

## Overview for 2007

**Annual Loading = 131.9 vs. 175 lbs limit**

**3 Month Loading = 70.6 (Oct) and 62.6 (Nov) lbs vs. 55 lbs limit**

**Hatchery Flow = 6.99 vs. 20 mgd limit**

**19,019 passed vs. 20,000 Adult Coho limit**

**260 passed vs. 1,000 Adult Chinook limit**

**Lake TP Concentration: 7.34 mg/m<sup>3</sup> volume - weighted**

**63% vs. 95% compliance with 8 mg/m<sup>3</sup> goal**

**Annual Average Hatchery P Mass Balance methodology has been completed.**

**Hatchery Bio-Energetic and Process Model – calibration underway.**

**Hatchery flow meters calibrated and collaborated with outflow measurements.**

**Watershed P and Flow Mass Balance have been completed.**

**BASINS model report completed.**

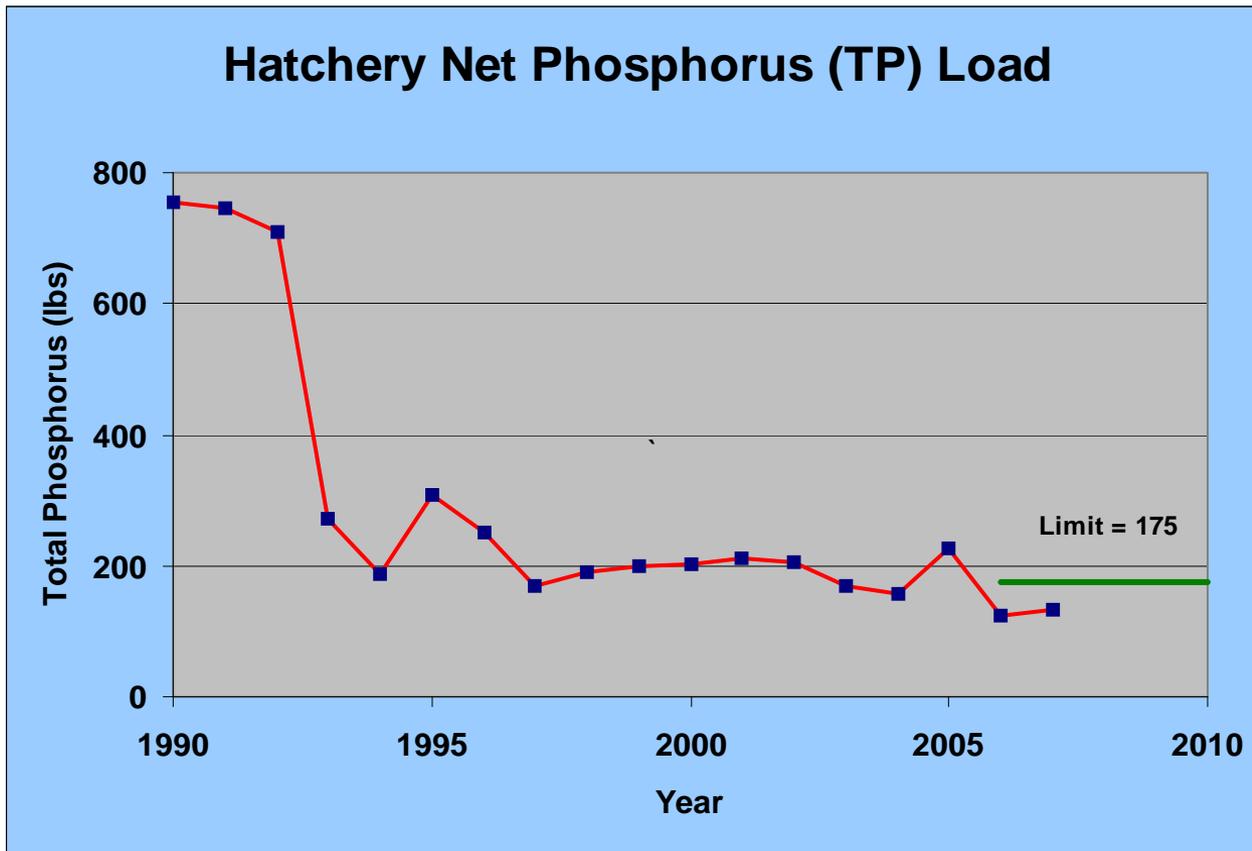
**Steady State and Preliminary Seasonal Water Quality Models Completed for Lake**

**Special Studies: Bio-availability study underway.**

**CMU billing and NPDES reporting connected to database.**

**Database documentation underway.**

**Figure 1. Overview of 2007 Annual Report.**



Why worry as long as the load is below 175 Lbs/Yr?

What factors cause load to go up like 2005?

Suppose you want to increase production in the future, what is the non-compliance risk?

Suppose you want to control loading from another MDNR Hatchery facility?

We need to quantitatively understand the link between  
Net Load and Fish Production Activities and Plant Operations

Figure 2. Hatchery Loading.

# Law of Mass Balance: Accumulation = In – Out

## Accumulation Terms

=

## Input Terms

-

## Output Terms

Change in P associated with fish tissue  
Change of P stored in tank

P in fish food  
P in source water  
P in fry tissue

P in shipped, planted, or mort fish tissue  
P in outlet discharge  
P trucked away  
P buried to bottom of pond

[ Can = 0 or be < or > 0 ]

THE MYSTERY OF BIGFOOT SOLVED!



Figure 3. Mass Balance Law

Phosphorus  
Mass Balance:

End	-	Start	=	Inputs	-	Outputs
Fish Tank		Fish Tank		Source Water Food Fry		Discharge Planted Fish Shipped Fish Mort Fish Trucked Sludge Pond Loss

Special Case : Fish and Tank at End = Start

Then  $\Sigma$  Inputs =  $\Sigma$  Outputs

Source + Food + Fry = Discharge + Planted + Shipped + Morts + Trucked + Pond Loss

Discharge - Source = Food + Fry - Planted - Shipped - Morts - Trucked - Pond Loss

**Figure 4. Steady State Mass Balance**

General Case:

$$\text{Outputs} = \text{Inputs} + \text{Start} - \text{End}$$

Discharge	Source Water	Fish
Planted Fish	Food	Tank
Shipped Fish	Fry	
Mort Fish		
Trucked Sludge		
Pond Loss		

## Definitions & Assumptions

Net Load = Discharge – Source Water

Harvest =  $\Sigma$  [ Planted + Shipped + Mort ]      Harvest = Fish that leave the Hatchery

Fish Increase = Fish End – Fish Start

Production = Fish Increase + Harvest – Fry In      Production = Actual Net Growth of new Fish Biomass

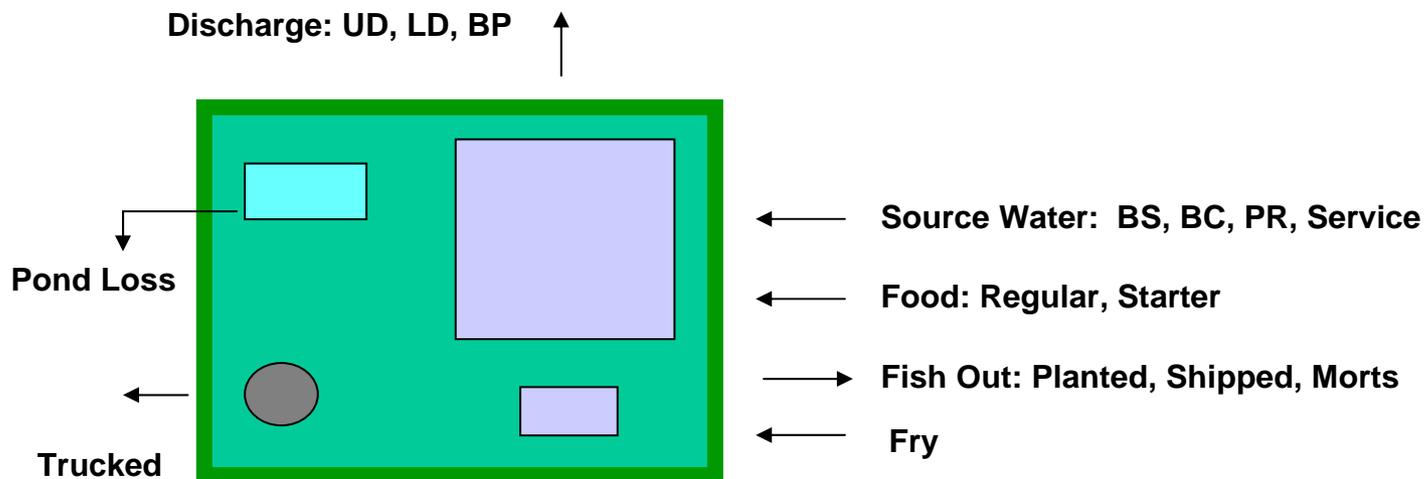
Tank Retention = Tank End – Tank Start + Trucked

$$\text{Discharge} - \text{Source} = \text{Food} - [ \text{Harvest} + \text{Fish End} - \text{Fish Start} - \text{Fry} ] - \text{Trucked} - \text{Pond} + [ \text{Tank Start} - \text{Tank End} ]$$

$$\text{Food} - \text{Production} - \text{Tank Retention} - \text{Pond Loss} = \text{Net Load}$$

Observe that Production  $\neq$  Harvest because some of the Harvest could come from stock depletion.

