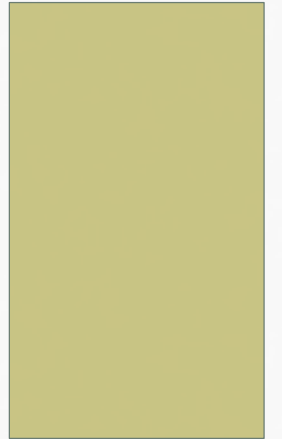


Troubleshooting Noncompliance at the Smallest Wastewater Treatment Plants

Part 1: Conversion

ACTIVATED SLUDGE PROCESS CONTROL

TROUBLESHOOTING CHART



Jon van Dommelen – Ohio EPA, Compliance Assistance Unit

THE COMPLIANCE ASSISTANCE UNIT

- Clean Water Act: Section 104(g)(1)
- In Ohio, the federal grant was used for equipment, supplies, travel and training
- Positions were funded through normal revenues
- Most importantly, the CAU had support of management

THE COMPLIANCE ASSISTANCE UNIT

Provide **on-site** technical assistance to communities

- Typically smaller communities (1500 gpd up to 15+ MGD)
- Help operators to overcome noncompliance with NPDES permits

THE COMPLIANCE ASSISTANCE UNIT

Provide **on-site** technical assistance to communities

- Troubleshooting all aspects of wastewater treatment
- Process optimization using cheap, easy, and effective process control tools

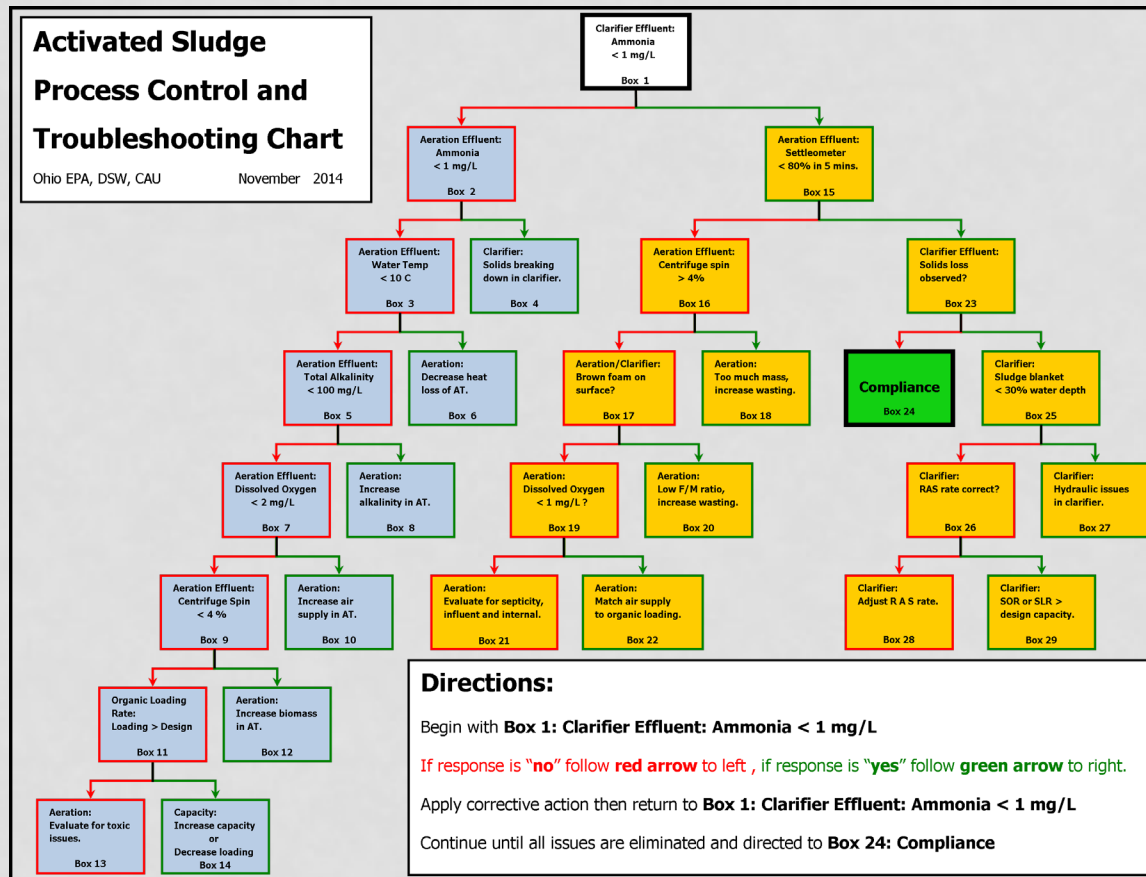
CAU created the Activated Sludge Process Control and Troubleshooting Manual and Flow Chart

Activated Sludge Process Control and Troubleshooting



Training Manual

Division of Surface Water
Compliance Assistance Unit
March 2015



THE PACKAGE PLANT INITIATIVE

- Target SNC in Small WWTPs in Ohio
- Focus on Design Capacity less than 100,000 gpd
- Focus on mechanical systems (not lagoon systems)

THE PACKAGE PLANT INITIATIVE

Reason:

If we could get the operators to do **process control**, we believed we could solve **Significant Noncompliance** through process optimization



THE PACKAGE PLANT INITIATIVE

Reason:

If we could get the operators to do **process control**, we believed we could solve **Significant Noncompliance** through process optimization



THE PACKAGE PLANT INITIATIVE

Compliance Assistance Unit (CAU)

- View wastewater treatment as a biological process
- Measure the **physical** characteristics, the **visual** clues and the **chemical** trails that bacteria leave behind as they convert the pollutants in wastewater into carbon dioxide, nitrate and more bacteria.

The Universe of Small Discharge Non-compliance

NPDES Permitted WWTPs < 100,000 gpd design
SNC at some time over 2 year period

Central	153	37	24%
Private	44	12	
Public	41	11	
Semi-Public	16	3	
Specific	52	11	
Northeast	732	151	21%
Private	109	33	
Public	99	23	
Semi-Public	439	77	
Specific	85	18	
Northwest	389	78	20%
Private	72	19	
Public	105	20	
Semi-Public	178	34	
Specific	34	5	
Southeast	210	52	25%
Private	37	9	
Public	92	24	
Semi-Public	38	11	
Specific	43	8	
Southwest	233	28	12%
Private	75	14	
Public	41	5	
Semi-Public	14	9	
Specific	103	0	
Grand Total	1717	346	10 20%

Ohio NPDES Permit 1 P B 0 0 0 0 5 * A D

Letter	Public
A	Municipality – Under 0.1 MGD
B	Municipality – 0.1 to 0.5 MGD
C	Municipality – 0.5 to 1.0 MGD
D	Municipality – 1.0 to 10 MGD
E	Municipality – 10 to 50 MGD
F	Municipality – Greater than 50 MGD
G	County/Sewer District – Under 0.1 MGD
H	County/Sewer District – 0.1 to 0.5 MGD
I	Storm Water
J	County/Sewer District – 0.5 to 1.0 MGD
K	County/Sewer District – 1.0 to 10 MGD
L	County/Sewer District – 10 to 50 MGD

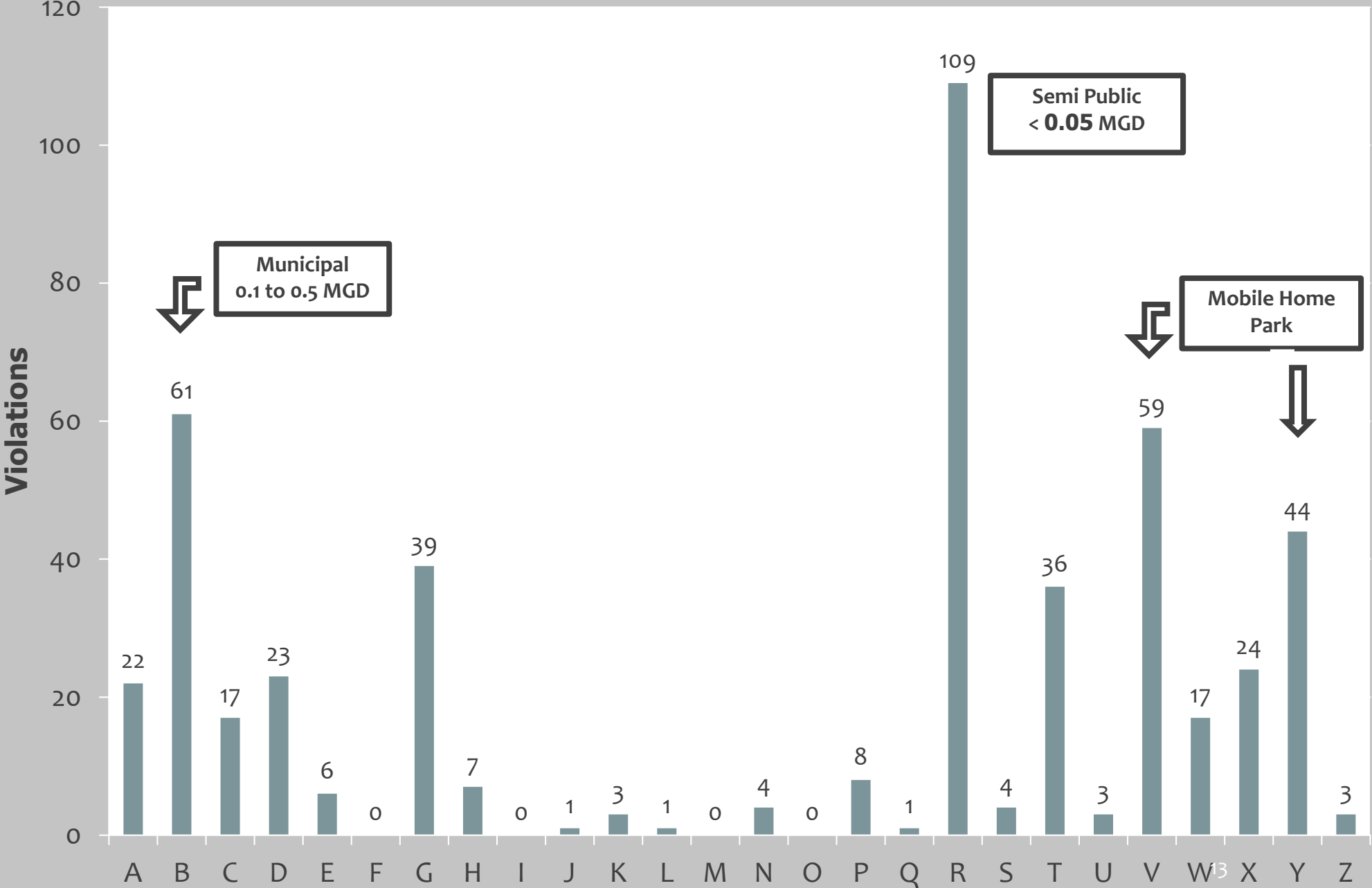
M	County/Sewer District – 50 MGD or more
N	Federal Facility
O	-
P	State Facility
Q	Regional Authority
R	Semi-Public – less than 0.05 MGD
S	Semi-Public – Greater than 0.05 MGD
T	Schools and Hospitals
U	PUCO
V	Mobile Home Parks
W	Subdivisions and Apartment Complexes
X	Miscellaneous
Y	Mobil Home Parks
Z	Extension of R's

Ohio NPDES Permit 1 **B** 0 0 0 0 5 * A D

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Z	Extension of R's

Facility Type



STOP THE BLEEDING . . .

