NPDES PERMITTING COURSE FOR PERMITTEES – PART II

Imposition of NPDES Permit Effluent Limitations

Clean Water Professionals of Kentucky and Tennessee

by
Gary B. Cohen and Bill Hall
Hall & Associates
Washington, D.C.
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BASIS FOR PERMIT EFFLUENT LIMITATIONS

- **Usually Two-Types of Effluent-Limits**

  - Technology-Based Effluent Limits (TBELs)

  - Water Quality-Based Effluent Limits (WQBELs)

- **BUT:**

  - NJ: EEQ (Existing Effluent Quality)

  - TN: Antidegradation-Based

OBJECTIVES

PERMITTING AGENCY	PERMITTEE
1. Protection of Environment	Protection of the Environment in a Cost-Effective Manner
2. Expeditious and Non-adversarial Permitting	Expeditious and Non-adversarial Permitting
3. Cost of Compliance but secondary to #2	Cost of Compliance – Primary to #2.
4. Understaffed/Overworked with Limited Resources	Minimize Risk of Noncompliance

TBELs

- Effluent Limits Applicable to a Category or Class of Discharges Based Upon the Technology Available to Treat the Pollutants.
- CWA Goal: Zero Discharge
- Can be More or Less Stringent than the Level Necessary to Protect the Receiving Water
- Some Have Described it as "Treatment for Treatment Sake."

SECONDARY TREATMENT STANDARDS FOR MUNICIPAL DISCHARGERS

Parameter	30-Day Average	7-Day Average
$BOD_5/CBOD_5$	30/25 mg/L	45/40 mg/L
TSS	30 mg/L	45 mg/L
pH	Range: 6.0 – 9.0	
Percent Removal	85% (monthly average) for BOD_5/TSS	

SECONDARY TREATMENT ADJUSTMENTS

- **Adjustment of BOD/TSS Limits Based Upon Significant Industrial Influent**

- **Adjustment of Percent Removal Based Upon Dilute Influent**

- **Equivalent-to-secondary limits:**
  - Up to 45 mg/l (30 day average)
  - Up to 65 mg/l (7 day average)
  - Not less than 65% removal

INDUSTRIAL FACILITIES

- Effluent Limitation Guidelines (ELGs)
  - BPT: Best Practicable Control Technology Currently Available
  - BCT: Best Conventional Pollutant Control Technology
  - BAT: Best Available Control Technology Economically Achievable
  - NSPS: New Source Performance Standards
- Best Professional Judgment (BPJ)
- Direct Discharger vs Indirect Discharger