**Figure 5. Definition of terms in Mass Balance Equation**



$$\text{Food} - \text{Production} - \text{Tank Retention} - \text{Pond Loss} = \text{Net Load}$$

**Fish Rearing Activities**

**Plant Operations**

**Net Load**

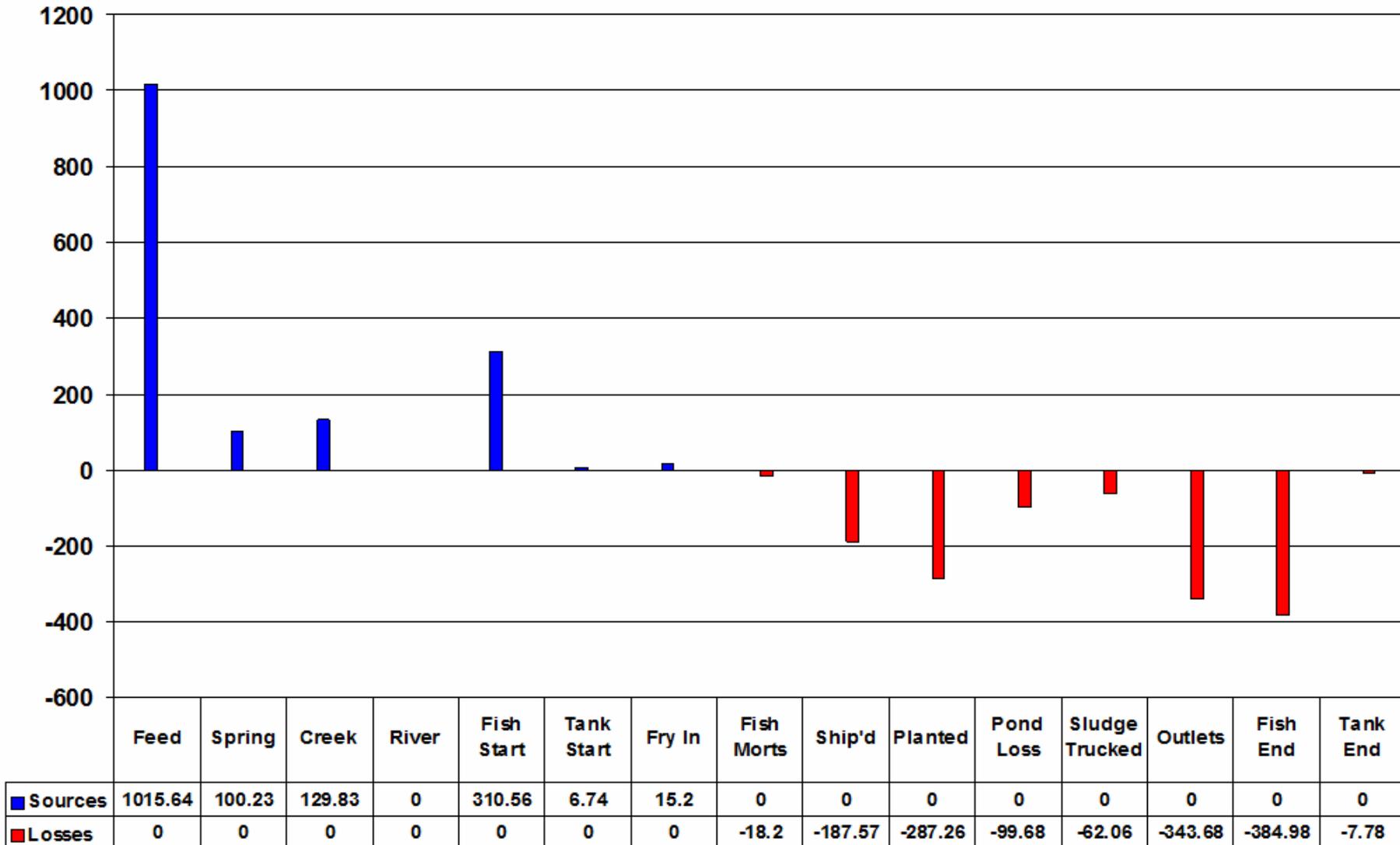
Note that only the terms that cross the system boundaries are included in the mass balance equation. Internal activities are not relevant.

**Figure 6. Mass Balance Expressed in Practical Terms.**

# Hatchery Phosphorus Mass Balance for 2007

Total Sources: 1578.20 lbs, Total Losses: 1391.18 lbs

Method: Jug & Needle



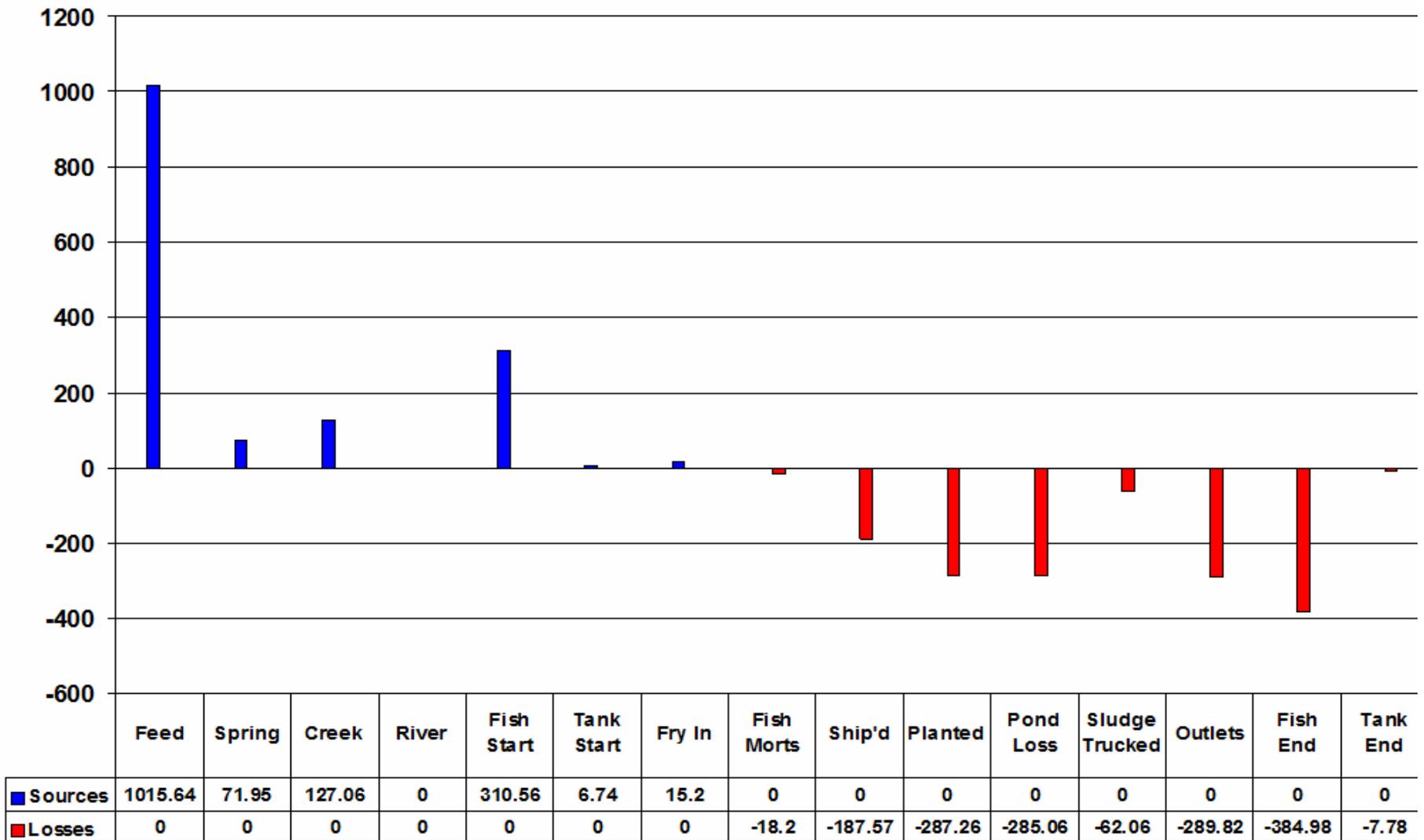
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Figure 7. Hatchery Mass Balance for 2007 (JN).

