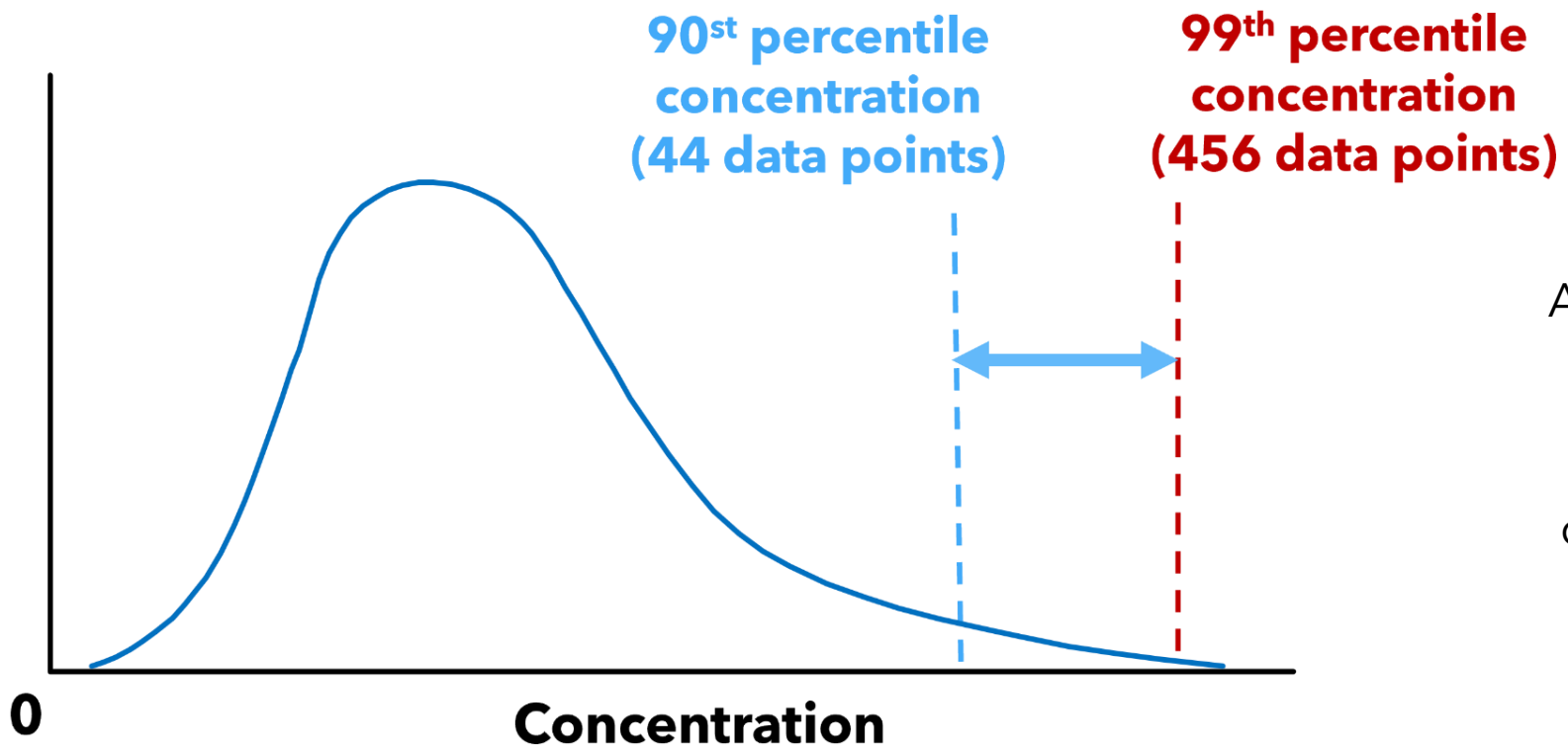
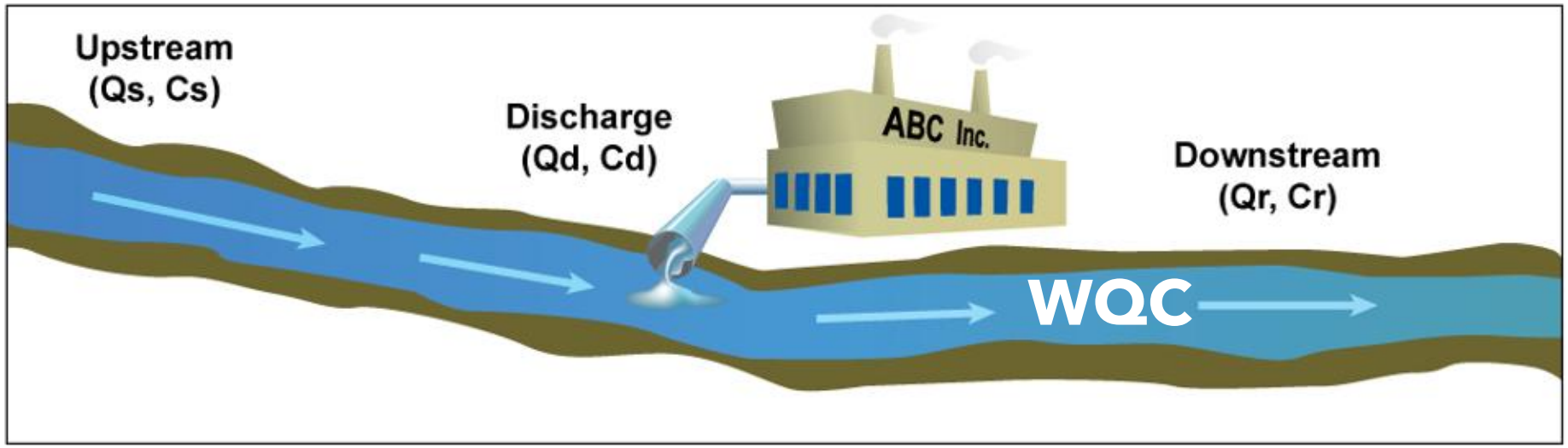