POTENTIAL INCREASED STRINGENCY UNDER ELGs

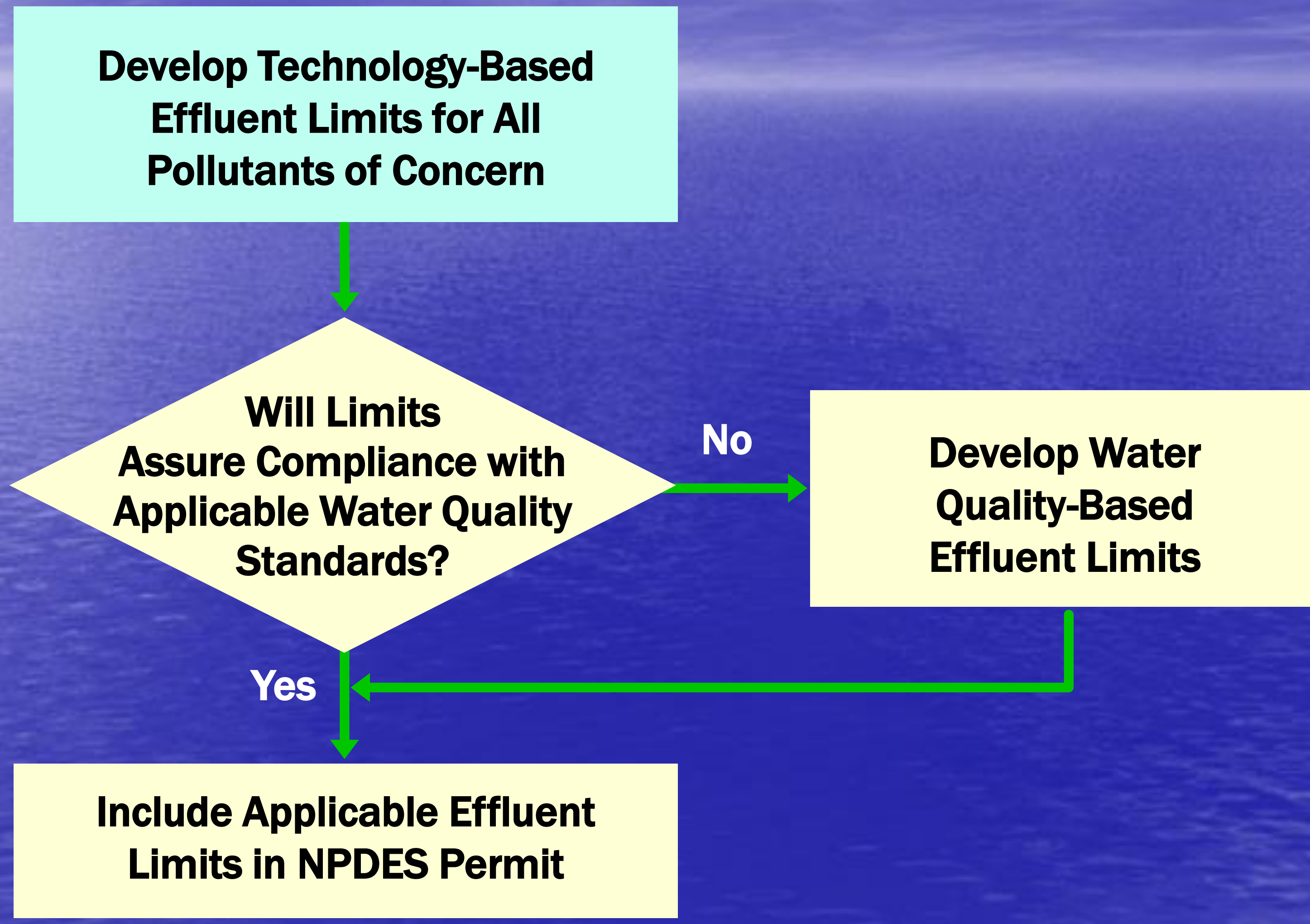
NSPS: New Source Performance Standards

BCT: Best Conventional Pollutant Control Technology

BAT: Best Available Control Technology Economically Achievable

BPT: Best Practicable Control Technology Currently Available

TYPICAL EFFLUENT LIMITATION DEVELOPMENT



WHEN IS A WQBEL REQUIRED?

- Reasonable Potential Test – 40 CFR § 122.44(d) or State Standard

- Limitations Must Control Pollutants or Pollutant Parameters (Either Conventional, Nonconventional, or Toxic Pollutants) That Are or May be Discharged <u>at a Level Which Will Cause, Have the Reasonable Potential to Cause, or Contribute</u> to an Excursion Above any State Water Quality Standard, including State Narrative Criteria for Water Quality. [§ 122.44(d)]

- Cause or Contribute is Not a Prohibition!

- Permit Limit May be Numeric or Best Management Practice (BMP)

FACTS PREEMPT ASSUMPTIONS

- Potential Concern: You Know What They Say When Someone "Assumes"
- Assumptions Result in More Stringent Permit Limits than Necessary to Protect Water Quality
- Who Do You Think Will Likely Be Tracking Down the Facts to Dispel Inappropriate Assumptions?

Who has the Greater Interest?

NO WQBEL REQUIRED

- No Reasonable Potential = No WQBEL.
- So no Effluent Limitation Unless TBEL.
- Would This be Good News to the Permittee?
  - In the Newly Reissued NPDES Permit?
  - What About Future Reissued NPDES Permits?

TDEC ANTIDEGRADTION EFFLUENT LIMITS

- **Future Permit Providing for Increased Discharges Triggering Antidegradation**
- **Applies to Degradation Above *De Minimis* Levels**
- **If Permit Limit, Antidegradation Decision Based on Pre-Expansion Permitted Levels**
- **BUT, if no Permit Limit, Antidegradation Based on Pre-Expansion Actual Discharge Levels**

EXAMPLE ANTIDEGRADTION EFFLUENT LIMITS

- Actual Discharge of copper at 20 mgd = 2O ug/l.
- No Reasonable Potential = No WQBEL (and no TBEL)
- Calculated WQBEL for Copper Would Have Been 100 ug/l.
- Seeking Facility Expansion to 30 mgd.
- Would Still be no Reasonable Potential.
- But Antidegradation Based Upon Loadings at 20 ug/l Plus De Minimis Increase = 14 ug/l.
- Should Permittee:
  - Request Otherwise Unnecessary Permit Limits?
  - Provide Justification Based Upon Important Economic or Social Development?

WQBELs

- Objective: Ensure Compliance with Designated Uses by Meeting Water Quality Criteria for Aquatic Life Uses, Recreation, Water Supply, Etc.
- Assumption: If Water Quality Criteria are Achieved In-stream, Uses are Protected.
- WQC: Magnitude, Duration, Frequency
- WQBELs are Often Developed for Critical Conditions. If Objective is Achieved for Critical Conditions, it Will be Achieved for All Other Conditions.

PARAMETERS OF CONCERN

- Metals: Copper, Zinc, Lead, Mercury
- Organics: Volatiles/Non-Volatiles, PCBs, Disinfection Byproducts
- Ammonia-nitrogen
- Whole Effluent Toxicity (WET)
- Salts: Chloride, Sulfate, Conductivity, etc.

