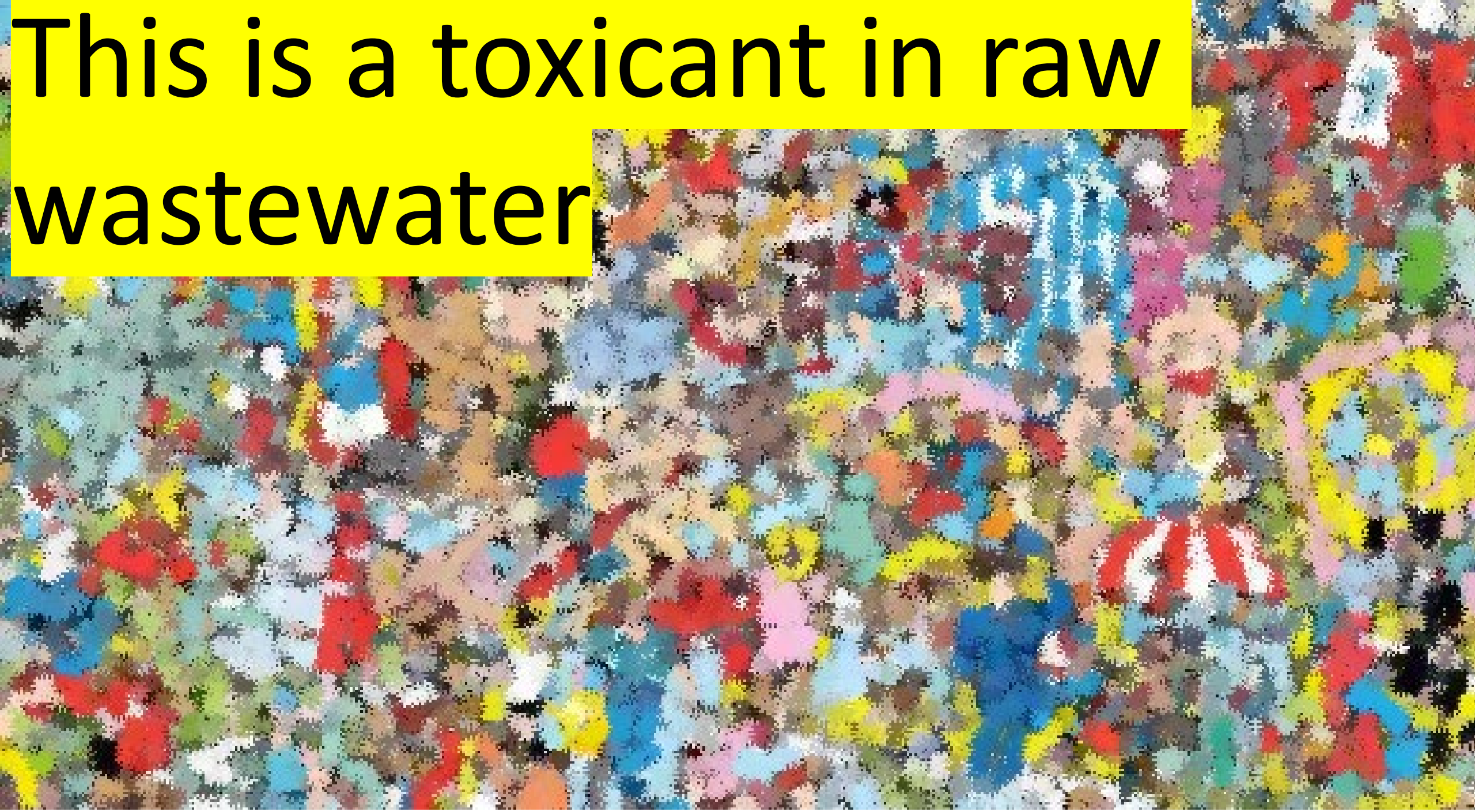
Whole Effluent Toxicity Testing

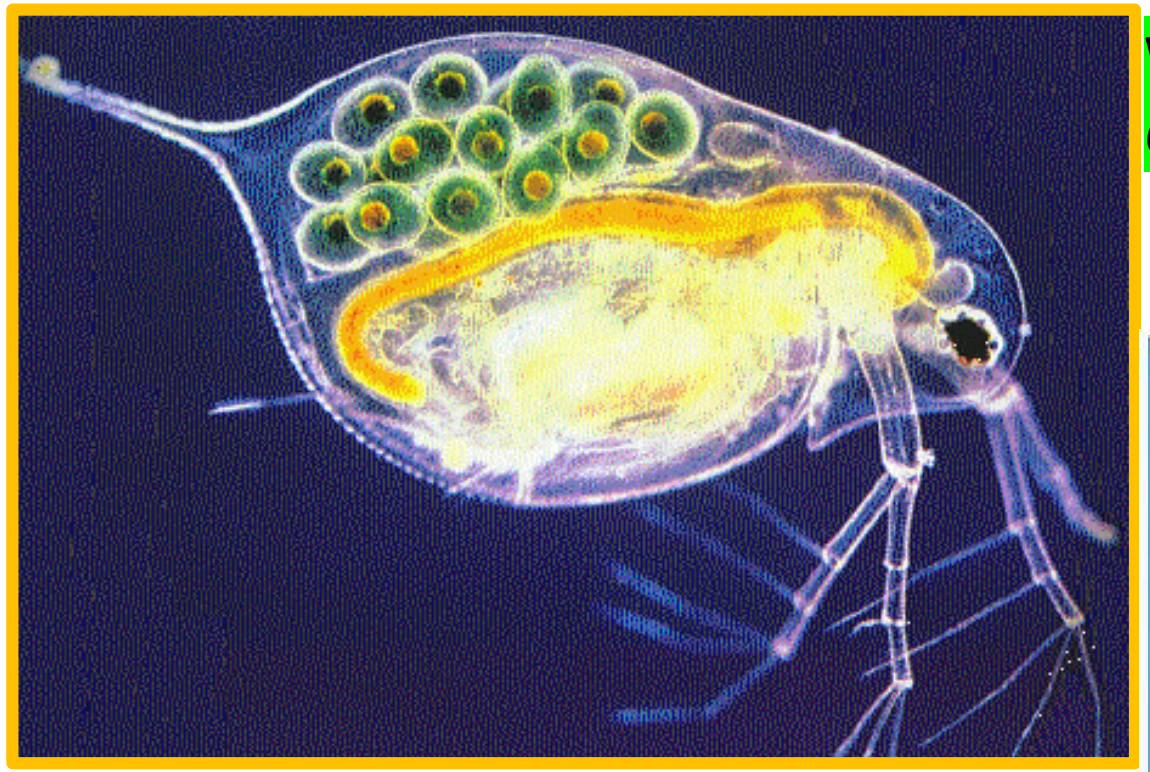
Toxicants in the Pretreatment Program

Chris Pasch,
Plummer Associates, Inc.