# Hatchery Phosphorus Mass Balance for 2007

Total Sources: 1547.15 lbs, Total Losses: 1522.71 lbs

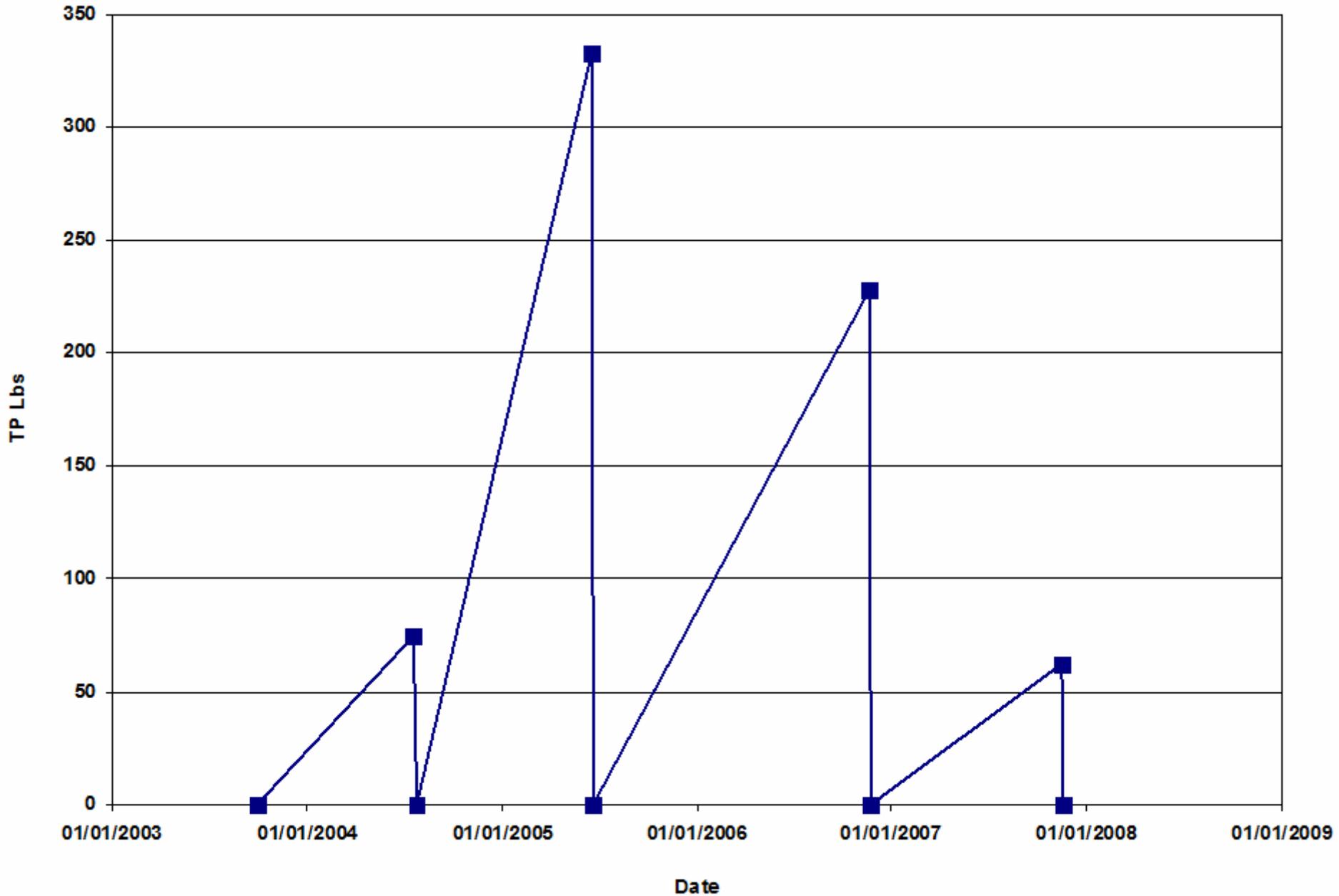
Method: Sigma



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Figure 8. Hatchery Mass Balance for 2007 (Sigma).

# Phosphorus Stored in Sludge Tank



Method	Year	Food	Spring	Creek	River	Fish S	Tank S	Fry In	Total In
JN	2001	1272	50	166	51	426	0	17	1983
JN	2002	1019	64	220	77	424	0	17	1822
JN	2003	704	94	216	189	388	0	16	1607
Sigma	2003	704	73	188	172	388	0	16	1540
JN	2004	1071	62	249	25	204	24	19	1653
Sigma	2004	1071	58	239	24	204	24	19	1637
JN	2005	993	81	183	0	407	163	23	1851
Sigma	2005	993	69	187	0	407	163	23	1843
JN	2006	963	74	131	0	352	85	11	1615
Sigma	2006	963	57	148	0	352	85	11	1616
JN	2007	1016	100	130	0	311	7	15	1578
Sigma	2007	1016	72	127	0	311	7	15	1547

Method	Year	Morts	Ship	Plant	Pond Loss	Trucked	Outlet	Fish End	Tank End	Total Out
JN	2001	33	344	259	37	0	477	424	0	1573
JN	2002	17	372	229	25	0	558	387	0	1587
JN	2003	13	191	355	85	0	609	204	24	1479
Sigma	2003	13	191	355	195	0	429	204	24	1409
JN	2004	106	172	161	99	75	475	407	163	1657
Sigma	2004	106	172	161	47	75	439	407	163	1570
JN	2005	8	383	228	-1	333	492	352	85	1879
Sigma	2005	8	383	228	-55	333	456	352	85	1789
JN	2006	6	325	247	55	228	321	311	7	1498
Sigma	2006	6	325	247	3	228	287	311	7	1413
JN	2007	18	188	287	100	62	344	385	8	1391
Sigma	2007	18	188	287	285	62	290	385	8	1523

**Figure 10. Terms in Mass Balance Equation.**

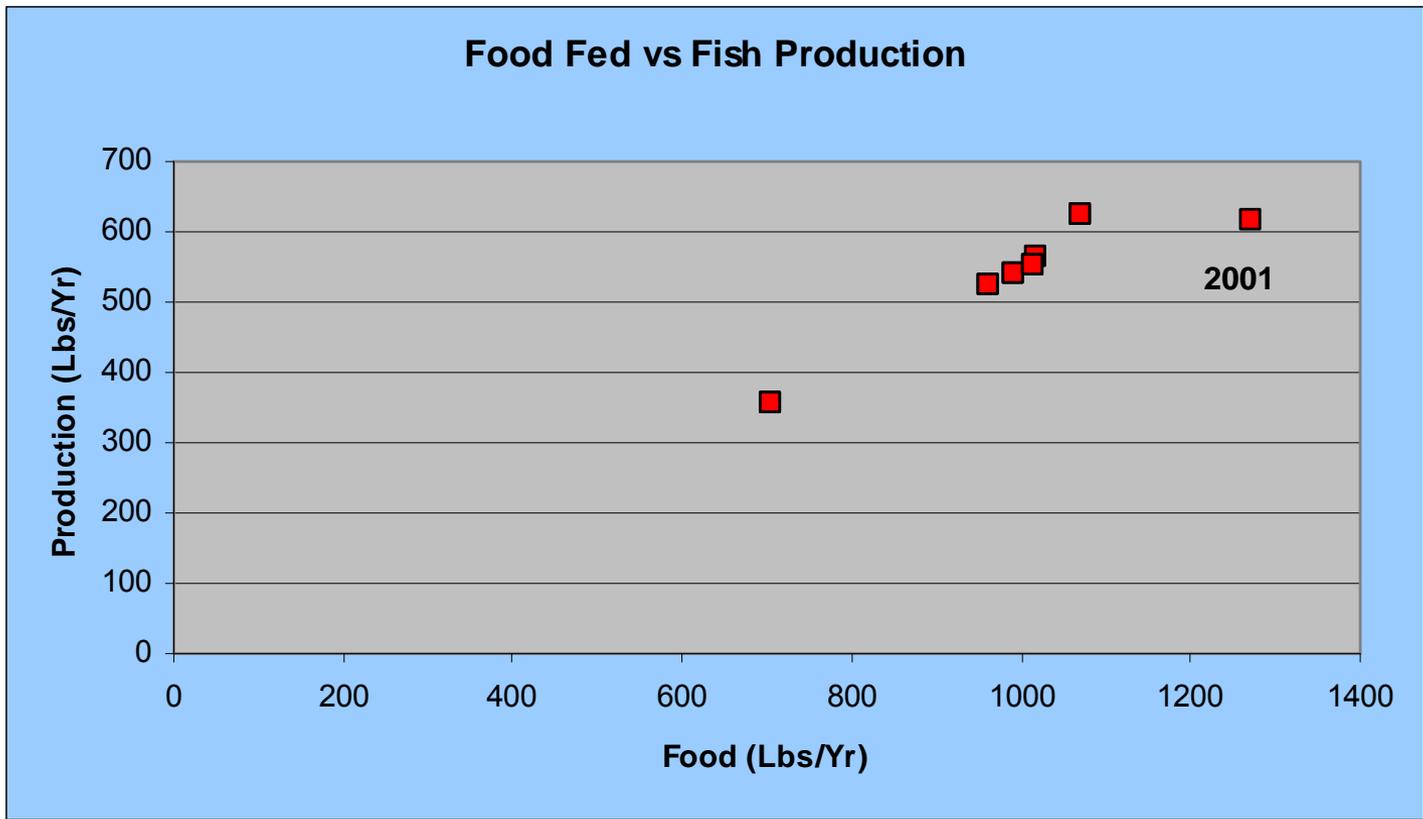


Figure 11. Relationship between Fish Food and Production.

