

# **BIOMONITORING OF THE SAN LUIS DRAIN**

**A Review: 1997-2010**

David Block, Ph.D

Block Environmental Services, Inc.  
Pleasant Hill, CA

# Monitoring Program Components

---

## ■ Water Quality

- Selenium, boron, conductivity, etc...

## ■ Biological Monitoring

- Body burdens in fish and invertebrate community

## ■ Sediment

- Selenium, TOC, volume analysis

## ■ Physical Measurements

- Flow Rates

## ■ Toxicity

# Toxicity Program Objective

---

Use toxicity testing to evaluate potential impact of SLD discharge on biota

Is drainage water toxic at point of discharge?

Is drainage water toxic downstream of discharge?

# Toxicity Program Overview

---

## Phase I (Oct. 1997 – Sept. 2001)

Laboratory Toxicity Tests – quarterly (monthly)

*In-situ* toxicity tests – quarterly

Concurrent selenium and sulfate water analysis

## Phase II (Oct. 2001 – Dec. 2009)

Laboratory Toxicity Tests – quarterly (monthly)

Concurrent selenium water analysis

## Phase III (Jan. 2010 – Dec. 2019)

Currently same as Phase II

???

# Toxicity Tests

---

measures the NET effect of toxicants

not just selenium

## Laboratory (USEPA Methodologies)

Short Term Chronic Bioassays with three trophic levels

- › Invertebrate → Water flea (*Daphnia magna*)
- › Vertebrate → Fathead minnow larvae (*Pimephales promelas*)
- › Plant → Green Algae (*Selenastrum capricornutum*)

# Test Organisms

---

*Daphnia magna*



Green Alga



Fathead Minnow



# Test Design and Endpoints

---

*Daphnia magna* – Survival and Reproduction

Head minnow larvae – Survival and Growth

Green Algae - Growth

100% site water used for all sites

Dose response series (100, 75, 50, 25, 12.5%) for Site B algae tests since 1999.

Water renewed each day for water flea and fish tests;  
not renewed in algal tests