WATER QUALITY-BASED EFFLUENT LIMITS

- **Simple Mass Balance Equation**

$$C_s\left(Q_e + D_f Q_b\right) = C_e Q_e + C_b D_f Q_b$$

Where:

C_s = Water Quality Criterion (µg/L)
C_e = Effluent Limit (µg/L)
C_b = Background Concentration (µg/L)
Q_e = Effluent Flow (MGD)
Q_b = Receiving Water Flow (MGD)
D_f = Dilution Factor (decimal)

WATER QUALITY-BASED EFFLUENT LIMITS

- **Solving for Waste Load Allocation**

$$C_e = {\left(C_s\left[Q_e + D_f Q_b\right] - C_b D_f Q_b\right)}\Big/{Q_e}$$

POTENTIAL ASSUMPTIONS OF CONCERN

- Default Values in WQBELs
- Toxic Fraction
  - Total Recoverable (Very Conservative)
  - Dissolved Fraction (Better, But Still Conservative)
  - Water Effect Ratio
  - Biotic Ligand Model (BLM)
- Steady-State vs Drifting Organism
- Non-Detects in Permit Application: Assumption that Discharge Occurs at Detection Level

WATER QUALITY CRITERION

- Is it a Fixed Concentration?
  - Yes (e.g., Chlorine) – Use Criteria Directly in Simple Mixing Equation
  - No (e.g., Copper – Dependent upon Other Factors – pH, Dissolved Organic Carbon, Hardness, Other Cations and Anions) – Requires Further Analysis
  - No (e.g., Ammonia-nitrogen – Dependent upon pH, Temperature, Presence of Early Life Stages, Presence of Sensitive Mussels or Salmonids) – Seasonal Analysis Required
- Acute Criterion (toxicity); Chronic/Human Health (Growth, Reproduction, Health Effects)

CRITICAL RECEIVING WATER FLOW

- Harmonic Mean – Carcinogens (Criteria Based on 70-year Exposure)
- 7Q10 – Most Acute and Chronic Criteria
- 30Q10 – Ammonia-nitrogen (Chronic Criterion – 30-day Average Concentration); Human Health Parameters
- 1Q10 – May be Appropriate for Acute Criteria if Parameter is a Fast-Acting Toxicants (Most Toxicants are not Fast Acting)

Stream Flows Change with Time. Check for Fundamental Changes due to Changes in Hydrology (Impoundments, Tile Drains)

SEASONAL FLOWS

- What if Criteria differ during Seasons?
- Example: Ammonia (Criterion is a Function of pH, Temperature, Life Stage)
- Critical Flows Can be Based Upon Seasons

In other words, Permit Writer can use a Higher Winter Critical Flow to Avoid having Overly Stringent Winter Limits based upon Critical Low Flow during the Summer.

DILUTION FACTOR

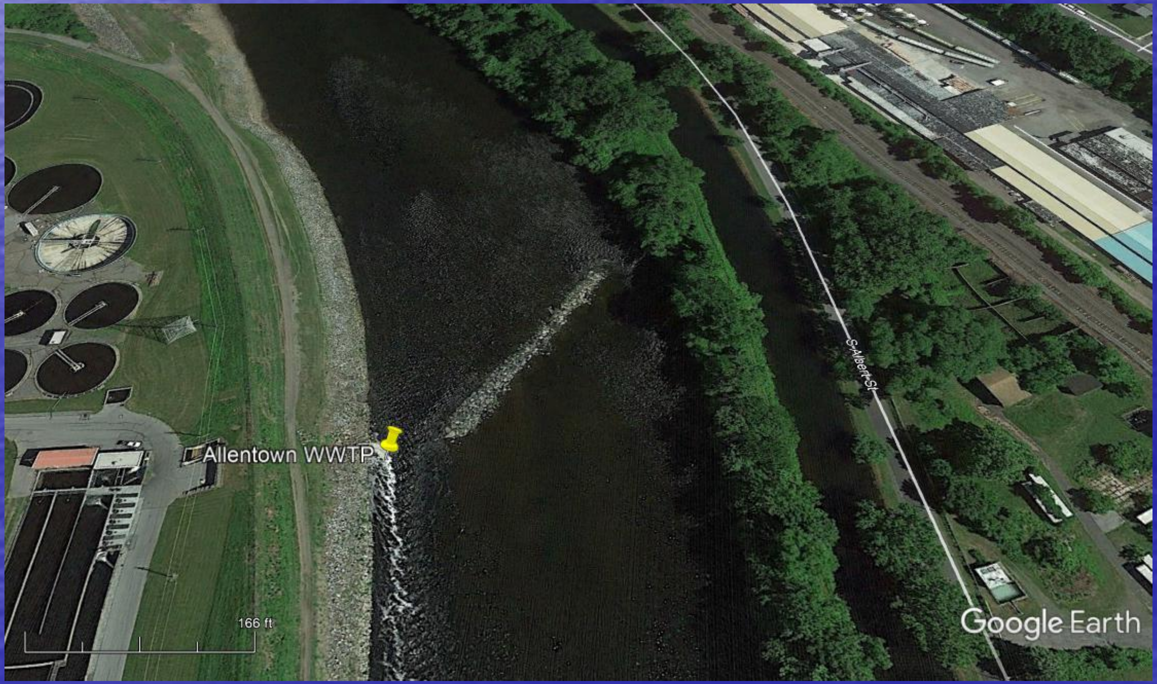
- Evaluated in Zone of Initial Dilution (ZID) and Edge of Regulatory Mixing Zone
- Acute Criteria – Applied at Edge of ZID or Evaluated as Average Exposure for 1-hour Drift
- Chronic Criteria – Applied at Edge of Regulatory Mixing Zone
- Seasonal Effects?