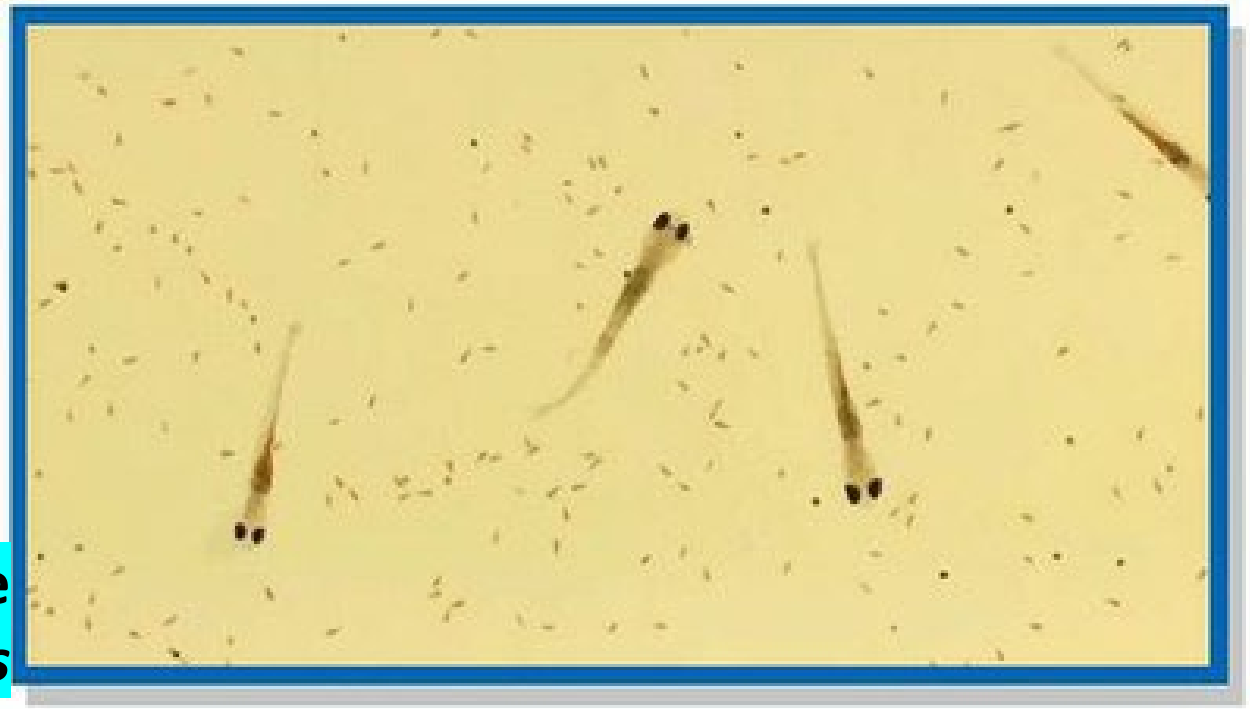
Let me tell you a story

This is a toxicant in raw wastewater





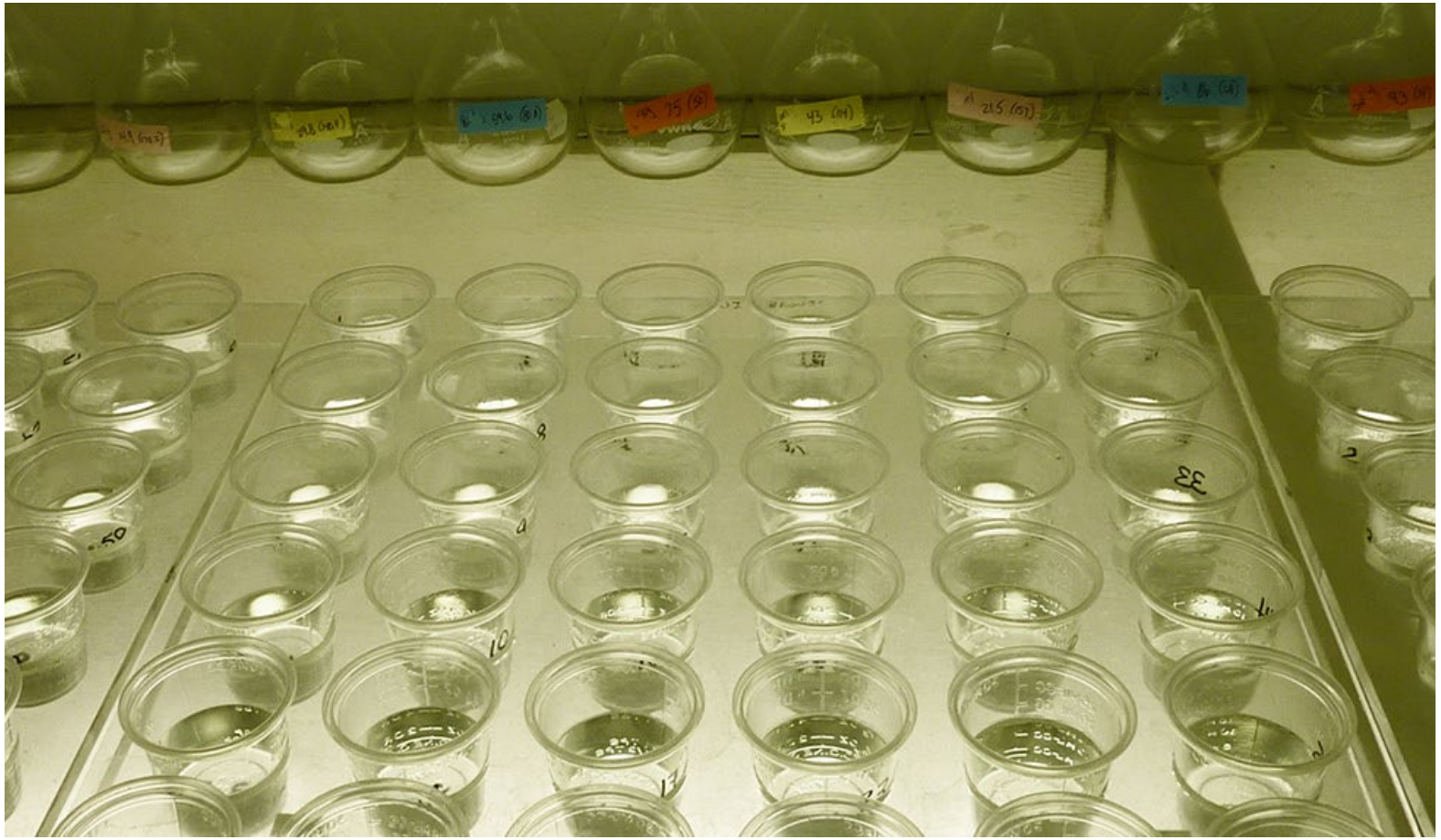
Water flea
Ceriodaphnia dubia



Fathead minnow larvae
Pimephales promelas

CIPCA

Control + 5 effluent dilutions
10 replicates each



Control + 5 effluent dilutions
10 dilutions each

Dilution Water Used: [X] Receiving Water [ ] Synthetic Dilution Water

NUMBER OF YOUNG PRODUCED PER ADULT AT TEST TERMINATION

	EFFLUENT CONCENTRATION (%)						
REPLICATE	TCON	PCON	34 %	46 %	61 %	81 %	100 %
A	24	28	19	37	30	27	26
B	23	23	30	33	33	30	25
C	23	25	26	26	29	29	26
D	28	26	27	23	27	29	27
E	27	25	26	30	27	29	26
F	24	23	30	29	25	27	23
G	27	27	30	33	26	26	24
H	29	28	30	30	32	26	26
I	32	26	31	25	31	29	24
J	31	25	23	27	28	25	23
Surv. MEAN	26.8	25.6	27.2	29.3	28.8	27.7	25.0
Total MEAN	26.8	25.6	27.2	29.3	28.8	27.7	25.0
CV % [1]	12.1	6.9	14.1	14.4	9.2	6.1	5.6
PMSD	Acceptable Range 47 or Less					11.7 %	

[1] Coefficient of Variation = (standard deviation/mean) x 100) Calculations are based on young of the surviving females. Males are designated (M), and dead females are designated (D) along with the number of neonates released prior to death.