A rule of thumb is that to get to the 90th percentile we need 22-44 samples depending upon our confidence level.

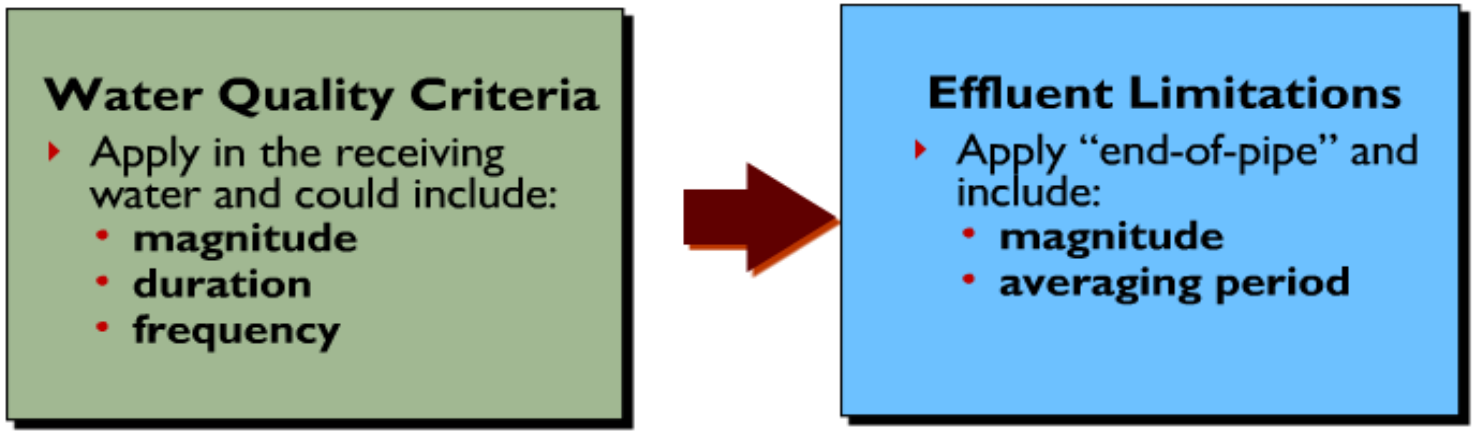
"Is There Reasonable Potential?"



- **Cr <= WQC:** If the projected receiving water concentration is *equal to or less than* the applicable water quality criterion, then there is *no reasonable potential* and we <u>have not demonstrated a need</u> to establish WQBELs.

- **Cr > WQC**: If the projected receiving water concentration *exceeds* the applicable water quality criterion, then there is *reasonable potential* and the permit writer <u>must</u> establish WQBELs.

Step 5: Develop Chemical-Specific WQBELs



- EPA's TSD establishes statistical procedures for calculating maximum daily limits (MDLs) and average monthly limits (AMLs) from Waste Load Allocations (WLAs) derived from acute and chronic aquatic life criteria and human health criteria based on the lognormal distribution.

Magnitude	1.5 ug/L
Duration	1/4/30 days
Frequency	Not more than once in three years

Magnitude	1.2 ug/L
Averaging Period	Maximum Daily Average (MDL) Average Weekly (AWL) Average Monthly (AML)

TSD Process to Develop Chemical-Specific WQBELs

Determine Wasteload Allocations (WLAs)
from applicable WQ criteria for each pollutant (typically acute and chronic aquatic life and human health)