# Water Quality Monitoring

---

Selenium

Sulfate

Temperature

EC

Dissolved Oxygen

pH

Alkalinity

- Ammonia
- Chlorine
- Hardness
- Alkalinity
- Total Suspended Solids



# Station Locations

---

Station C – Mud Slough upstream of SLD discharge

Station B – SLD at new bridge

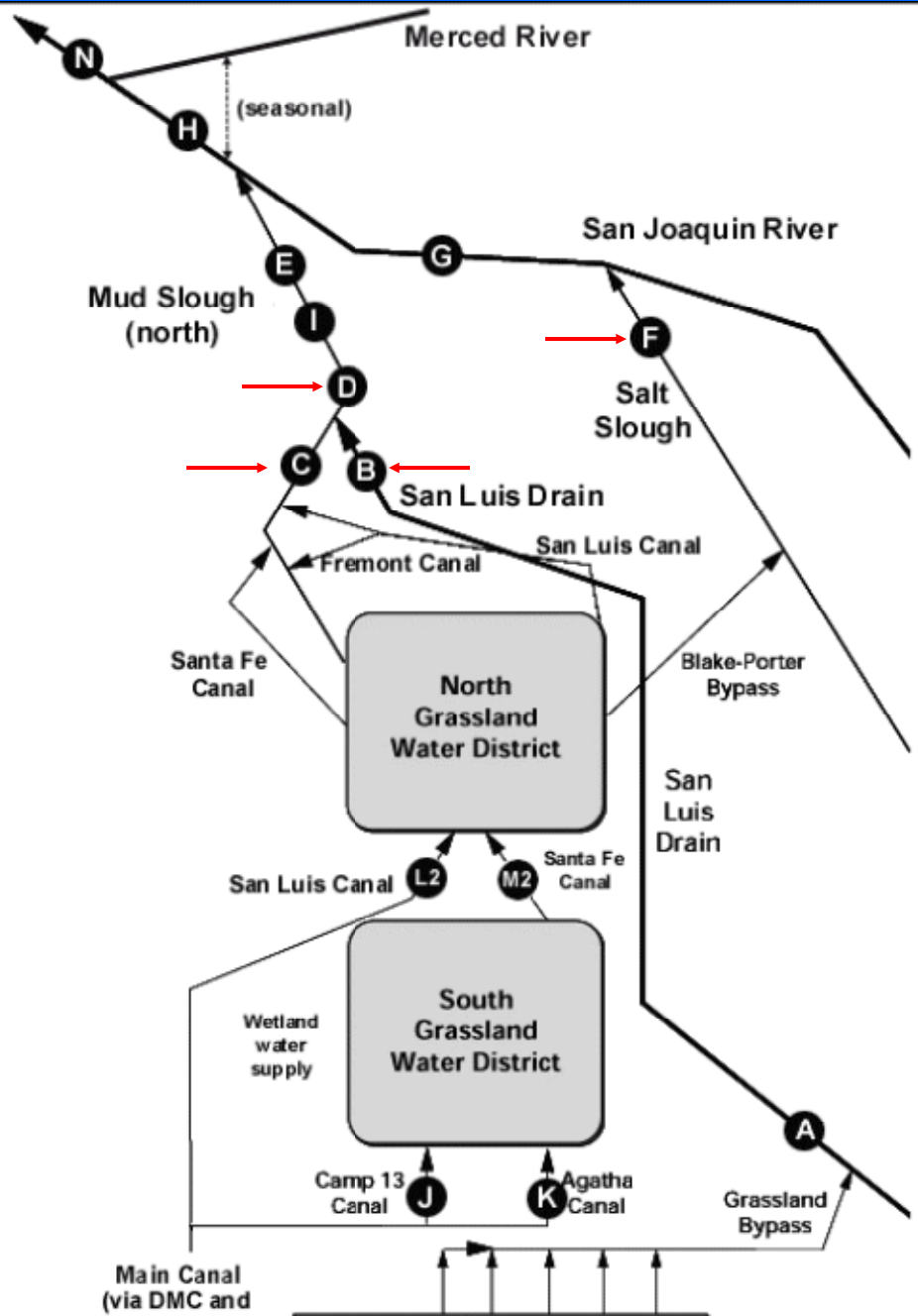
Station D – Mud Slough downstream of SLD