Method	Year	Food	Source Water	Fish Production	Tank Retention	Pond Loss	Outlet
JN	2001	1272	267	617	0	37	477
JN	2002	1019	362	563	0	25	558
JN	2003	704	499	358	24	85	609
Sigma	2003	704	432	358	24	195	429
JN	2004	1071	337	624	214	99	475
Sigma	2004	1071	321	624	214	47	439
JN	2005	993	264	540	255	-1	492
Sigma	2005	993	256	540	255	-55	456
JN	2006	963	204	525	150	55	321
Sigma	2006	963	205	525	150	3	287
JN	2007	1016	230	552	63	100	344
Sigma	2007	1016	199	552	63	285	290

**Figure 12. Combined Terms in Mass Balance Equation.**

Method	Year	Food	% Tissue P 0.4		Tank Retention	Pond Loss	Mass Bal Net Load	Meas Net Load	Error
			Fish Production						
JN	2001	1272	617		0	37	619	210	410
JN	2002	1019	563		0	25	431	196	235
JN	2003	704	358		24	85	238	110	128
Sigma	2003	704	358		24	195	127	-4	131
JN	2004	1071	624		214	99	134	138	-4
Sigma	2004	1071	624		214	47	185	118	67
JN	2005	993	540		255	-1	199	227	-28
Sigma	2005	993	540		255	-55	253	200	53
JN	2006	963	525		150	55	233	116	117
Sigma	2006	963	525		150	3	285	82	203
JN	2007	1016	552		63	100	300	114	187
Sigma	2007	1016	552		63	285	115	91	24

Expected Net Load  
assuming all the  
other measurements  
are correct

Actual  
Measured  
Net Load

Figure 13. Predicted vs Measured Loading.

# Brundage Spring at Intake - Phosphorus for Year 2007

Average Dip: 11.45, Average J/N: 12.76, Average Sigma: 9.21

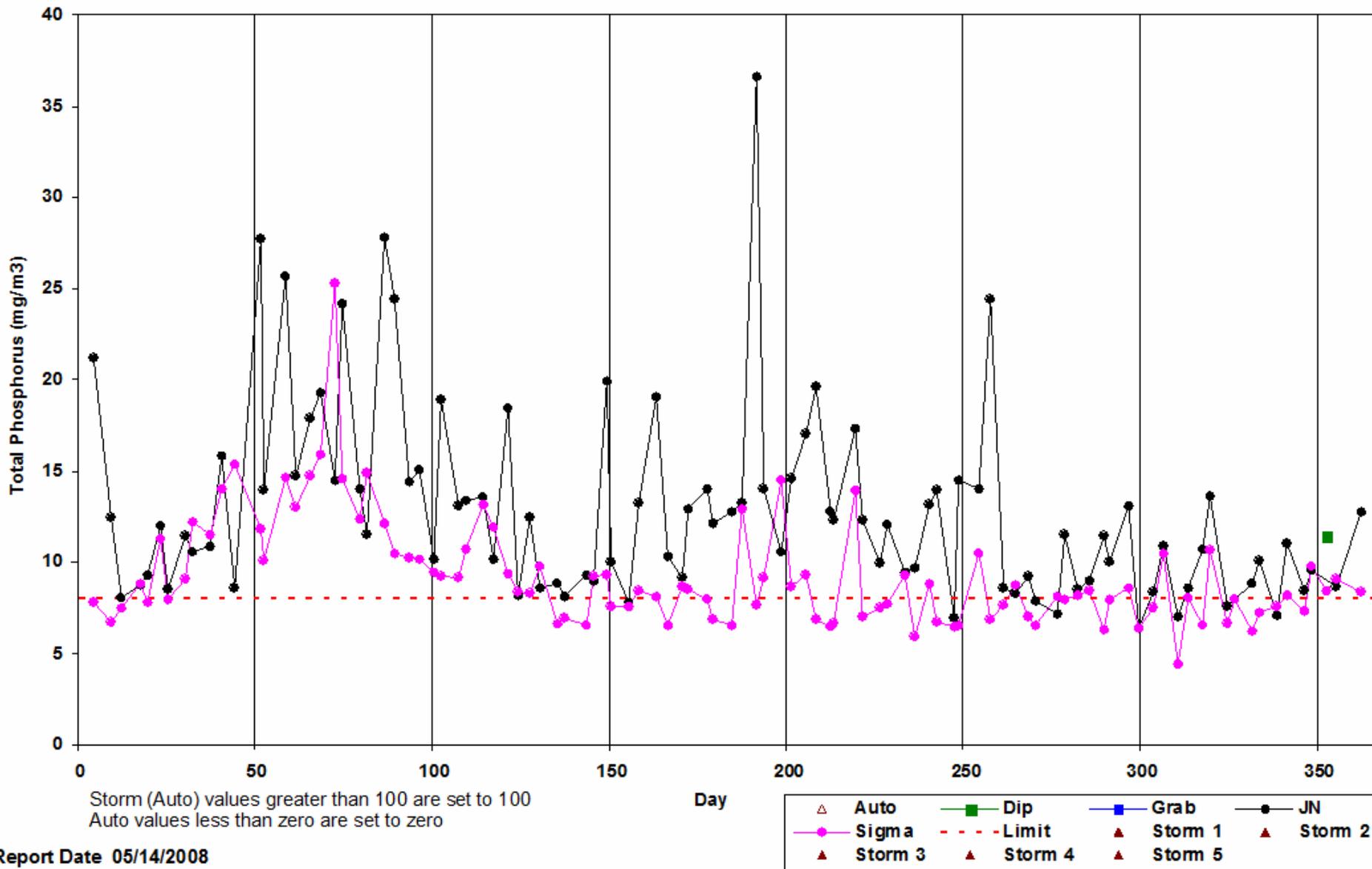


Figure 14.

# Brundage Spring at Intake Turbidity for Year 2007

Average Dip: 2.14, Average J/N: 2.28, Average Sigma: 2.05

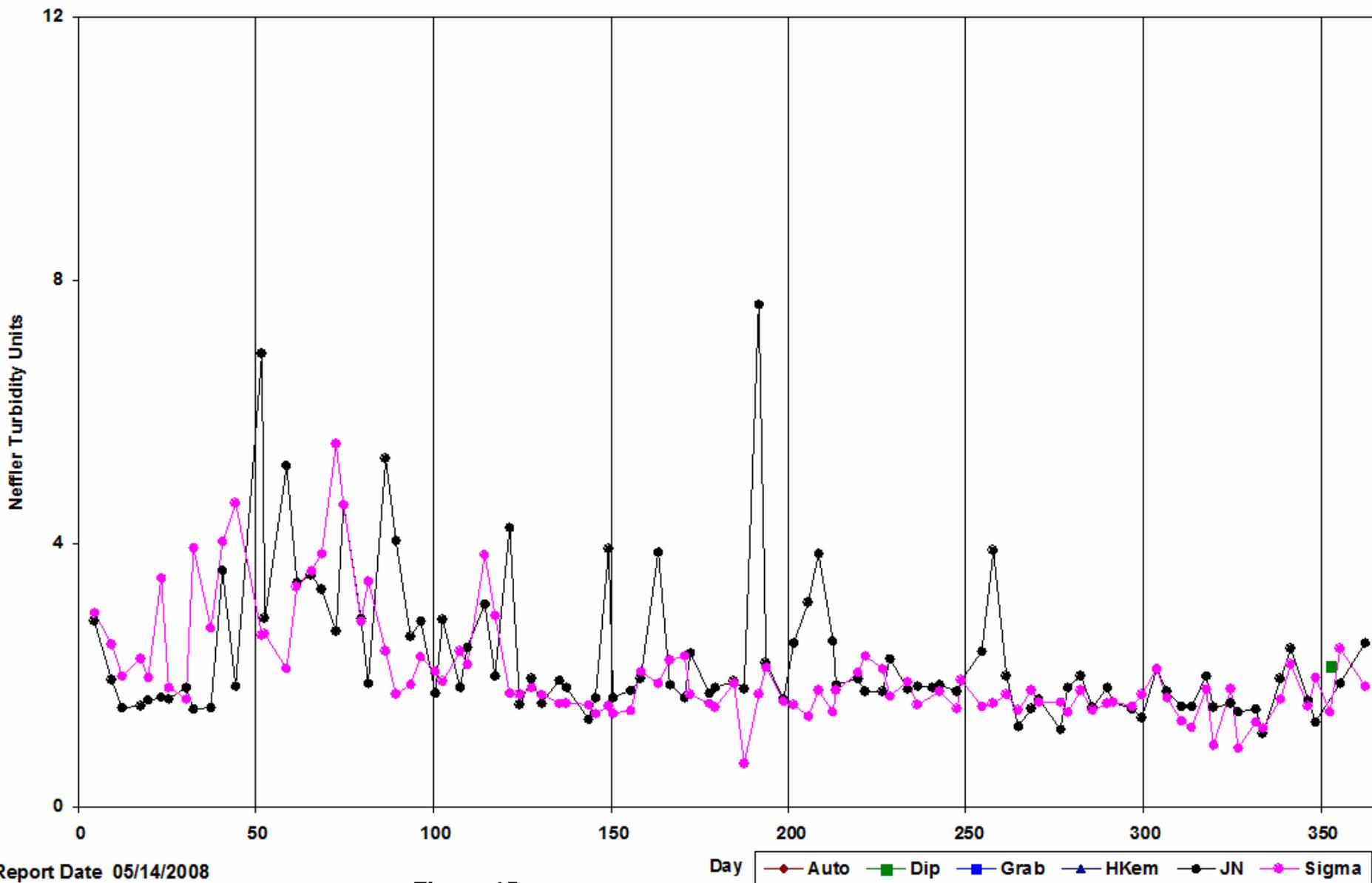


Figure 15.