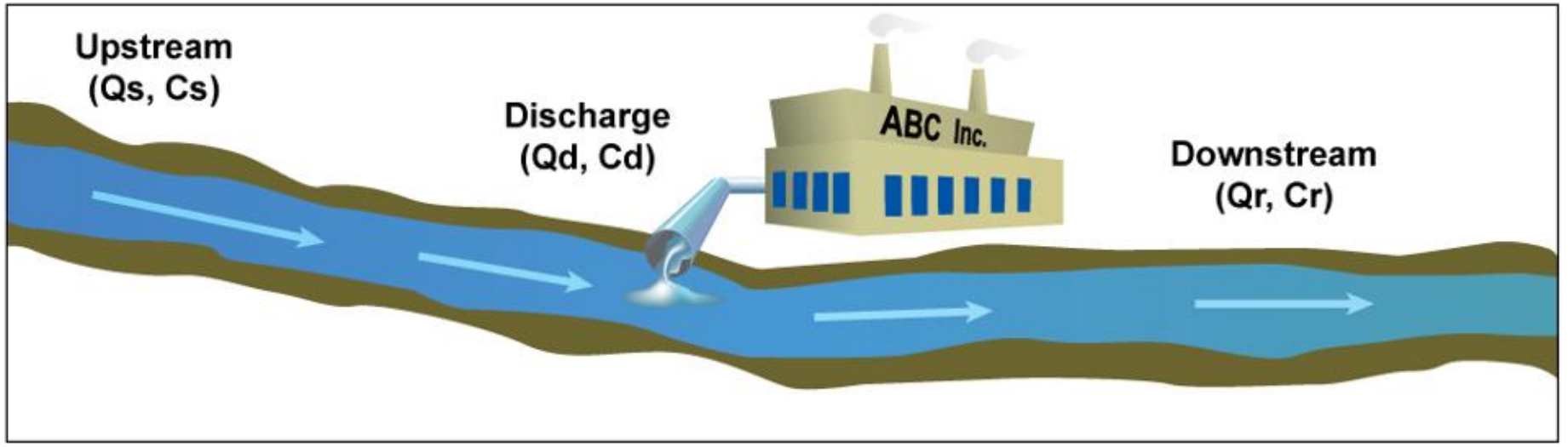
↓

Account for WLA duration and frequency differences by converting each criteria to a Long Term Average (LTA) and then choose lowest (most conservative) value

↓

Use lowest LTA to Calculate Maximum Daily and Average Monthly WQBELs

Determine Wasteload Allocation(s) – Facility-specific WLA

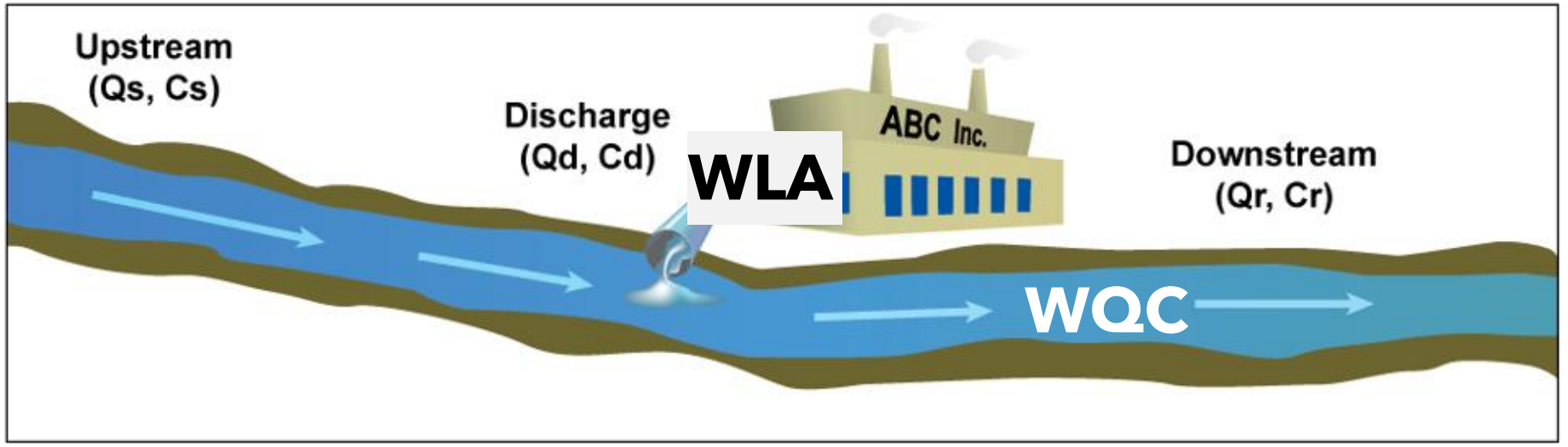


WLA = the maximum allowable pollutant concentration in the effluent from ABC Inc. that, after accounting for available dilution under critical conditions, will ensure an applicable water quality criterion (WQC) will not be exceeded.

$$Q_s C_s + Q_d C_d = Q_r C_r \quad \Rightarrow \quad C_d = \frac{Q_r C_r - Q_s C_s}{Q_d}$$

Mass Balance Equation

Determine Wasteload Allocation(s) – Facility-specific WLA



WLA = the maximum allowable pollutant concentration in the effluent from ABC Inc. that, after accounting for available dilution under critical conditions, will ensure an applicable water quality criterion (WQC) will not be exceeded.

