Suisun Bay Toxicity Study – Initial Findings

AQUA-Science and Michael Johnson LLC, USGS

A collaborative study with the CCCSD, Dugdale/Wilkerson/Parker Lab and USGS funded by SFCWA, SFBRWQCB, CCCSD, and BACWA

Please do not cite data

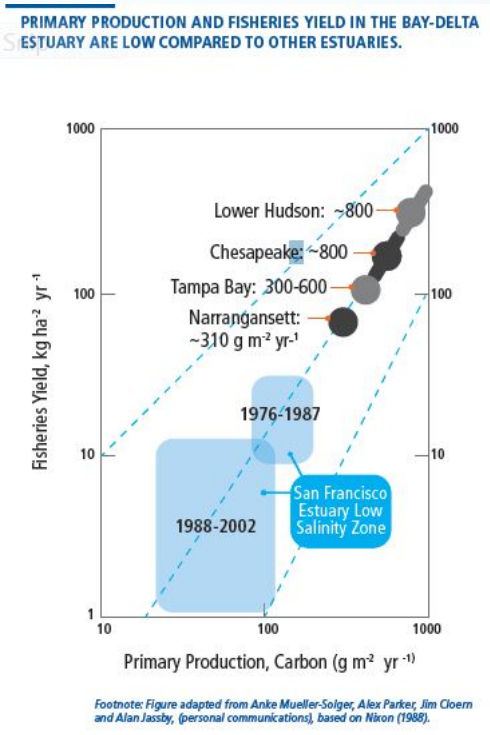
Study Background

Part of the SFBRWQCB SWAMP study

Algal biomass in Suisun Bay is chronically low when compared to historic values and other estuaries.

Potential reasons include:

- grazing by non-native clams,
- diatom growth inhibition by ammonium,
- algal toxicity due to contaminants.

