

WET in NPDES Permits

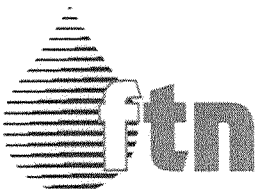
Arkansas Water Works &
Water Environment Conference

May 2, 2016

Pat Downey

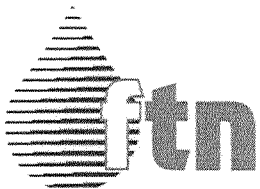
FTN Associates, Ltd.

May 2, 2016



WET Monitoring Requirements

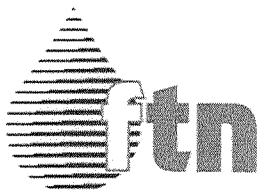
Acute or chronic biomonitoring
at some frequency (e.g.
Quarterly)



WET Monitoring Requirements

Acute

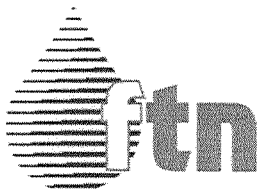
- Short term (48 h)
- Life or death



WET Monitoring Requirements

Chronic

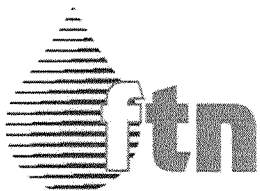
- Longer term (7 days)
- Life, death, reproduction (flea), growth (fish)



WET Monitoring Requirements

Chronic biomonitoring when:

- Discharge > 10% of stream flow
- All majors

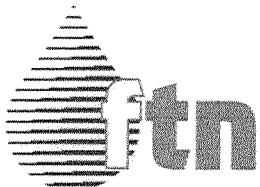


WET Monitoring Requirements

Chronic biomonitoring when
discharge $> 10\%$ of stream flow

Critical dilution $\sim 90\%$

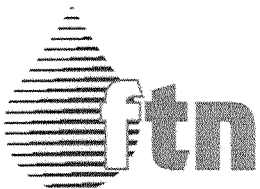
= end of pipe compliance



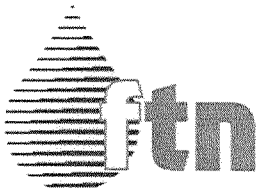
Test Failure

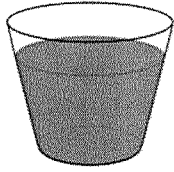
**Permit typically specifies a failure as
an NOEC < some concentration.**

(No Observed Effect Concentration)

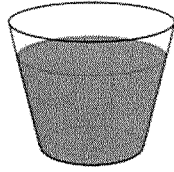


WET Testing 99½

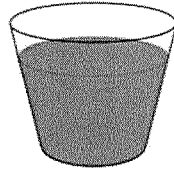




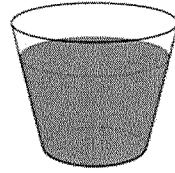
Lab Water



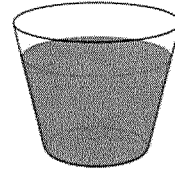
32 % Effluent



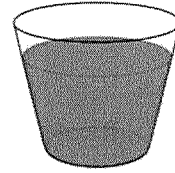
46 % Effluent



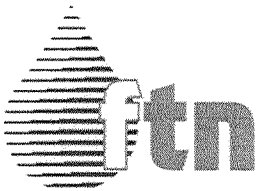
56 % Effluent

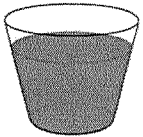
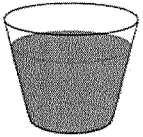
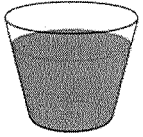
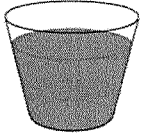
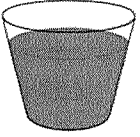
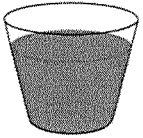
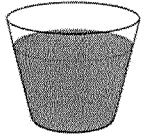
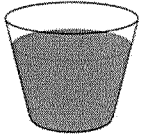
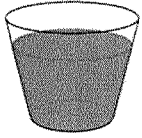
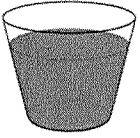
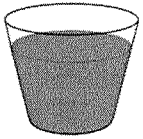
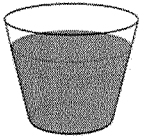
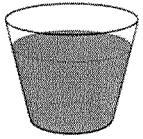
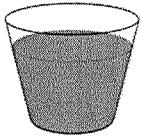
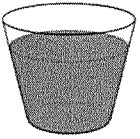
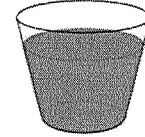
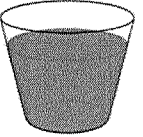
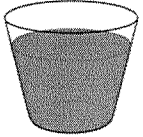
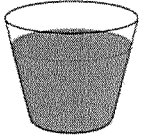
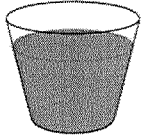
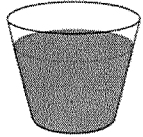
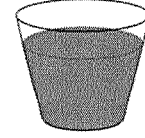
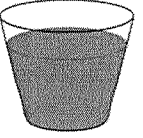
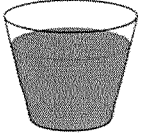
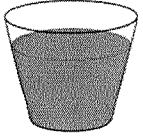
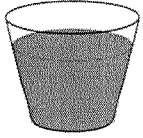
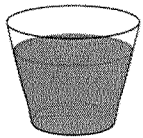