$$Q_s C_s + Q_d C_d = Q_r C_r \Rightarrow WLA = \frac{Q_r WQC - Q_s C_s}{Q_d}$$

Mass Balance Equation

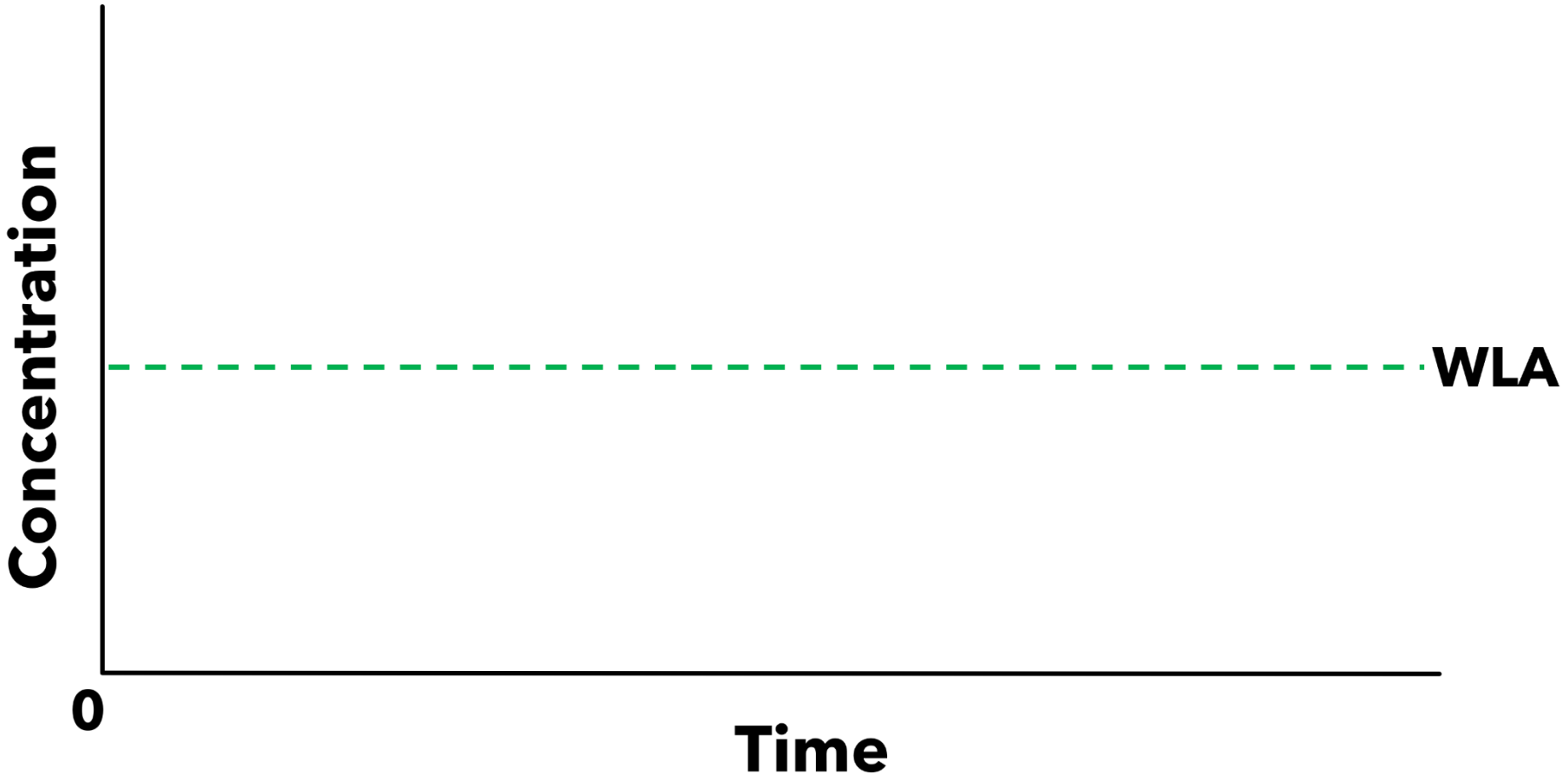
Not there yet! A WLA is Not a WQBEL

WLAs	WQBELs
Derived from water quality criteria through TMDLs, watershed analyses, or facility-specific analyses	Derived from applicable WLAs
Often have the same duration as criteria (e.g., 1-hour average, 4-day average)	Regulations [§ 122.45(d)] require that, for continuous discharges, all effluent limitations shall, ***unless impracticable***, be stated as • MDLs and AMLs for non-POTWs • AWLs and AMLs for POTWs

Next, convert the WLA pollutant concentration to a facility Long Term Average (LTA) concentration to derive WQBELs