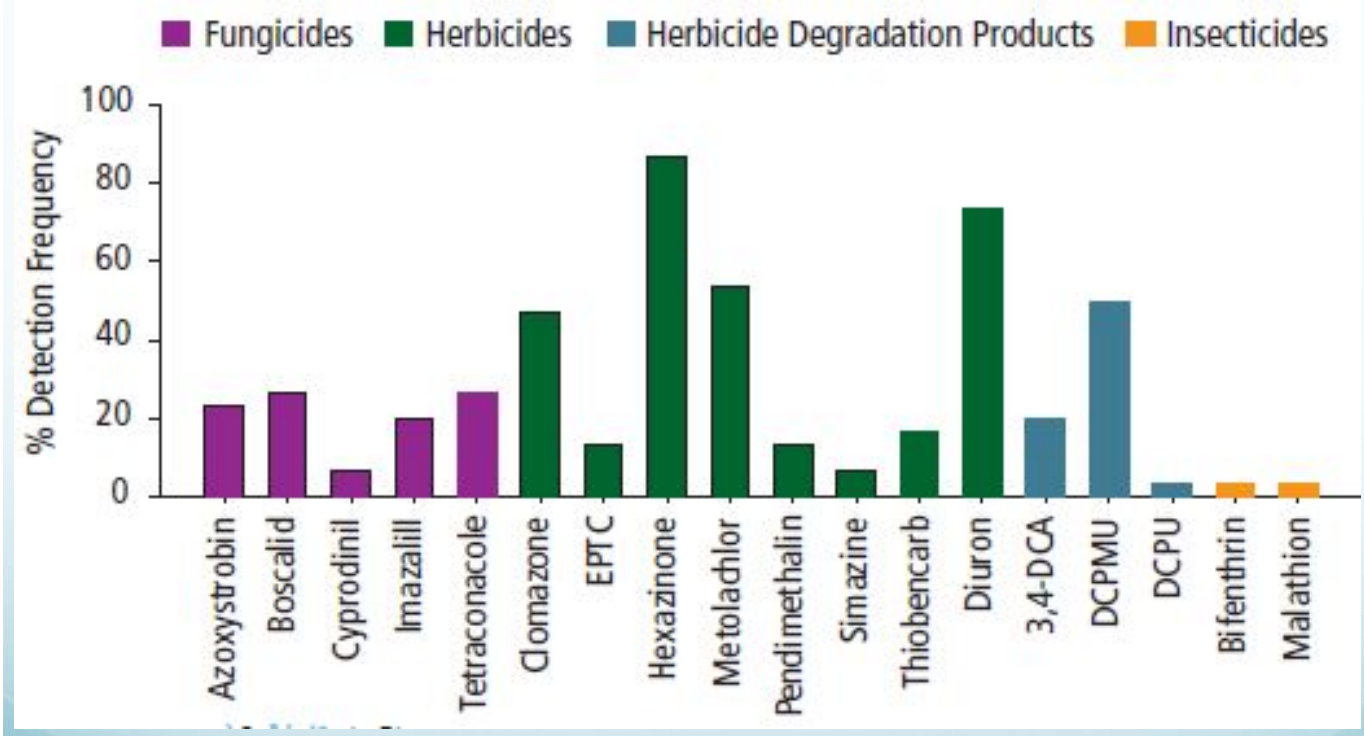


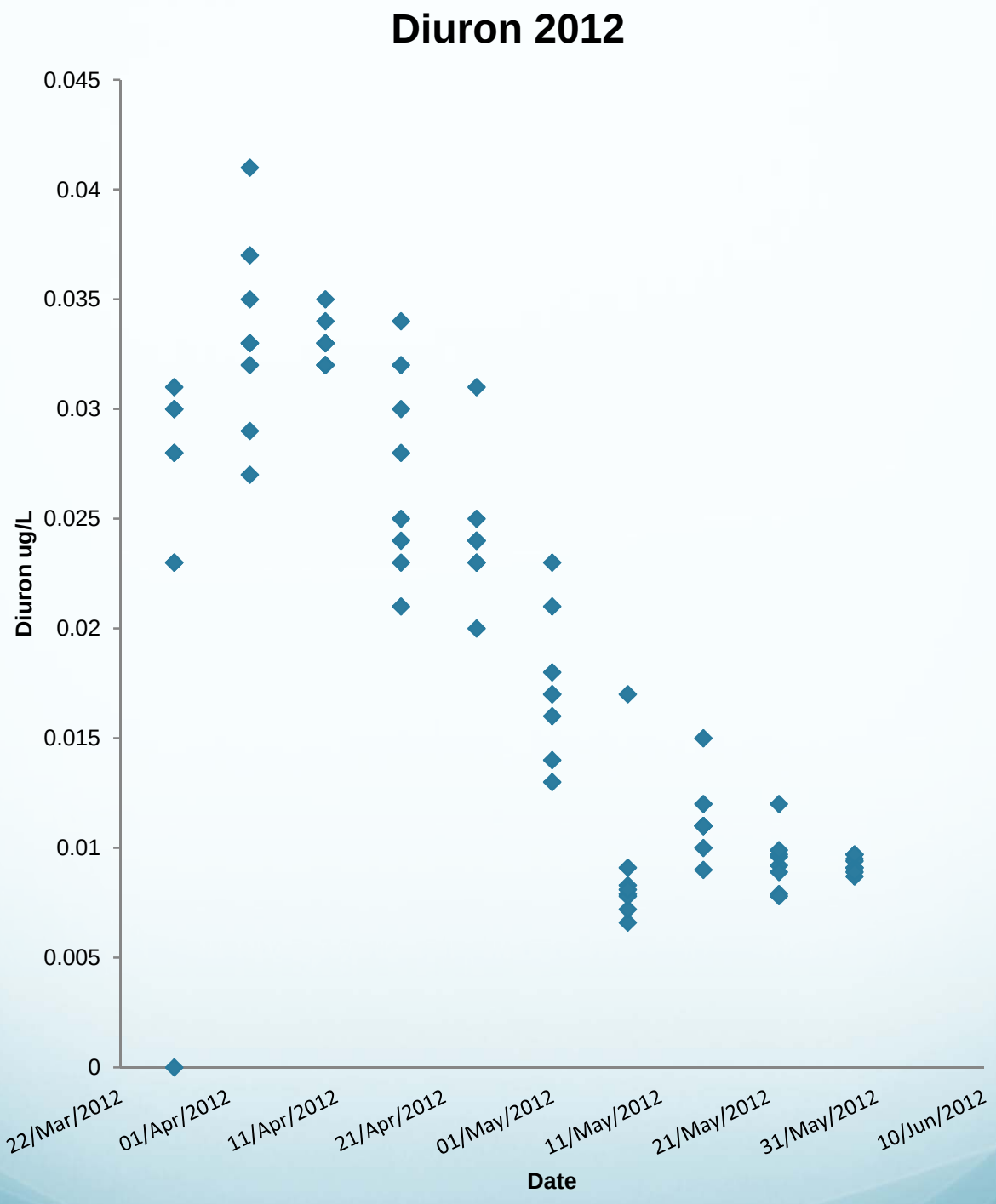
Study Objectives

- Determine if contaminants are causing toxicity to Suisun Bay phytoplankton during the Spring.
  - Monitor potential pesticides, metals, and surfactants
  - Conduct toxicity tests and TIEs
- Determine if ammonium inhibition of nitrate uptake and growth of phytoplankton can be observed in toxicity tests coupled to Toxicity Identification Evaluations (TIEs)