Type "R" Semi Public < 0.05 MGD

Who are they?

4-H / FFA camps

Restaurants

Marinas

Schools

Small Manufacturing

Motels

Bars/Taverns

Churches

Their #1 business is not the #1 business.

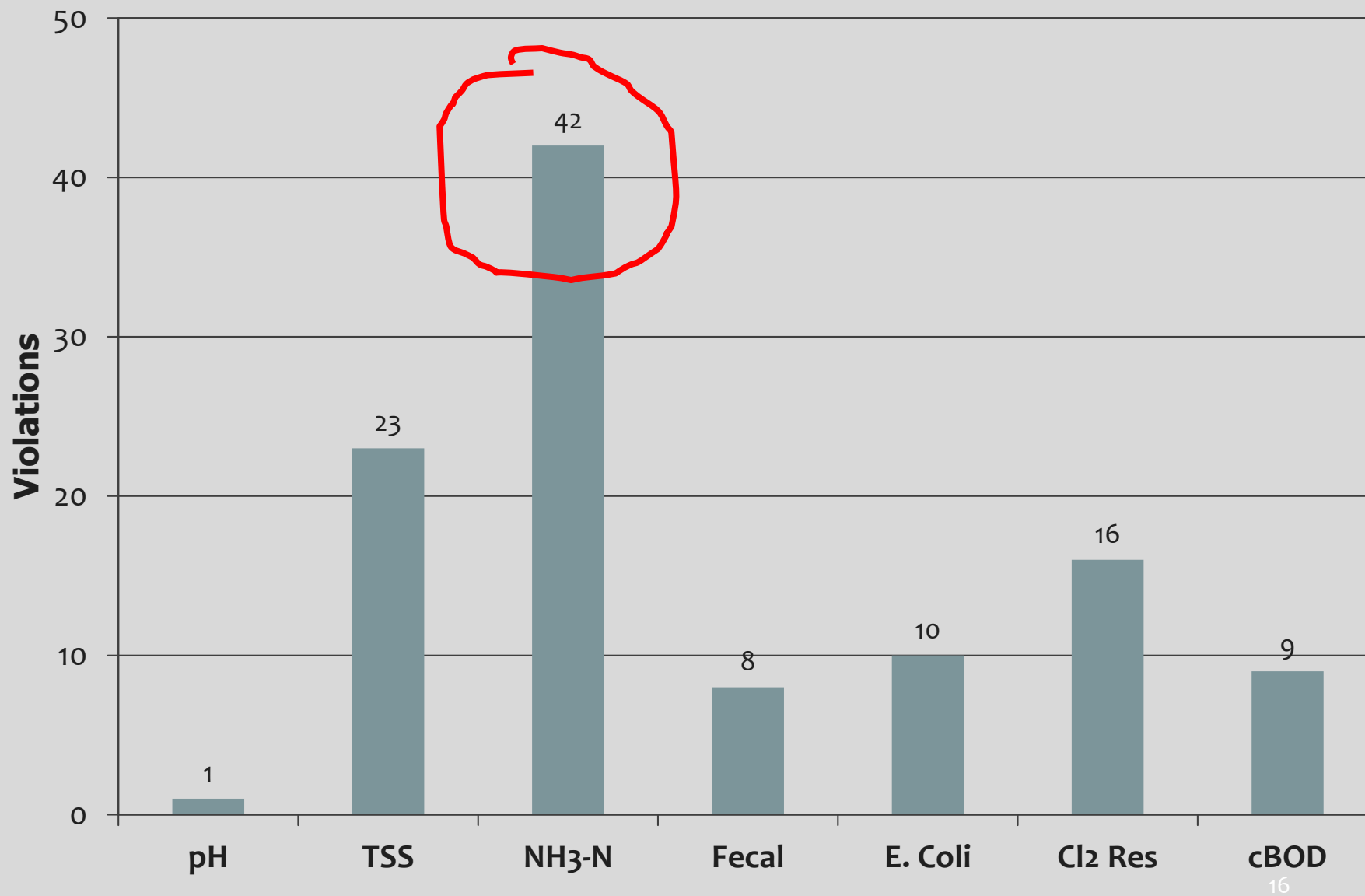
Might require more "hand holding".

STOP THE BLEEDING . . .

Type "R" Semi Public < 0.05 MGD

What are their issues?

Semi Public < 0.05 MGD (violations by parameter)

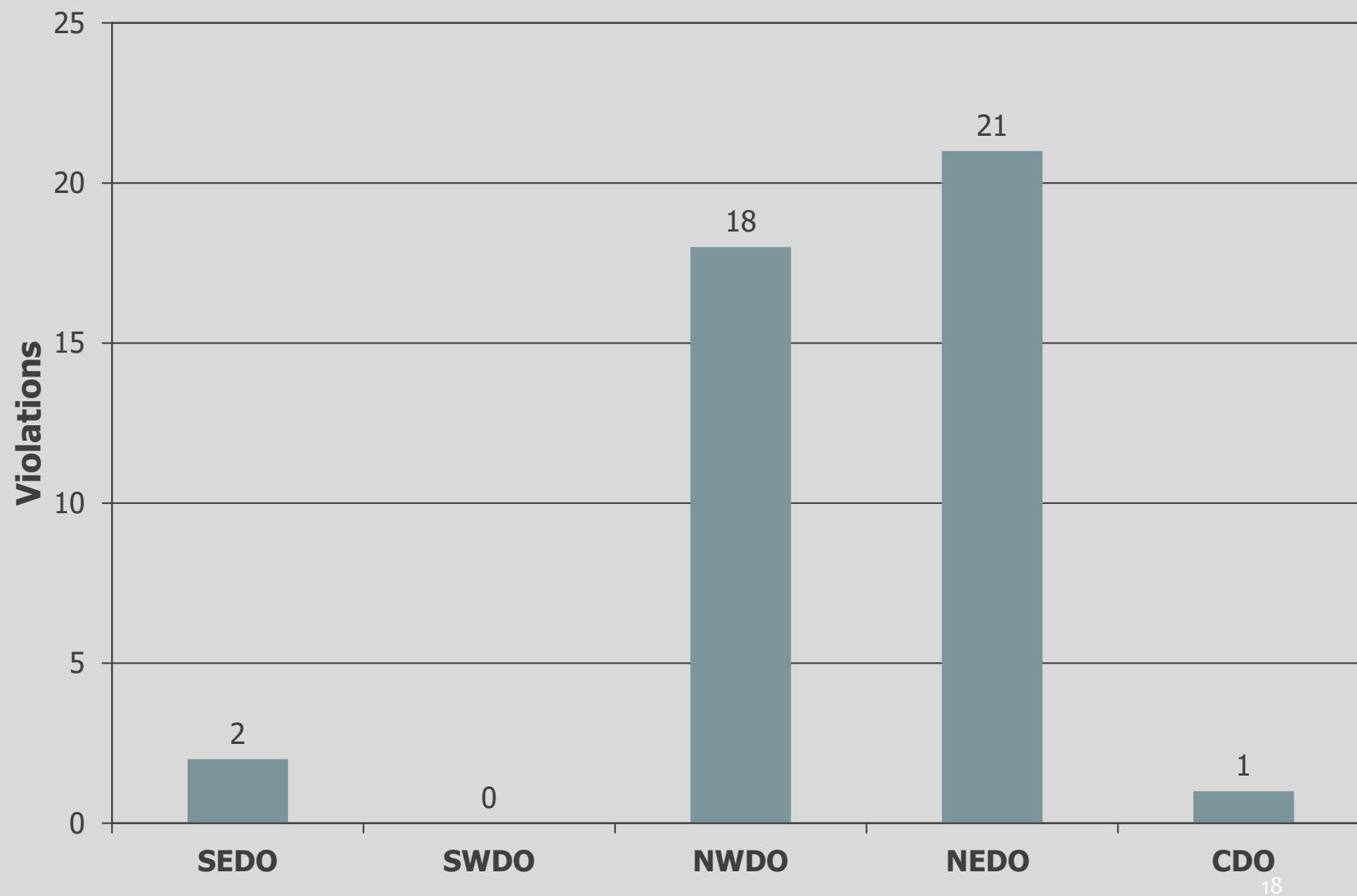


STOP THE BLEEDING . . .

Type "R" Semi Public < 0.05 MGD

Where are they?

Semi Public < 0.05 MGD
NH3-N violations by district



The World of Noncompliance – Causes and Fixes

- Operational Issues
 - Process control
 - Maintenance
- Design Issues
 - Increased process control
 - Work arounds
- Administrative Issues
 - Staffing
 - O, M, and R costs



Welcome to my world



Welcome to my world.

Welcome to my world





Welcome to my world.



Welcome to my world.

A photograph of a polluted waterway. In the foreground, there is a concrete curb covered in green moss and scattered brown leaves. Two dark, vertical pipes run down from the curb into the water. The water is dark and murky, with some debris floating on the surface. The background shows a dark, textured ground, possibly asphalt or concrete, also covered with leaves and some small pieces of trash.