# Brundage Creek at Intake - Phosphorus for Year 2007

Average Dip: 13.98, Average J/N: 9.77, Average Sigma: 9.42

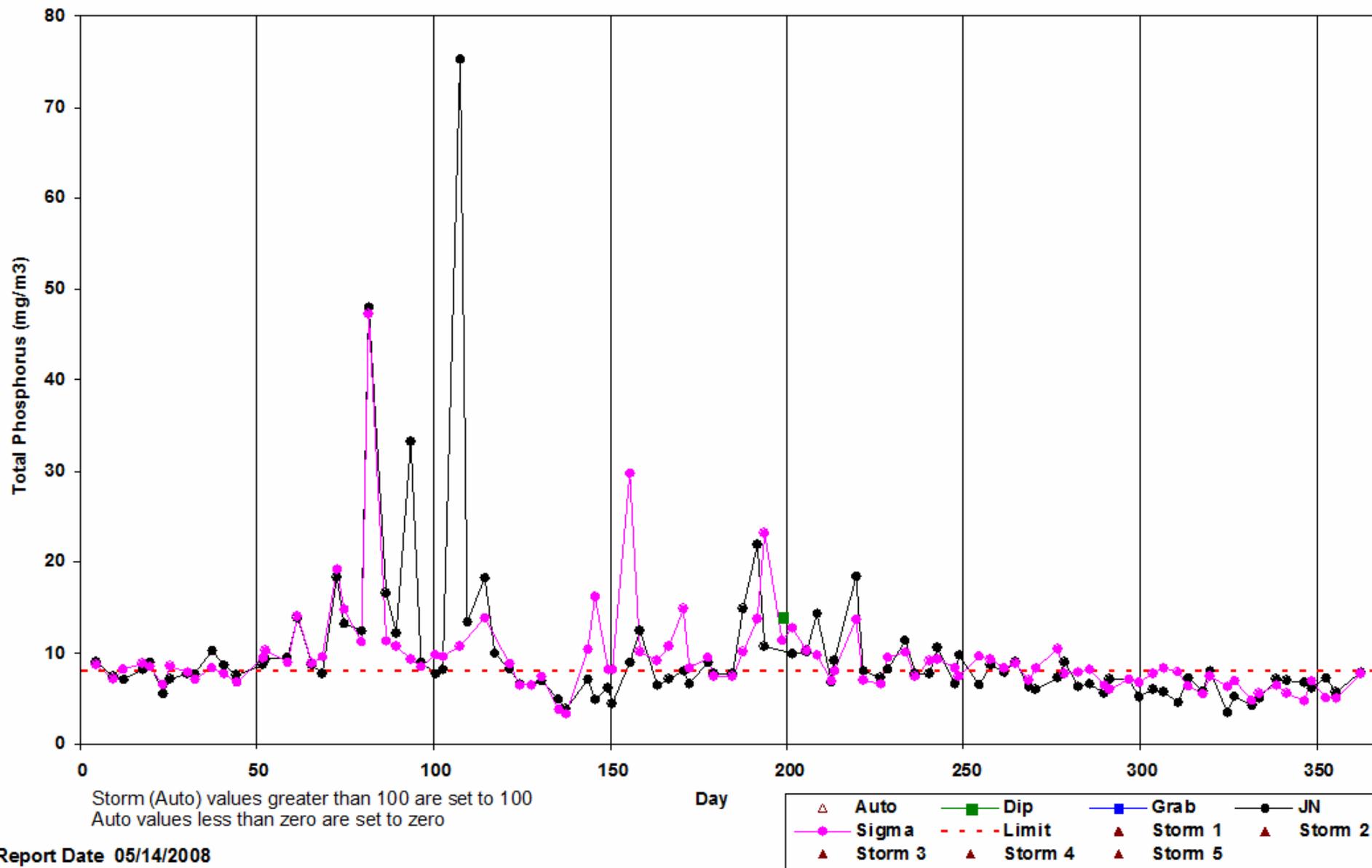


Figure 16.

# Brundage Creek at Intake Turbidity for Year 2007

Average Dip: 3.51, Average J/N: 2.82, Average Sigma: 3.84

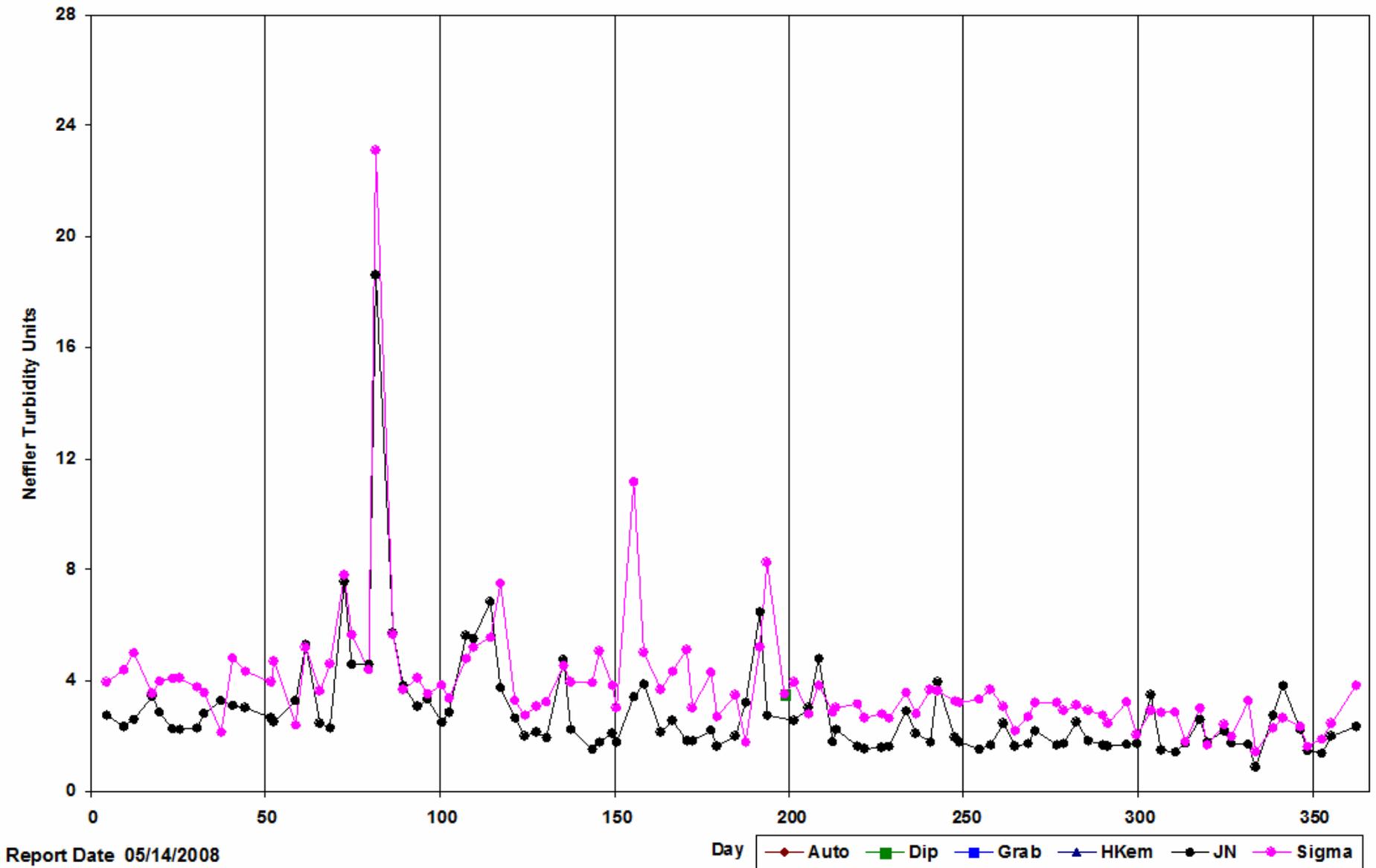


Figure 17.