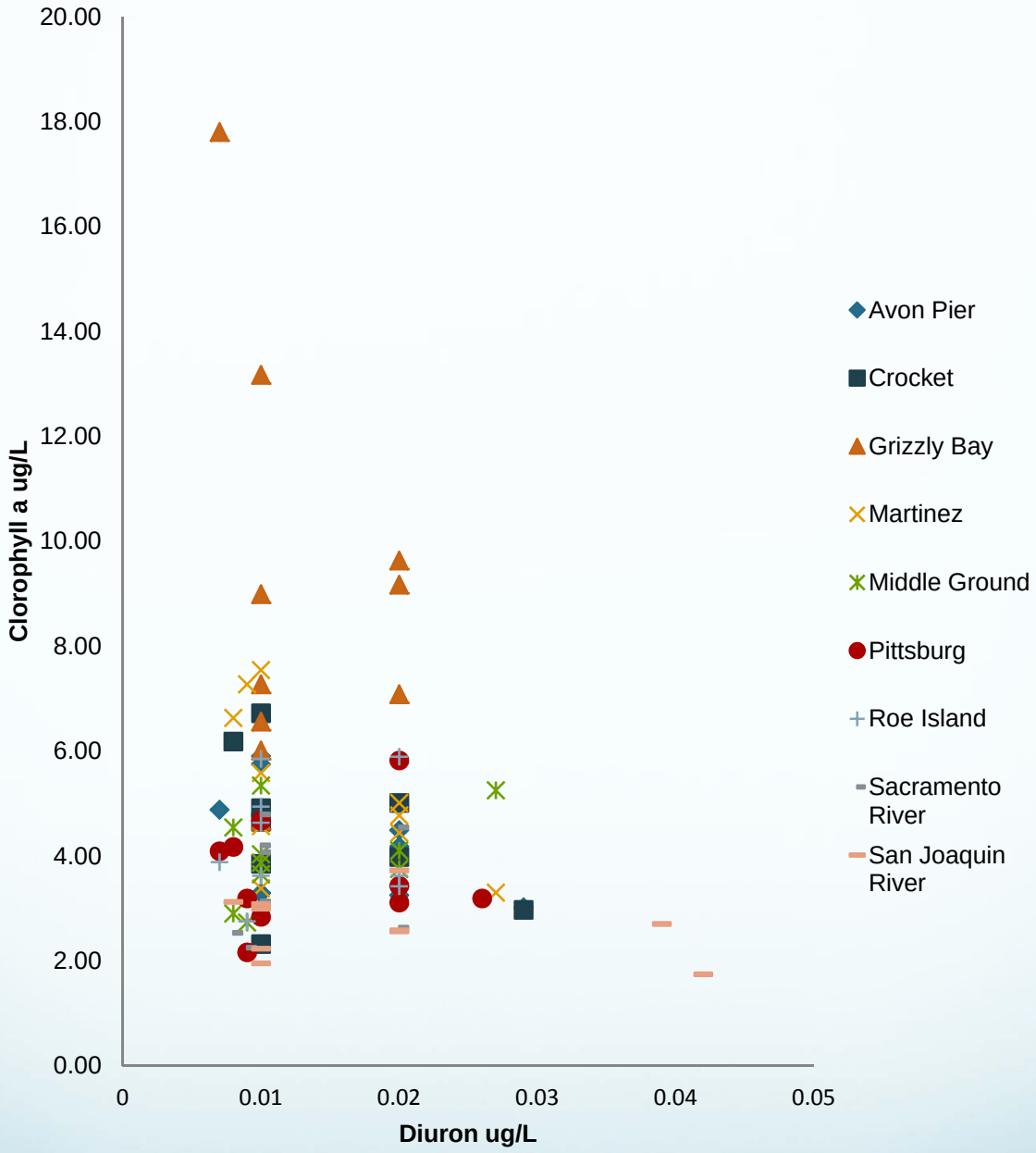
Pesticide Detections

USGS multi-year study (2011 -13)
•Review Pesticide Use Reports for candidates
•Develop Analytical Methods -100 compounds
•Spring 2011 monitor Suisun Bay
•Spring 2012 monitor Suisun Bay
•2012-13 monitor Sac. R.@ Freeport & SJR @ Vernalis




Diuron 2012
Diuron ug/L
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
22/Mar/2012
01/Apr/2012
11/Apr/2012
21/Apr/2012
01/May/2012
11/May/2012
21/May/2012
31/May/2012
10/Jun/2012
Date