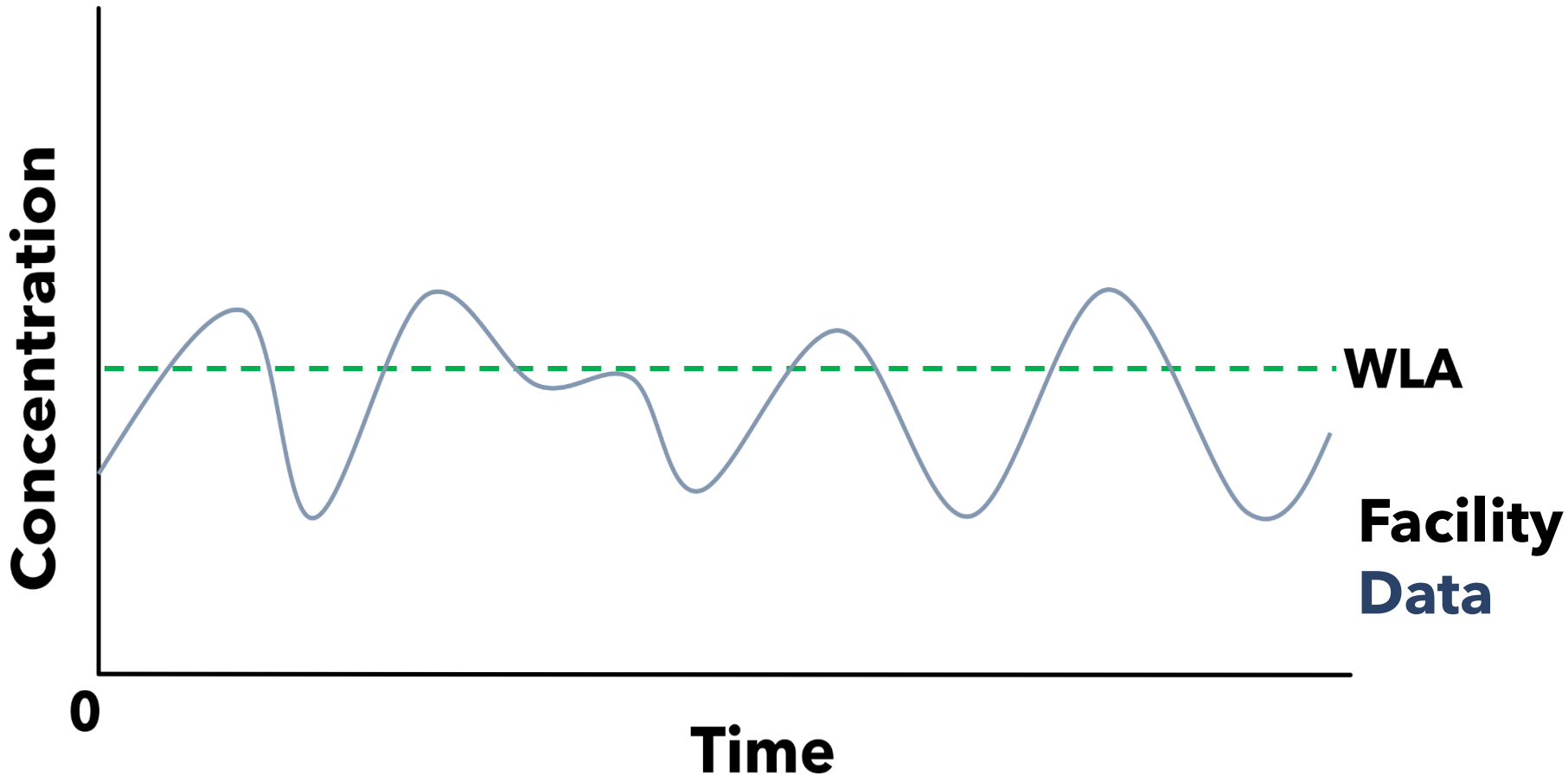
Account for WLA duration and frequency

Deriving the Facility Long Term Average (LTA) Pollutant Concentration Based on the WLA