Station F – Salt Slough near hwy 165

To document environmental improvements

MC – Delta Mendota Canal

Control Site



# Site C



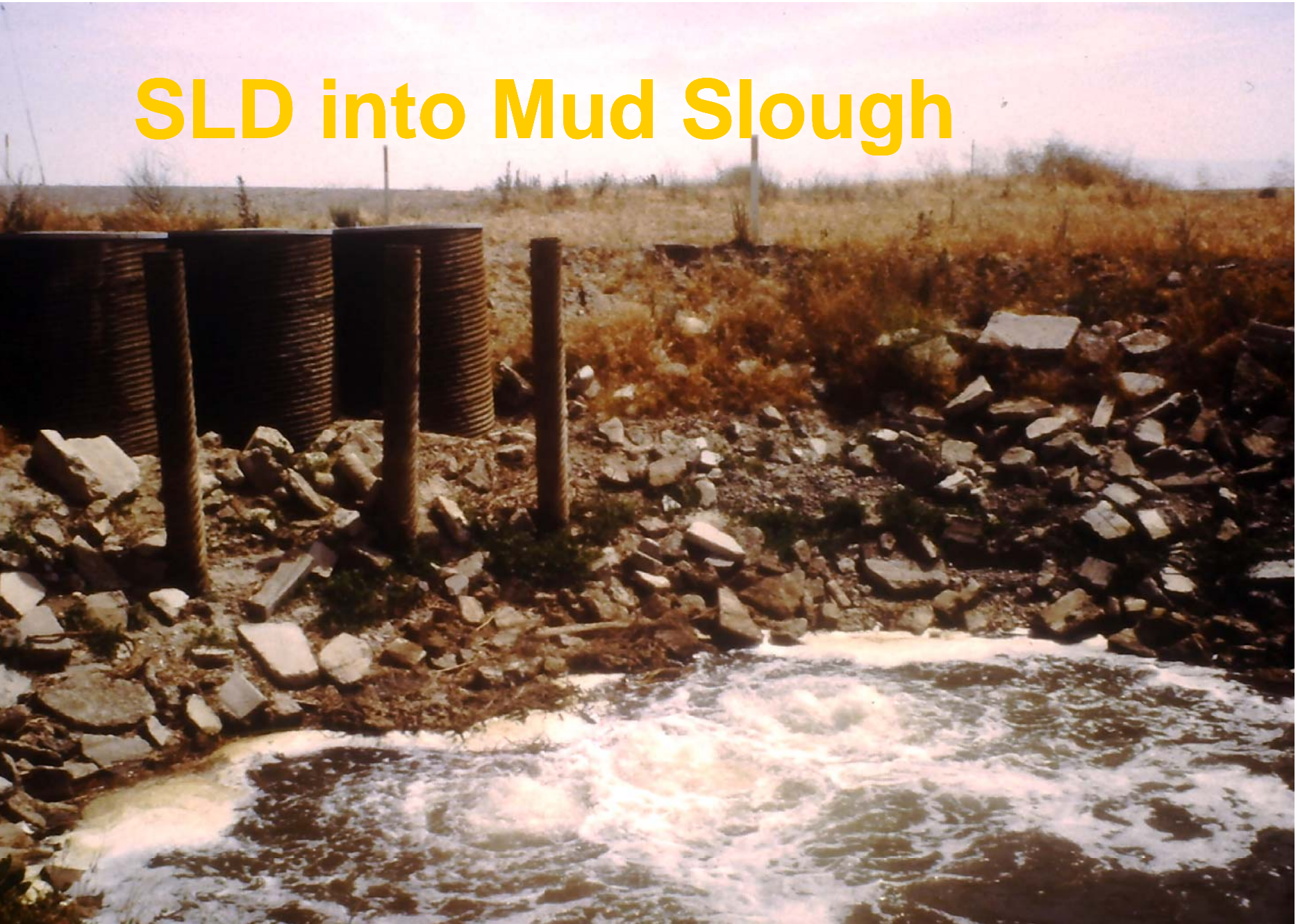
# Site B



# SLD Terminus



# SLD into Mud Slough



# Site D



# Site F





# Toxicity Data

October 1997 through December 2010