2011 Diuron vs Chlorophyll a by Site



Toxicity Tests

- Phytoplankton Growth Test Conditions-modified EPA

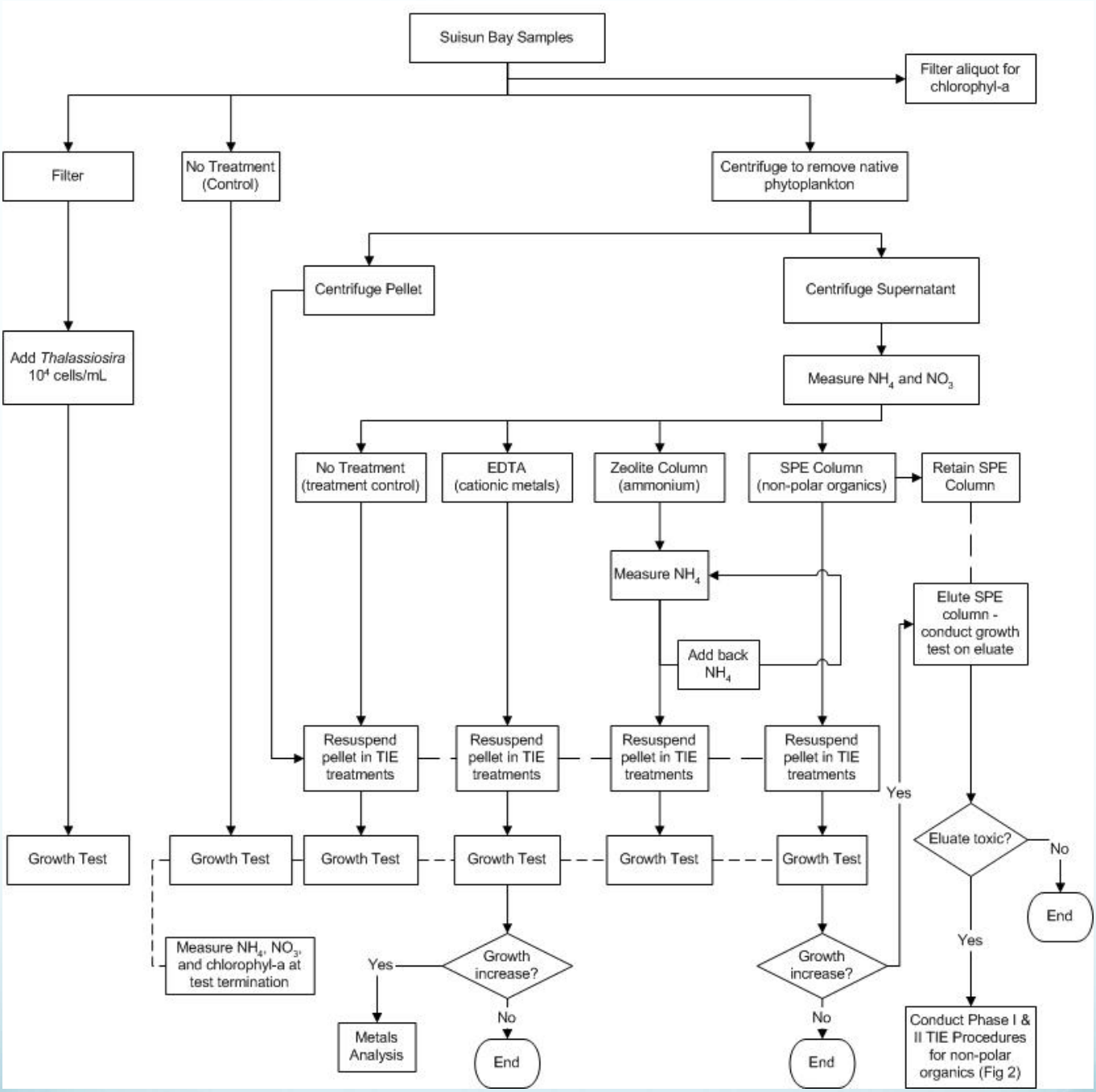
- Suisun Bay Phytoplankton
- Test Duration: 96 hours
- Temperature: 18 C
- Light: 540 uE/m^2/sec (20% of ambient)
- Photoperiod: 12L:12D
- Test Containers: 150 mL flask with 50 mL solution with constant rotation
- No added nutrients
- Chl-a, NH_4 and NO_3 measured at 0, 24, 48, 72 and 96 hours.