75 % Effluent



100 % Effluent





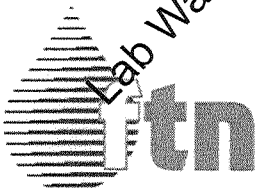
32%

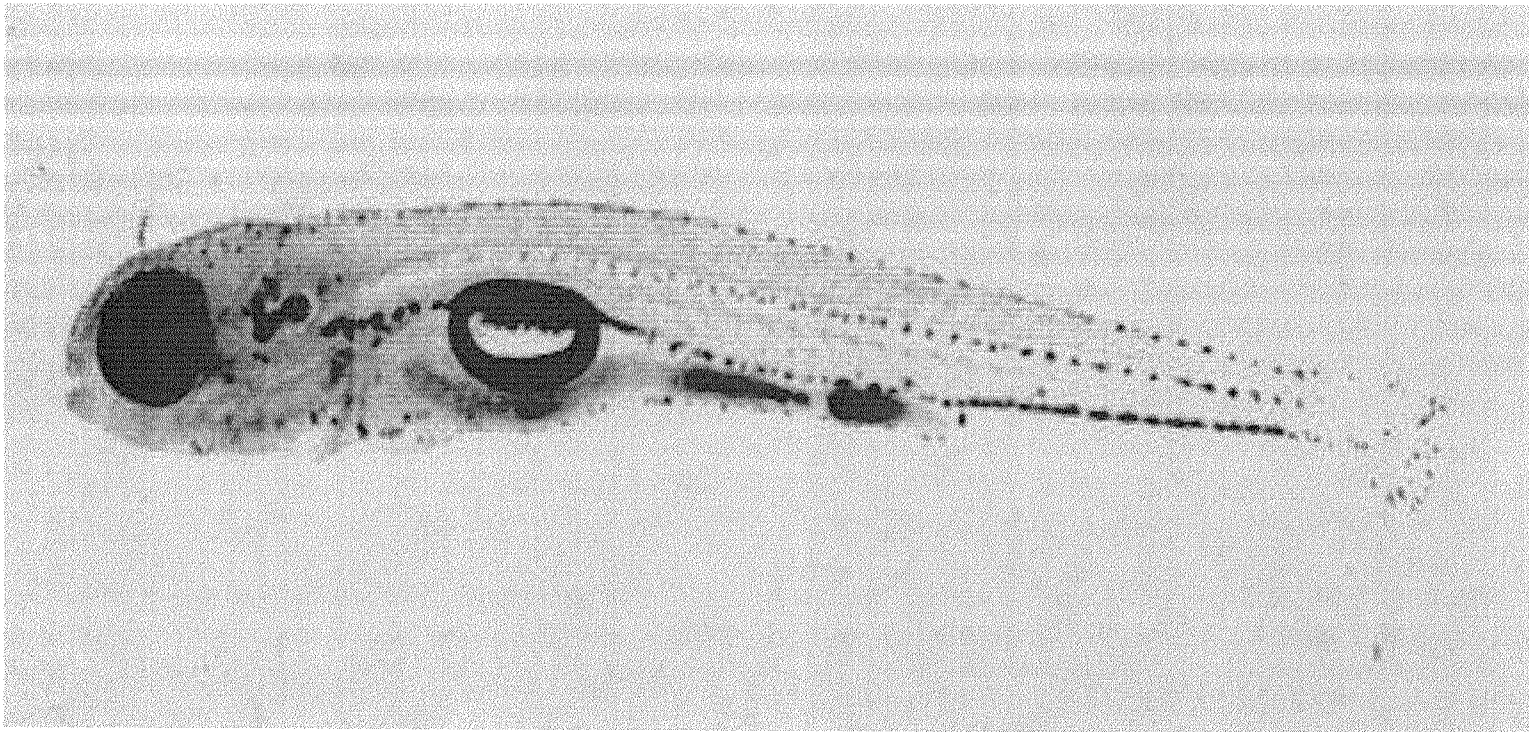
46%

56%

75%

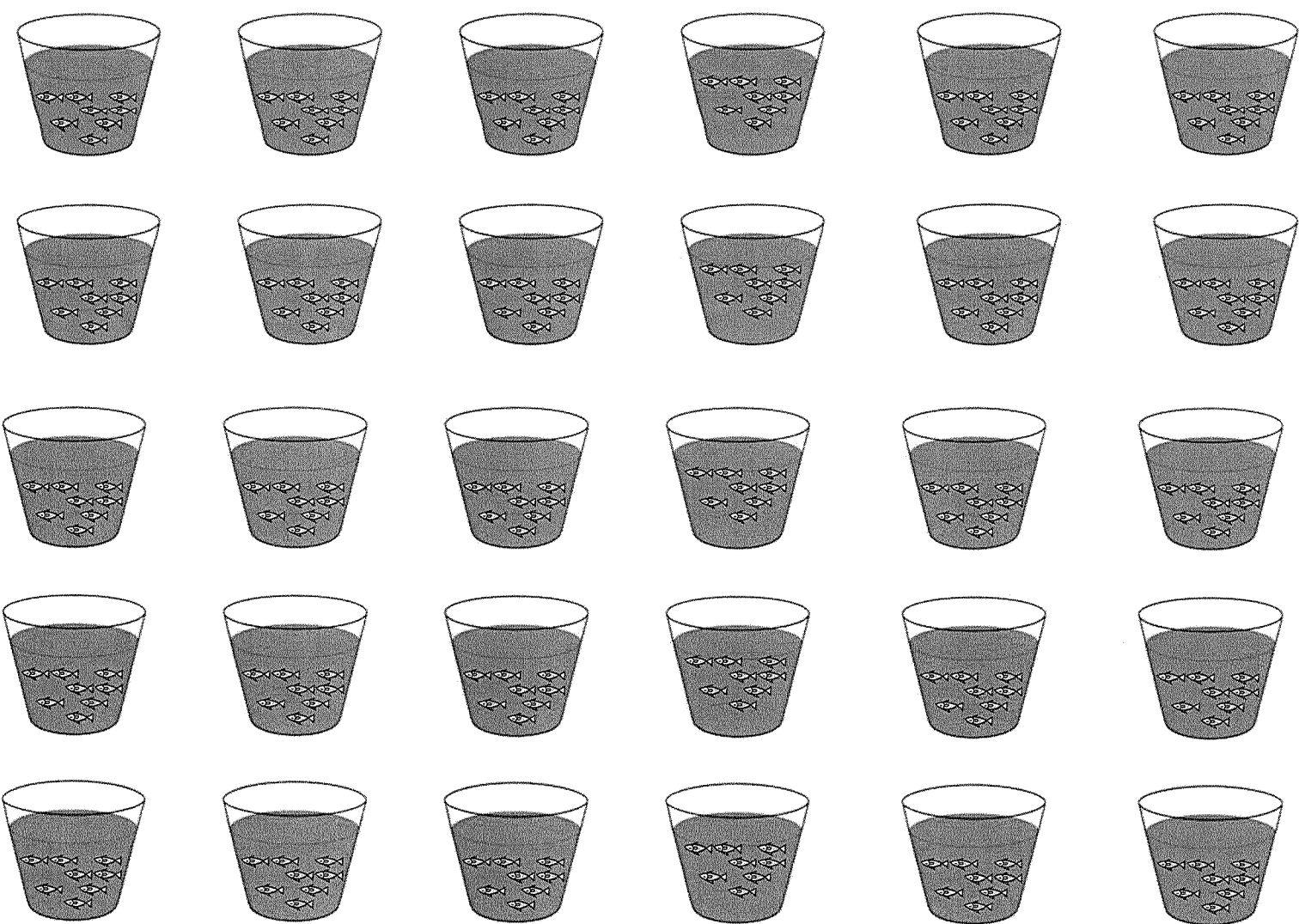
100%





← 6 mm →

Fathead minnow larva used in chronic tests:
Pimephales promelas



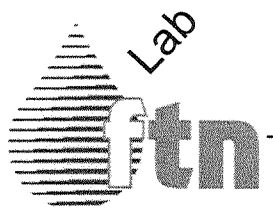
32%

46%

56%

75%

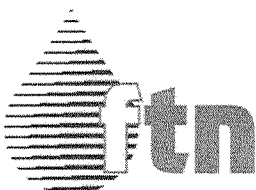
100%



V FATHREAD MINNOW SURVIVAL AND GROWTH 7-DAY CHRONIC TOXICITY TEST
EPA-821-R-02-013 Method 1000.0

TEST LOG NO _____ BEGINNING HRS: 5:34 DATE: 10/21/14 PHOTO PERIOD: 16 hr light/8 hr dark
 JOB NUMBER _____ ENDING HRS: 1:58 DATE: 10/21/14 FEEDING REGIME:
 INDUSTRY: _____ TEST DILUTIONS: 32, 42, 56, 75, 100 0.15 mL Artemia @ 2 times/day
 EFFLUENT: _____ ORGANISM AGE (days): 10/20/14 TEST VESSEL CAPACITY: 450 mL
 DILUTION WATER: _____ ORGANISM SOURCE: BT #4547 TEST SOLUTION VOLUME: 250 - 300 mL
 NPDES Yes X SOURCE TEMP @ TEST START: 24.5 NO. ORGANISMS/TREATMENT: 8
 FOOD BATCH: 4018 RANDOMIZED BY: JV NO. REPLICATES: 5

CONC (%)	REP ID	SURVIVAL (#)							
		START	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7
Soft Water	A	8	8	8	8	8	8	8	8
	B	8	8	8	8	8	8	8	8
	C	8	8	8	8	8	8	8	8
	D	8	8	8	8	8	8	8	8
	E	8	8	8	8	8	8	8	8
	Temp (°C): old/new	24.1	24.0/24.4	24.1/24.5	24.1/24.4	24.1/24.4	24.3/24.5	24.1/24.1	24.1/24.1
32%	A	8	8	8	8	8	8	8	8
	B	8	8	8	8	8	8	8	8
	C	8	8	8	8	8	8	8	8
	D	8	8	8	8	8	8	8	8
	E	8	8	8	8	8	8	8	8
	Temp (°C): old/new	24.0	24.0/24.4	24.1/24.2	24.1/24.1	24.1/24.1	24.1/24.4	24.1/24.4	24.1/24.2
42%	A	8	8	8	8	8	8	8	8
	B	8	8	8	8	8	8	8	8
	C	8	8	8	8	8	8	8	8
	D	8	8	8	8	8	8	8	8
	E	8	8	8	8	8	8	8	8
	Temp (°C): old/new	24.1	24.0/24.6	24.5/24.6	24.4/24.6	24.4/24.6	24.2/24.6	24.1/24.6	24.1/24.6
56%	A	8	8	8	8	8	8	8	8
	B	8	8	8	8	8	8	8	8
	C	8	8	8	8	8	8	8	8
	D	8	8	8	8	8	8	8	8
	E	8	8	8	8	8	8	8	8
	Temp (°C): old/new	24.0	24.7/24.5	24.3/24.4	24.3/24.6	24.3/24.6	24.3/24.6	24.1/24.4	24.0/24.6
SO 75% Hard Water	A	8	8	8	8	8	8	8	8
	B	8	8	8	8	8	8	8	8
	C	8	8	8	8	8	8	8	8
	D	8	8	8	8	8	8	8	8
	E	8	8	8	8	8	8	8	8
	Temp (°C): old/new	24.1	24.1/24.5	24.4/24.4	24.4/24.6	24.4/24.6	24.3/24.6	24.1/24.4	24.1/24.4
100%	A	8	8	8	8	8	8	8	8
	B	8	8	8	8	8	8	8	8
	C	8	8	8	8	8	8	8	8
	D	8	8	8	8	8	8	8	8
	E	8	8	8	8	8	8	8	8
	Temp (°C): old/new	24.1	24.4/24.5	24.6/24.6	24.6/24.6	24.6/24.6	24.6/24.6	24.1/24.6	24.1/24.6
Test Renewal	Time	15:34	15:37	15:50	16:05	17:22	17:46	18:14	18:29
	Date	10/21/14	10/21/14	10/21/14	10/21/14	10/21/14	10/21/14	10/21/14	10/21/14
	Initials	AT	AT	LL	HT	HT	HT	AT	LL
Morning Feeding	Int/Time	16:20	16:05	16:05	16:02	16:02	16:02	16:02	16:02
Afternoon Feeding	Int/Time	17:15	17:15	17:15	17:15	17:15	17:15	17:15	17:15



FATHEAD MINNOW SURVIVAL AND GROWTH 7-DAY CHRONIC TOXICITY TEST
EPA-821-R-02-013 Method 1000.0

TEST LOG NO.:
JOB NO.: 20-3
INDUSTRY: DC
EFFLUENT:
NPDES: Yes X No

BEGINNING: HRS: 1334 DATE: 10/21/14
ENDING: HRS: 1327 DATE: 10/21/14
NO. ORGANISMS/TREATMENT: 8
NO. REPLICATES: 5

PHOTOPERIOD: 16 hr light
FEEDING REGIME:
0.15 mL Artemia @ 2 times/day
TEST VESSEL CAPACITY: 450 mL
TEST SOLUTION VOLUME: 250 mL

GROWTH RESULTS							
CONC (%)	REP ID	Boat ID	Tare wt (g)	Combined wt (g)	Tot Fish wt (g)	# of Fish	Fish Wt (mg) Per Final # of Fish
Soft Water	A	1	1.07356	1.08097	0.00341	8	0.426
	B	2	1.09906	1.10310	0.00404	8	0.505
	C	3	1.07485	1.08129	0.00344	8	0.430
	D	4	1.10341	1.10802	0.00461	8	0.576
	E	5	1.11394	1.11913	0.00519	8	0.649
32	A	6	1.07982	1.08466	0.00484	8	
	B	7	1.10598	1.11034	0.00436	8	
	C	8	1.10500	1.10992	0.00439	8	
	D	9	1.09322	1.09742	0.00420	8	
	E	10	1.09318	1.09892	0.00574	8	
42	A	11	1.11340	1.11703	0.00363	8	
	B	12	1.09986	1.10392	0.00406	8	
	C	13	1.091089	1.10045	0.00356	7	
	D	14	1.08345	1.08958	0.00563	8	
	E	15	1.10646	1.11277	0.00631	8	
56	A	16	1.08779	1.09202	0.00423	6	
	B	17	1.10496	1.10890	0.00384	8	
	C	18	1.08493	1.08914	0.00421	8	
	D	19	1.09502	1.10149	0.00581	8	
	E	20	1.07590	1.08115	0.00525	8	
75 RD NW	A	21	1.08260	1.08755	0.00495	8	
	B	22	1.07126	1.07708	0.00582	8	
	C	23	1.07654	1.08141	0.00482	8	
	D	24	1.09636	1.10191	0.00515	8	
	E	25	1.10072	1.10588	0.00566	8	
100	A	26	1.08221	1.08751	0.00520	8	
	B	27	1.08013	1.08511	0.00398	7	
	C	28	1.08507	1.08994	0.00427	8	
	D	29	1.09004	1.09529	0.00525	8	
	E	30	1.08728	1.09293	0.00505	8	
MH	A	31	1.10357	1.10853	0.00546	8	
	B	32	1.09021	1.09432	0.00409	8	
	C	33	1.10537	1.11041	0.00504	8	
	D	34	1.09057	1.09559	0.00422	8	
	E	35	1.11310	1.11793	0.00483	8	
Initials / Date:		LM/10/21					

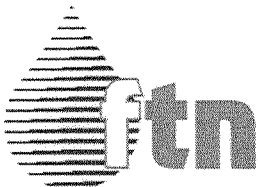
AVG Control Fish wt: 0.617 (using final #)

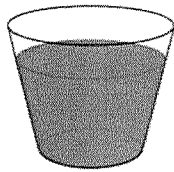
Oven ID: #1

Tins In:
Date: 10/21/14
Time: 1403
Temp (°C): 104
Initials: LM

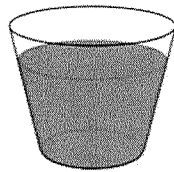
Tins Out:
Date: 10/29/14
Time: 1024
Temp (°C): 160
Initials: LM