Welcome to my world

**Welcome
to
my
world.**

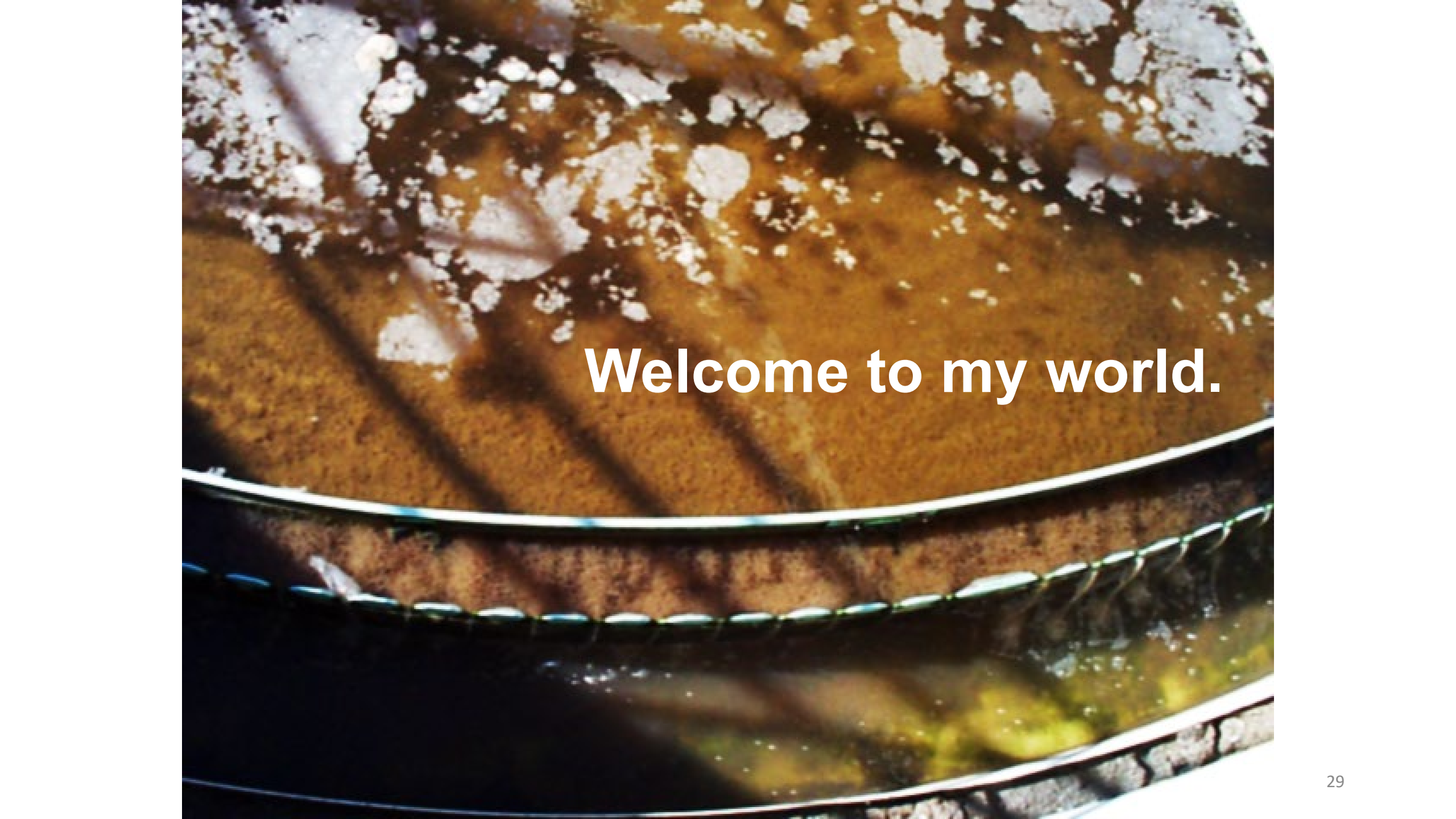




Welcome to our world.



Welcome to my world.



Welcome to my world.



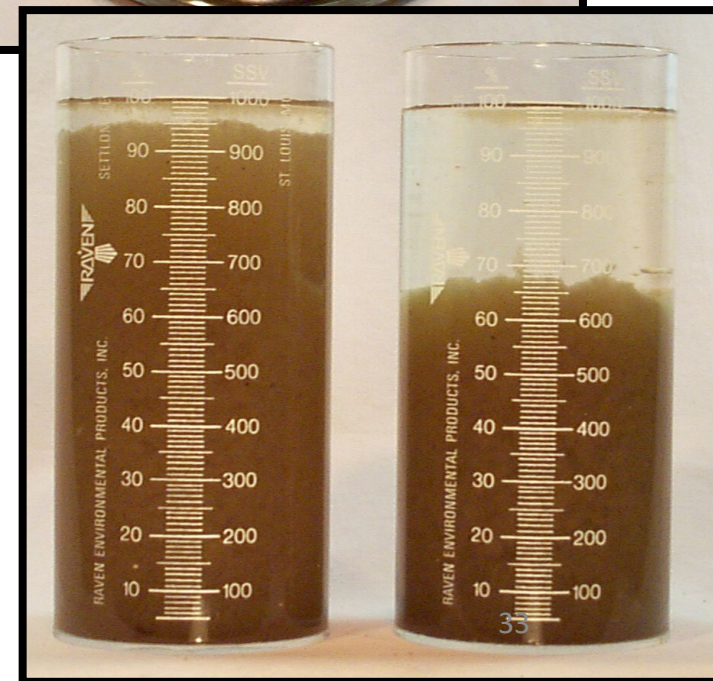
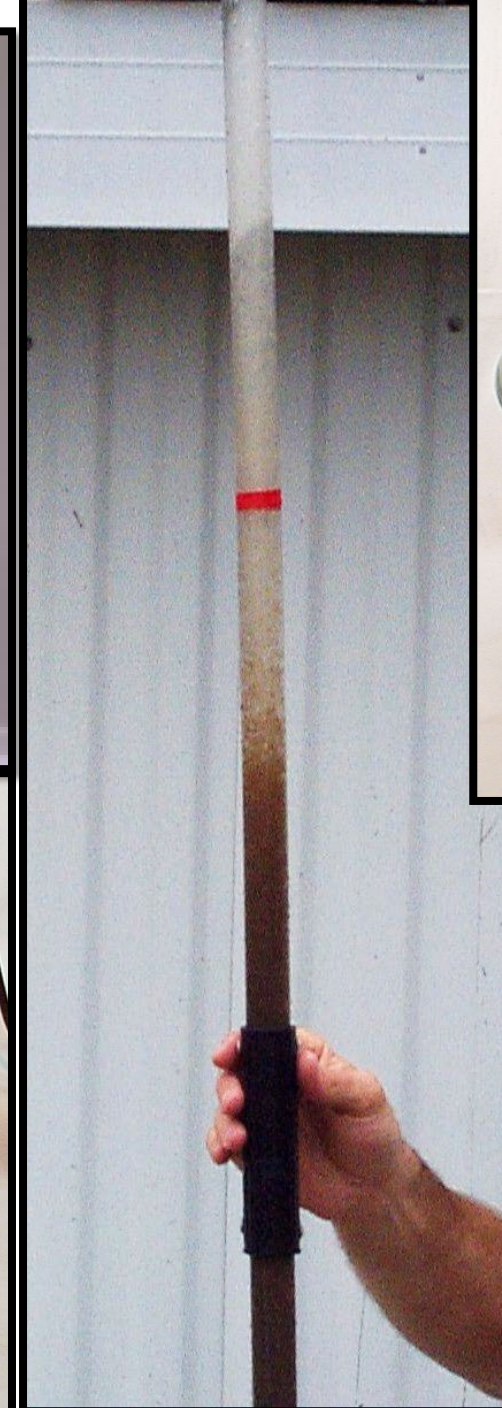
Welcome to my world.

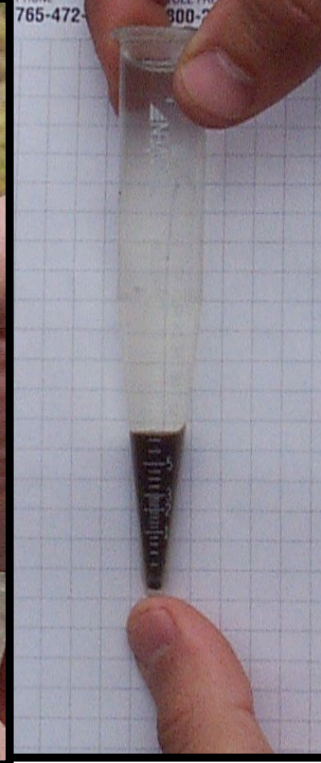
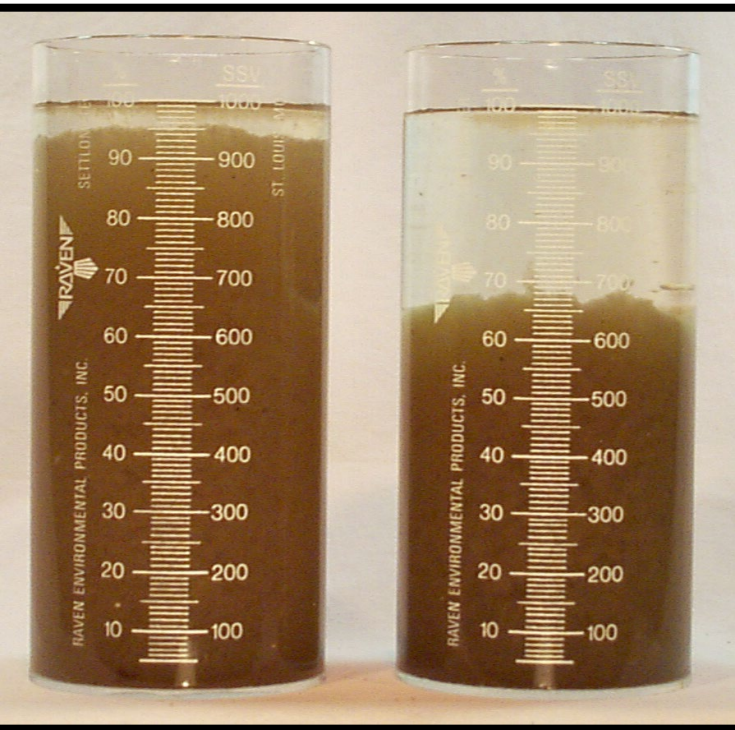
Welcome to my world



Welcome to my world.

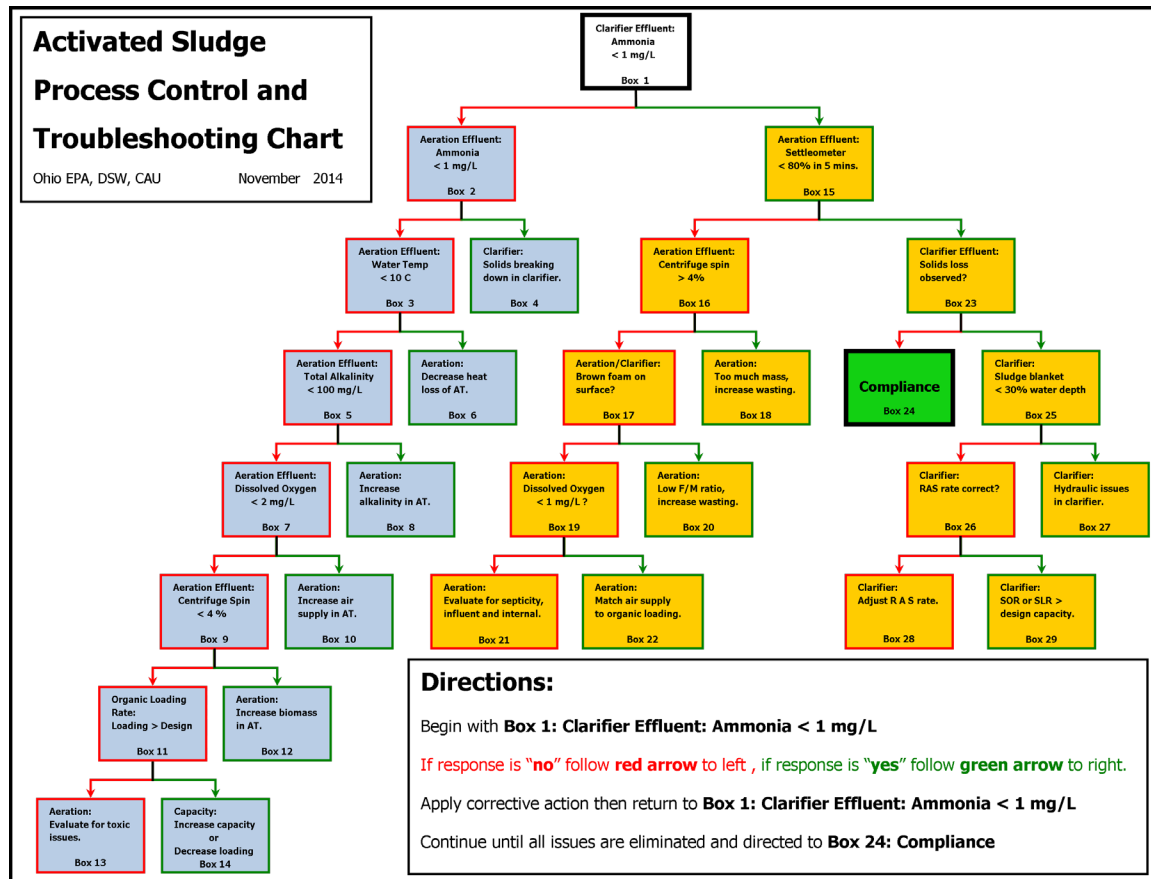






The Solution...