- Phytoplankton species composition

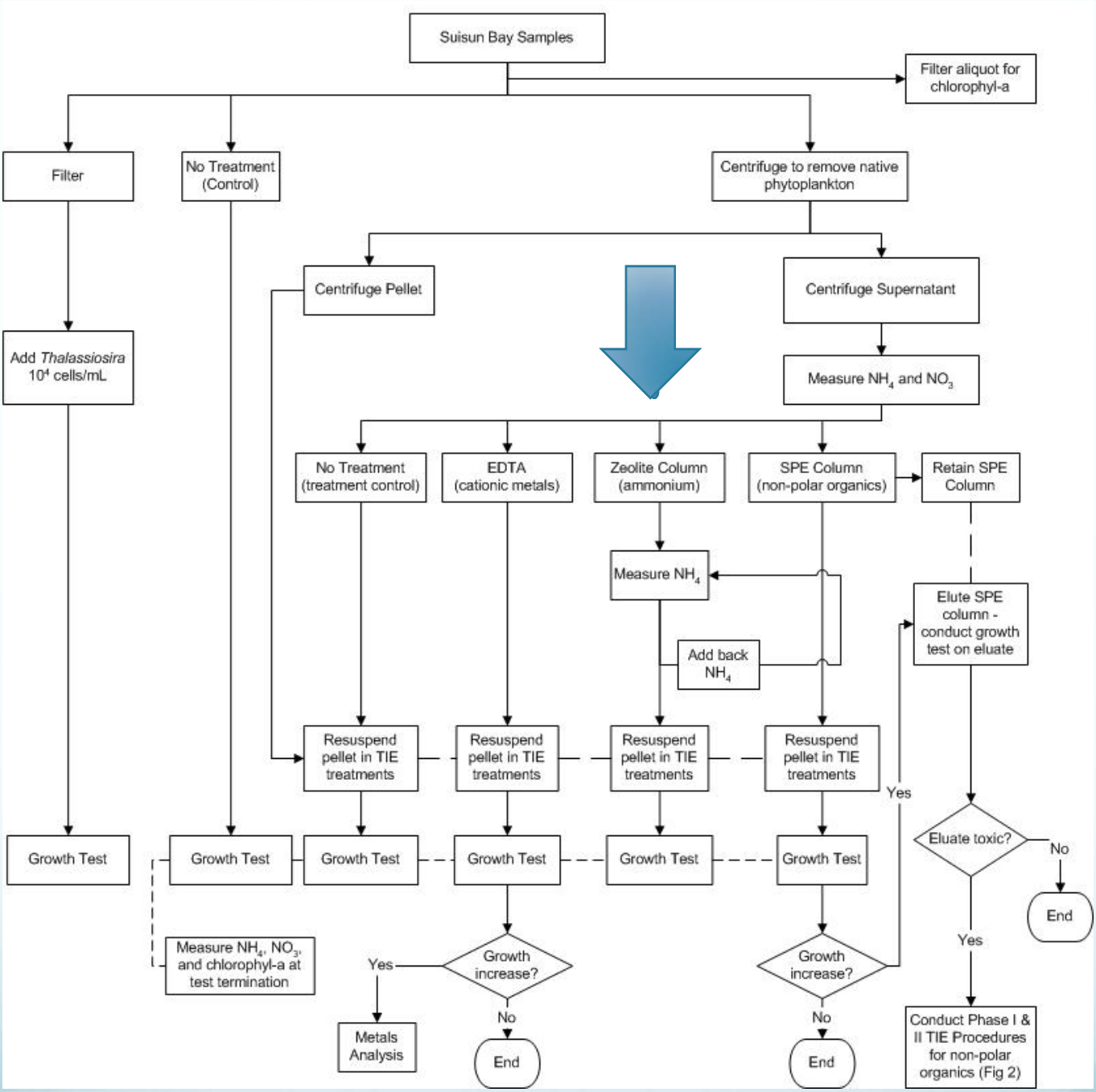
Toxicity Identification Evaluation (TIEs)