FINAL WEIGHTS
DATE: 10/29/14
INITIALS: LM

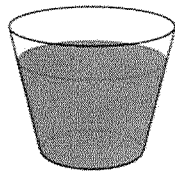




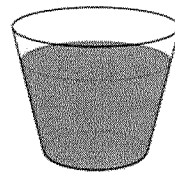
Lab
Water



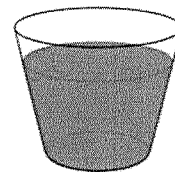
32%
Effluent



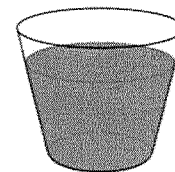
42%
Effluent



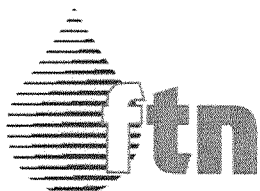
56%
Effluent

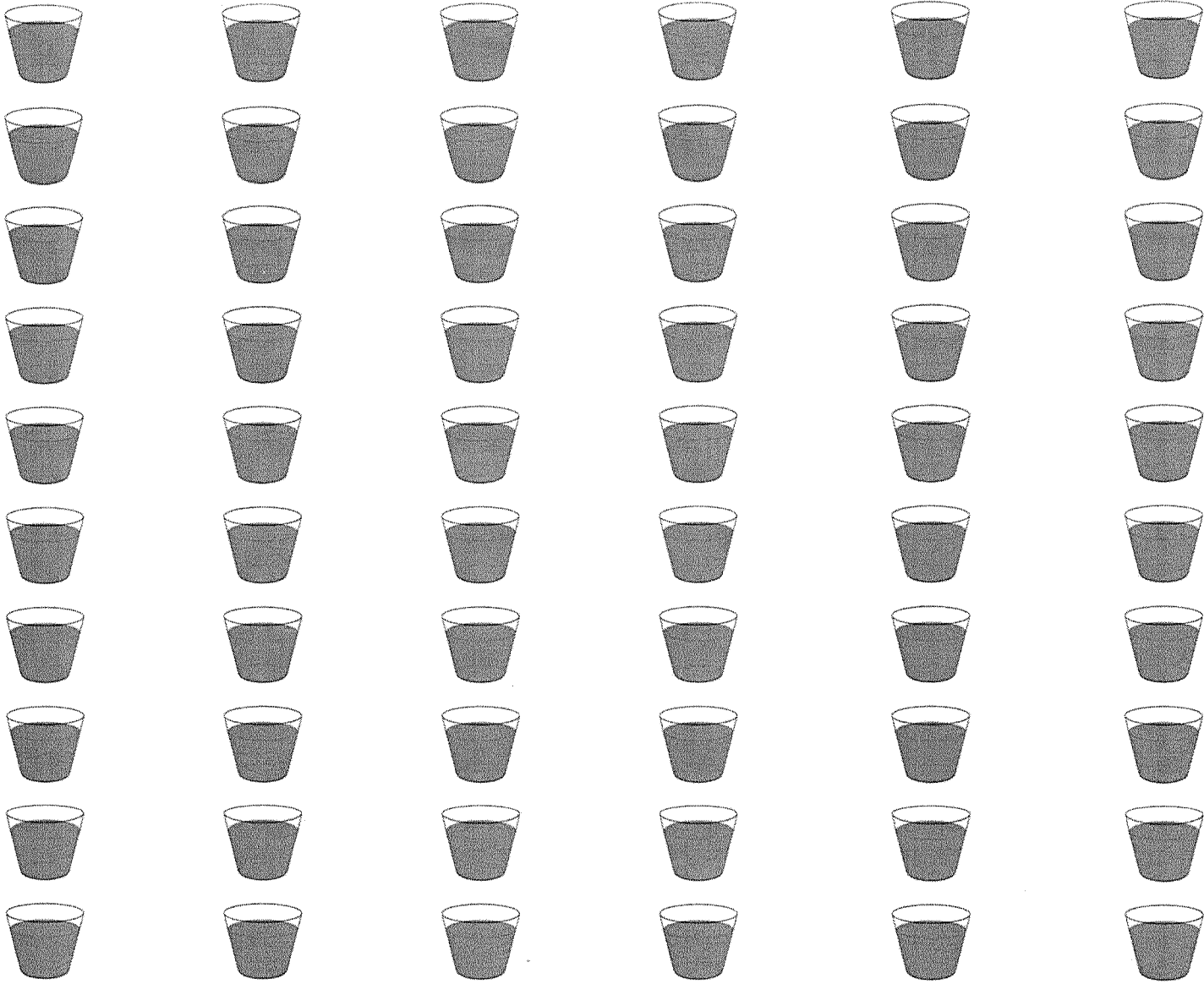


75%
Effluent



100%
Effluent





Lab

Water

32%

Effluent

42%

Effluent

56%

Effluent

75%

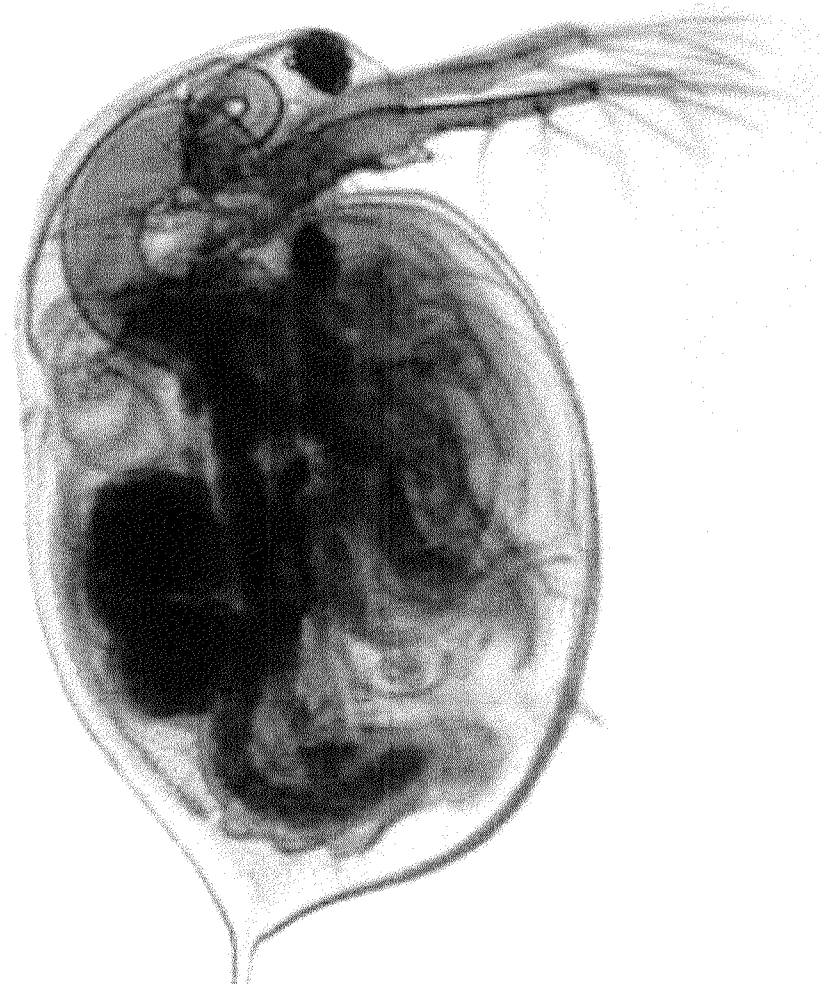