# Upper Discharge - Outfall 0002 - Phosphorus for Year 2007

Average Dip: 18.19, Average J/N: 16.23, Average Sigma: 13.81

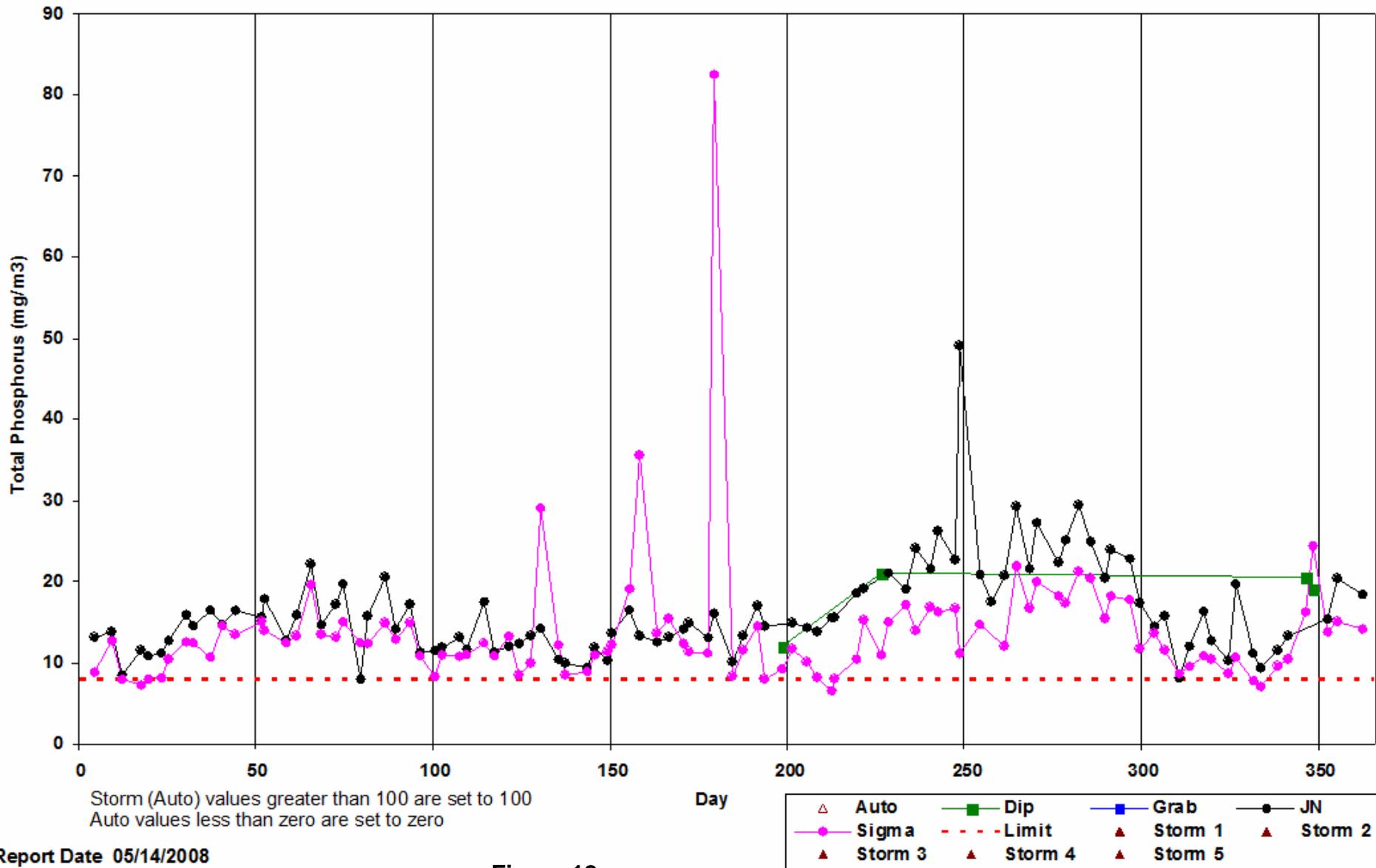
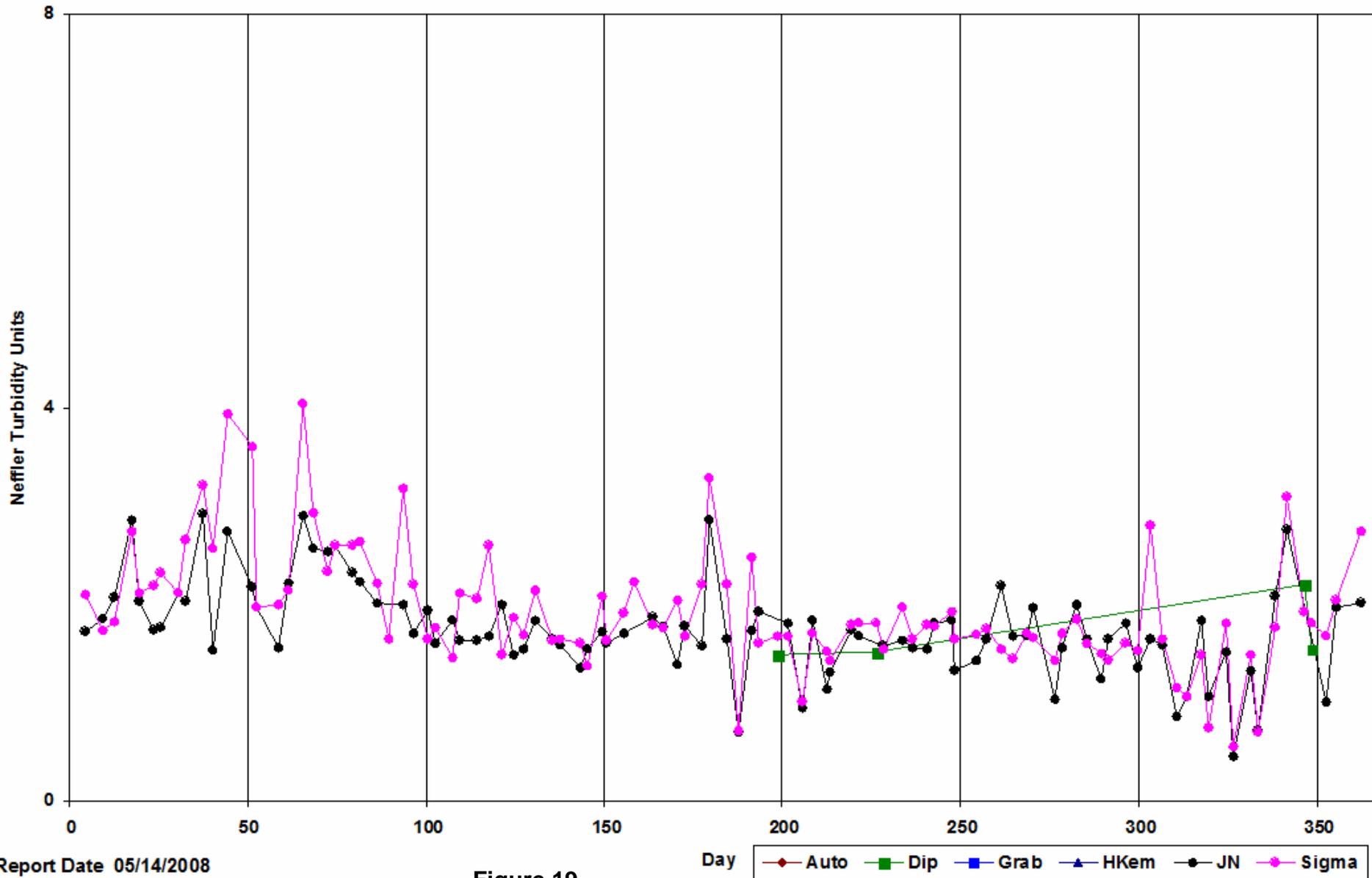


Figure 18.