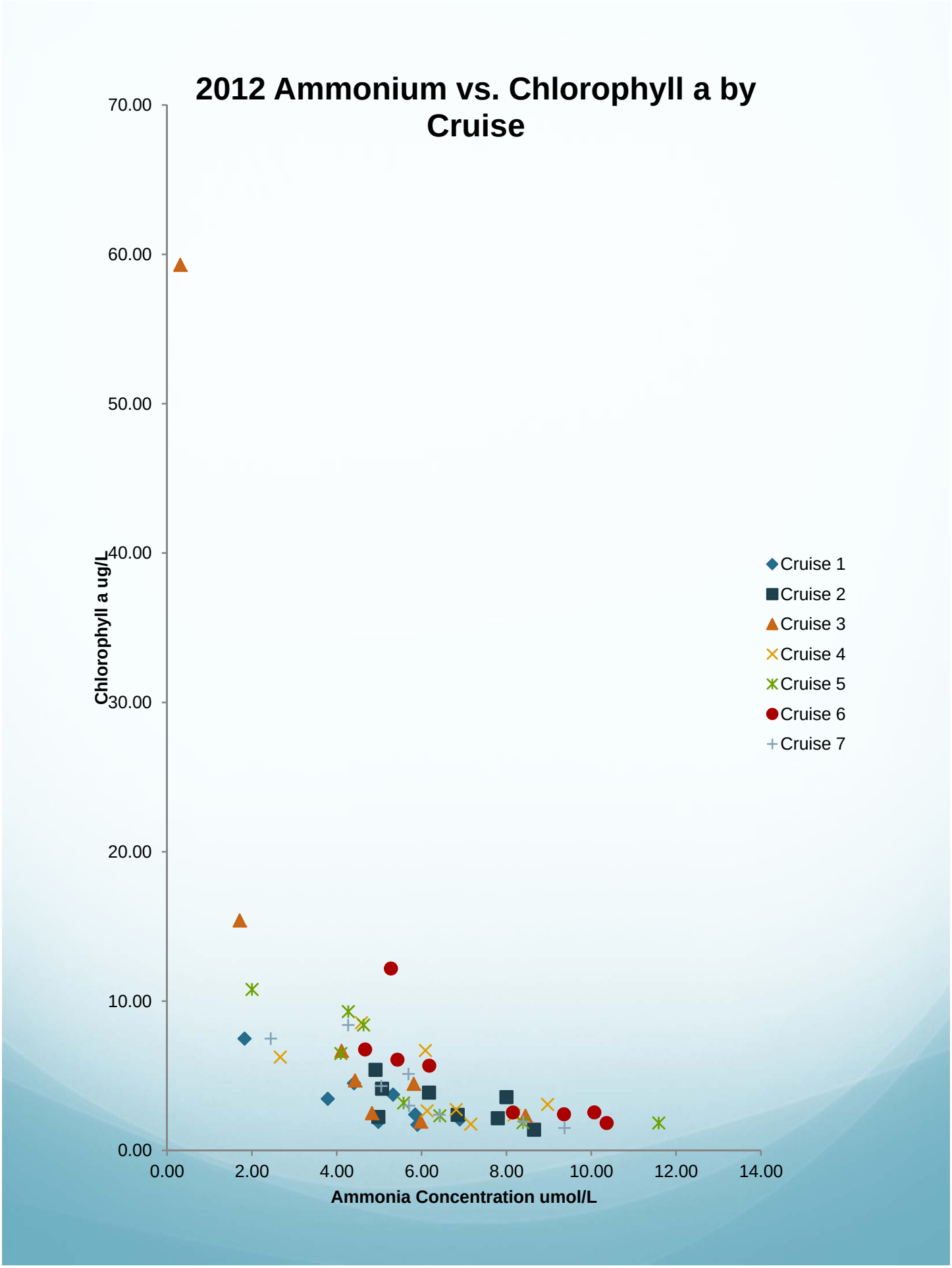
- EPA standard protocols to identify chemicals causing toxicity
- Selectively remove classes of chemicals
  - Pesticides (non-polar organics)
  - Metals (divalent cations)
  - Ammonia
- Conduct side by side tests
- Improvement in algal growth in the treated samples relative to untreated sample suggests toxicity
- Add back potential contaminant to treated sample to “recover” toxicity