Options for Improving Dilution Factor

DILUTION FACTOR

Options for Increasing Dilution Factor

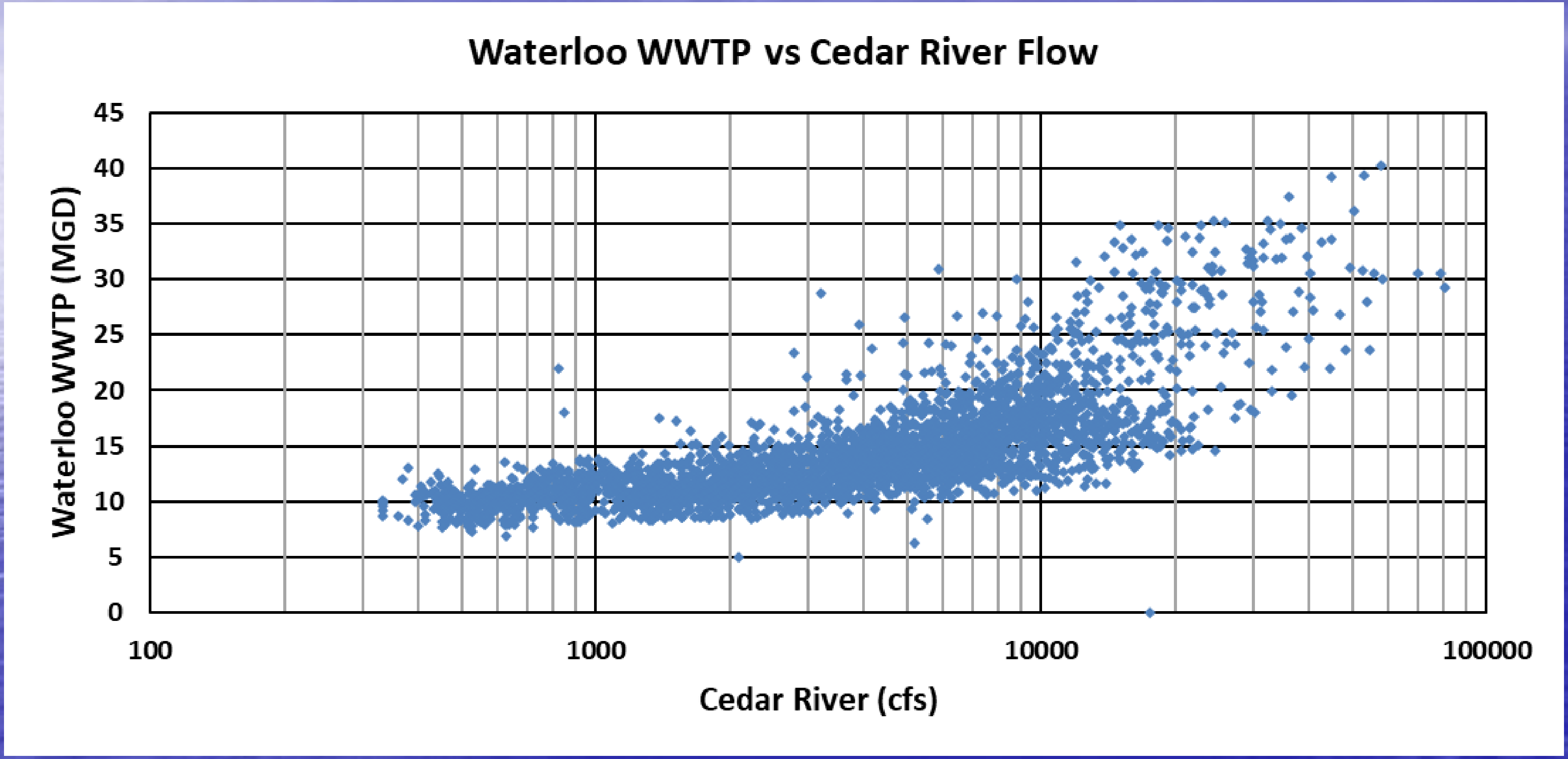
1. Do a Dye Study – Confirm Actual Dilution
2. Install a Diffuser
3. Bring Flow to Outfall (Under Design Conditions)



EFFLUENT FLOW

- Typically use Design Flow
- Other Considerations
  - Wet Weather versus Dry Weather
  - How does Facility Flow vary with Stream Flow?
- Tiered Permit Limits Based Upon Different Plant Flows
  - Current Flow << Design Flow
- Issue With Mass-Based Limits