Effluent

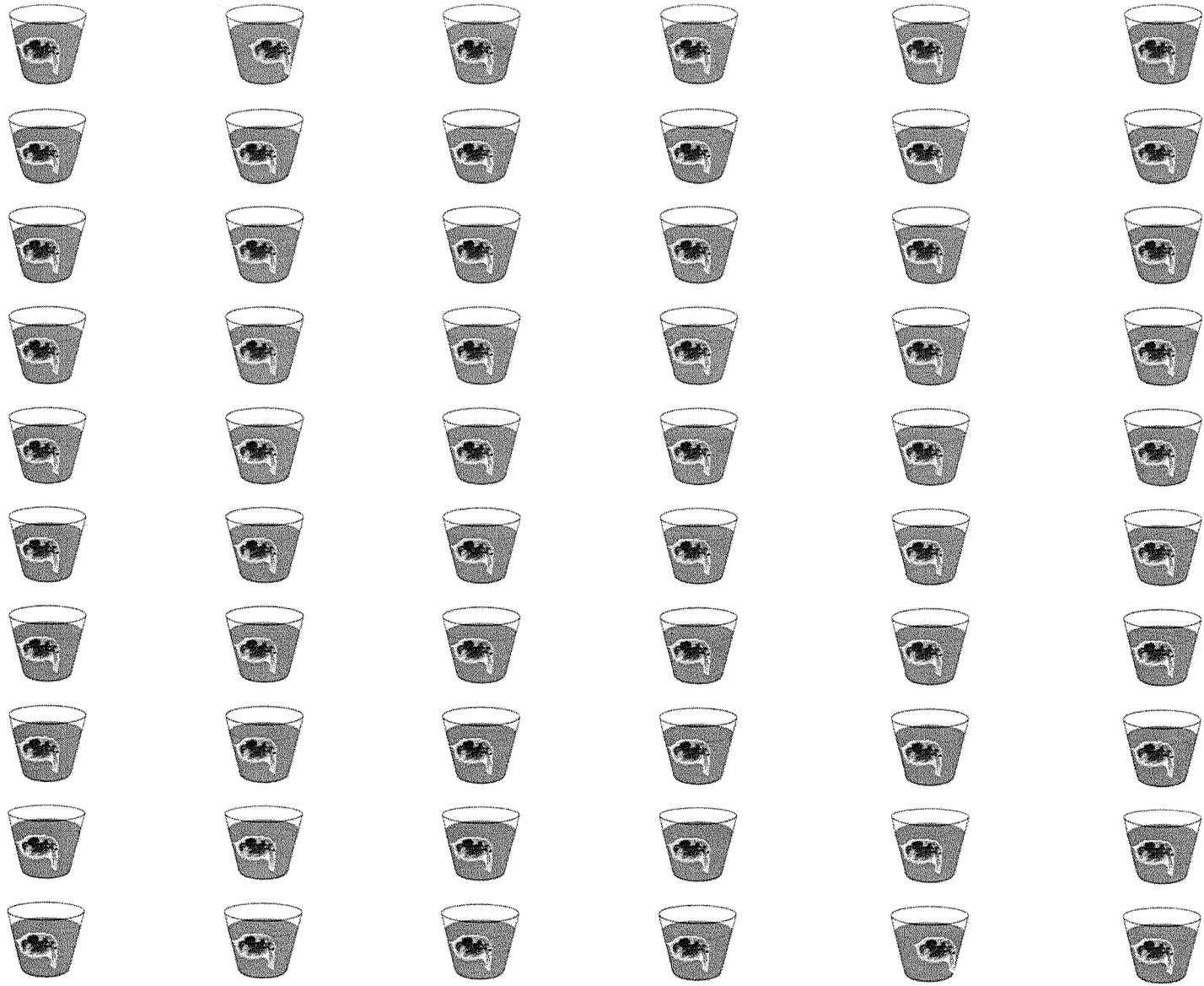
100%

Effluent

Water flea used
in chronic tests:
Ceriodaphnia
dubia

0.5 mm





Lab

Water

32%

Effluent

42%

Effluent

56%

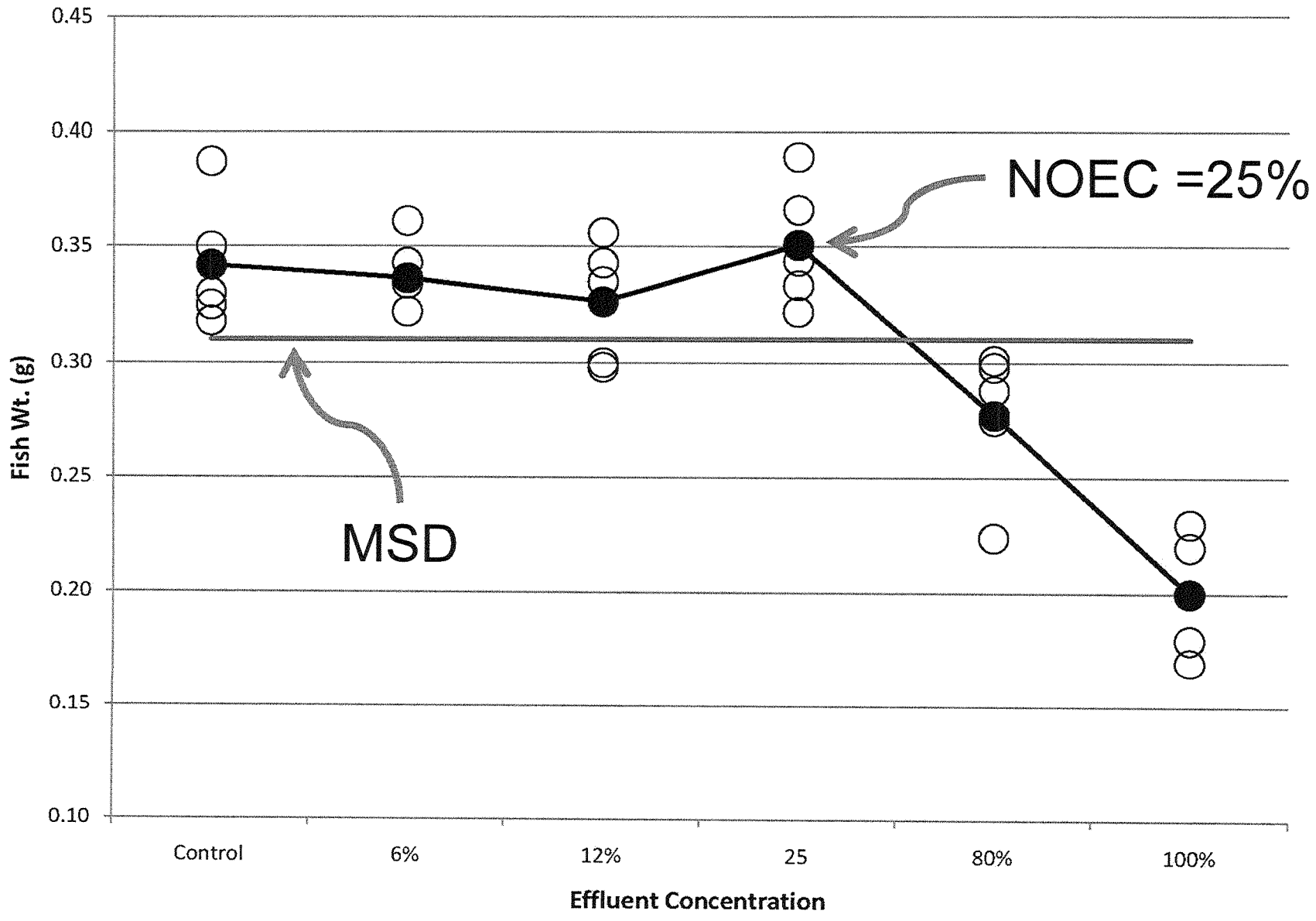
Effluent

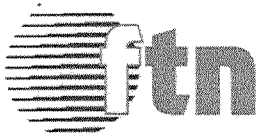
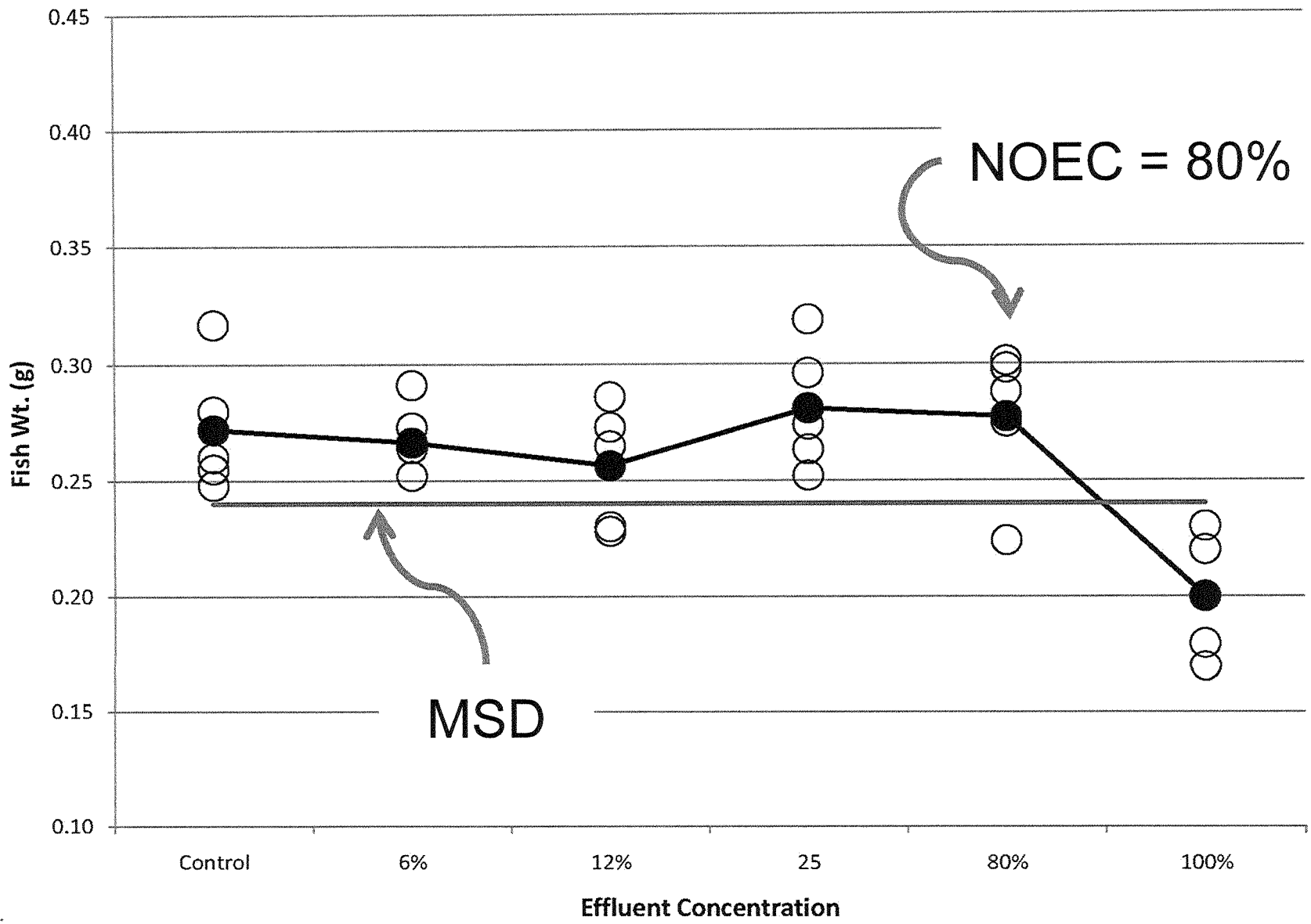
75%

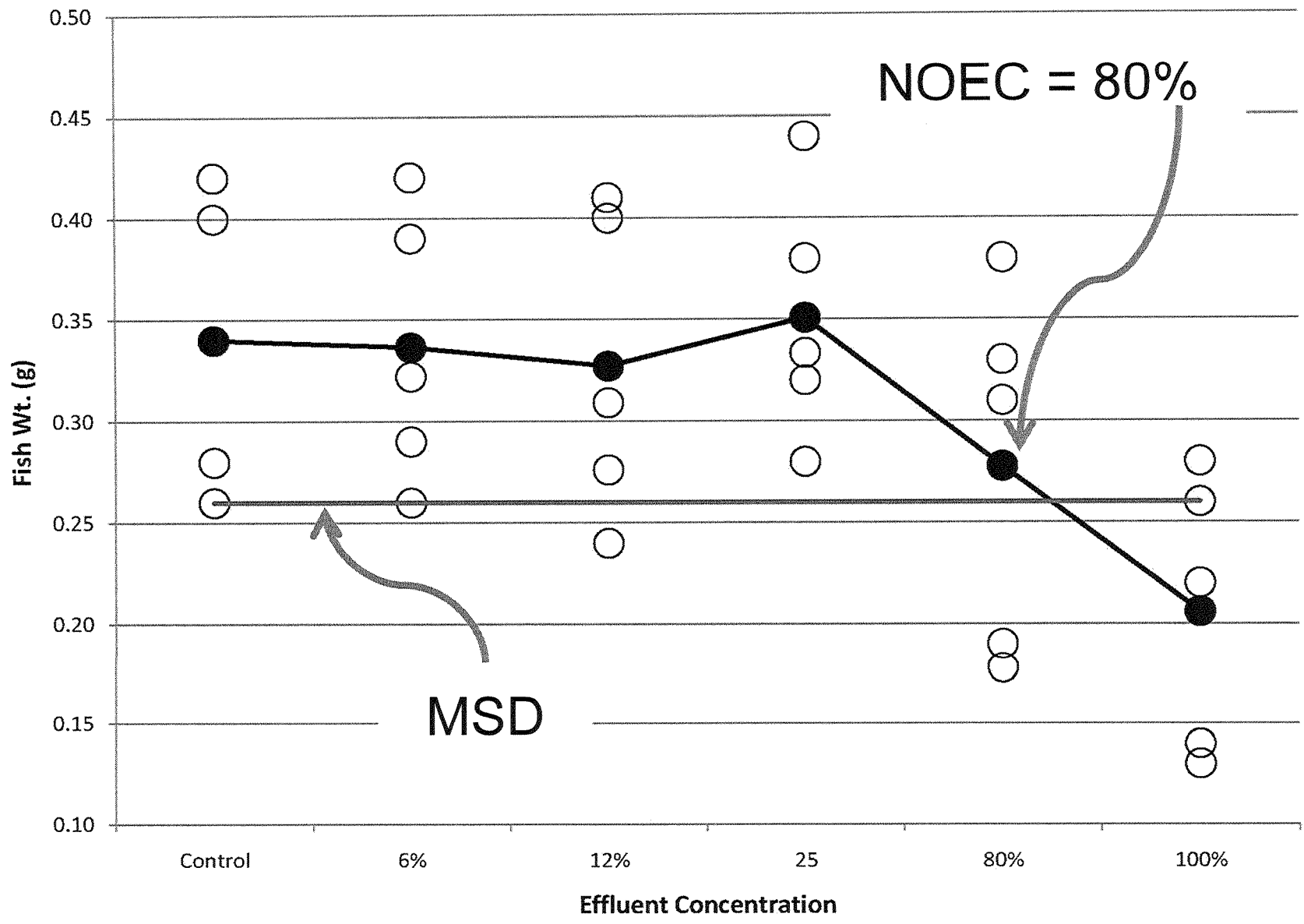
Effluent

100%

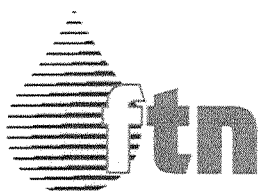
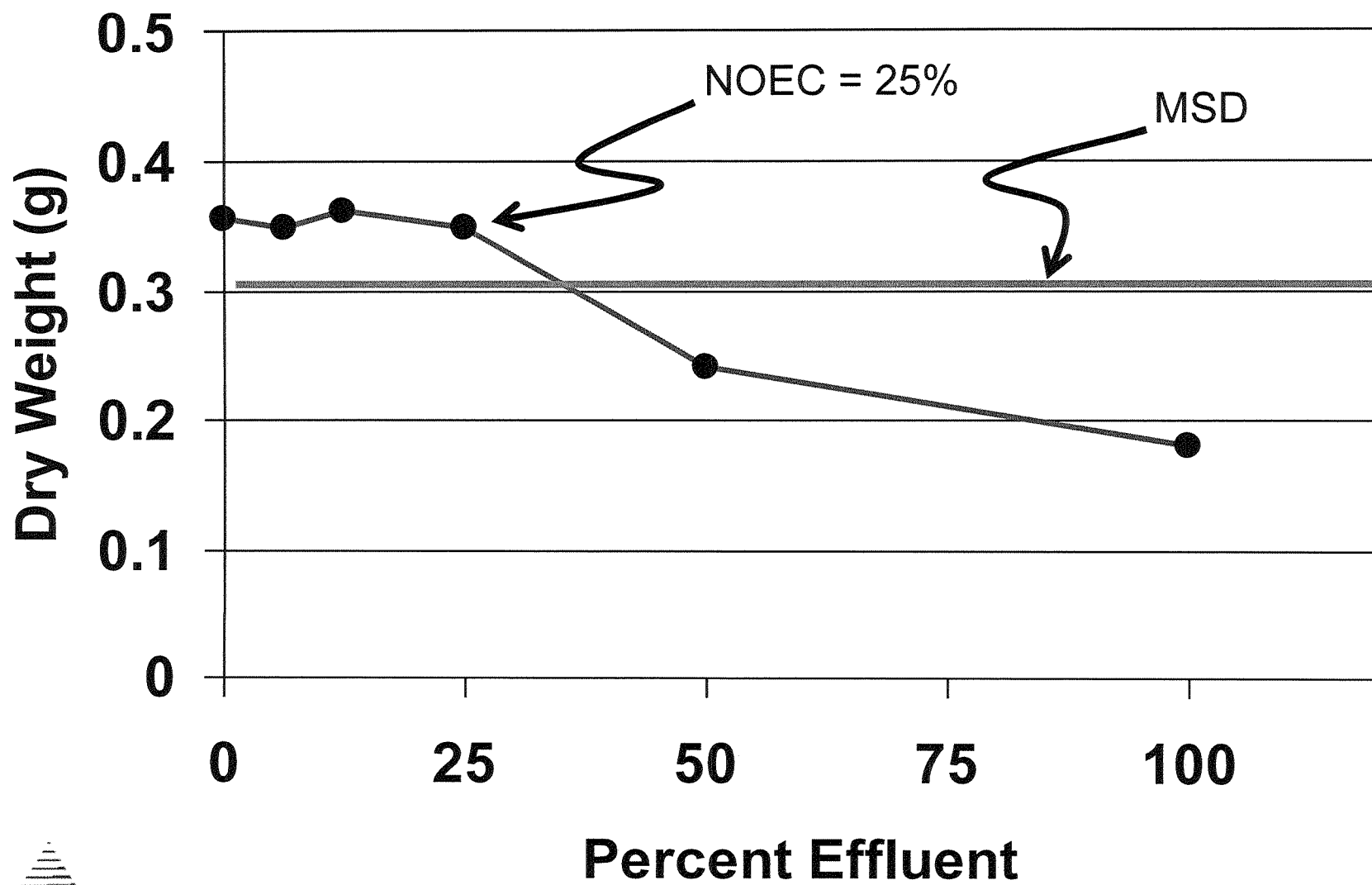
Effluent