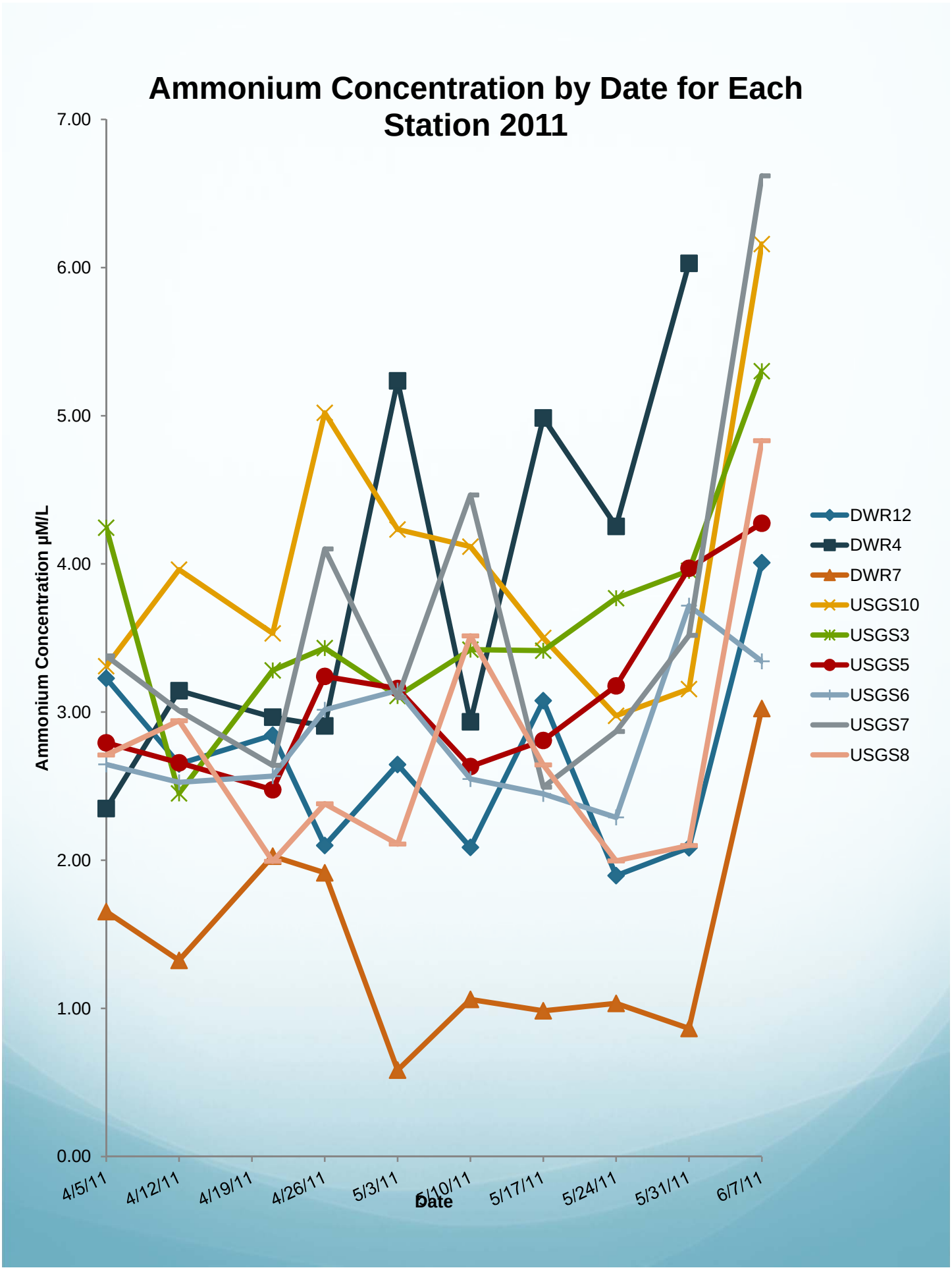
Flowchart for Suisun Bay TIE – 2012



Flowchart for Suisun Bay TIE – 2012




2012 Ammonium vs. Chlorophyll a by Cruise
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Chlorophyll a ug/L
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Ammonia Concentration umol/L
Cruise 1
Cruise 2
Cruise 3
Cruise 4
Cruise 5
Cruise 6
Cruise 7


Ammonium Concentration by Date for Each Station 2011
Ammonium Concentration µM/L
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
4/5/11
4/12/11
4/19/11
4/26/11
5/3/11
5/10/11
5/17/11
5/24/11
5/31/11
6/7/11
Date
DWR12
DWR4
DWR7
USGS10
USGS3
USGS5
USGS6
USGS7
USGS8