EFFLUENT FLOW



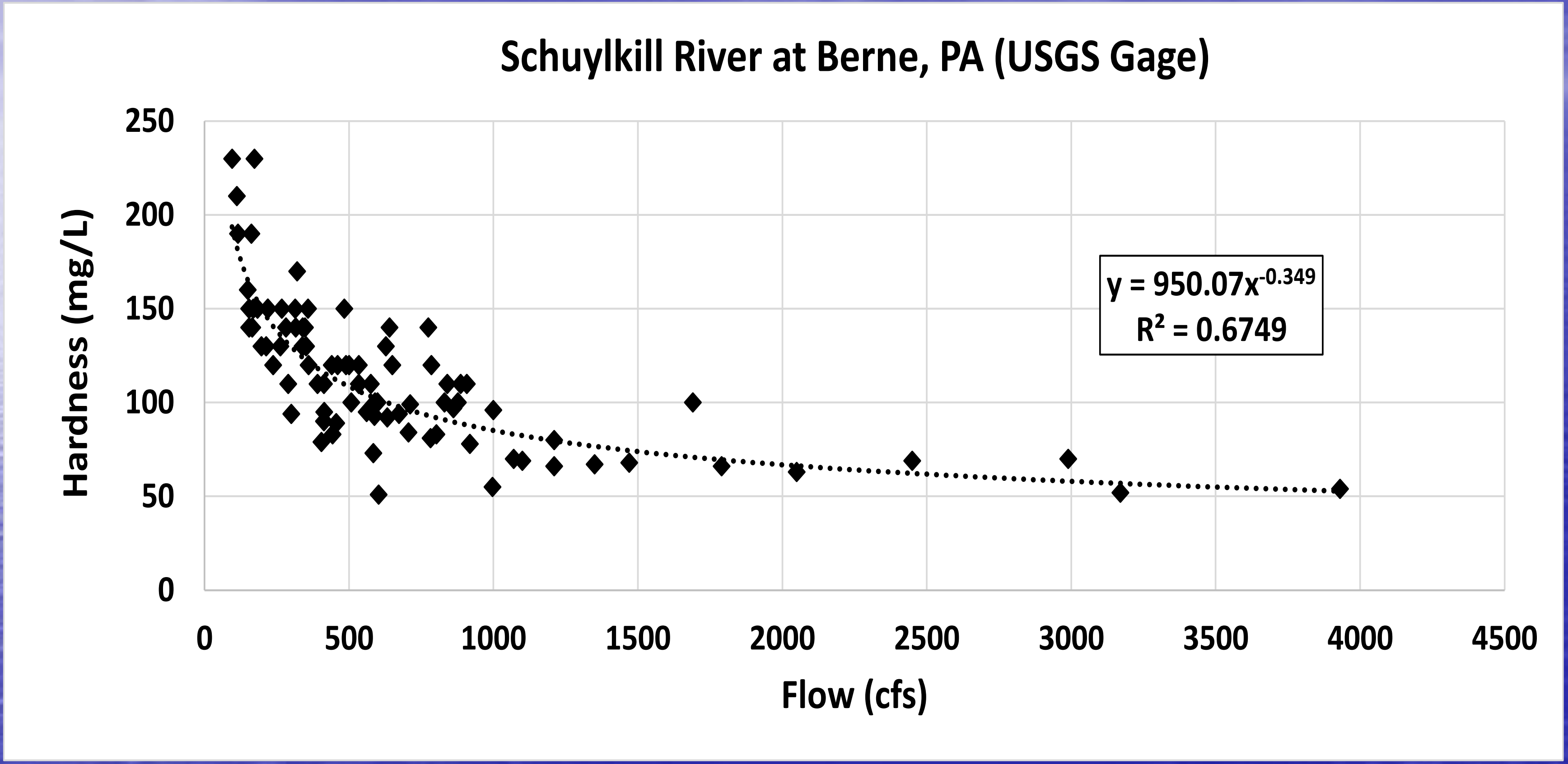
Effluent flow correlated with stream flow – use effluent flow expected at 7Q10

BACKGROUND CONCENTRATION

- Characterization of Background Conditions
- What Concentration should be Used?
  - Maximum
  - High Percentile
  - Average/Median

Typically, an Average or Median Concentration should be used because the Calculation Methodology is already Conservative (Assume High Discharge Concentration Occurs during 7Q10). However, Need to Check whether Higher Background Concentration is Correlated with Low Flow Conditions.

BACKGROUND CONCENTRATION



Variability of Hardness with Stream Flow – Background Hardness may Increase under Drought Flow Conditions – Important for Hardness-based Criteria.

OTHER CONSIDERATIONS

- Steady State
  - Mass Balance Approach
  - Evaluation at Edge of Mixing Zone
  - Conservative
- Drifting Organism
  - Consideration of Mixing Zone Size and Travel Time
  - Account for Increase in Dilution with Distance
  - Fate of Pollutant with Time (Important for Chlorine)
  - Calculate Flux-Averaged Concentration over Time
- Probabilistic Modeling
  - Need Lots of Data
  - Correlations are Considered
  - WQBEL Based on Frequency of Exceedance (Once in Three Years, on Average)

CONVERSION TO PERMIT LIMITS

- Converting WLAs to Effluent Limits
  - Determine Acute and Chronic WLAs
  - Determine corresponding Long-Term Averages (LTAs) – function of CV, n, and p)