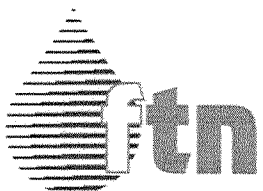
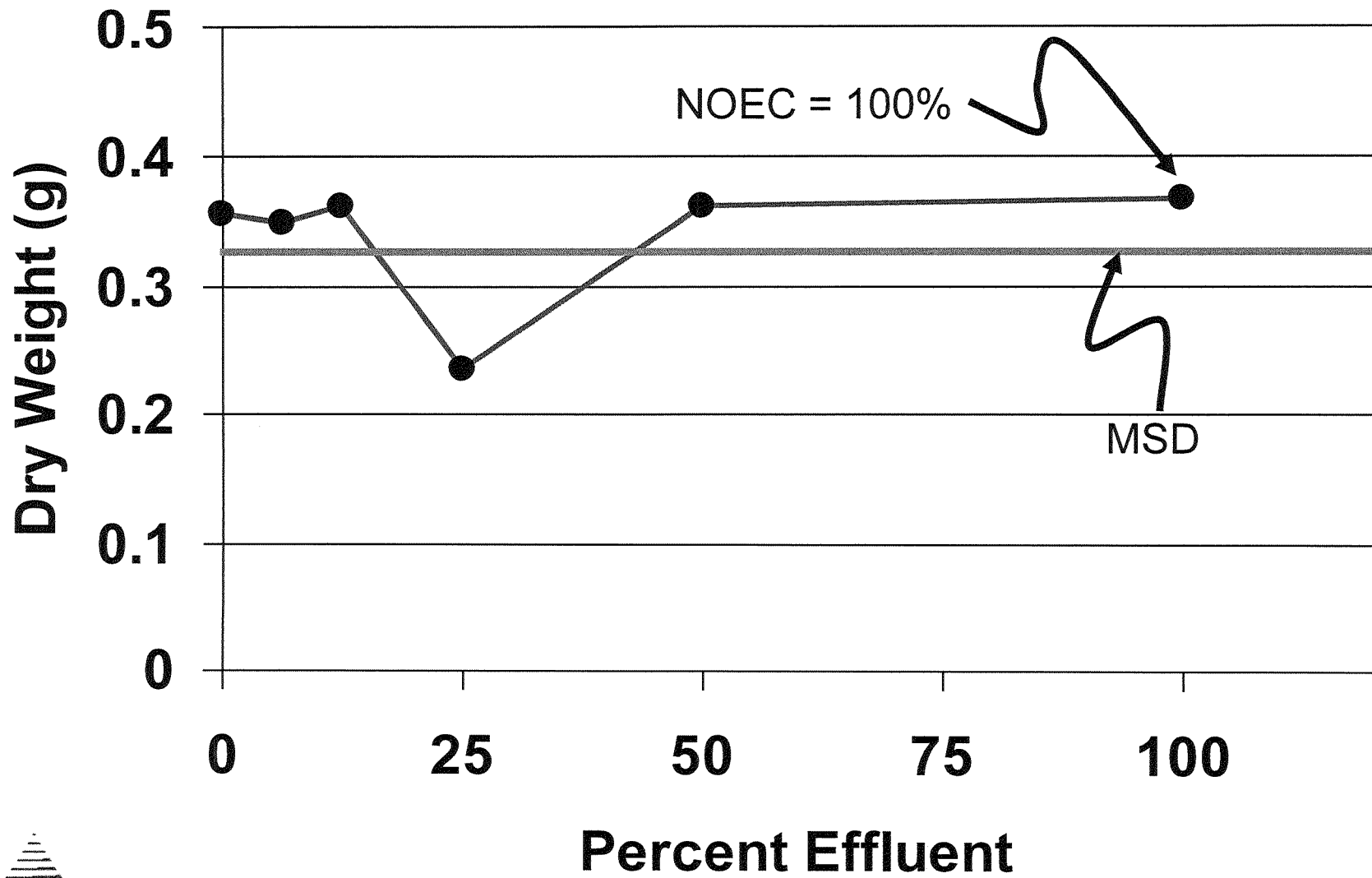


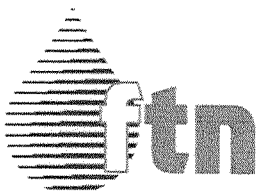
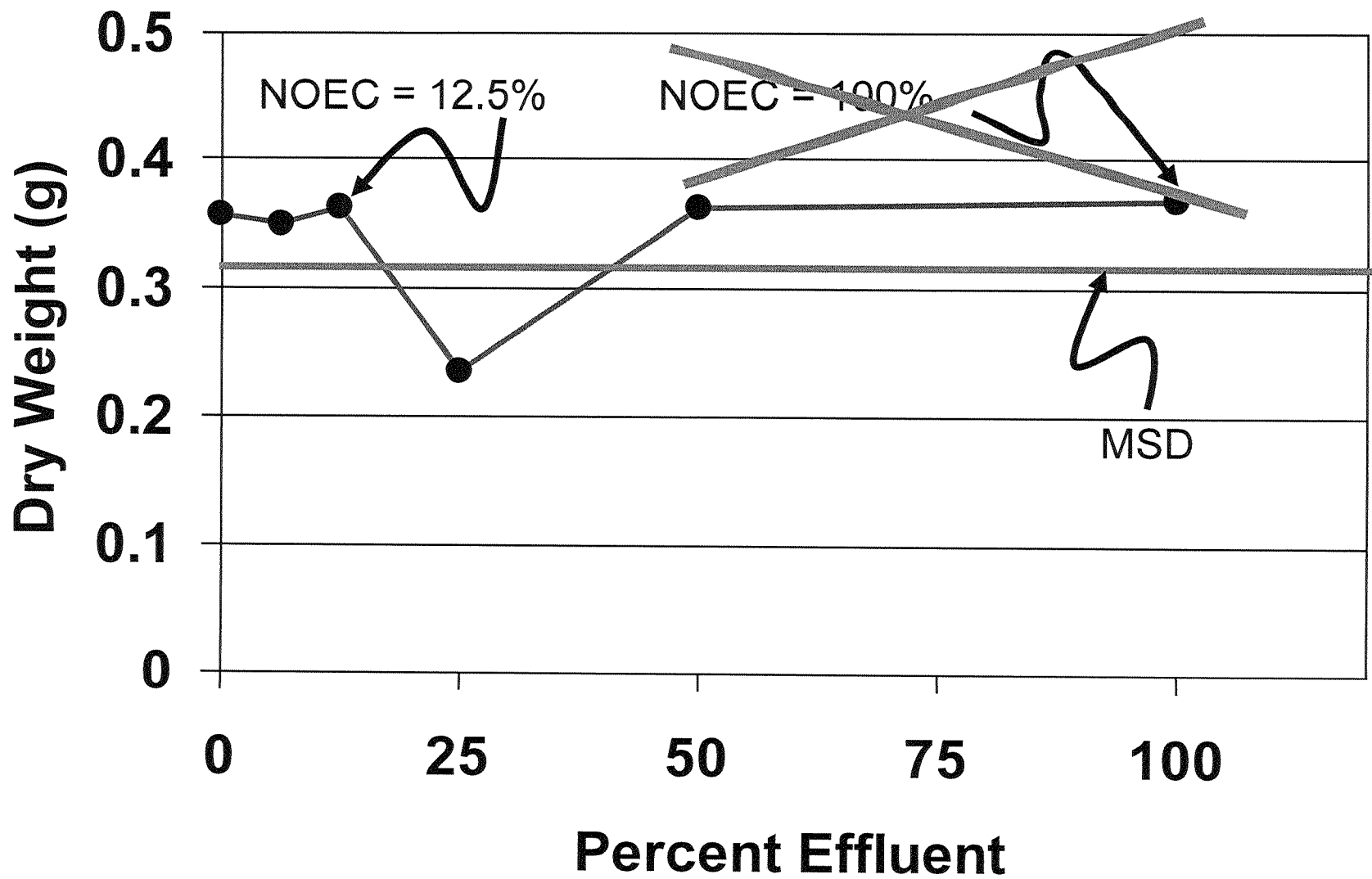


Monotonic Dose Response



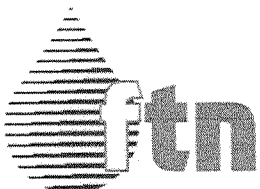
Non-monotonic Dose Response



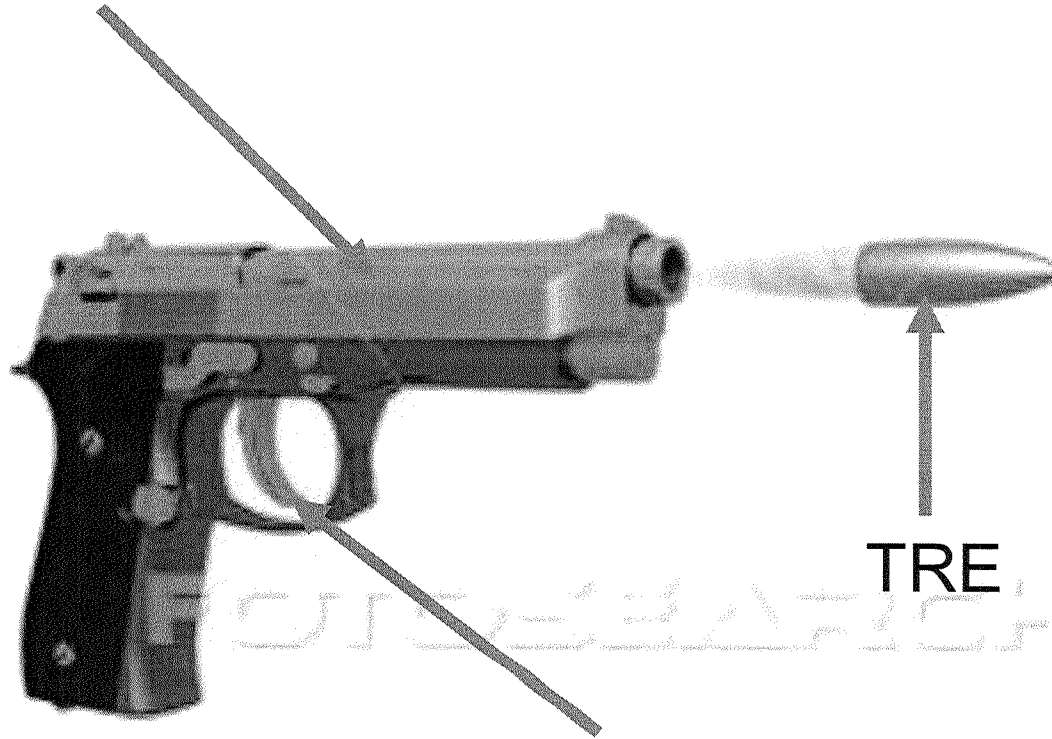


TREs

- If no RP and no WET limit, permit will have TRE trigger
- Total of **2** lethal failure in regular test + retesting
- After **2** sublethal failures in retesting