The CAU training material:



Activated Sludge Process Control and Troubleshooting

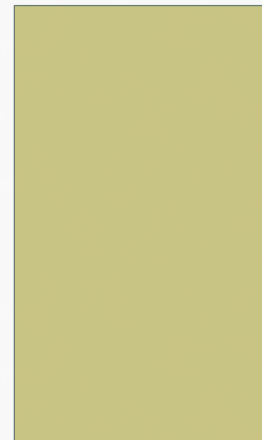


Training Manual

Division of Surface Water
Compliance Assistance Unit
March 2015

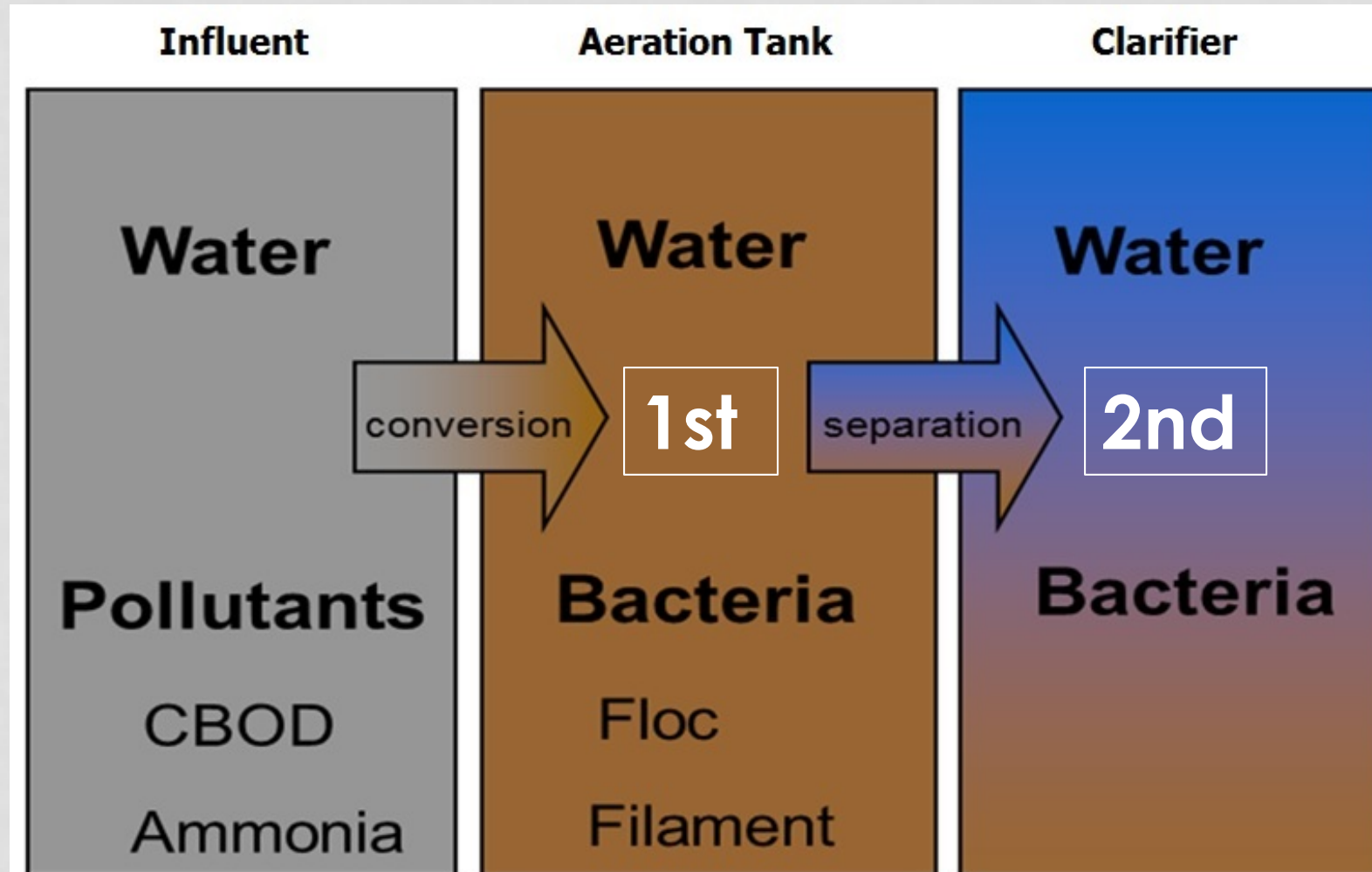
ACTIVATED SLUDGE PROCESS CONTROL

TROUBLESHOOTING CHART

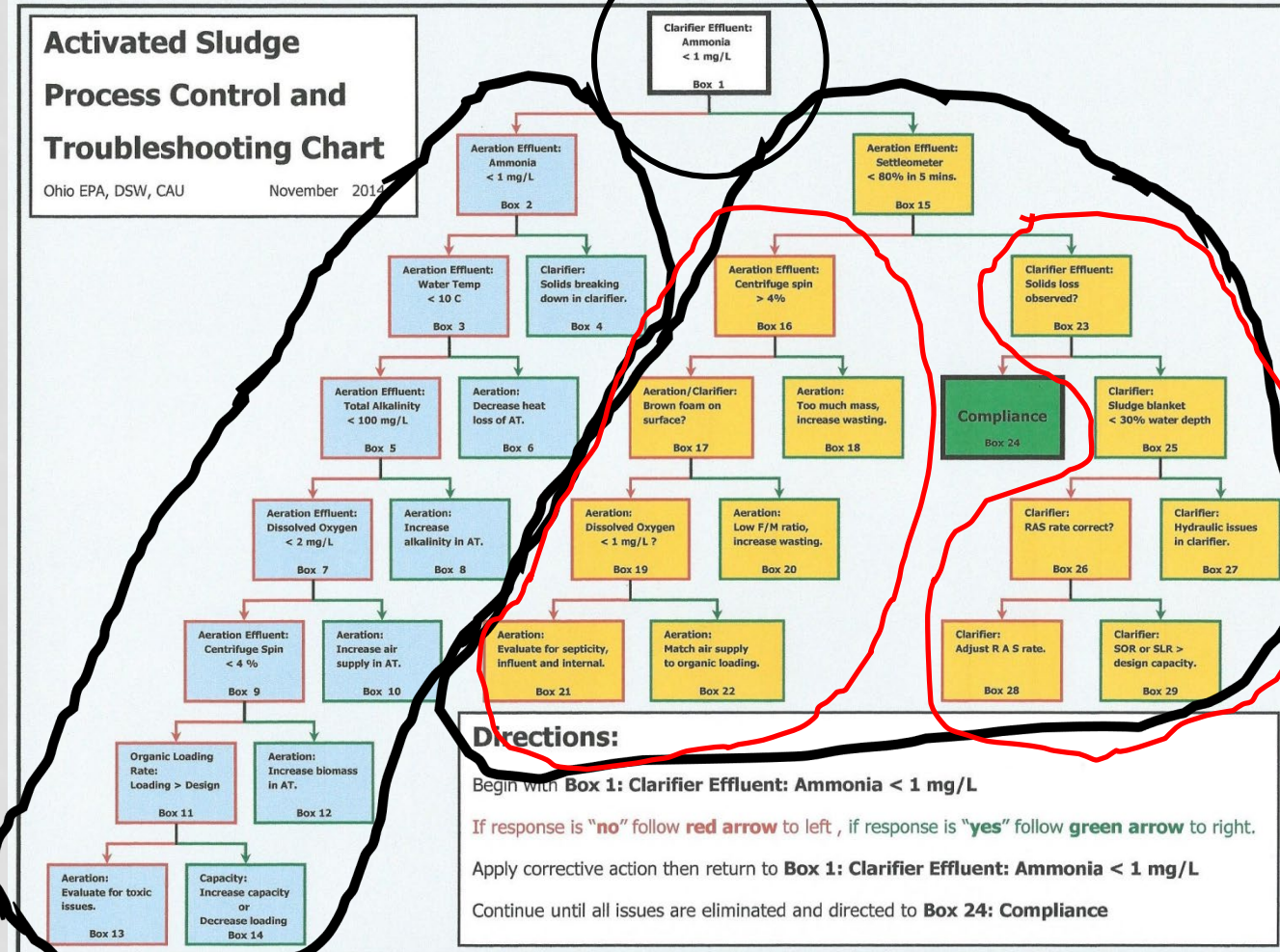


Part One: Conversion

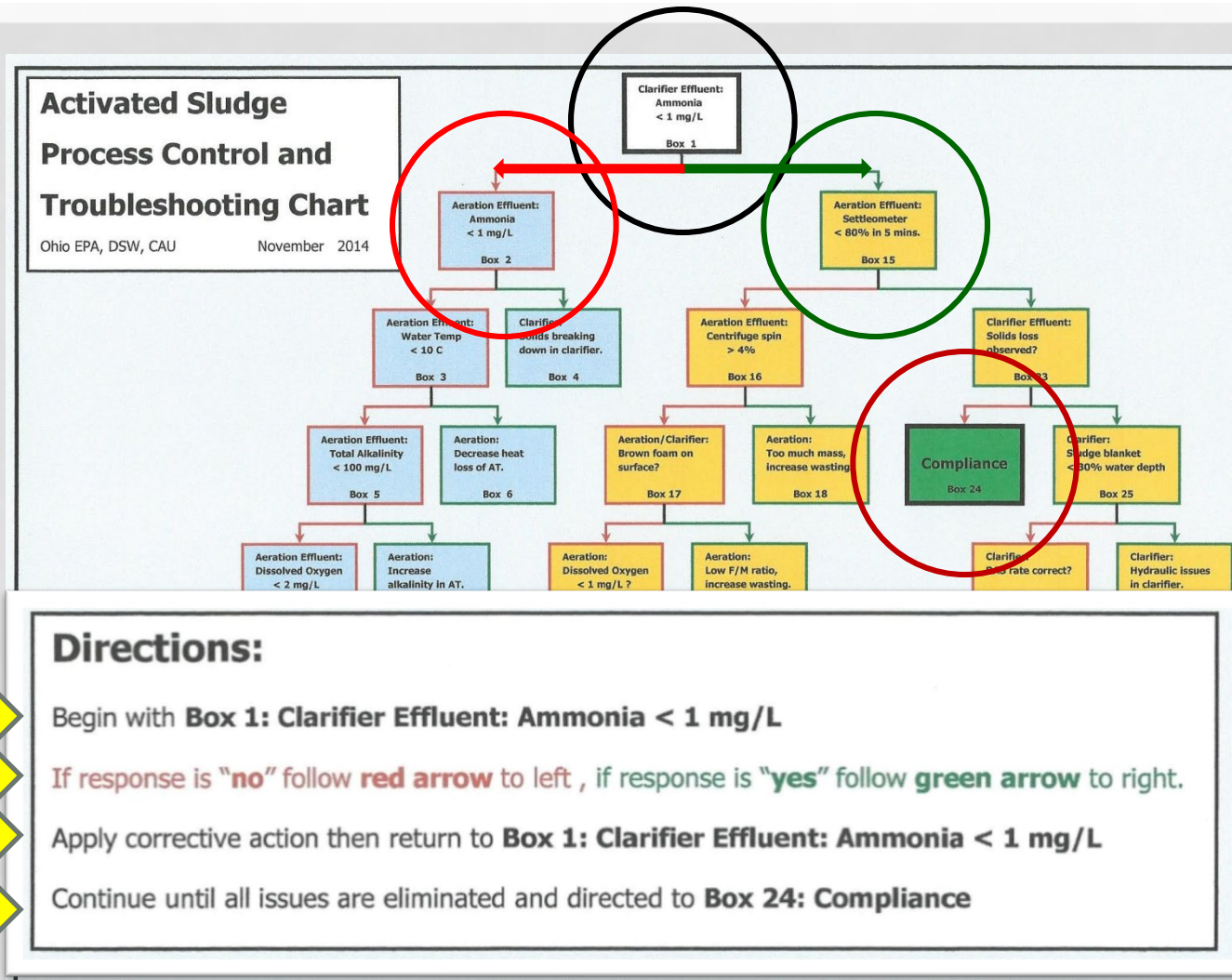
BASIC CONCEPTS



ACTIVATED SLUDGE PROCESS CONTROL

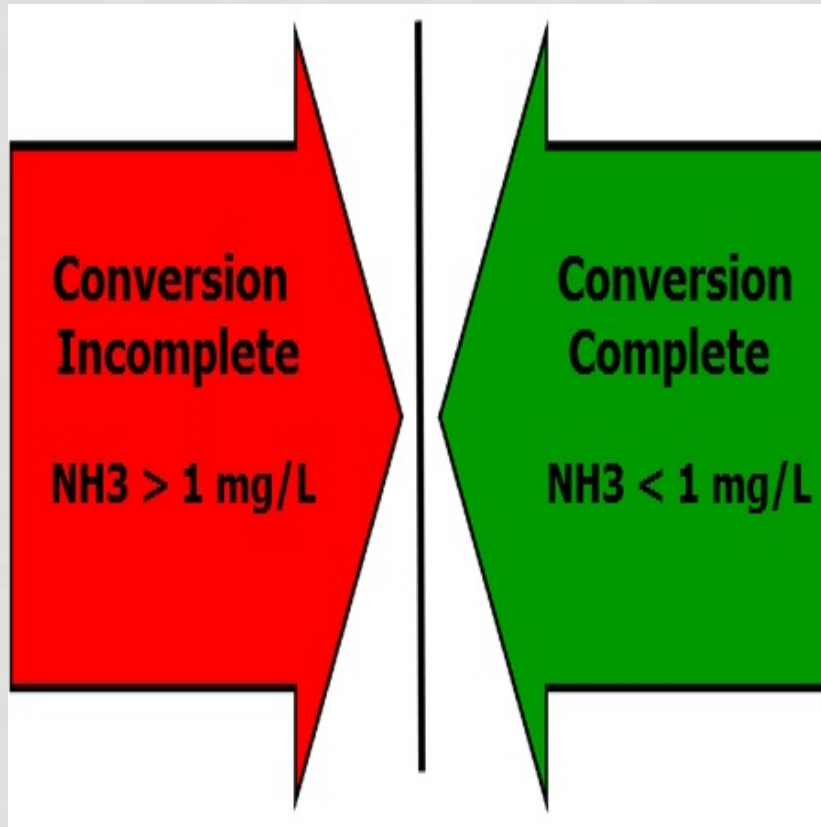


Each box will either request more data or identify the issue.



BOX # 1

CLARIFIER EFFLUENT: AMMONIA < 1 MG/L



- Conversion Process
 - CBOD & NH3
- Ammonia Indicator
 - “sensitive”
 - Early warning
 - < 1 mg/L NH3
 - Conversion Complete
 - > 1 mg/L
 - Conversion problem

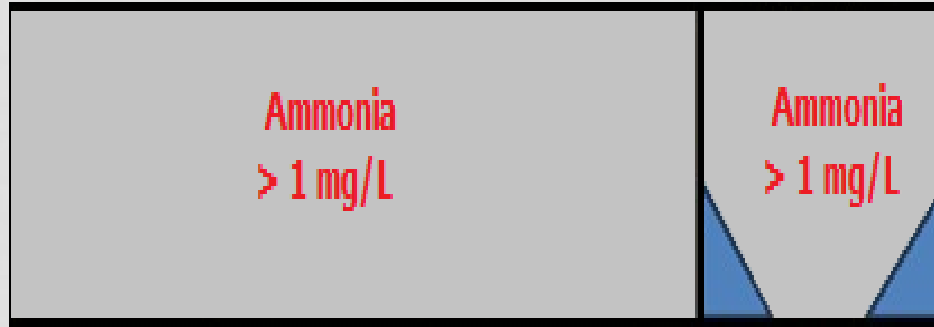
BOX # 1

CLARIFIER EFFLUENT: AMMONIA < 1 MG/L

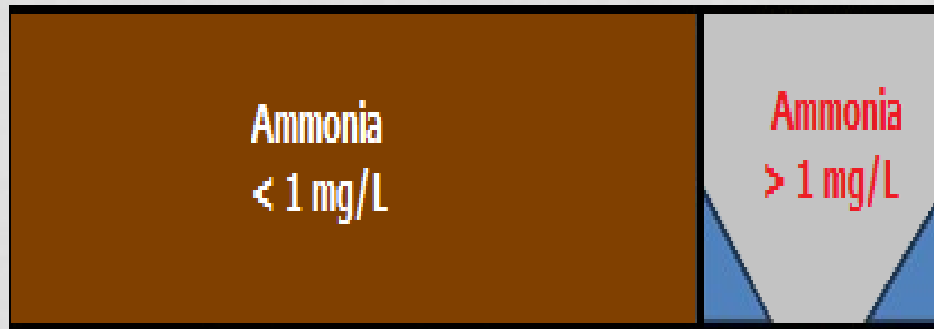


BOX # 2

AERATION EFFLUENT: AMMONIA < 1 MG/L



- Aeration Effluent
 - Problem: Conversion
 - Location: Aeration



- Clarifier Effluent