$$\sigma_n = \sqrt{\ln\left({CV^2}/{n} + 1\right)}$$

$$LTA = WLA\ x\ EXP\left(0.5\sigma_n^2 - Z_p\sigma_n\right)$$

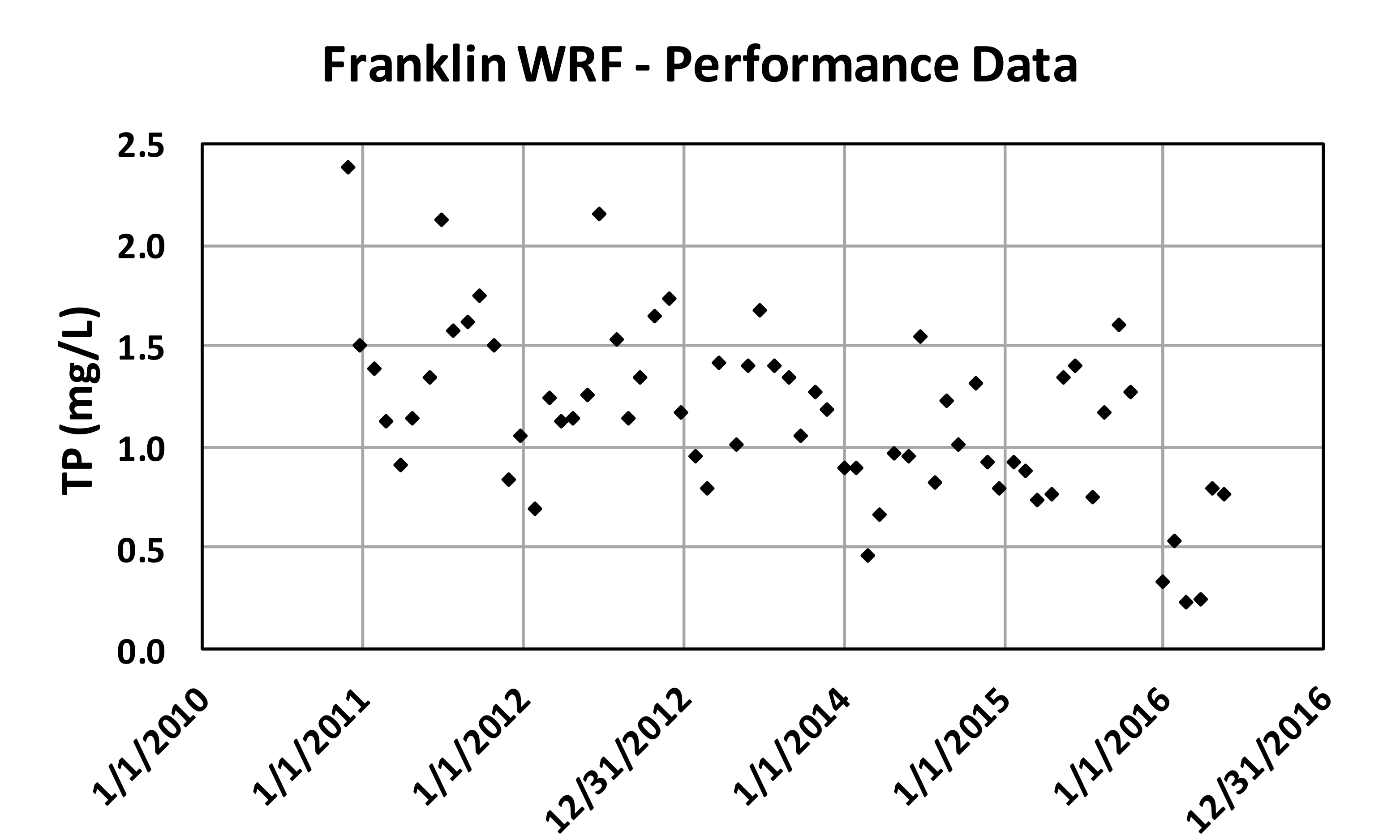
  - Using Minimum LTA, Calculate MDL, AML