# Upper Discharge - Outfall 0002 Turbidity for Year 2007

Average Dip: 1.68, Average J/N: 1.75, Average Sigma: 1.94



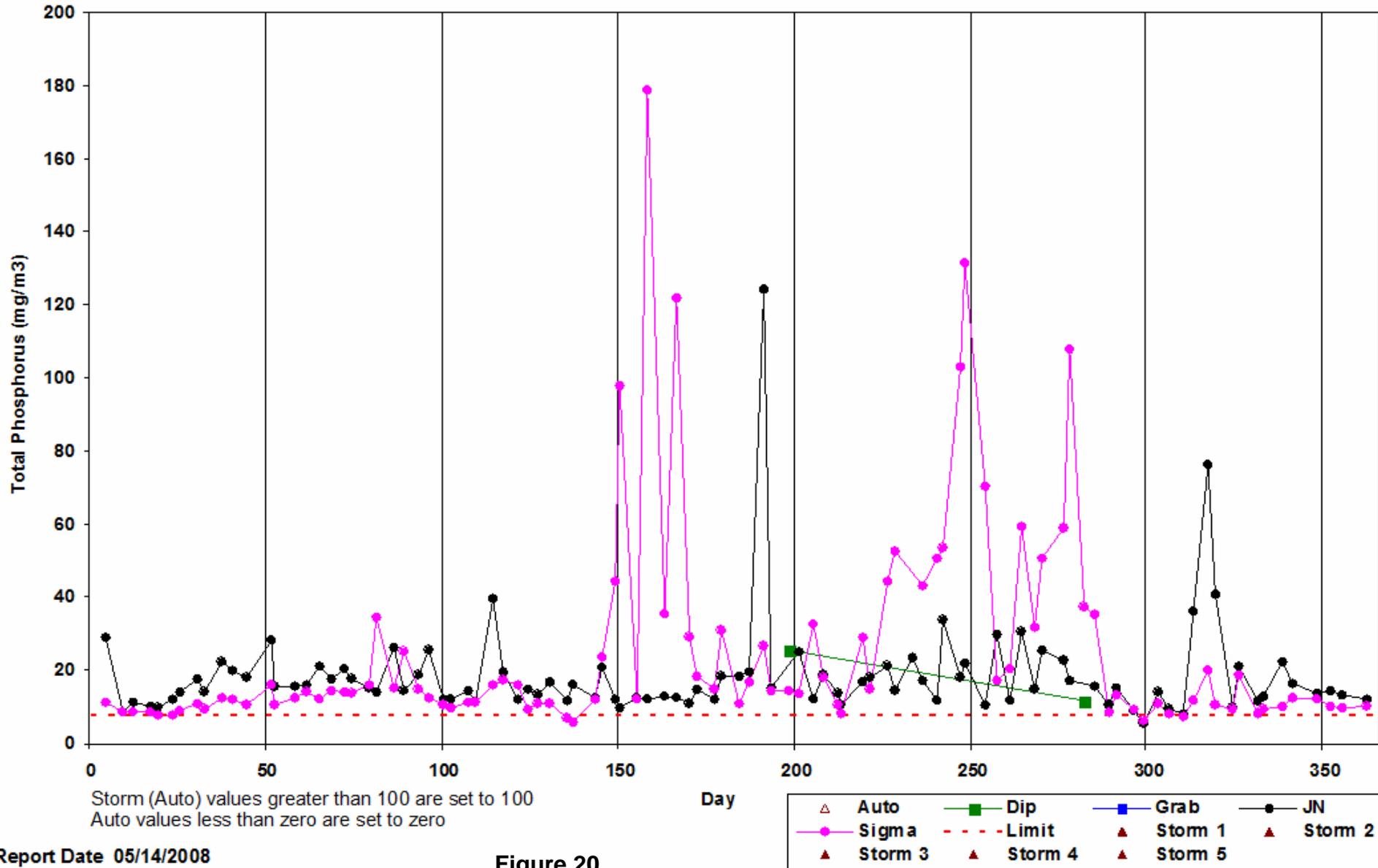
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Figure 19.

Day Auto Dip Grab HKem JN Sigma

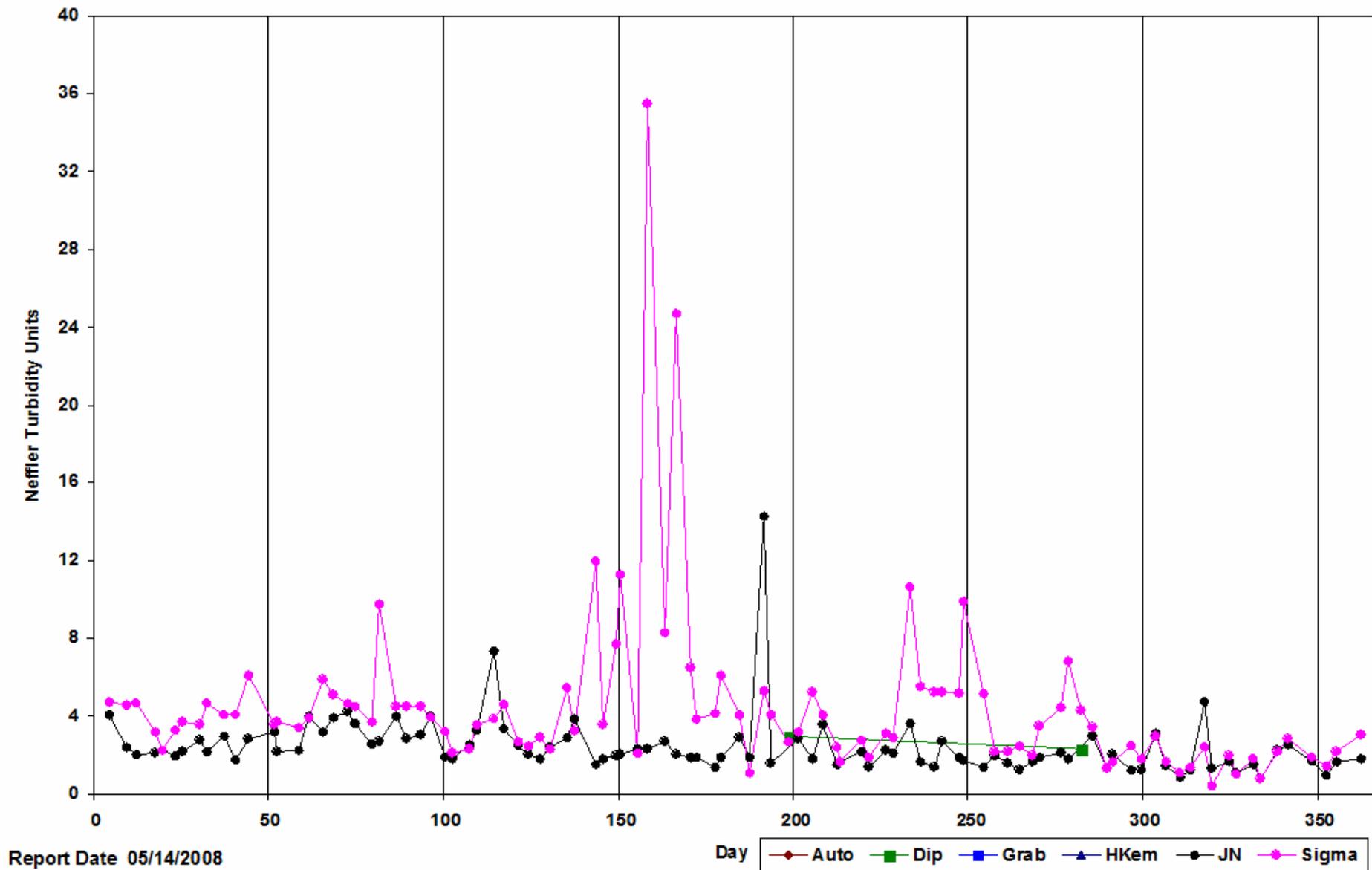
# Screens to Treatment Pond - Phosphorus for Year 2007

Average Dip: 18.74, Average J/N: 18.60, Average Sigma: 25.28



# Screens to Treatment Pond Turbidity for Year 2007

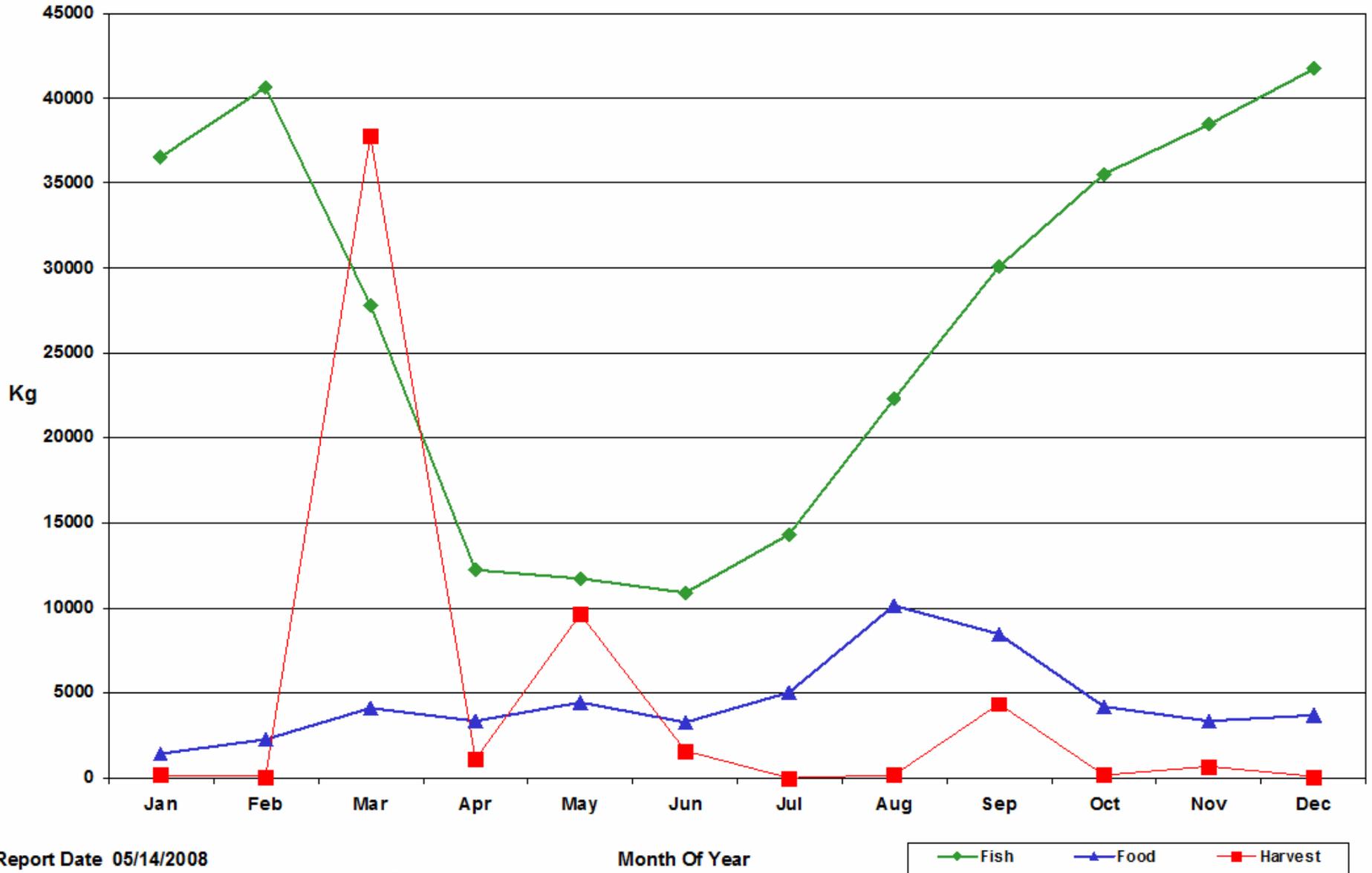
Average Dip: 2.68, Average J/N: 2.44, Average Sigma: 4.39



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Figure 21.