 - Problem: Re-release
 - Location: Clarifier

BOX # 4

**CLARIFIER:
SOLIDS BREAKING DOWN IN CLARIFIER**



- Sources:
 - Scum Baffle
 - Clarifier Surface
 - Clarifier Sludge Blanket

BOX # 4

CLARIFIER: SOLIDS BREAKING DOWN IN CLARIFIER



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Sources:

- Scum Baffle
- Clarifier Surface
- Clarifier Sludge Blanket

BOX # 3

**AERATION EFFLUENT:
WATER TEMPERATURE < 10 C**



- WATER temperature impacts growth rate
 - slower growth = slower removal rates
- Measure AT effluent water temperature

BOX # 3

**AERATION EFFLUENT:
WATER TEMPERATURE < 10 C**

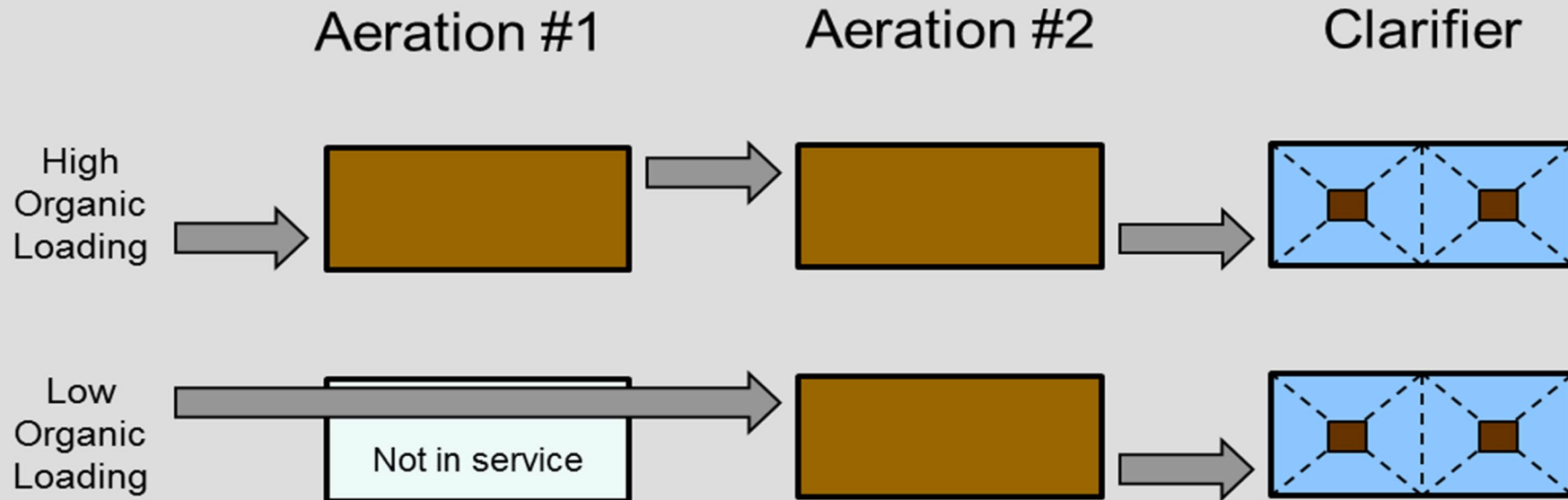


- WATER temperature impacts growth rate
 - slower growth = slower removal rates
- Measure AT effluent water temperature

BOX # 6

AERATION: DECREASE HEAT LOSS OF AERATION TANK

- Reduce Heat Loss
 - Aeration Capacity



BOX # 6

AERATION: DECREASE HEAT LOSS OF AERATION TANK



- Reduce Heat Loss
 - Aeration Capacity
- Reduce Blower Timers
 - Match supply to load
- Reduce Loss
 - Cover AT, EQ, clarifiers