$$MDL = LTA_{min}\ x\ EXP\left(Z_p\sigma_1 - 0.5\sigma_1^2\right)$$

$$AML = LTA_{min}\ x\ EXP\left(Z_p\sigma_n - 0.5\sigma_n^2\right)$$

See EPA TSD (1991) for Statistical Methods

EVALUATION OF EFFLUENT DATA



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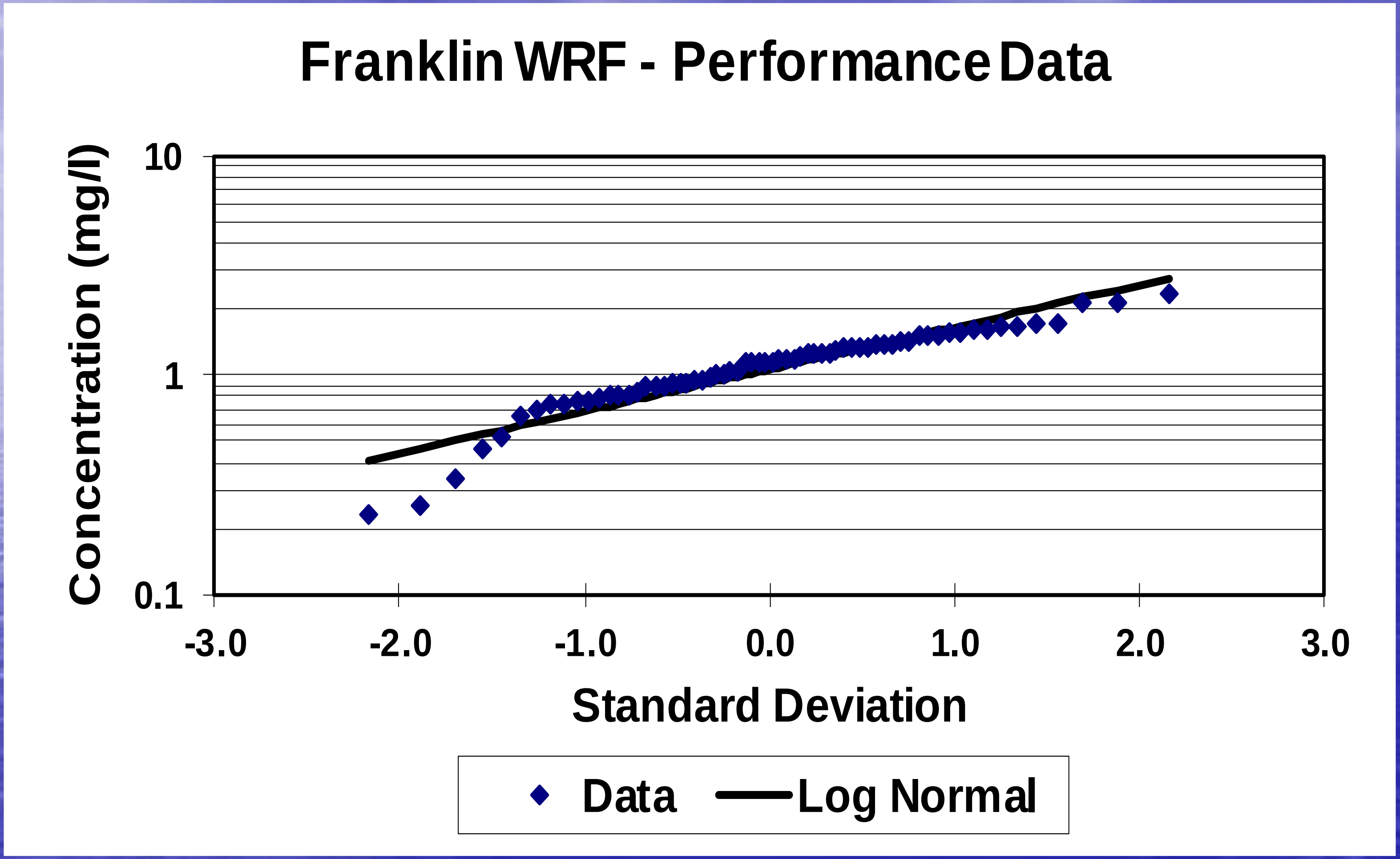
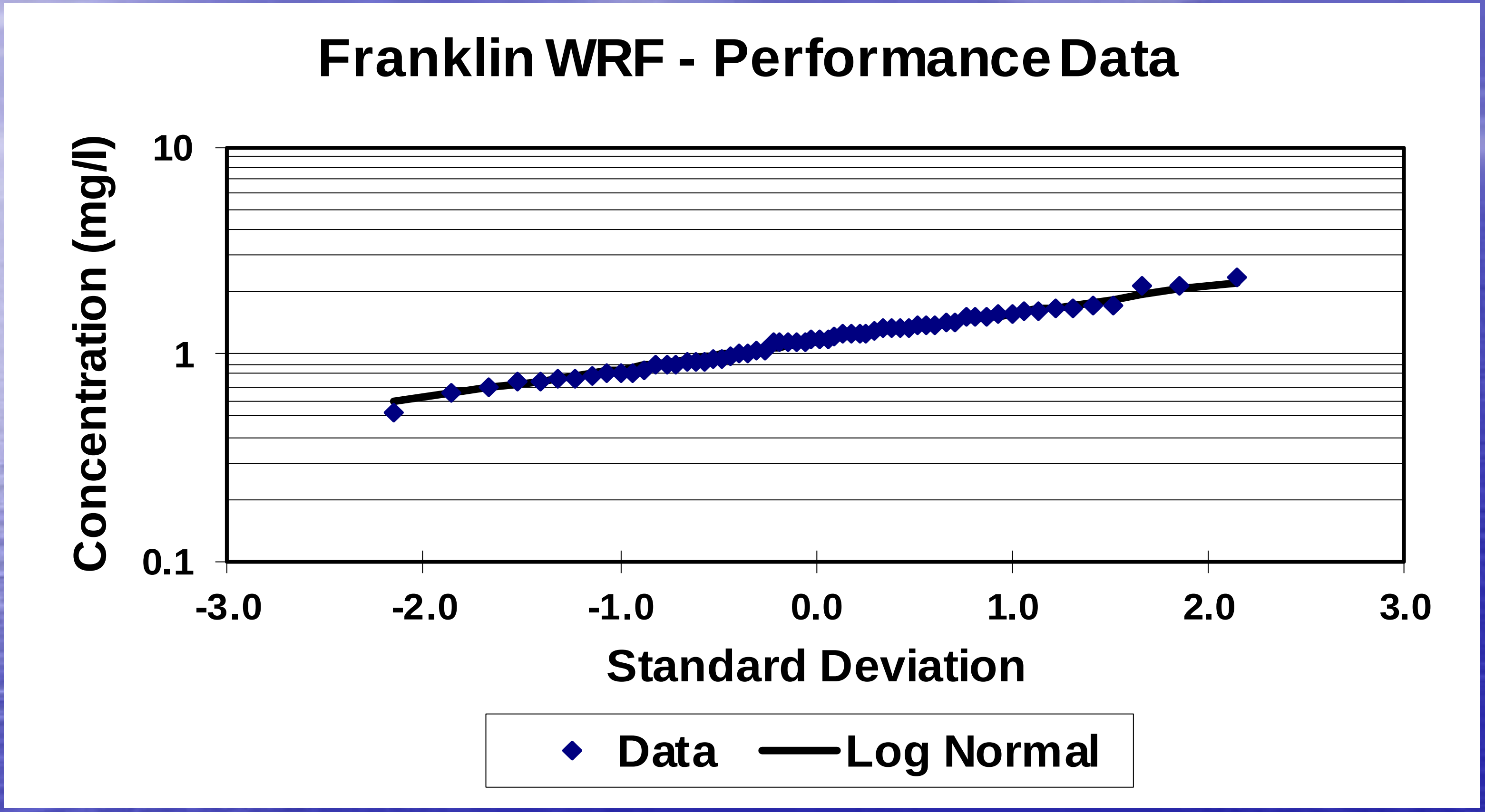