CIPCA

Control + 5 effluent dilutions
10 replicates each

Dilution: 61 %

	1	2	3	4	5	6	7	8	9	10
24 hrs	A									A
2 days	A									A
3 days	A									A
4 days	6	5	6	7	3	4	6	6	7	3
5 days	8	10	6	8	10	8	8	8	10	B
6 days	16	18	17	12	14	13	12	15	14	12
7 days	A	A	A	A	A	A	A	3	A	A
8 days				2	3	3	4		0	4

NUMBER OF YOUNG PRODUCED PER ADULT AT TEST TERMINATION

	EFFLUENT CONCENTRATION (%)						
REPLICATE	TCON	PCON	34 %	46 %	61 %	81 %	100 %
A	24	28	19	37	30	27	26
B	23	23	30	33	33	30	25
C	23	25	26	26	29	29	26
D	28	26	27	23	27	29	27
E	27	25	26	30	27	29	26
F	24	23	30	29	25	27	23
G	27	27	30	33	26	26	24
H	29	28	30	30	32	26	26
I	32	26	31	25	31	29	24
J	31	25	23	27	28	25	23
Surv. MEAN	26.8	25.6	27.2	29.3	28.8	27.7	25.0
Total MEAN	26.8	25.6	27.2	29.3	28.8	27.7	25.0
CV % [1]	12.1	6.9	14.1	14.4	9.2	6.1	5.6
PMSD	Acceptable Range 47 or Less					11.7 %	

CIPCA

Dilution: 61 %

	1	2	3	4	5	6	7	8	9	10
24 hrs	A									A
2 days	A									A
3 days	A									A
4 days	6	5	6	7	3	4	6	6	7	3
5 days	8	10	6	8	10	8	8	8	10	B
6 days	16	18	17	12	14	13	12	15	14	12
7 days	A	A	A	A	A	A	A	3	A	A
8 days				9	8	9	4		8	4