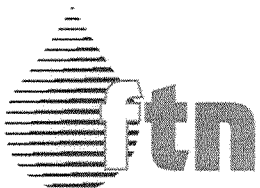


Agency

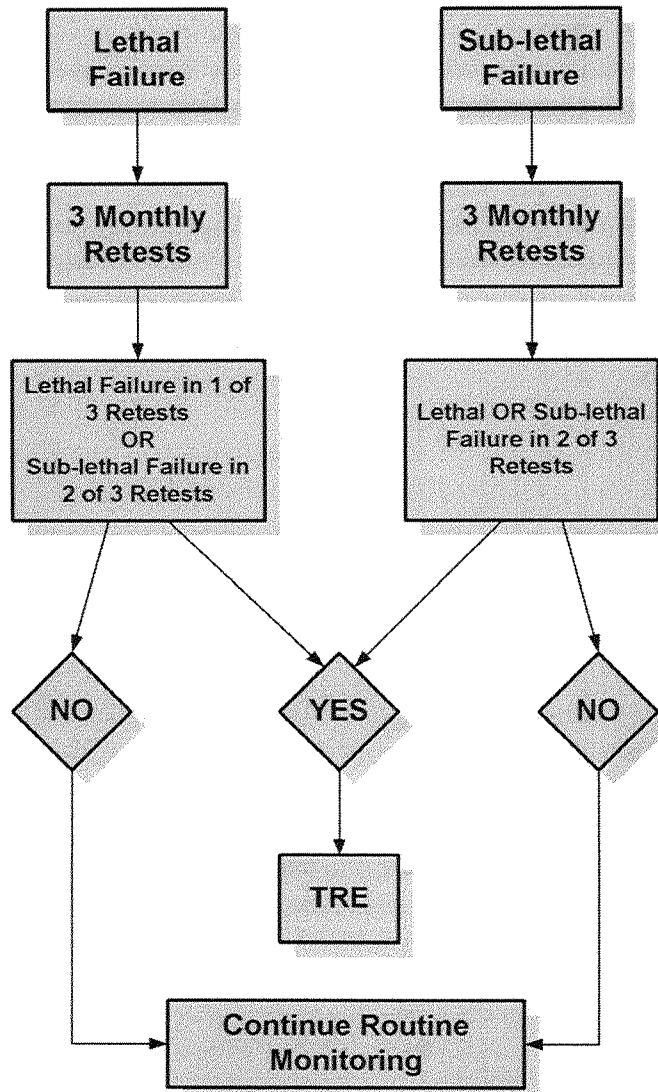


TRE

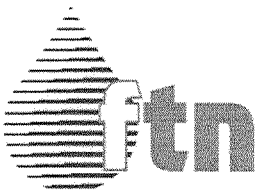
Toxicity
(Trigger)

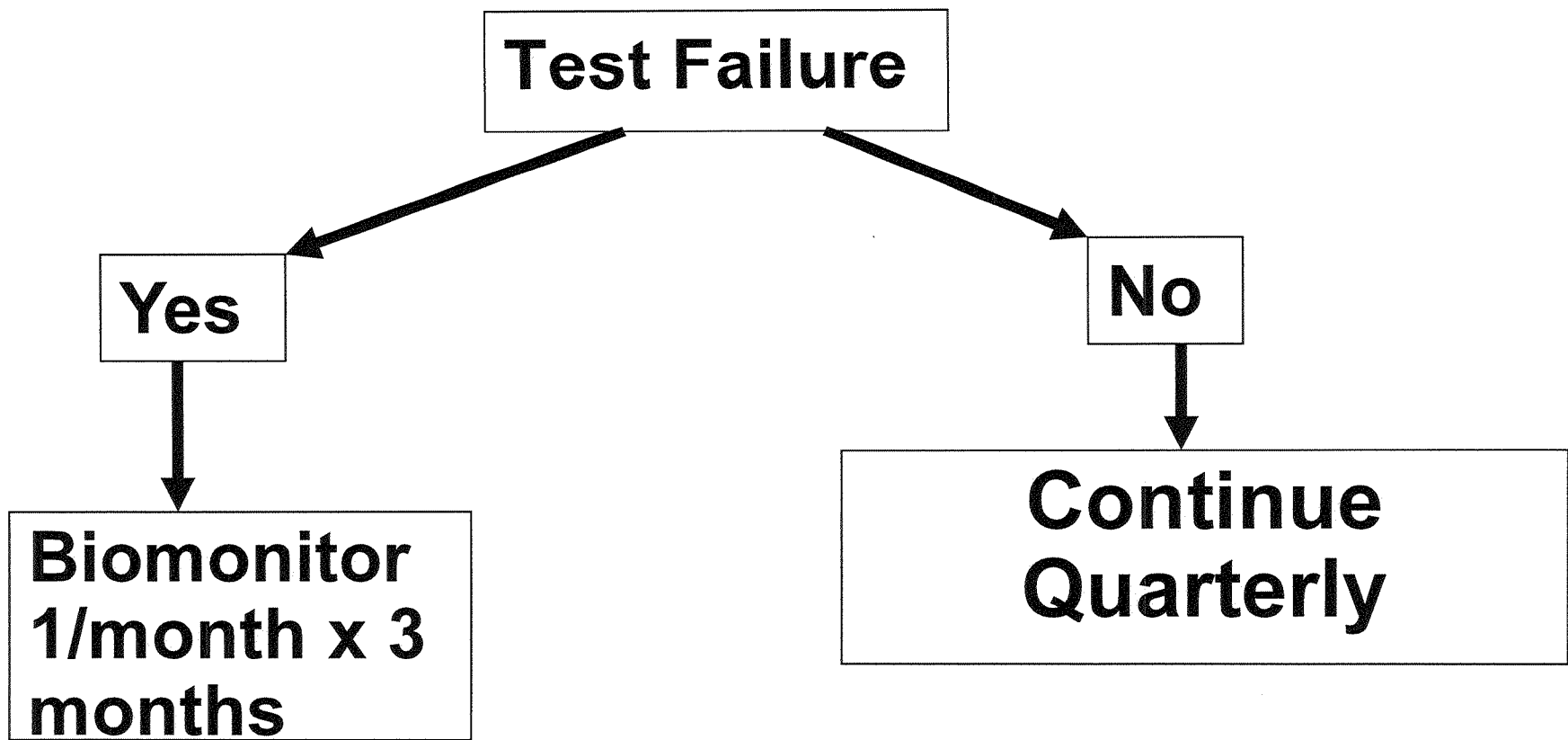


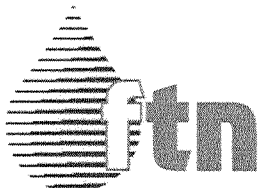
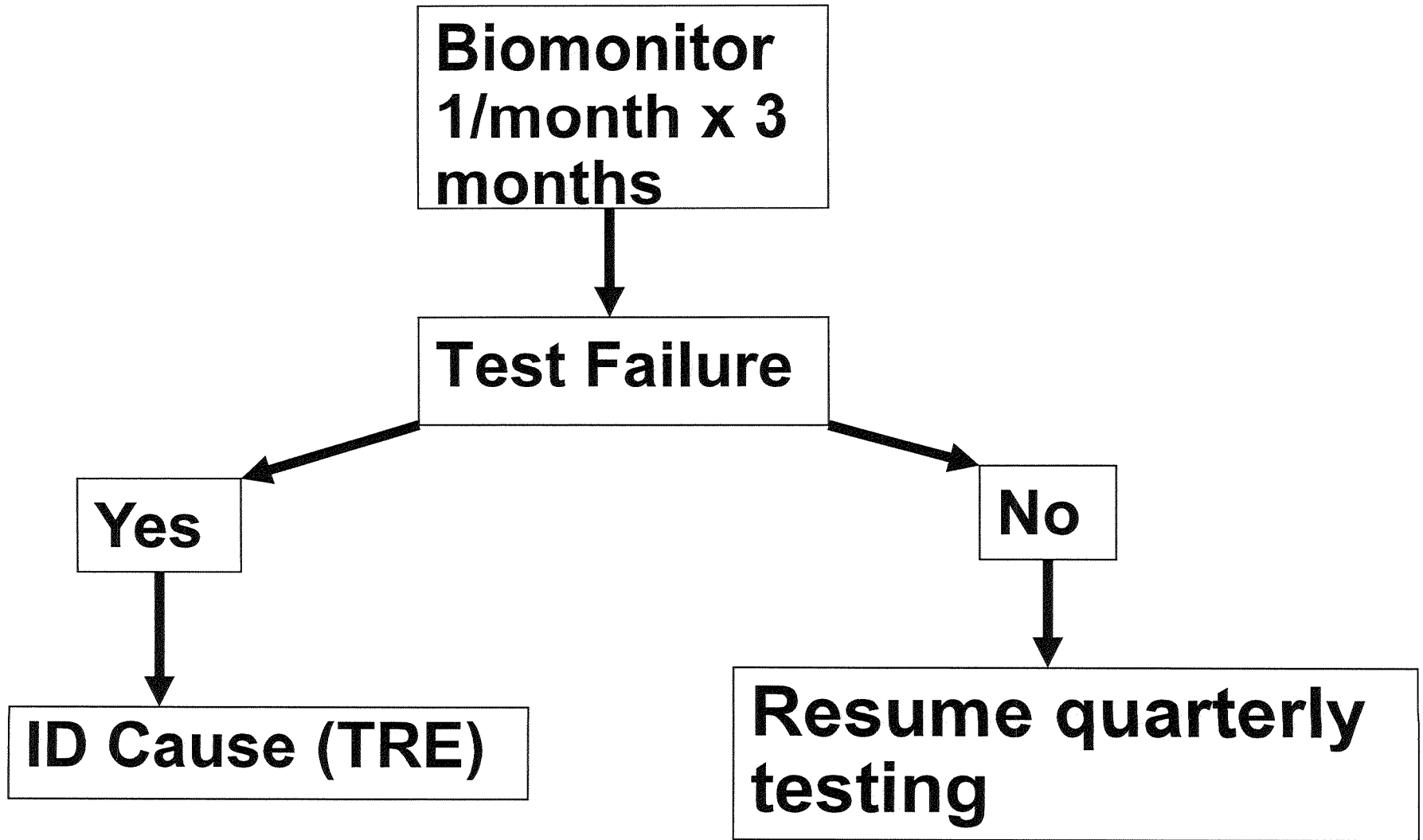
TRE Trigger Flowchart



Sub-lethal Failure = Statistically significant reduction in growth or reproduction at or below 75% effluent concentration.