BOX # 6

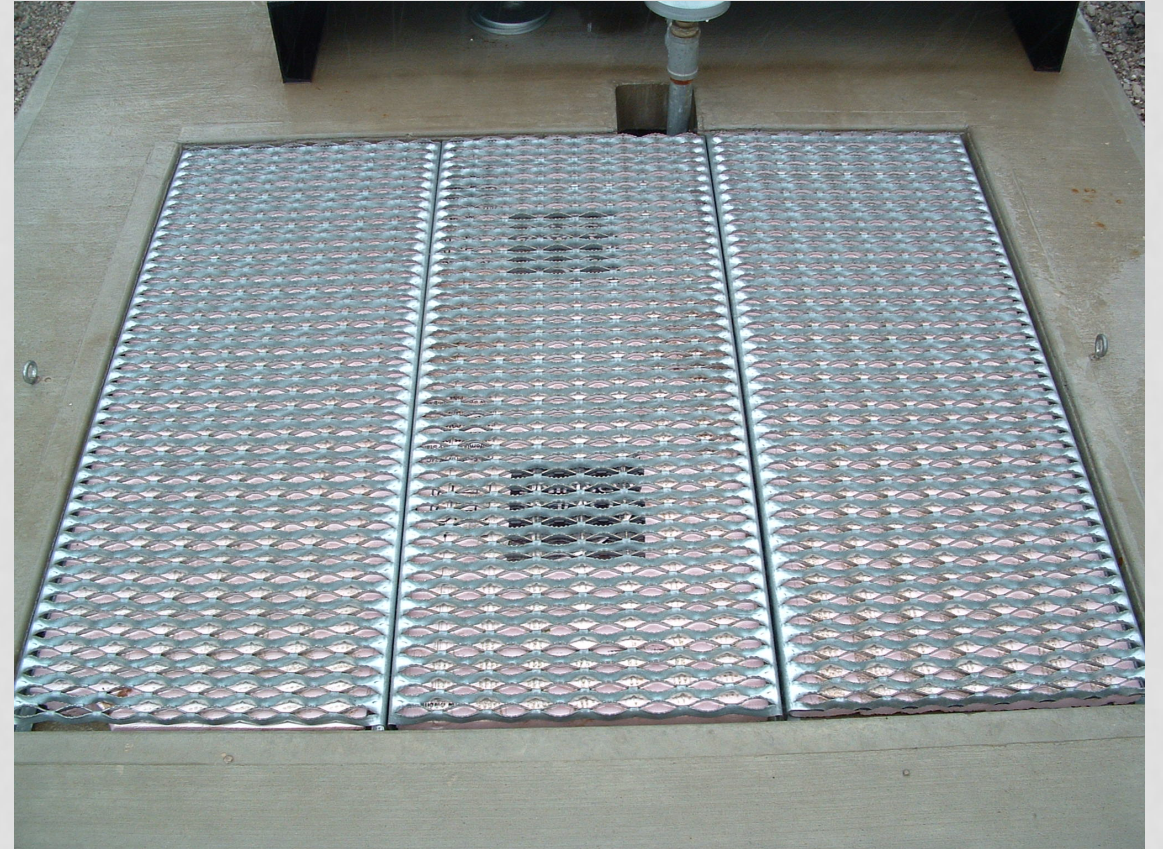
AERATION: DECREASE HEAT LOSS OF AERATION TANK



- Reduce Heat Loss
 - Aeration Capacity
- Reduce Blower Timers
 - Match supply to load
- Reduce Loss
 - Cover AT, EQ, clarifiers

BOX # 6

**AERATION:
DECREASE HEAT LOSS OF AERATION TANK**



BOX # 5

**AERATION EFFLUENT:
TOTAL ALKALINITY < 100 MG/L**



- Nitrification
 - Consumes alkalinity
 - 7.14 mg/L alkalinity
 - No Alkalinity,
No Buffer
 - pH “post mortem”
 - Drops like a rock

BOX # 5

**AERATION EFFLUENT:
TOTAL ALKALINITY < 100 MG/L**



- Nitrification

- Consumes alkalinity
 - 7.14 mg/L alkalinity
- No Alkalinity,
No Buffer
- pH “post mortem”
 - Drops like a rock

BOX # 5

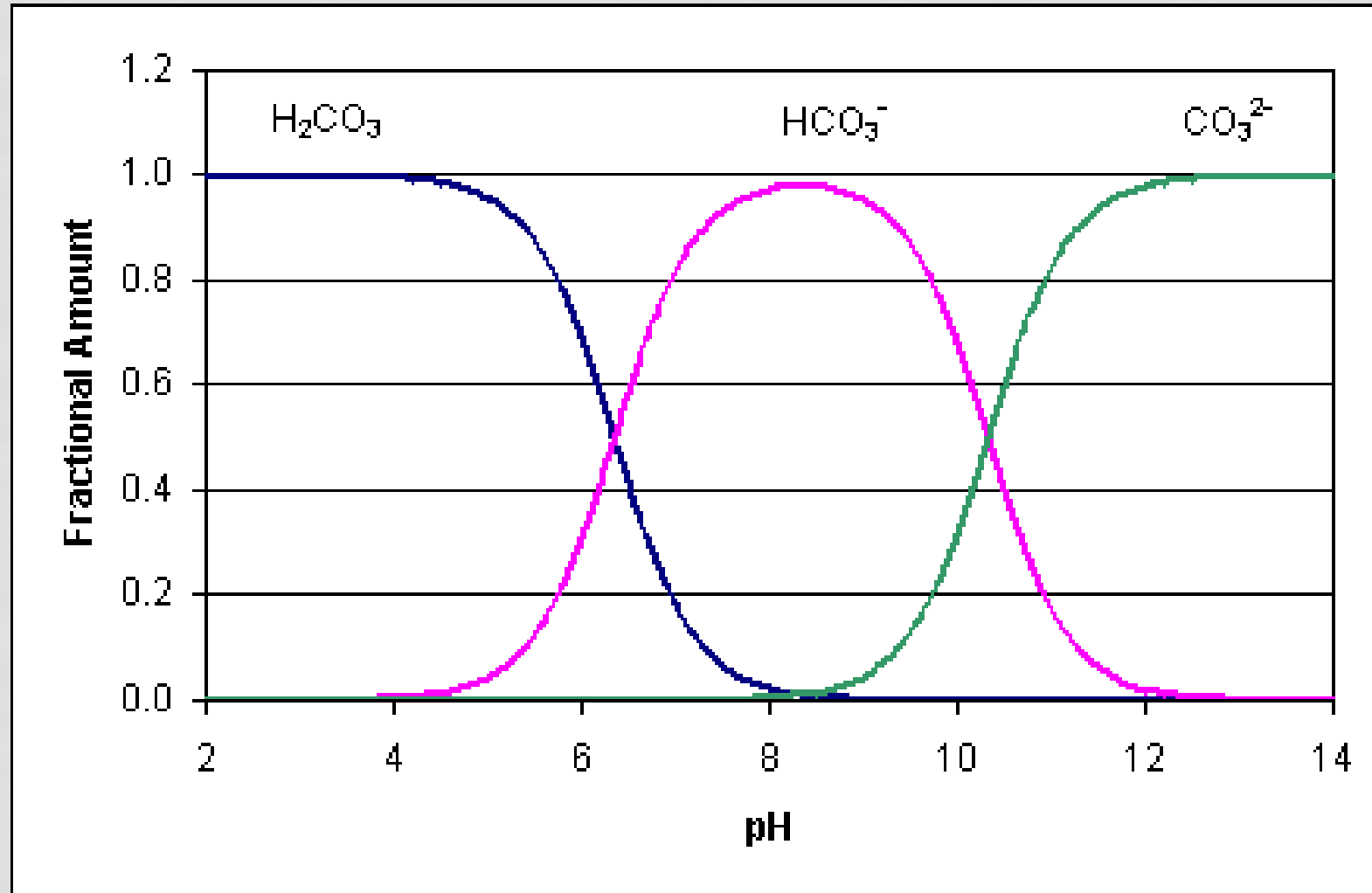
AERATION EFFLUENT: TOTAL ALKALINITY < 100 MG/L



- Nitrification
 - Consumes alkalinity
 - 7.14 mg/L alkalinity
- No Alkalinity,
No Buffer
- pH “post mortem”
 - Drops like a rock

BOX # 5

**AERATION EFFLUENT:
TOTAL ALKALINITY < 100 MG/L**



BOX # 8

AERATION: INCREASE ALKALINITY IN AERATION TANK



- Bicarb is best for an upset reactor
 - Safer to use in AT
 - Safer to use by operator
- Measure and know
 - Need 100 mg/L residual AND $\text{NH}_3 < 1 \text{ mg/L}$ in AT

BOX # 7

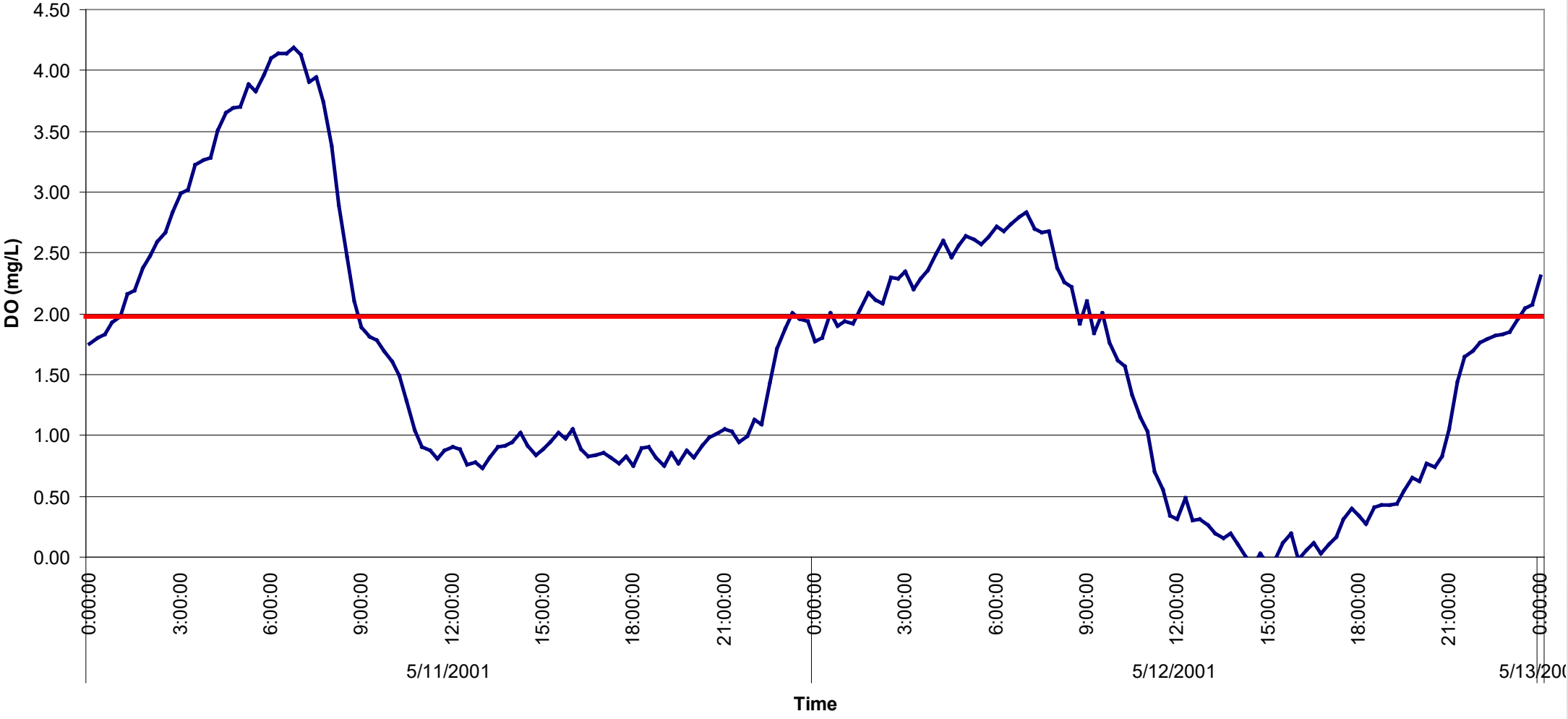
**AERATION EFFLUENT:
DISSOLVED OXYGEN < 2 MG/L**