CIPCA

Dilution: 61 %

	1	2	3	4	5	6	7	8	9	10
24 hrs	A									A
2 days	A									A
3 days	A									A
4 days	6	5	6	7	3	4	6	6	7	3
5 days	8	10	6	8	10	8	8	8	10	13
6 days	16	18	17	12	14	13	12	15	4	12
7 days	A	A	A	A	A	A	A	3	A	A
8 days				9	3	4	4		0	4

CIPCA

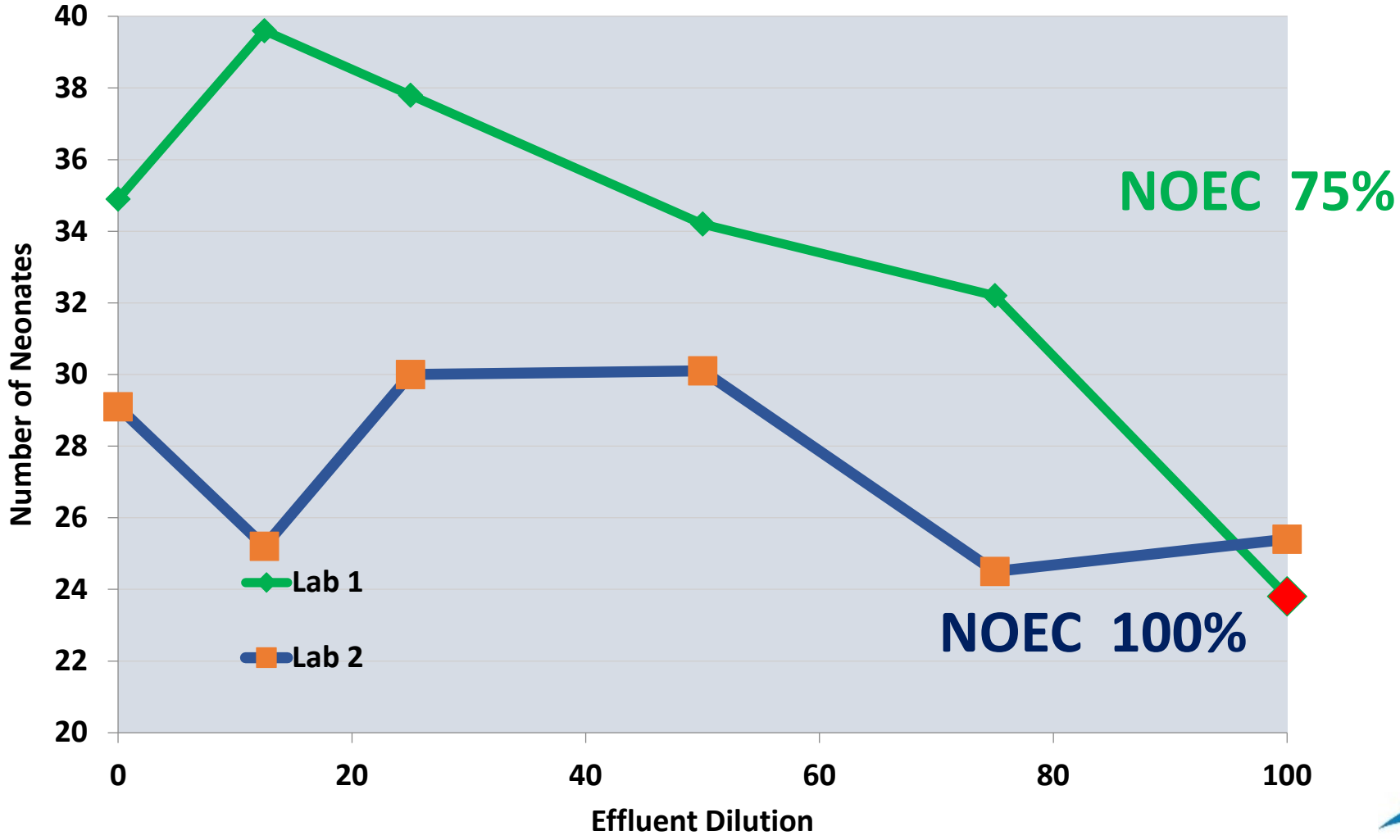
NUMBER OF YOUNG PRODUCED PER ADULT AT TEST TERMINATION

	EFFLUENT CONCENTRATION (%)						
REPLICATE	TCON	PCON	34 %	46 %	61 %	81 %	100 %
A	24	28	19	37	30	27	26
B	23	23	30	33	33	30	25
C	23	25	26	26	29	29	26
D	28	26	27	23	27	29	27
E	27	25	26	30	27	29	26
F	24	23	30	29	25	27	23
G	27	27	30	33	26	26	24
H	29	28	30	30	32	26	26
I	32	26	31	25	31	29	24
J	31	25	23	27	28	25	23
Surv. MEAN	26.8	25.6	27.2	29.3	28.8	27.7	25.0
Total MEAN	26.8	25.6	27.2	29.3	28.8	27.7	25.0
CV % [1]	12.1	6.9	14.1	14.4	9.2	6.1	5.6
PMSD	Acceptable Range 47 or Less					11.7 %	