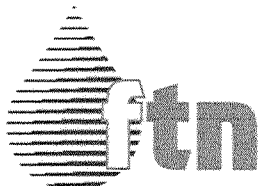


TRE

**Notify ADEQ of failed retests
(5 days)**

**Submit TRE Action Plan
(90 days)**

28 months to complete



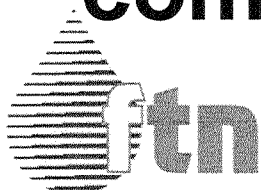
TRE: General Approach

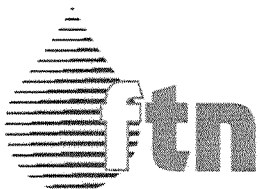
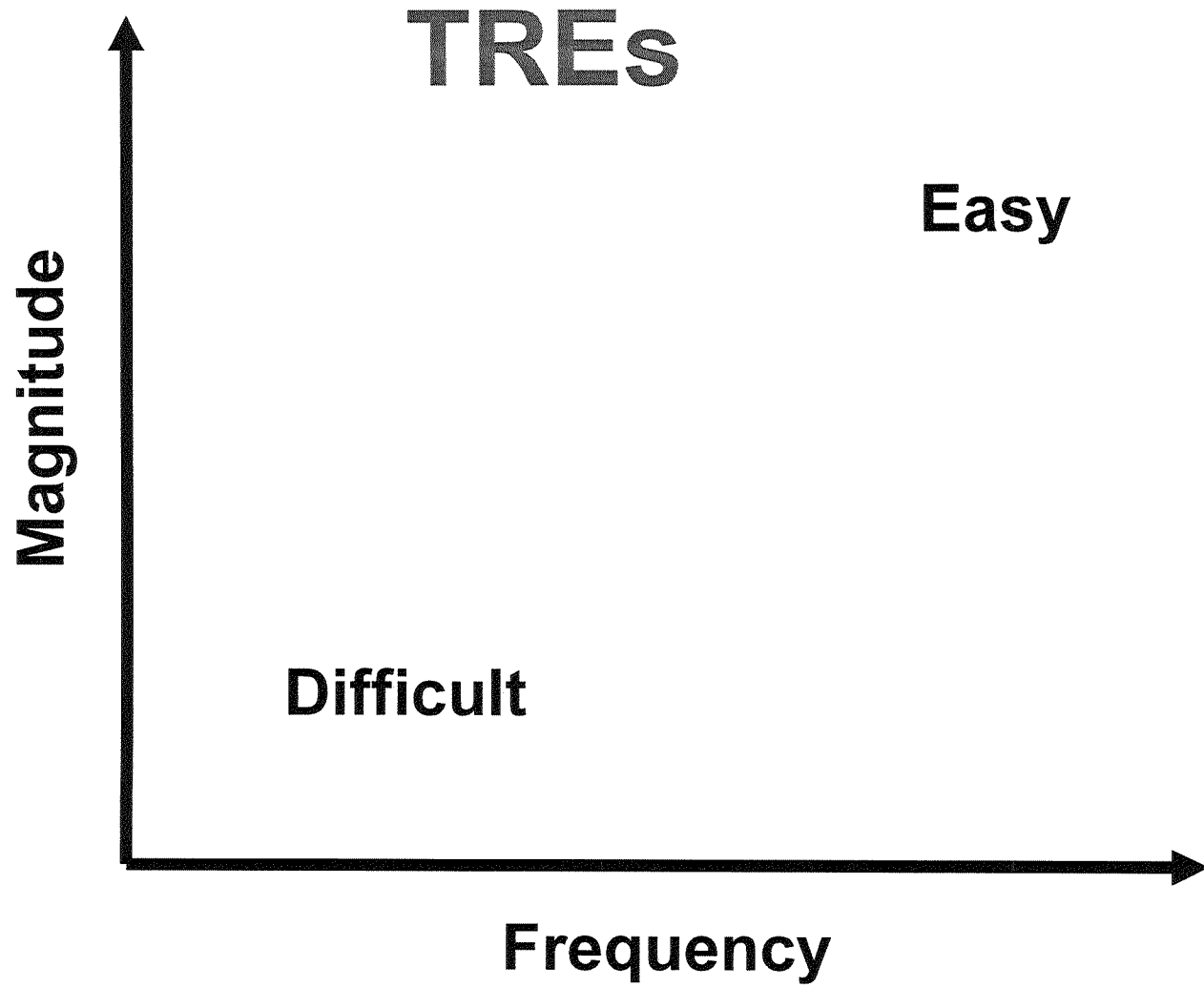
Capture episode of toxicity

Screen single samples every 3 – 5 wks.

Begin follow up testing as soon as screening test shows toxicity.

Follow up each episode of toxicity as completely as possible







What is it?

Paracelsus:

**“The dose makes the
poison”**

Anything



What is it?



Corollaries:

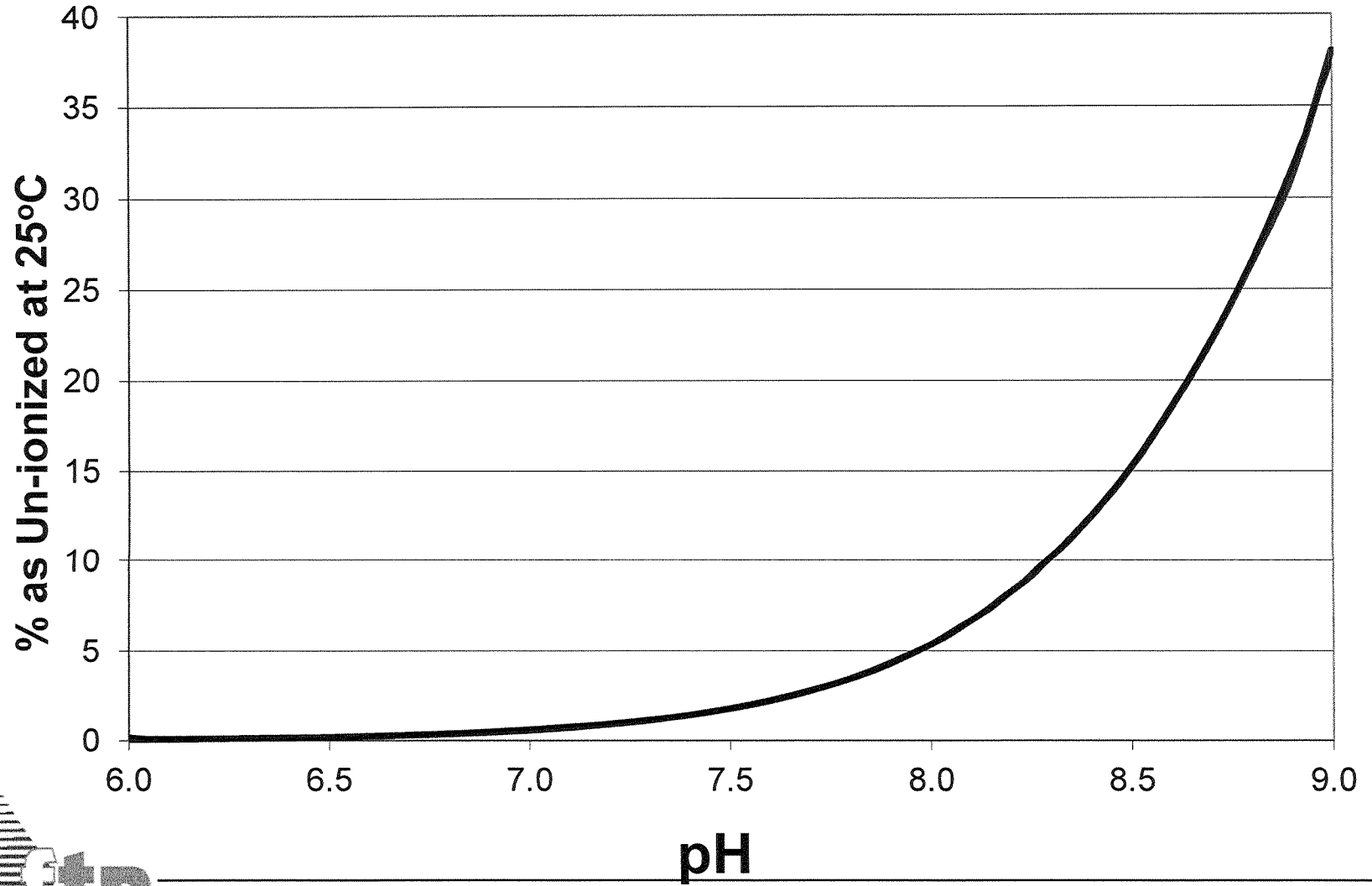
Total Cu in beaker = 100,000 ppm

Dissolved Cu toxic to aq life at 0.05ppm

Form makes the poison

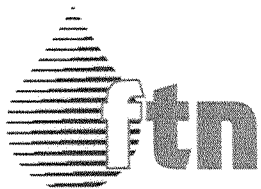


Percent of total ammonia as NH_3



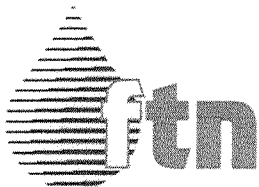
Pathogen Interference

- Recognized in the methods
- Can cause any of the “atypical” dose responses



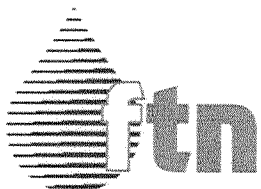
Pathogen Interference

- FHM only
- High variability among replicates
- Atypical dose response
- Cold months
- Surface water



Pathogen Interference

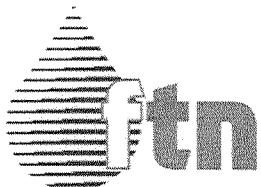
- Method provides guidance for responding
 - Sample manipulation
 - Modified test design



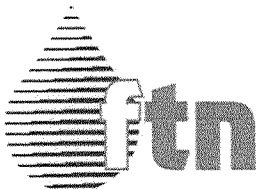
TRE

Result in either:

- **Chemical specific limit**
- **WET Limit**



Most Frequent TRE Result



WET Limits

- Begins With Reasonable Potential (RP) Determination
- Based on EPA's Technical Support Document (EPA/505/2-90-001) See Box 3-2, pg. 53

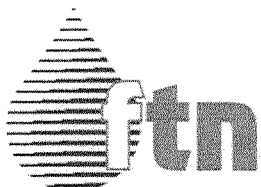


RP Determination

No RP when:

- Facility does not intend to alter discharge
- Has critical dilution $\geq 90\%$
- Quarterly testing for 5 years w/ no lethal or sublethal toxicity.

No WET Limit

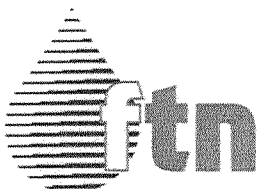


RP Determination

- One test failure = RP \longrightarrow WET Limit

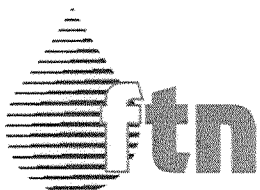
Wet Limit = permit control required where RP exists for exceedance and a specific toxicant has not been identified and controlled through a TRE.