- DO Concentration
 - Aeration Tank Effluent
 - Photo vs Video
 - Multiple tanks
 - Parallel = equal value
 - Series = increasing value



Dissolved Oxygen Profile
Pleasant Valley Regional Sewer District



BOX # 10

AERATION: INCREASE AIR SUPPLY IN AERATION TANK



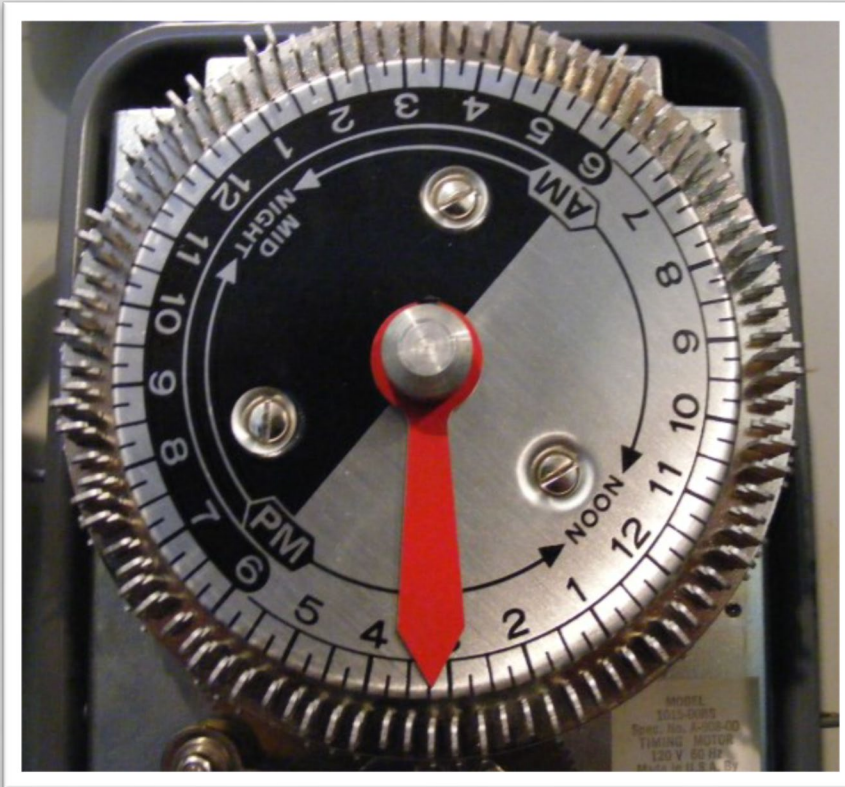
- Operational Issue
 - Blower run time
 - System Loading
- Mechanical Issue
 - Blower
 - Motor
 - Air Distribution





BOX # 10

AERATION: INCREASE AIR SUPPLY IN AERATION TANK



- Operational Issue
 - Blower run time
 - System Loading
- Mechanical Issue
 - Blower
 - Motor
 - Air Distribution

BOX # 9

AERATION EFFLUENT: CENTRIFUGE SPIN < 4%



- Need bacteria in AT to convert NH_3
 - Hiding in clarifier?
- Estimate amount in 15 minutes
- Typical range 2-4% by volume

BOX # 9

AERATION EFFLUENT: CENTRIFUGE SPIN < 4%



- Need bacteria in AT to convert NH_3
 - Hiding in clarifier?
- Estimate amount in 15 minutes
- Typical range 2-4% by volume

BOX # 12

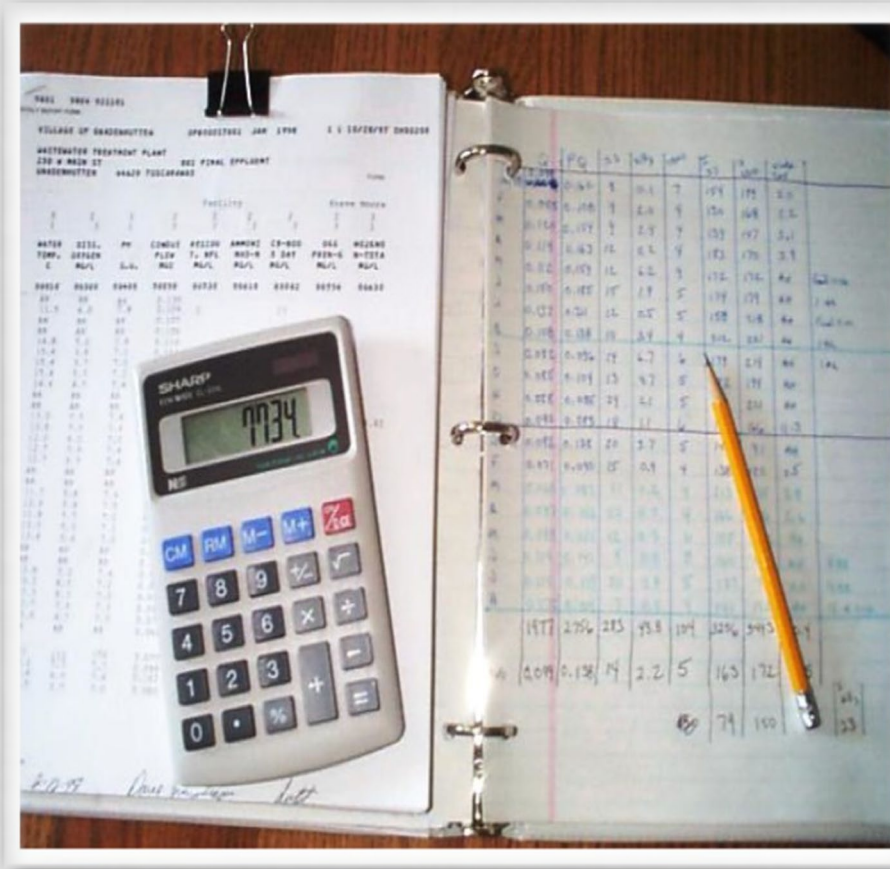
AERATION: INCREASE BIOMASS IN AERATION TANK



- Aeration Tank
 - 2% to 4% concentration
 - Decrease wasting to increase biomass
 - Colder temps require more biomass
 - Increased loadings require more mass

BOX # 11

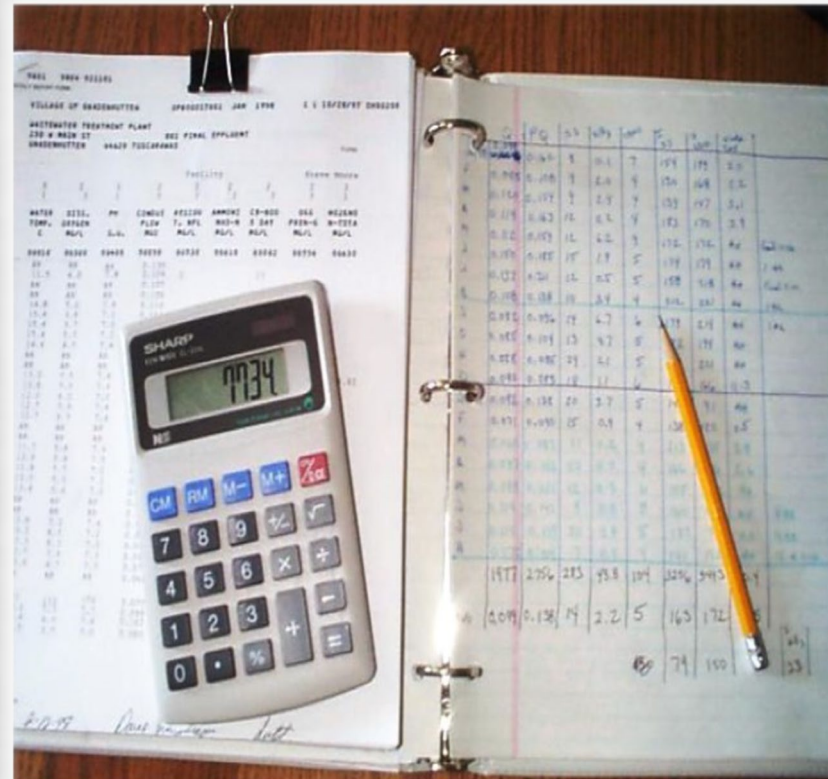
ORGANIC LOADING RATE: LOADING > DESIGN



- lbs./day/1,000 ft³
- (BOD)(MGD)(8.34)
- $\frac{(\text{length} \times \text{width} \times \text{wd})}{1,000 \text{ ft}^3}$
- <15 lbs./d/1,000 ft³

BOX # 11

ORGANIC LOADING RATE: LOADING > DESIGN



Typical Design

15 lbs./d/1,000 ft³

- **lbs./day/1,000 ft³**

AT Dimensions

=2[56'x 12'x 15' w.d.]