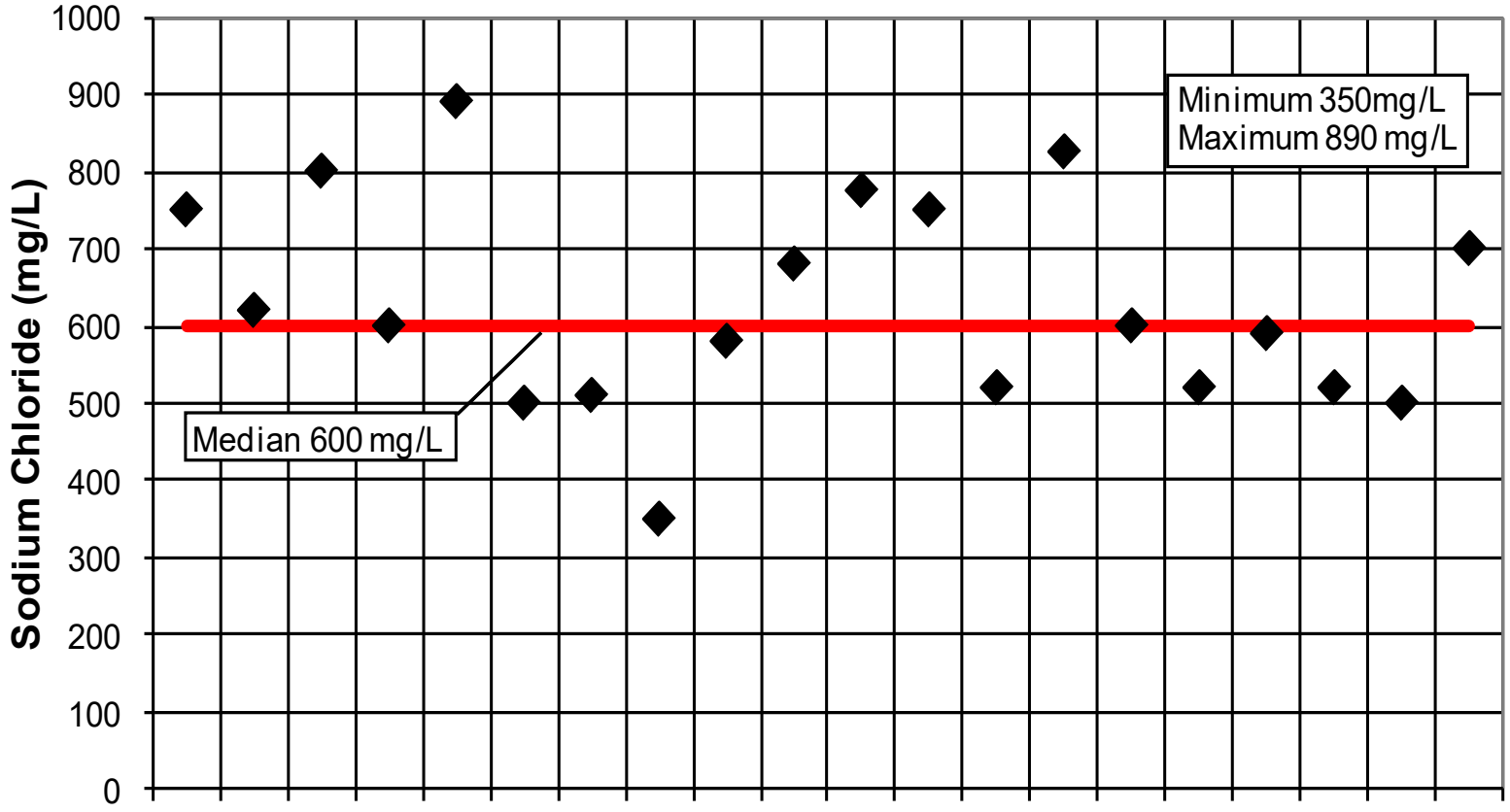
CIPCA

Don’t get stuck in a hole

Split Sample – POTW – 2 Labs



Reference Toxicant Data
Waterflea

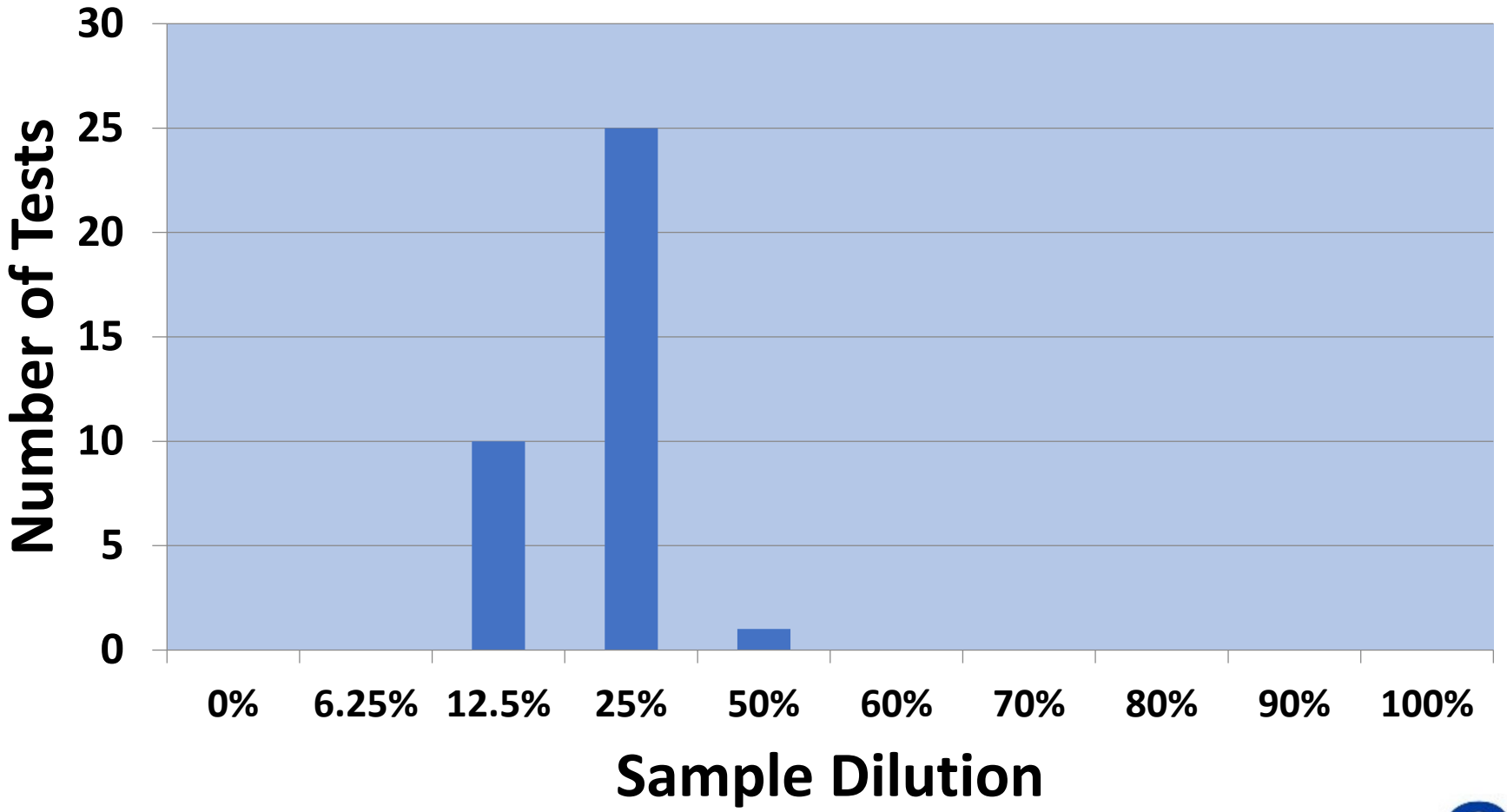


Concentration that produces sublethal effects in laboratory dilution water

Monthly Tests

CIPCA

DMR QA TESTING
PROFICIENCY SAMPLE NOEC



CIPCA

Where to turn when there is toxicity?

United States Environmental Protection Agency | Office of Wastewater Management Washington DC 20460 | EPA/833-B-99/002 August 1999

EPA

Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants

United States Environmental Protection Agency | Office of Research and Development Washington, DC 20460 | EPA/600/6-91/005F May 1992

EPA

Toxicity Identification Evaluation:

Characterization of Chronically Toxic Effluents, Phase I

United States Environmental Protection Agency | Office of Research and Development Washington DC 20460 | EPA/600/R-92/080 September 1993

EPA

Methods for Aquatic Toxicity Identification Evaluations

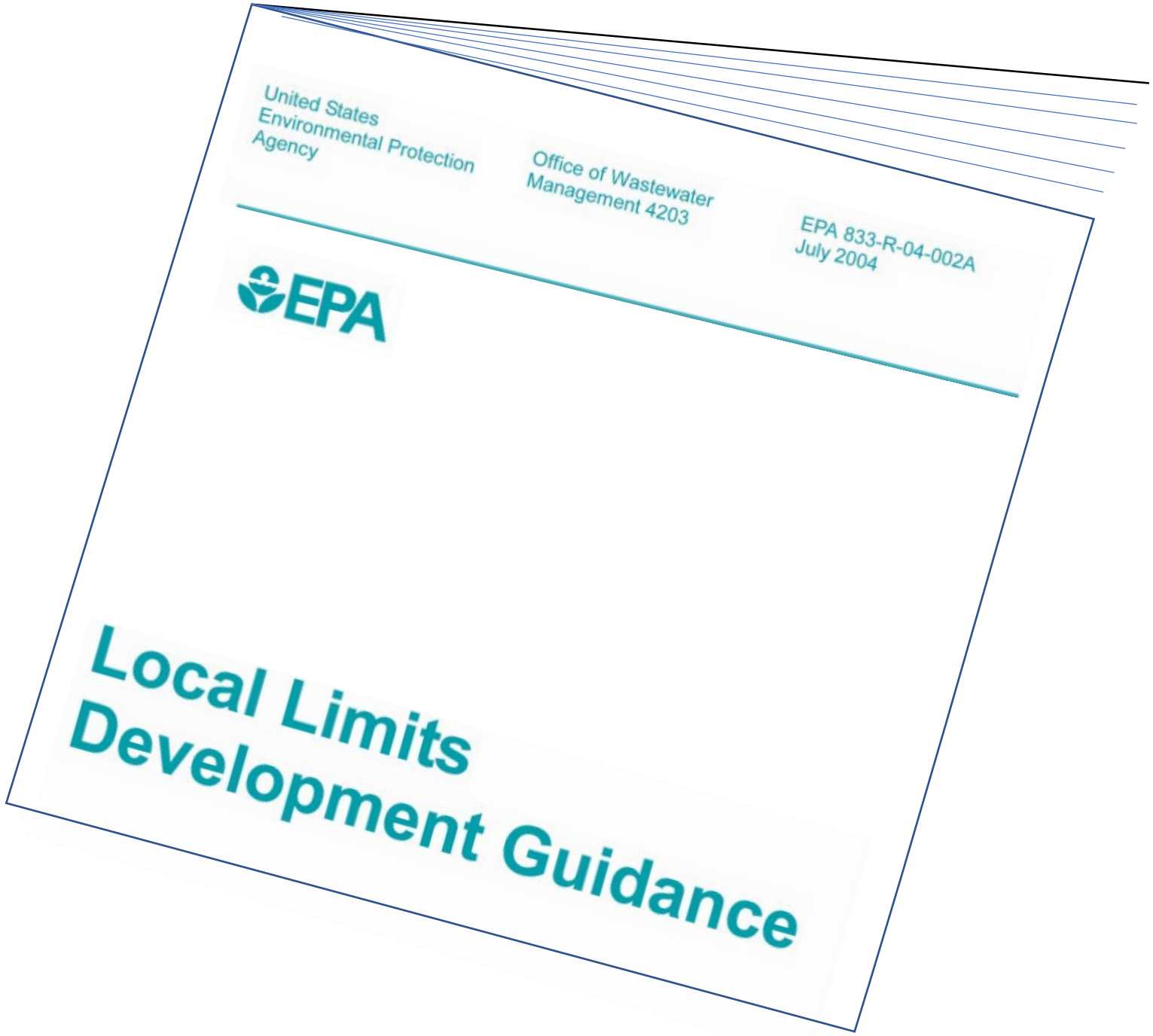
Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity

United States Environmental Protection Agency | Office of Research and Development Washington DC 20460 | EPA/600/R-92/081 September 1993

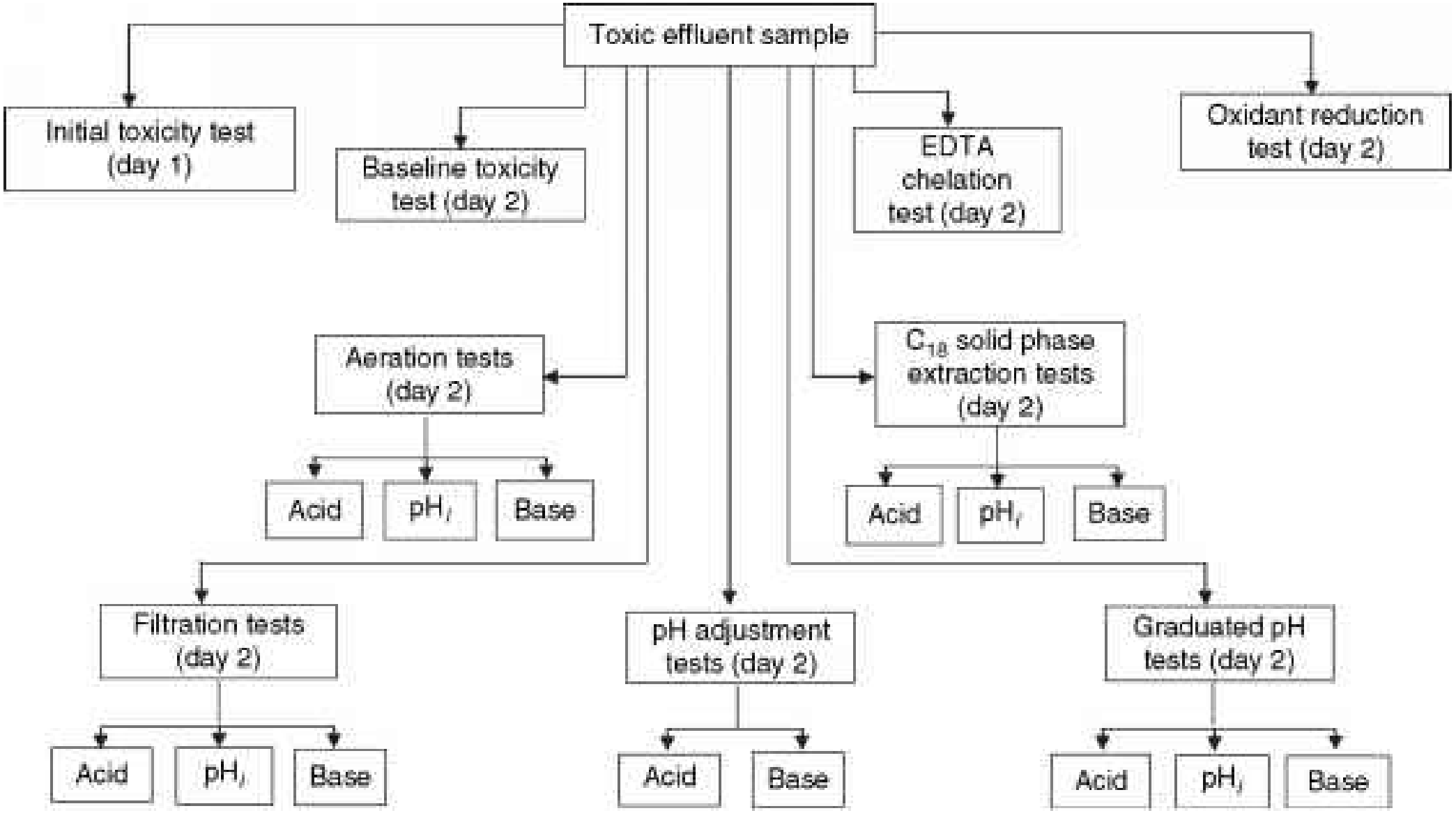
EPA

Methods for Aquatic Toxicity Identification Evaluations

Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity

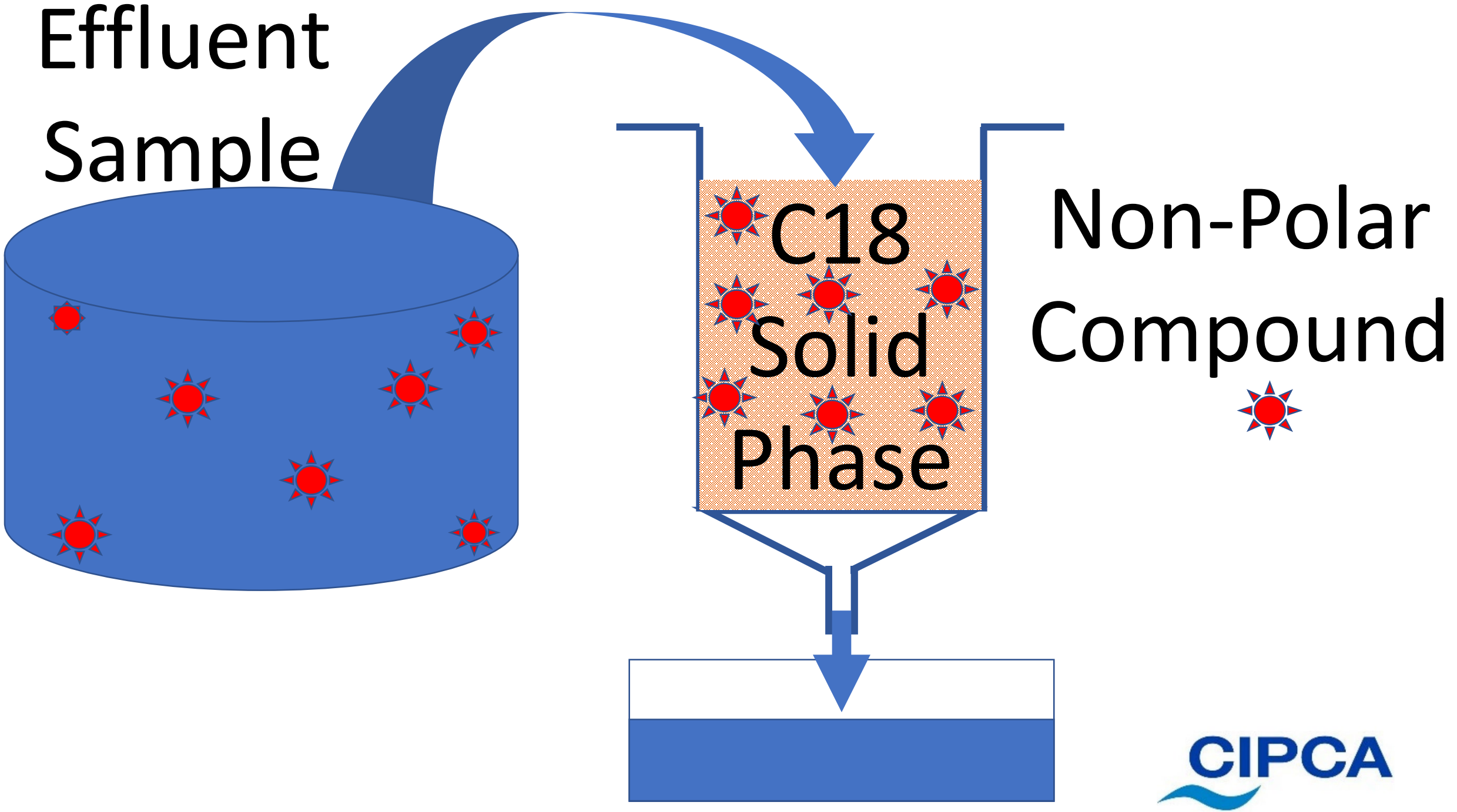

United States
Environmental Protection
Agency
Office of Wastewater
Management 4203
EPA 833-R-04-002A
July 2004
EPA
Local Limits
Development Guidance

CIPCA


Toxic effluent sample
Initial toxicity test (day 1)
Baseline toxicity test (day 2)
EDTA chelation test (day 2)
Oxidant reduction test (day 2)
Aeration tests (day 2)
Acid
pHi
Base
C18 solid phase extraction tests (day 2)
Acid
pHi
Base
Filtration tests (day 2)
Acid
pHi
Base
pH adjustment tests (day 2)
Acid
Base
Graduated pH tests (day 2)
Acid
pHi
Base

0. Baseline Test
1. EDTA Test
2. Sodium Thiosulfate
3. Aeration Test
4. C18 Solid Phase Extraction
5. Filtration
6. pH adjustment

Pay close attention


Effluent
Sample
C18
Solid
Phase
Non-Polar
Compound
CIPCA

Don’t jump to conclusions

2004 TBLL Guidance

- Determining inhibition values is difficult
- Some simply use the highest observed conc
- Only one example for Chesterfield County (VA)

2004 Guidance

Difficulties in Identifying Inhibitors

- Synergism
- Antagonism
- pH
- Temperature
- Hardness
- *Alkalinity*

2004 Guidance
Difficulties in Identifying Inhibitors

- Stressed conditions
- Microorganism acclimation
- Number and variety of microorganisms

CIPCA