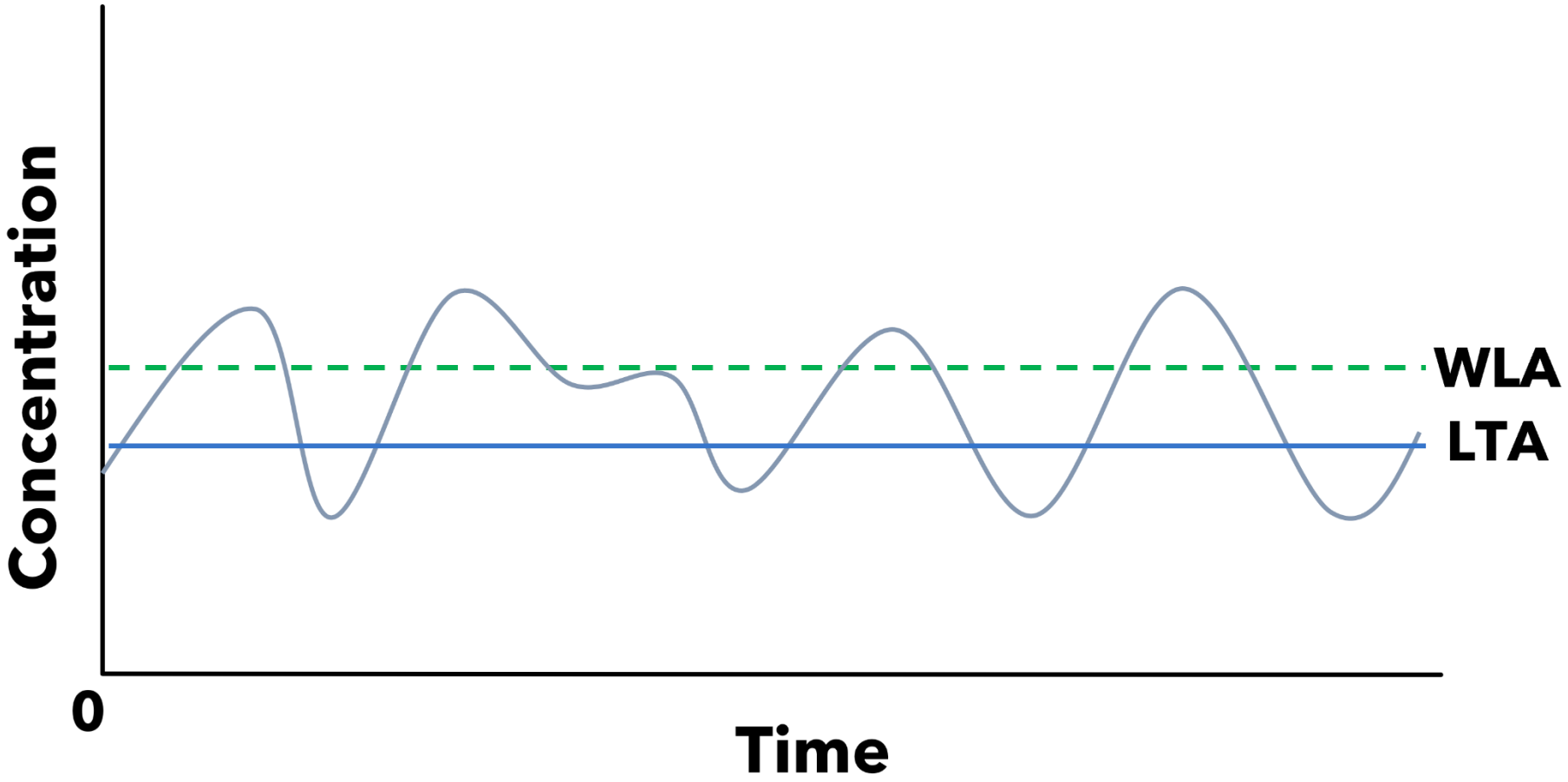
Account for WLA duration and frequency

Deriving the Facility Long Term Average (LTA) Pollutant Concentration Based on the WLA



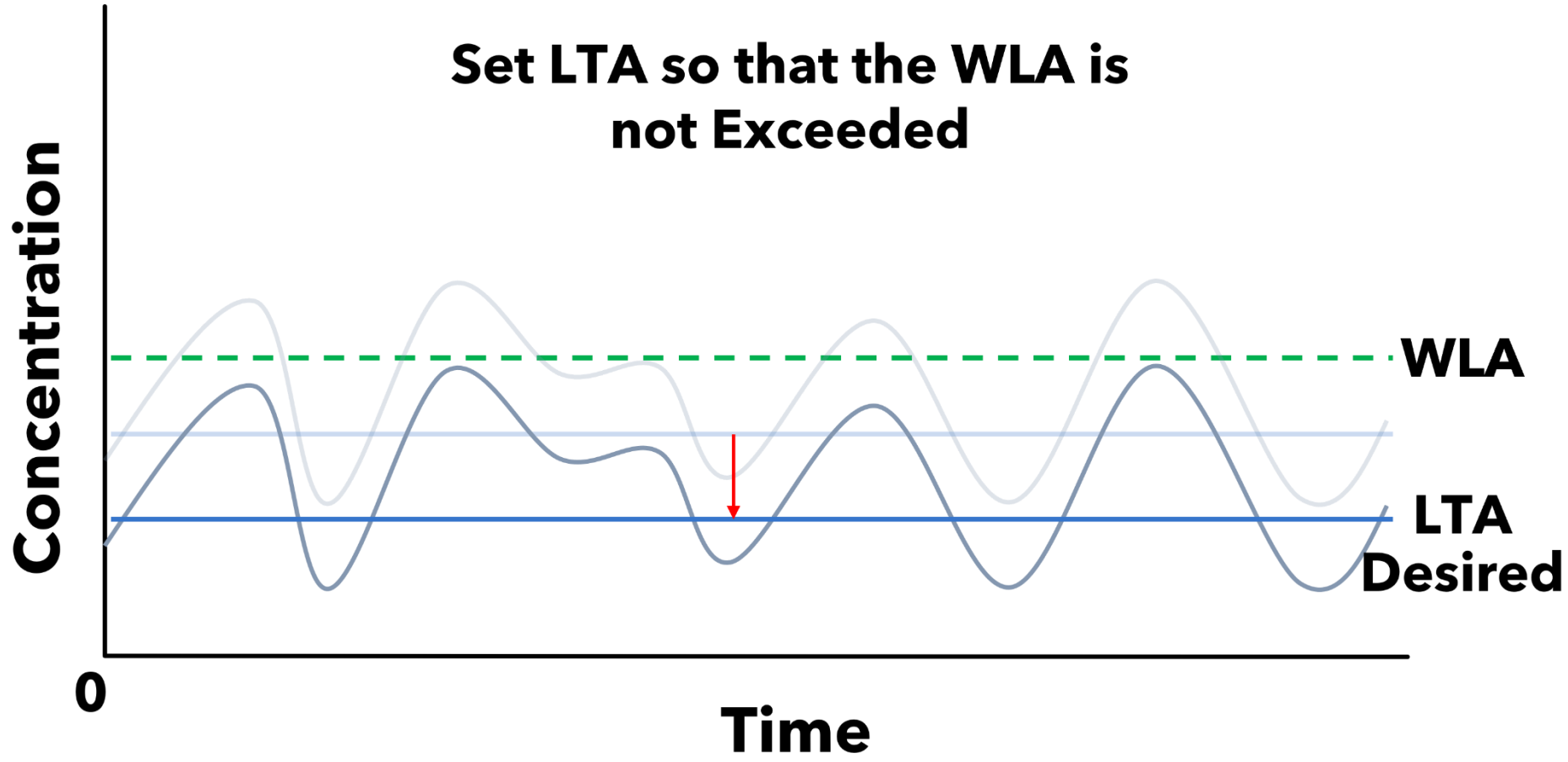
Account for WLA duration and frequency

Deriving the Facility Long Term Average (LTA) Pollutant Concentration Based on the WLA