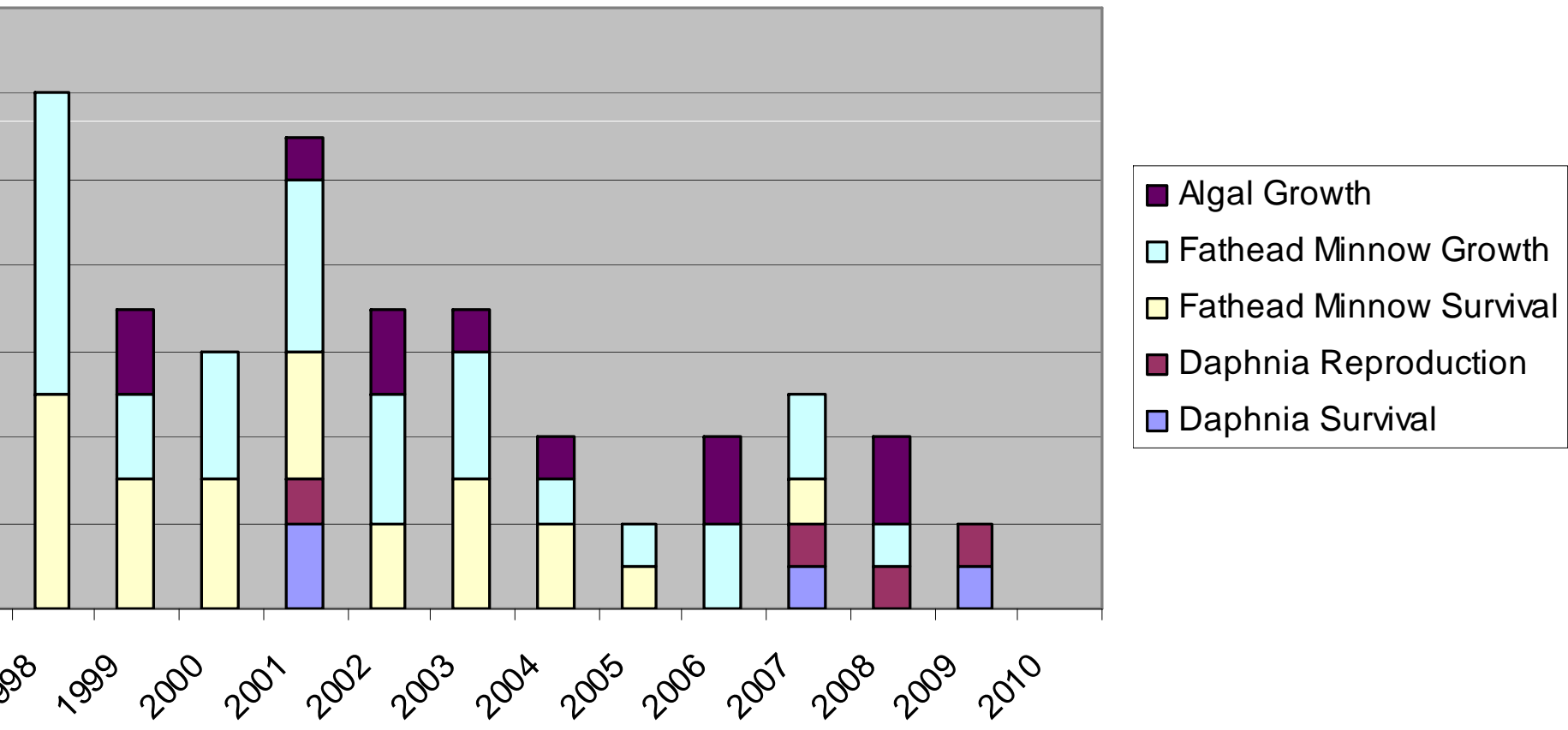
# Percent of Toxic Events by Site

---

<b>n=171</b>	<b>Site C</b>	<b>Site B</b>	<b>Site D</b>	<b>Site F</b>
<b>ia Survival</b>	2.3	3.5	2.3	<1
<b>ia Reproduction</b>	2.3	5.8	4.1	4.1
<b>d Minnow Survival</b>	14.6	0	12.3	7
<b>d Minnow Growth</b>	17.5	7.6	10.5	9.4
<b>Growth</b>	8.2	44.4	19.9	19.9