Perspective

Nitrite Lock at Large WWTP

- Increase in chlorine demand, nitrite reacts with chlorine (1:5)
- Processes studied, no cause for nitrite lock identified
- Lab data reviewed, no abnormalities
- Pretreatment program showed no new industries of concern

Nitrite Lock at Large WWTP

- Analyses:
  - QACs
  - Metals
  - CECs
  - TMA Salts

  - Difficulty finding laboratories and analytical methods

Nitrite Lock at Large WWTP

- Single industry with non-functional pretreatment system for QACs
- Enforcement
- Repeated reseeding from adjacent WWTP

CIPCA 2014

Greg Farmer
Littleton /City of Englewood

Nitrification Inhibition at a Large Advanced WWTP

What *is* this Stuff!!??

2014 CIPCA Fall Conference

Greg Farmer, CWP
Process Specialist
Littleton / Englewood WWTP

City of Littleton

City of Englewood

CIPCA

Tools to Assess Inhibition

- Bench-scale respirometer
- Microtox, LumiStox, ToxAlert
- BioFix
- Strathtox
- BI-2000 Respirometer

CIPCA

Nitrosomonas

Nitrobacter

CIPCA

Respirometer Measures Activated Sludge Bacterial Performance

CIPCA

What about Inhibitors for Advanced Treatment?

- Phosphorus removal
- Denitrification
- Anammox
- Aerobic granular sludge

Lessons:

- Know all chemical used by industries, not just the pollutants regulated
- Consider requiring respirometer tests
  - New industries
  - Non-compliant industries
- Understand the short-coming of the priority pollutant tests

Question

hijklmno

hijklmno

CIPCA

Chris Pasch
Plummer Associates, Inc.
cpasch@plummer.com
512.423.4285