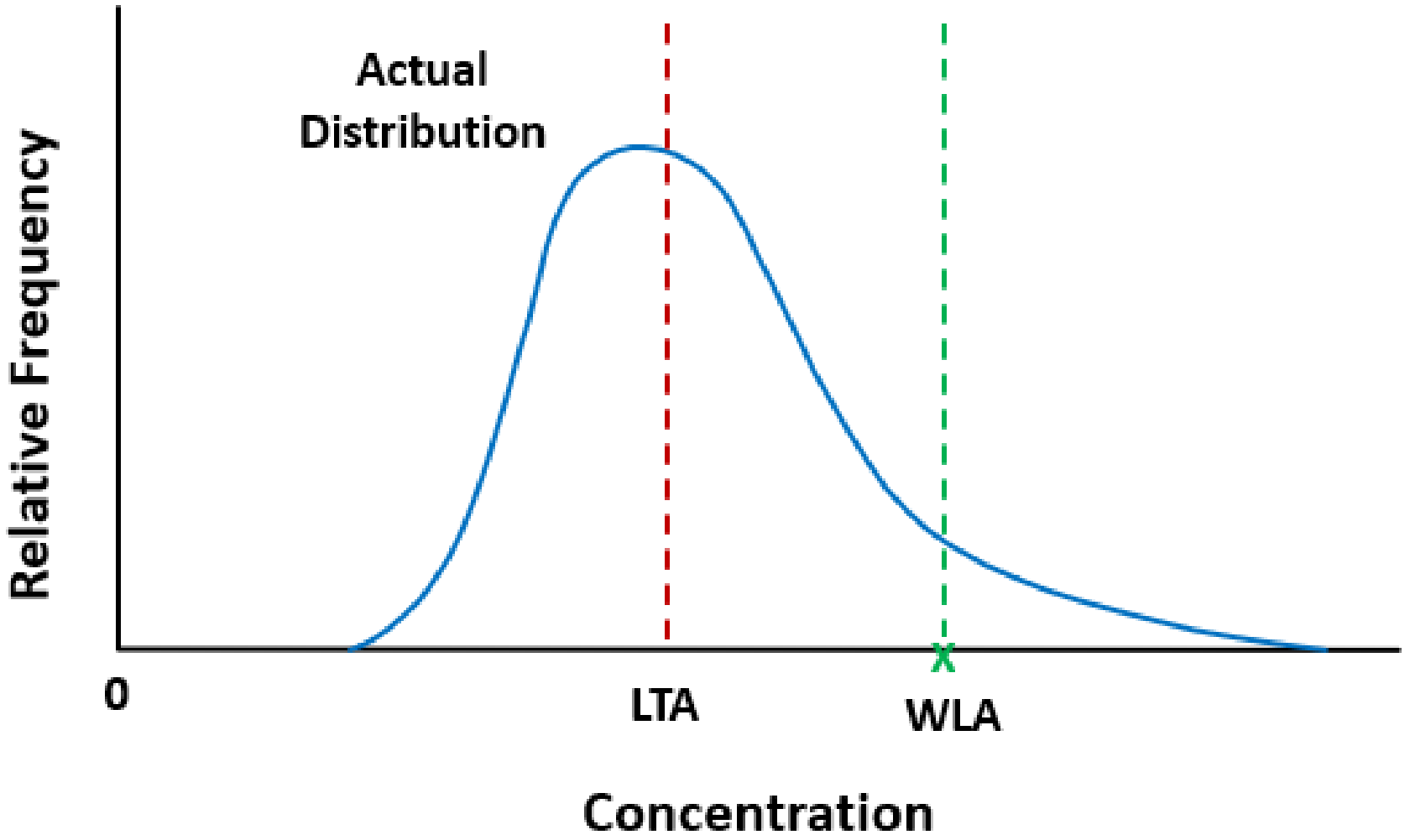


Account for WLA duration and frequency

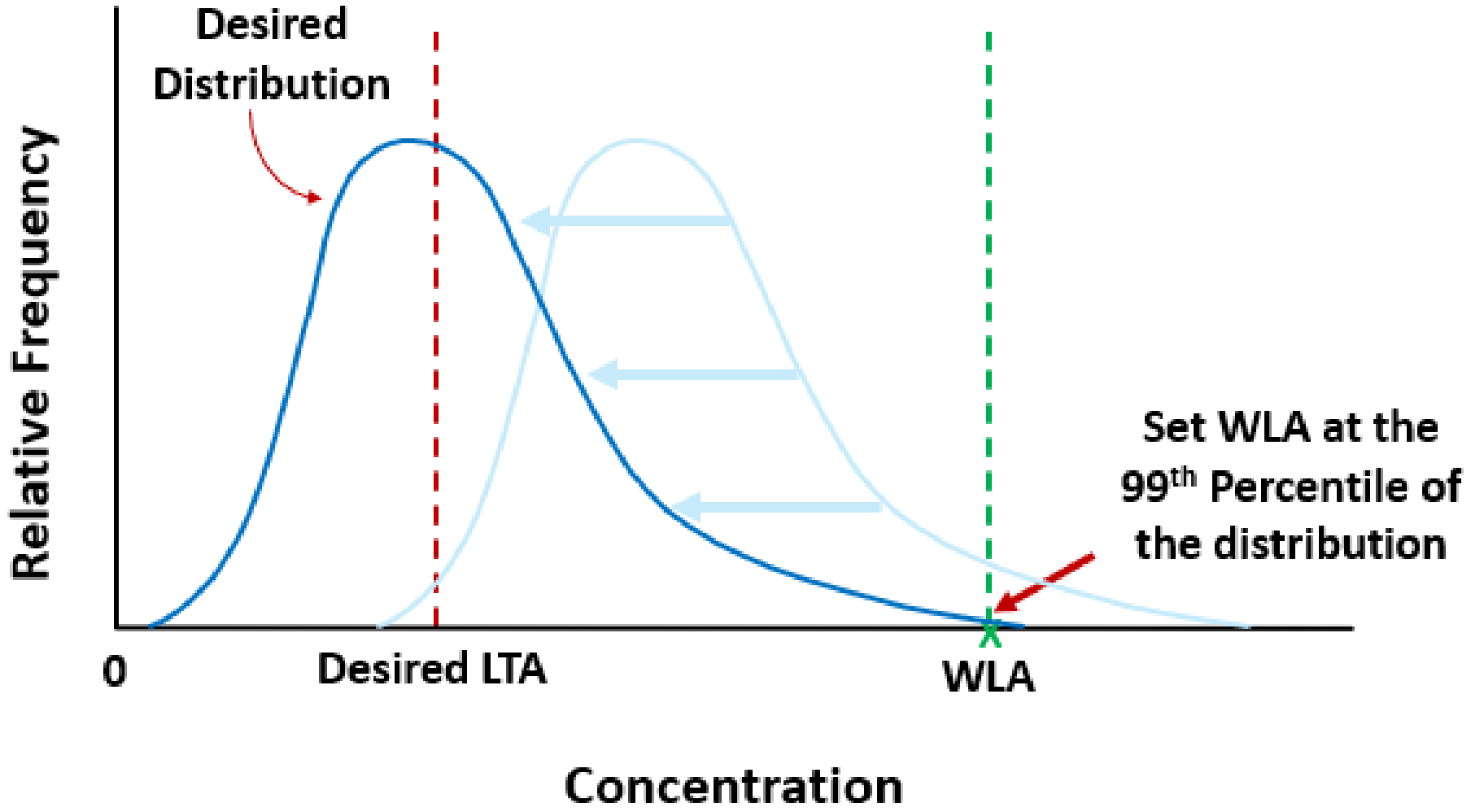
Deriving the Facility Long Term Average (LTA) Pollutant Concentration Based on the WLA



Characterize the Desired Distribution by LTA and CV



Characterize the Desired Distribution by LTA and CV



Calculate MDL and AML WQBELs

- Use the statistical process to calculate the Maximum Daily Average Limits and Average Monthly Limits from the lowest LTA
- EPA's TSD procedure:
  - Assumes lognormal distribution
  - uses upper-bound estimates for both MDL and AML (like effluent guidelines)
    - MDL set at 99th percentile
    - AML set at 95th percentile
- State procedures vary widely but must account for factors in 122.44(d)(1)(ii) [variability of the effluent, etc.] and comply with all applicable water quality standards.

Considerations for Other Parameters

Remember the TSD was developed for toxic pollutants and for pollutants that do not "follow" a lognormal distribution, we typically use other pollutant specific procedures as developed by the permitting authority.

pH

- Non-conservative
- Instantaneous effects
- Limits often based directly on water quality criteria with no consideration of dilution
- Typically applied as a range that must be met at all times

Pathogens

- Non-conservative
- Bacteria, viruses
- Human health impacts (beaches)
- Indicator criteria
- Complex duration and frequency considerations

Nutrients

- Non-conservative
- Limits often derived from interpretation of narrative criterion and state policy implementation
- Relationships between causal and response variables (e.g., far-field effects and delayed impacts)