AT Environment

= 0.135 MGD

= 218 mg/L BOD₅

lbs./day/BOD

$$= 8.34 \times 0.135 \text{ MGD} \times 218 \text{ mg/L}$$

= 245 lbs./d/ BOD₅

1,000ft³

$$= (2 \times 56 \times 12 \times 15) / 1,000$$

= 20.1 AT capacity in 1,000 ft³

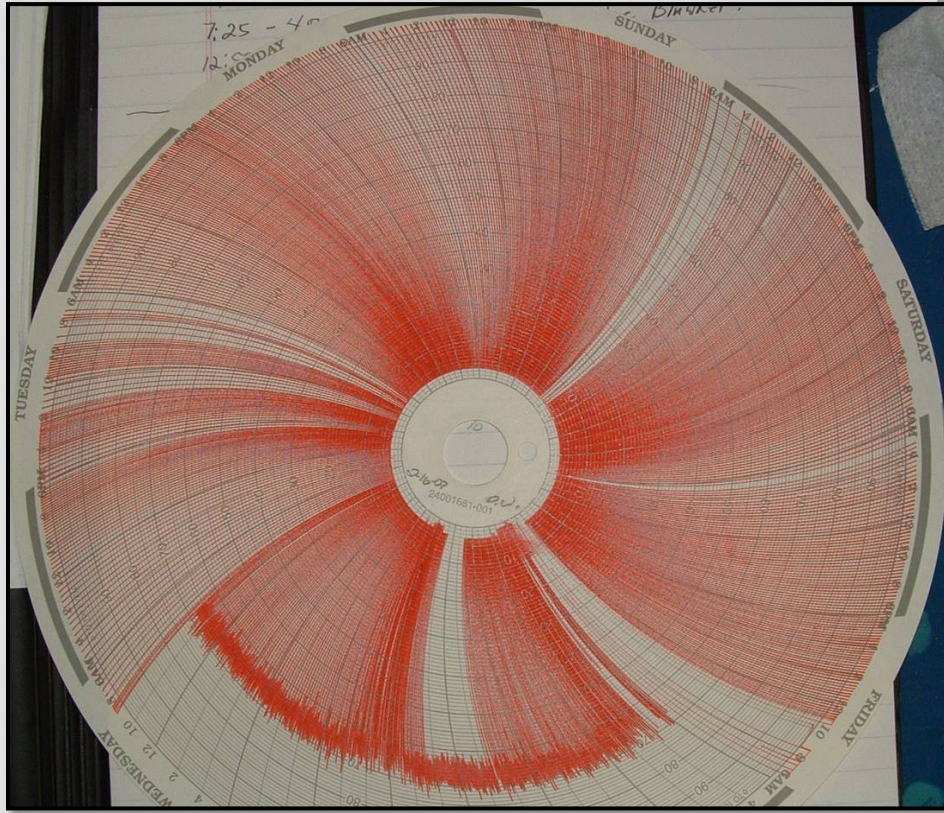
lbs./d/1,000 ft³

$$= 245/20.1$$

$$= 12.2 \text{ lbs./d/1,000 ft}^3$$

BOX # 14

CAPACITY: INCREASE CAPACITY OR DECREASE LOADING



Equalize Flows

- Avg. Daily Flow vs. Pumping Rate
- Flow EQ Design
- Evidence of Problem
 - “the block”

Add more capacity

BOX # 14

CAPACITY: INCREASE CAPACITY OR DECREASE LOADING



- Equalize Flows
 - Avg. Daily Flow vs. Pumping Rate
 - Flow EQ Design
 - Evidence of Problem
 - “the block”
- Add more capacity

BOX # 14

CAPACITY: INCREASE CAPACITY OR DECREASE LOADING



- Equalize Flows
 - Avg. Daily Flow vs. Pumping Rate
 - Flow EQ Design
 - Evidence of Problem
 - “the block”
- Add more capacity

BOX # 13

AERATION: EVALUATE FOR TOXIC ISSUES.



- Common sources
 - Internal
 - Digester Supernatant
 - Other side streams
- Other sources
 - External
 - Force Mains
 - Septage Receiving
 - Color, corrosion, odor

BOX # 13

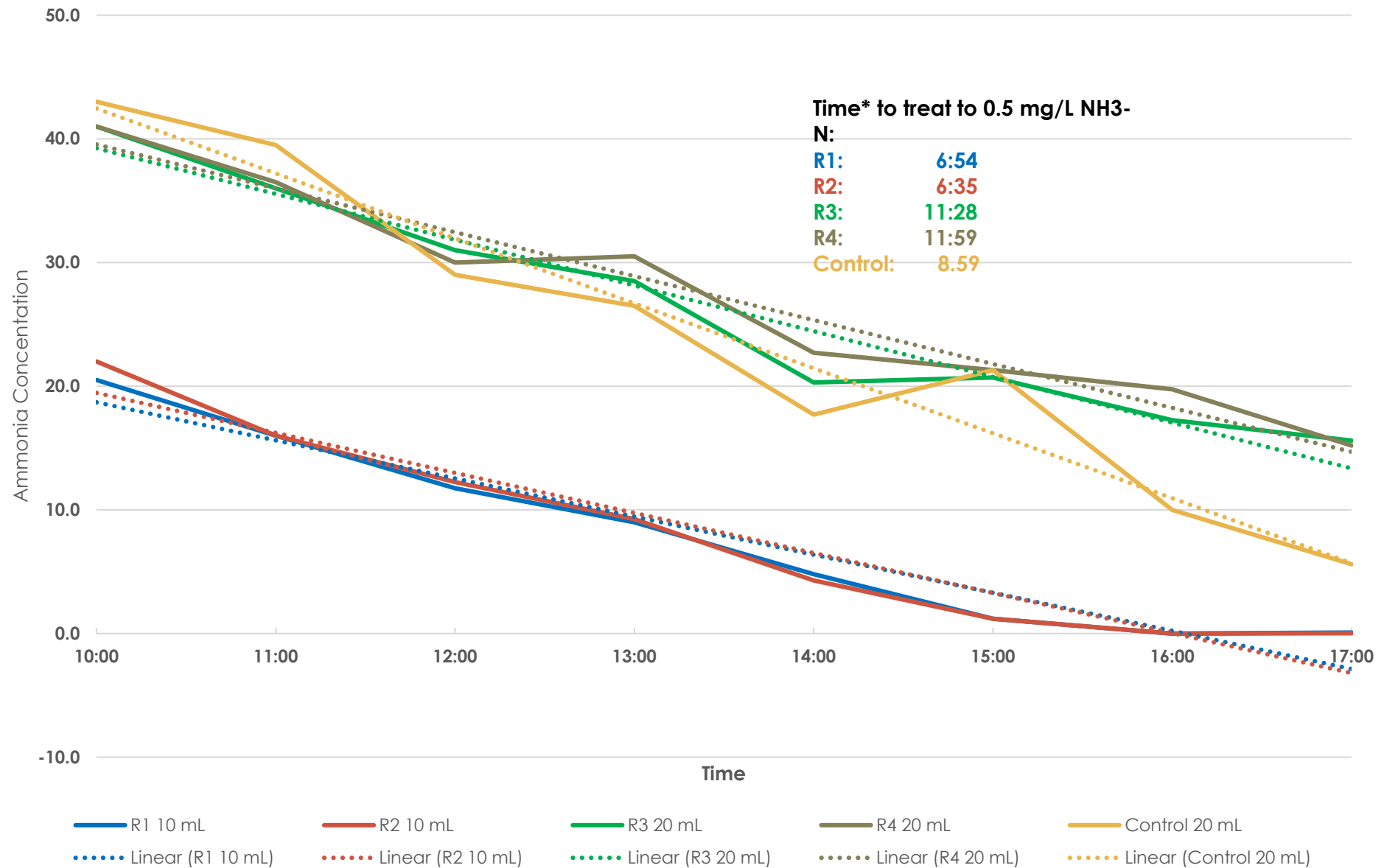
AERATION: EVALUATE FOR TOXIC ISSUES.



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Ammonia Uptake February 26, 2019

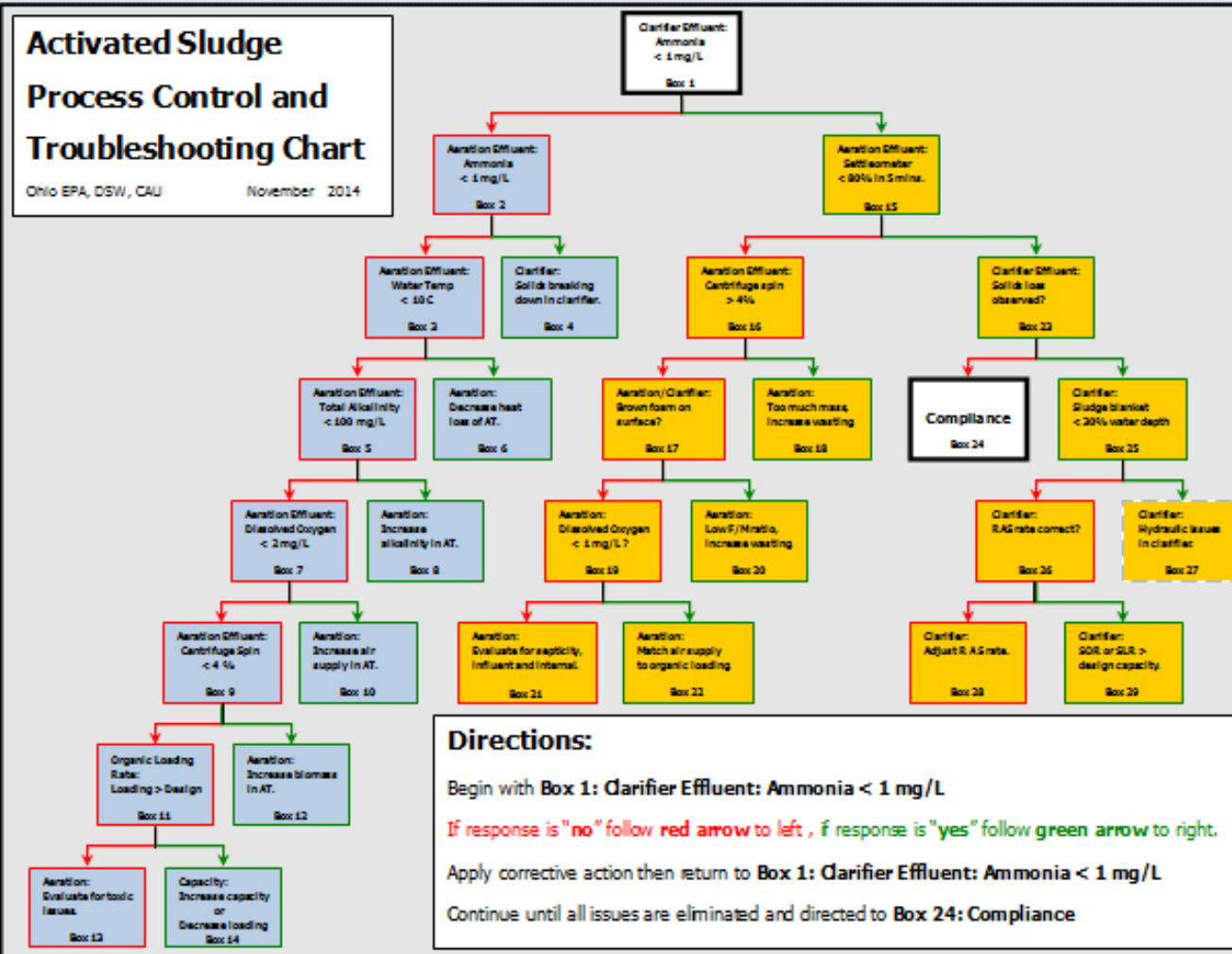


ACTIVATED SLUDGE PROCESS CONTROL

Activated Sludge Process Control and Troubleshooting Chart

Ohio EPA, DSW, CAU

November 2014



<http://epa.ohio.gov>

Divisions and Offices

Environmental and Financial Assistance

Wastewater Treatment Plants:

Get Free Technical Assistance to Improve Compliance

Technical Resources

***Activated Sludge Process Control and
Troubleshooting Chart and Manual***

Or email me at: jon.vandommelen@epa.ohio.gov