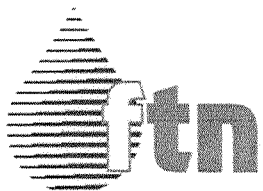
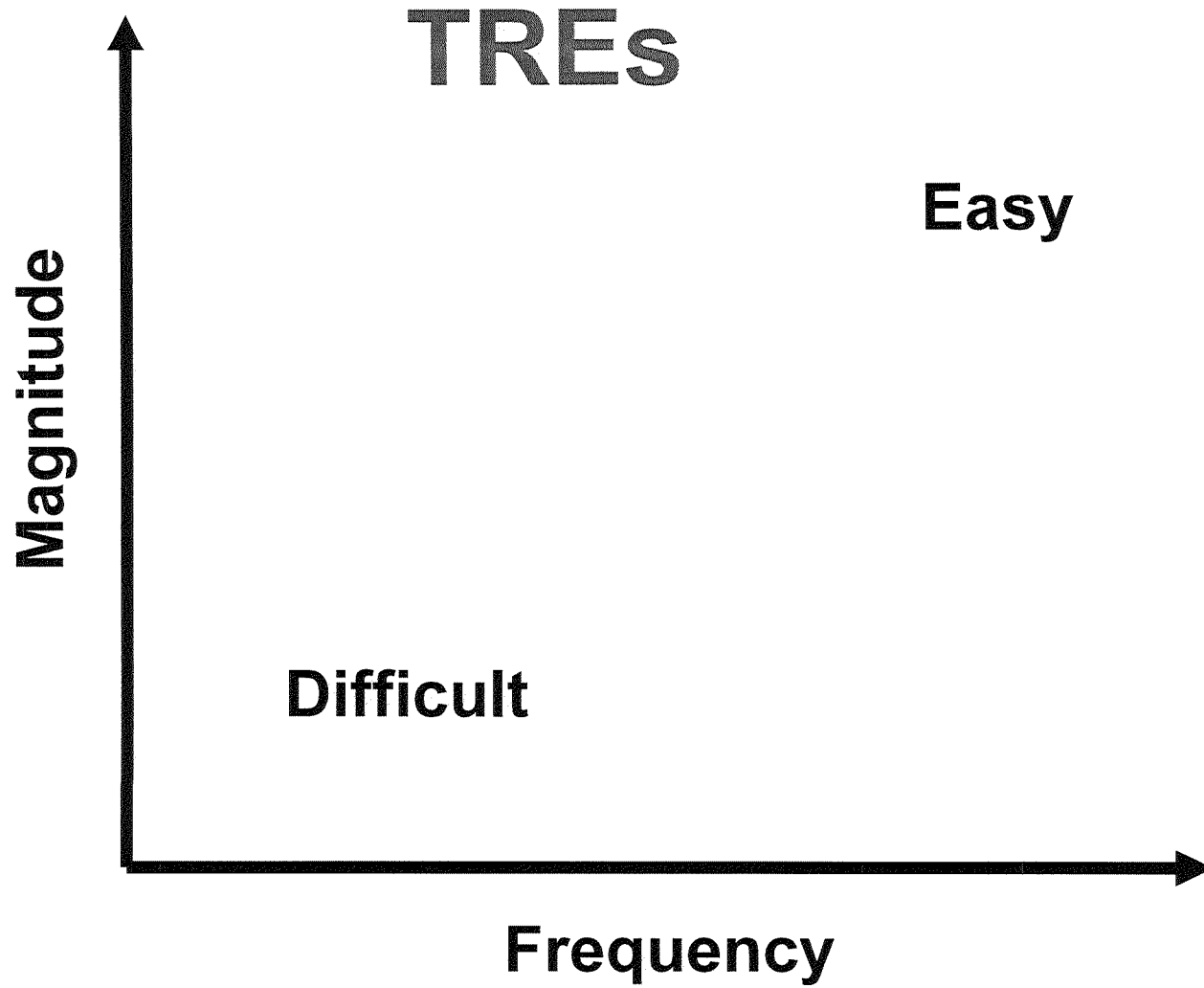
WET Limit + Toxicity = noncompliance



Implementation of Sublethal WET Limit

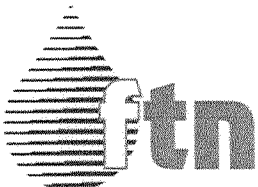
- Applies to effects at concentrations $\geq 80\%$.
- RP determination based on 5 year record
- Any failure in last 2 years = RP





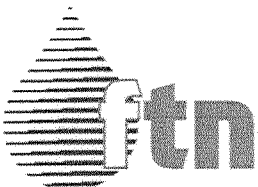
Implementation of Sublethal WET Limit

- If RP shown based on paucity of data may allow 12 months to acquire more information
- 3-year compliance schedule
- Quarterly biomonitoring
- Addressed in ADEQ CPP



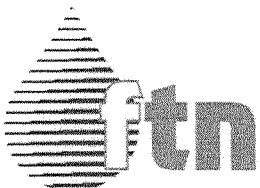
Implementation of Sublethal WET Limit

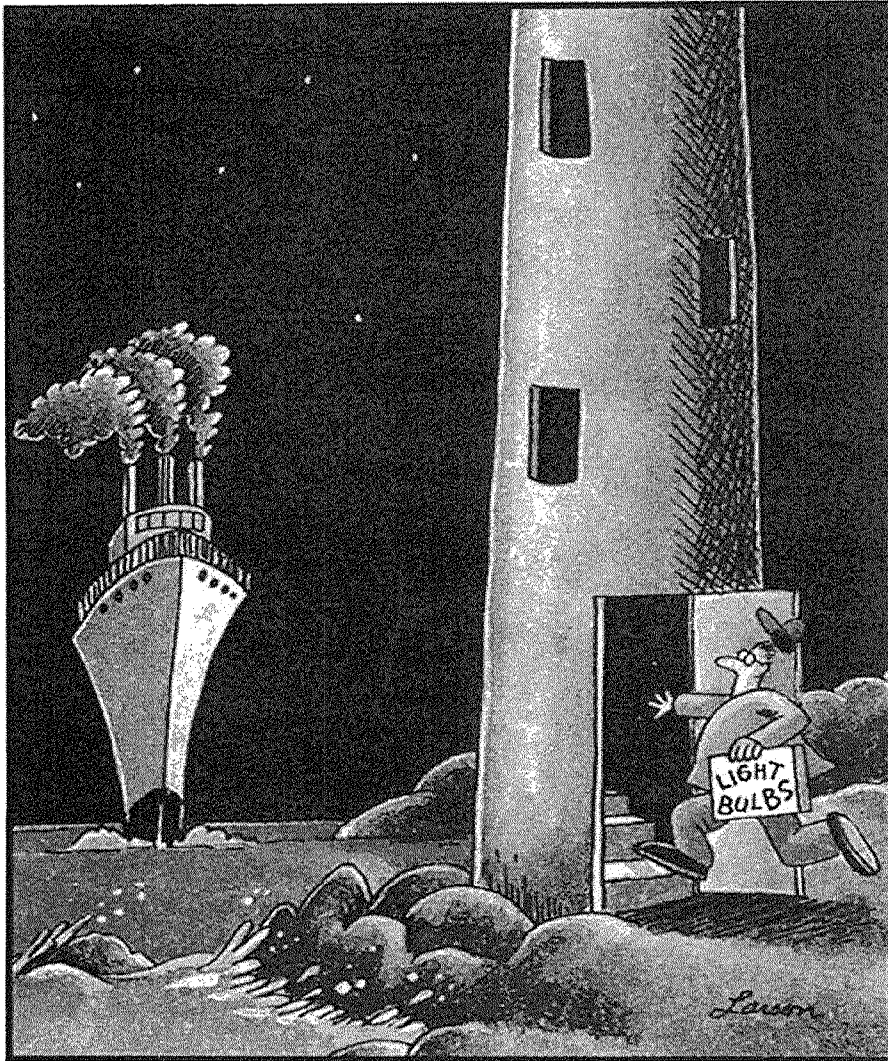
- Quarterly biomonitoring
- If quarterly test shows toxicity
 - Monthly biomonitoring until no toxicity for 3 consecutive months.
 - 3-year compliance schedule
- Addressed in ADEQ CPP



What to Do?

- Influence EPA policy (?)
- Provide input into CPP re. RP e.g. dose response, repeatability.
- Have a plan



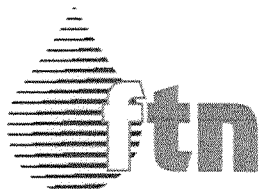


Pay attention.

**Don't wait until
last minute**

Have a Plan

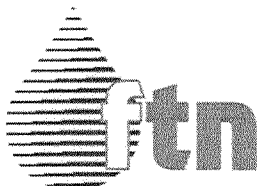
- Don't wait for lab report – get verbal results.
- Review results.
 - Plot them. Do they make sense?
 - Data entry errors.
- Respond to toxic events w/ followup testing **ASAP**

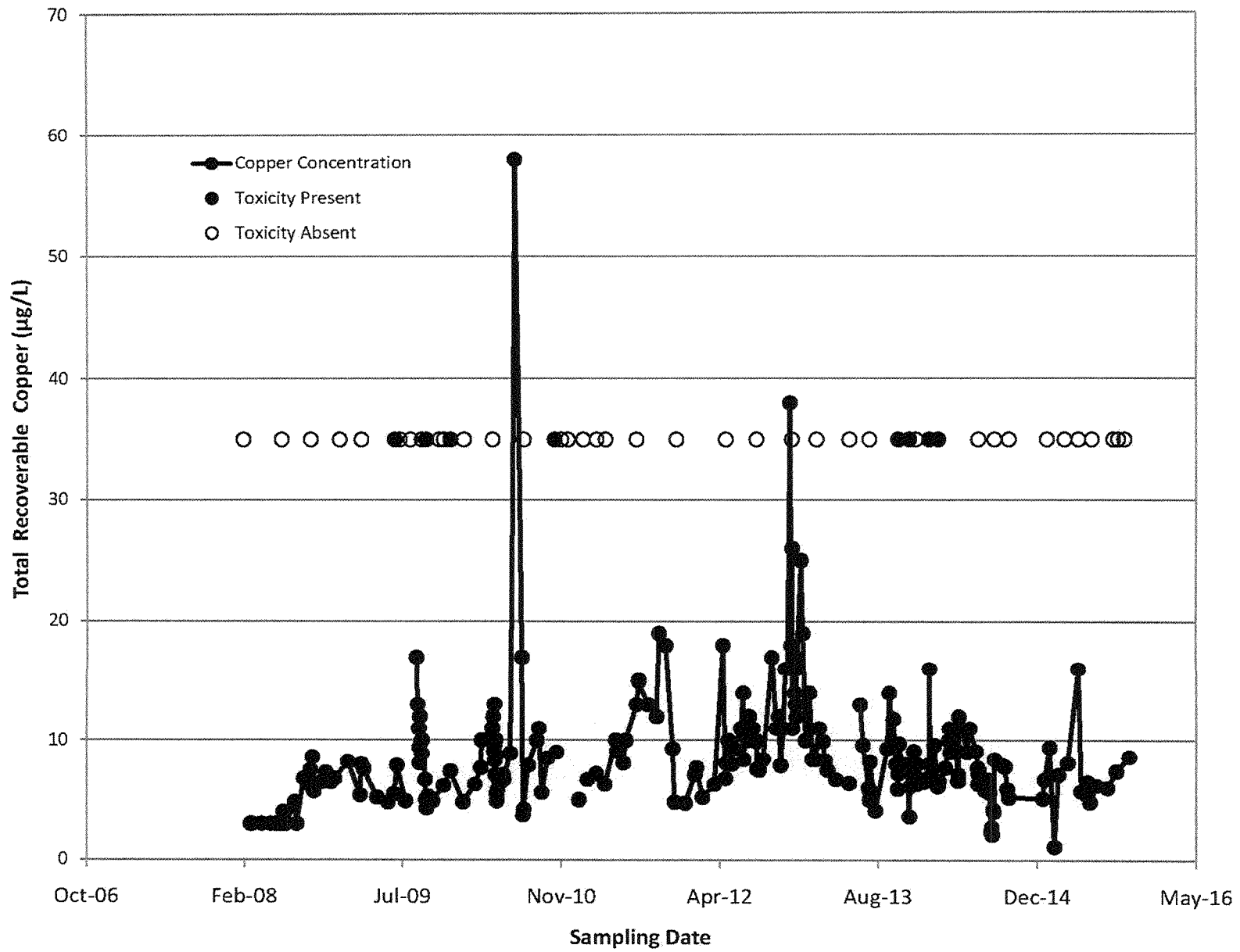




Knowledge is Good

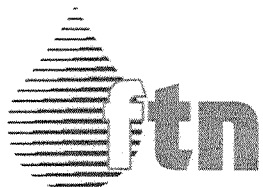
- With every biomonitoring test measure permit parameters (limits and “report only” *in all samples*)
 - Any metals or organics
 - TDS
 - Chloride, Sulfate
 - Ammonia (lab should measure)
 - (BOD, COD, bacteria, TSS less important)





Have a Plan

- Follow up toxic episodes
- More and/or better monitoring information





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“The Alchemist”