- Limit expression might include annual or seasonal averages or cumulative loading requirements

Temperature

- Non-conservative
- Often applied as:
  - maximum temperature on a seasonal basis and
  - a delta or rate of change limitation
- Modeling is typically required
- CWA Section 316(a) may be applicable

Final Effluent Limits

- Compare:
  1) WQBELs based on WLAs for all applicable criteria *with*
  2) TBELs or other existing limitations *with*
  3) WQBELs based on a TMDL or other watershed-based requirements
- The final effluent limitations must protect all applicable technology and water quality standards…for practical purposes, this is generally the most stringent limitation from the comparison
  - when variances or compliance schedules for water quality are authorized, the permit writer must ensure technology standards are not exceeded.
- Final effluent limitations in the permit must meet ***anti-backsliding*** and ***antidegradation*** requirements.
  - Anti-backsliding – proposed limits cannot be less stringent than any previous limit imposed in an NPDES permit unless certain criteria are met.
  - Antidegradation – new or increased discharges must meet certain criteria to be allowed.

For Additional Information:

- National Pollutant Discharge Elimination Program (NPDES):
  - https://www.epa.gov/npdes
- NPDES Permit Writers' Manual
  - https://www.epa.gov/npdes/npdes-permit-writers-manual
- NPDES Permit Writers' Course:
  - https://www.epa.gov/npdes/npdes-training
    - 5 Week Virtual courses held 4 times a year and 2 In-person courses held in the summer (Check website for scheduled courses)
    - Web training: "Recorded Webinars and Training" tab

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