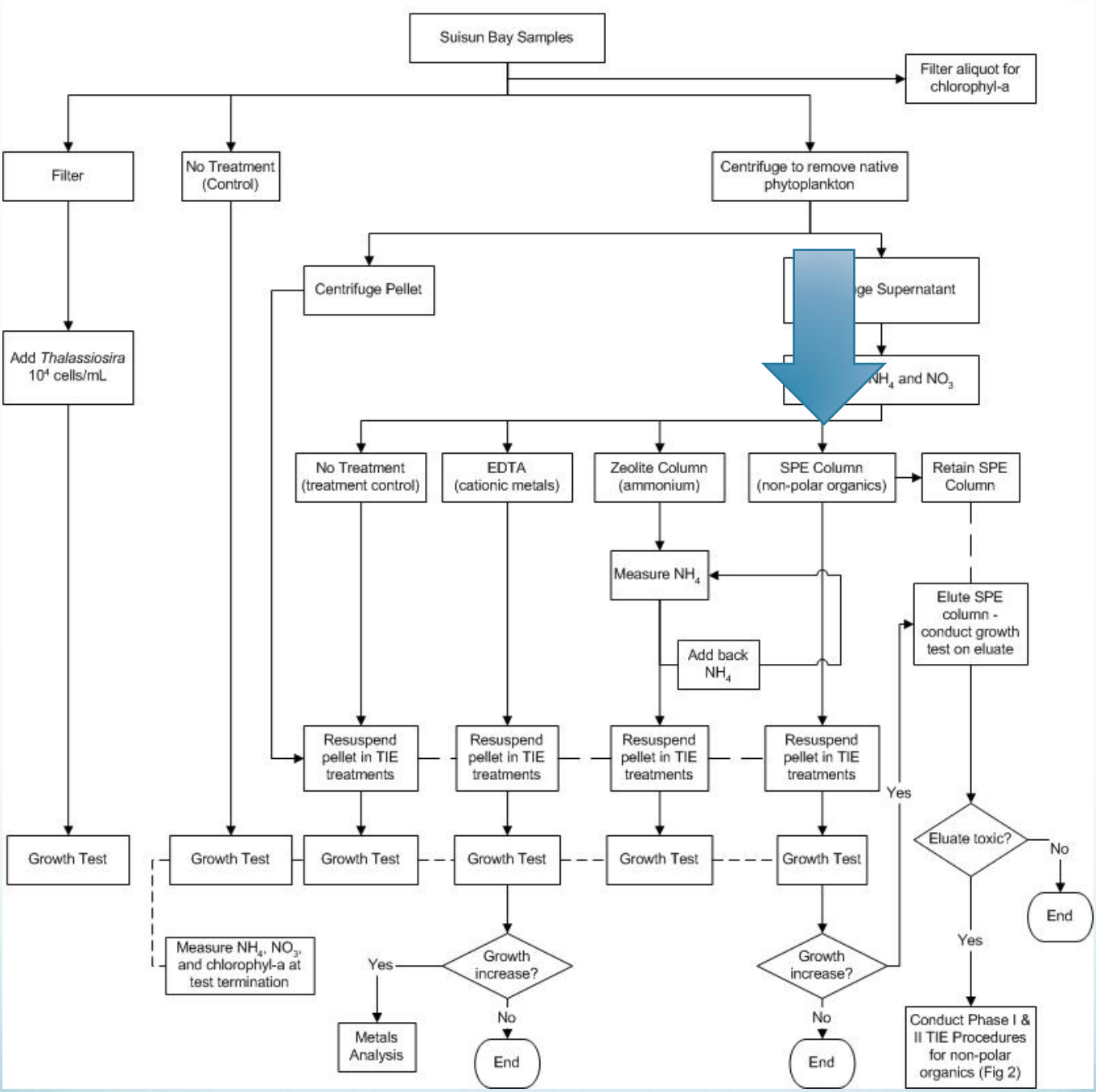
Ammonium

- Data analysis on-going
- Interpretation difficult
  - Ambient levels low
  - Nitrogen levels change during testing
- Low ammonium in samples –inhibition not expected and not detected
- Decreased growth with ammonium removal unexpected or expected?
- New Design: flow-through to maintain nutrient levels constant while testing
- Need to evaluate higher ammonium levels

Other Contaminants?

- Pesticide additivity?

Flowchart for Suisun Bay TIE – 2012



Results of SPE Treatment of Suisun Bay Samples

Test ID	Site (Date)	Chl-a Increase After SPE (%)	Contaminant (ng/L) [a]				
			Diuron	3,4-DCA	DCPMU	Hexazinone	Metolachlor
12-08	San Joaquin River (5/15/12)	17	14	13.2	nd	nd	nd
12-09	Pittsburg (5/22/12)	19	8.2	13.1	nd	nd	nd
12-10	San Joaquin River (5/29/12)	20	7.6	6.9	3.0	40.6	24.5

- Three samples exhibited increased chl-a after SPE treatment compared with control
- Samples analyzed by USGS detected 2-5 herbicides
- Phytoplankton toxicity studies with the detected herbicides are in progress; synergistic toxicity w/ ammonium

Conclusions

- Preliminary
- Significant methodological challenges
- Ammonium levels low –no inhibition
- Pesticide levels low – potential toxicity

- Ongoing:
  - Pesticide monitoring
  - Flow-through testing with both ammonium and herbicides
  - Toxy-PAM providing additional test endpoint