CV = 0.47; AML = 2.99 mg/L at 99th Percentile

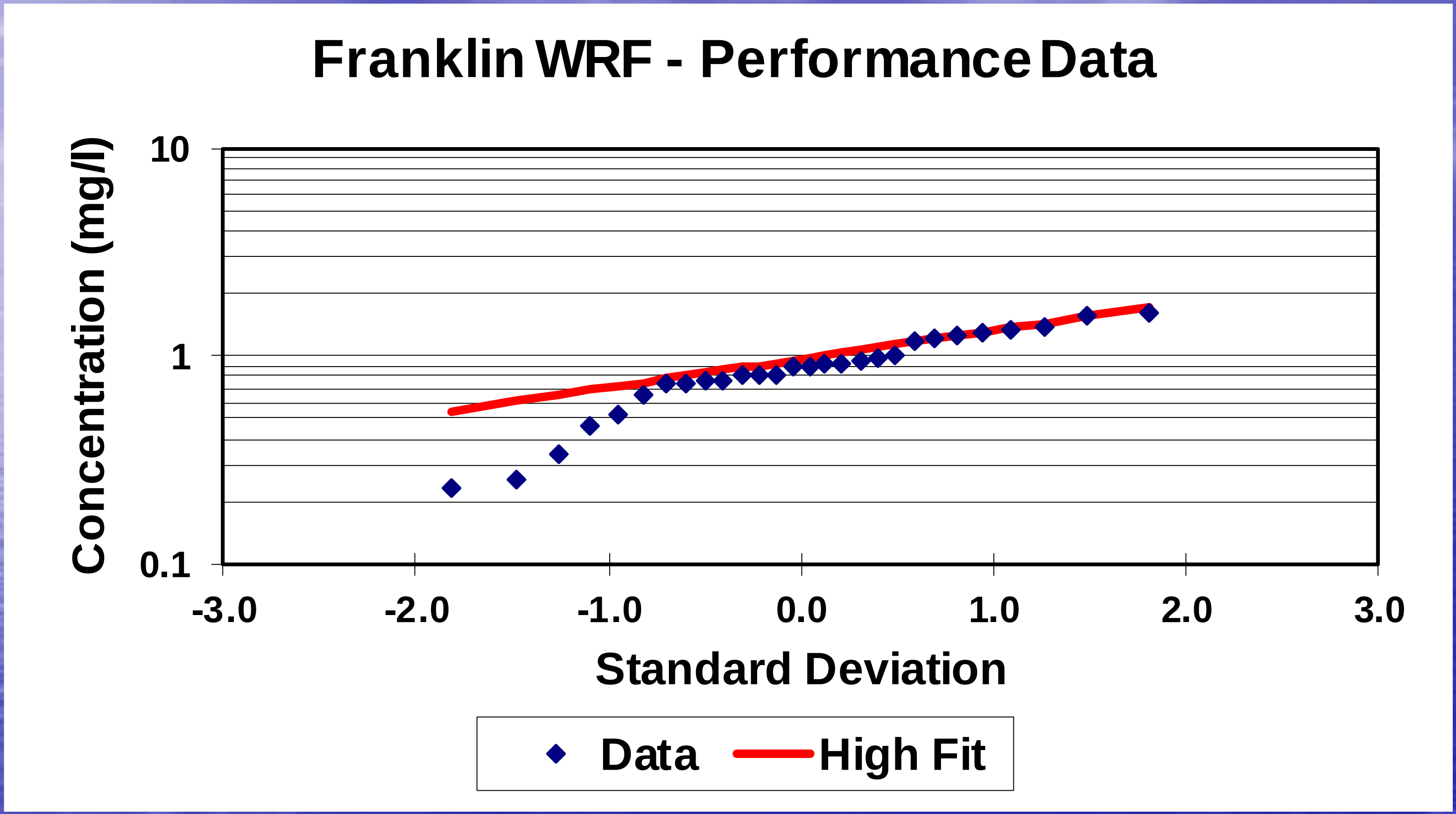
EVALUATION OF EFFLUENT DATA



Fit Data to Upper End of Distribution to Better Fit High Concentrations.

CV = 0.32; AML = 2.38 mg/L at 99th Percentile

EVALUATION OF EFFLUENT DATA



Use More Recent Data based on Steady Decline. Fit Data to Upper End of Distribution to Better Fit High Concentrations.
CV = 0.32; AML = 2.02 mg/L at 99th Percentile

For Additional Information

Gary B. Cohen
Bill Hall
Hall & Associates
1629 K Street, N.W.
Washington, DC 20006
(202) 463-1166
gcohen@hall-associates.com