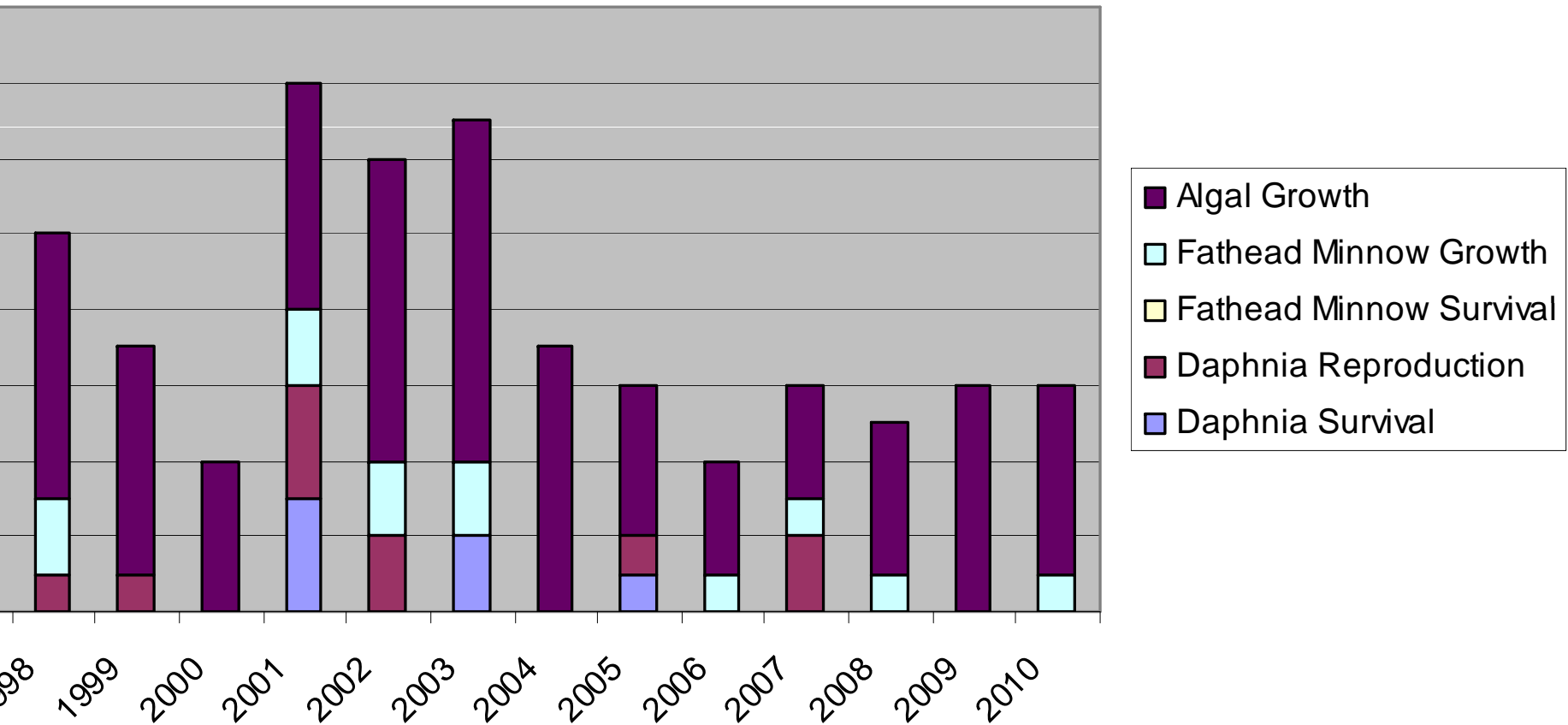
# Site C

Site C: Toxicity by Endpoint



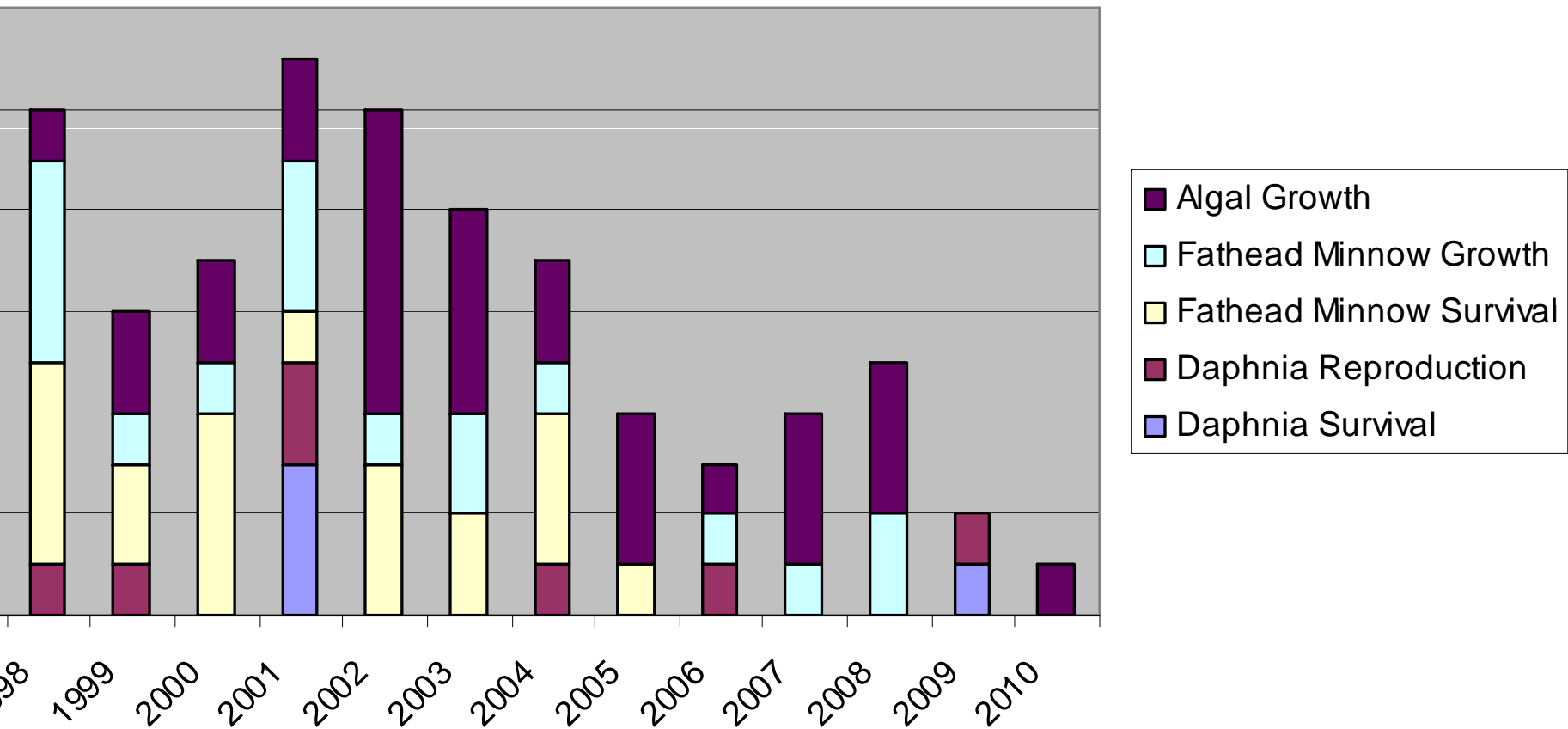
# Site B

Site B: Toxicity by Endpoint



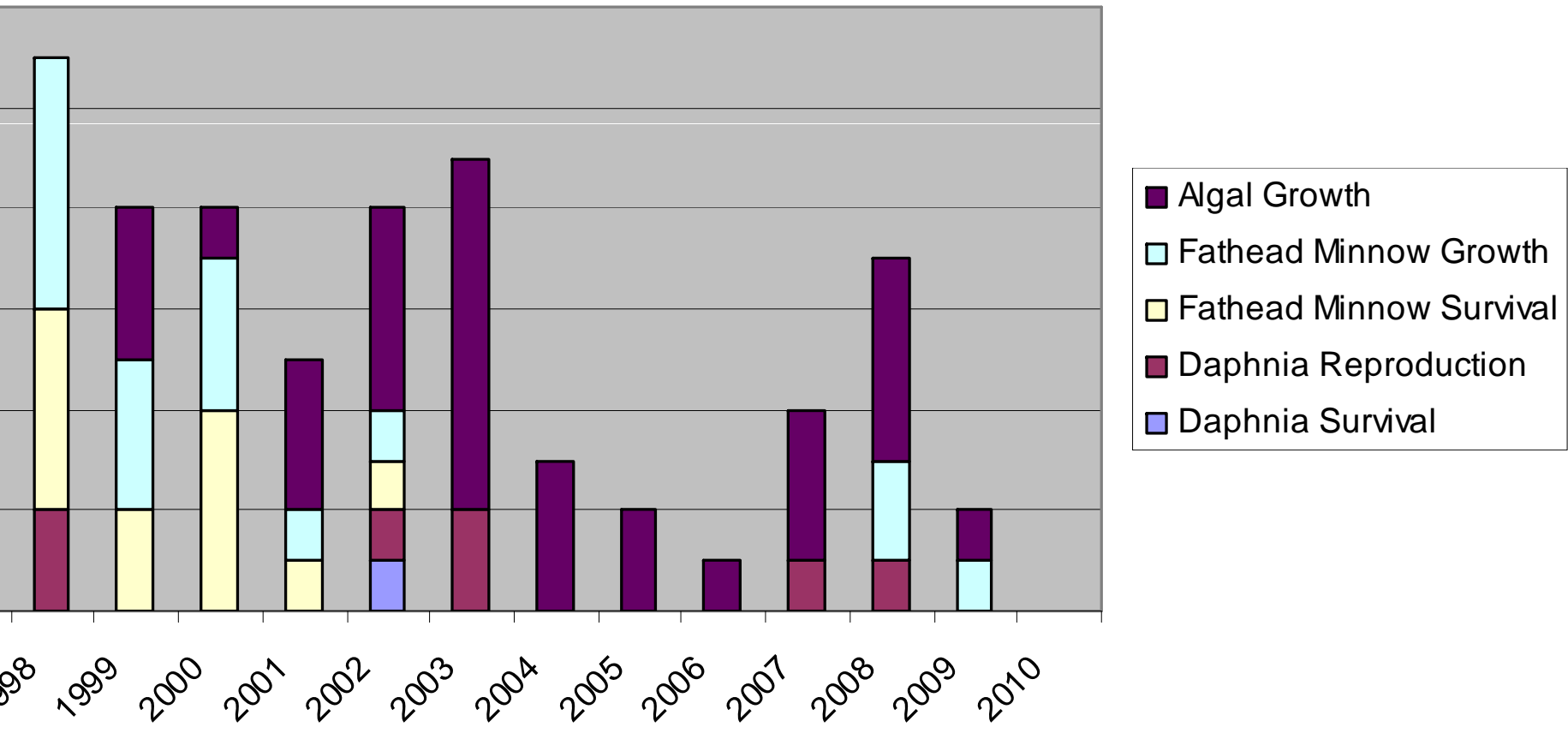
# Site D

Site D: Toxicity by Endpoint



# Site F

Site F: Toxicity by Endpoint



# Site B: Definitive Algal Tests

Total number of Tests with NOEC or LOEC <100

<b>=124</b>	<b>NOEC</b>	<b>LOEC</b>
<b>100%</b>	<b>64</b>	<b>82</b>
<b>75%</b>	<b>15</b>	<b>8</b>
<b>50%</b>	<b>11</b>	<b>11</b>
<b>25%</b>	<b>11</b>	<b>10</b>
<b>12.50%</b>	<b>10</b>	<b>11</b>
<b>&lt;12.5%</b>	<b>13</b>	<b>2</b>

# Trends Per 12-Month Period

---

**Ohio** – Toxicity occurs primarily in  
spring/summer

pesticides? TIEs inconclusive

**Head Minnow** – Toxicity occurs primarily in  
winter months

turbidity? Run-off?

**Bluegill** – Toxicity occurs throughout year



## Trends, Cont.

---

Toxicity highest in 2002-2003 followed by  
downward trend at all sites

High Frequency of Algal Toxicity at Site B (3 to  
events per year)

Selenium – Does not appear to be correlation  
between selenium concentrations and toxicity

# Conclusions

---

## **drainage water toxic at point of discharge?**

Toxicity in SLD is comparable with upstream of convergence zone with mud slough, except for algae

## **drainage water toxic downstream of discharge?**

Toxicity upstream and and downstream of SLD in mud slough are comparable, except for algae

# Additional Testing

---

**Sediment toxicity**

**TEs on SLD water when algae tests  
demonstrate toxicity**

**Increased scope of monitoring may lead  
to reduced toxicity monitoring frequency**