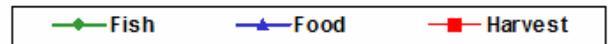
# Fish vs Food vs Harvest for 2007



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Figure 22.

Month Of Year



# Solid TP for Fish Food by Laboratory for Year 2007

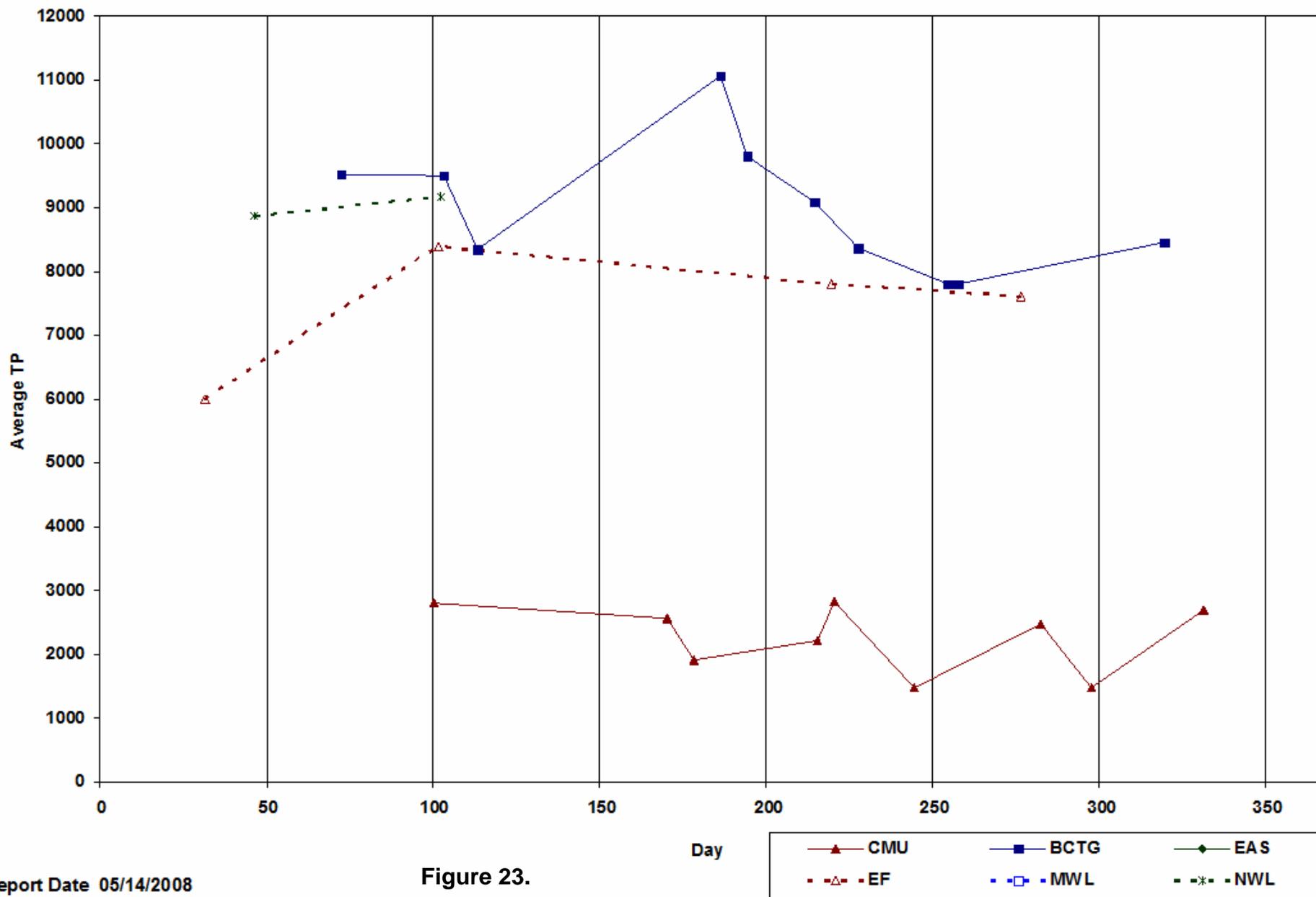
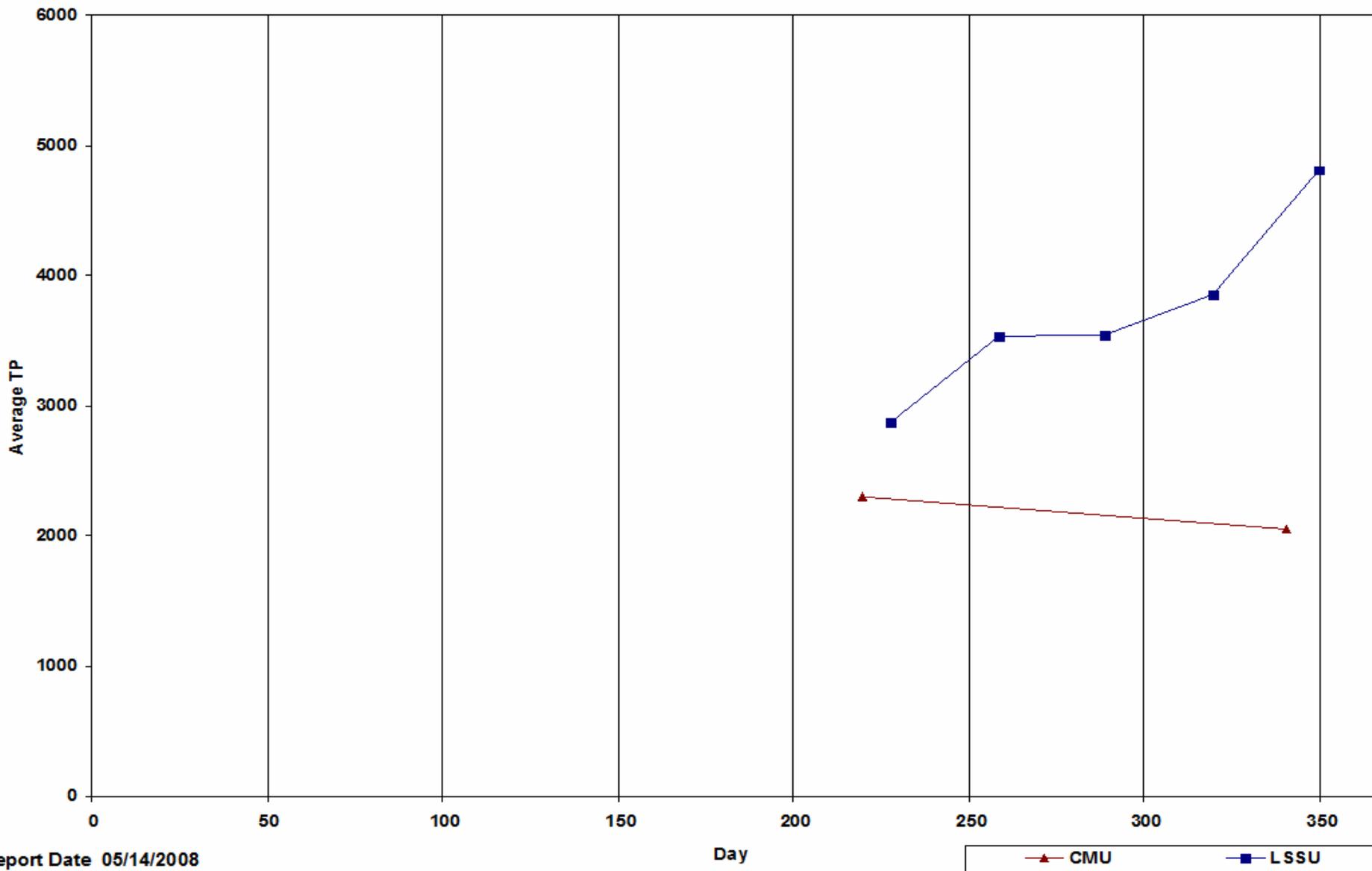


Figure 23.

# Solid TP for Fish by Laboratory for Year 2006

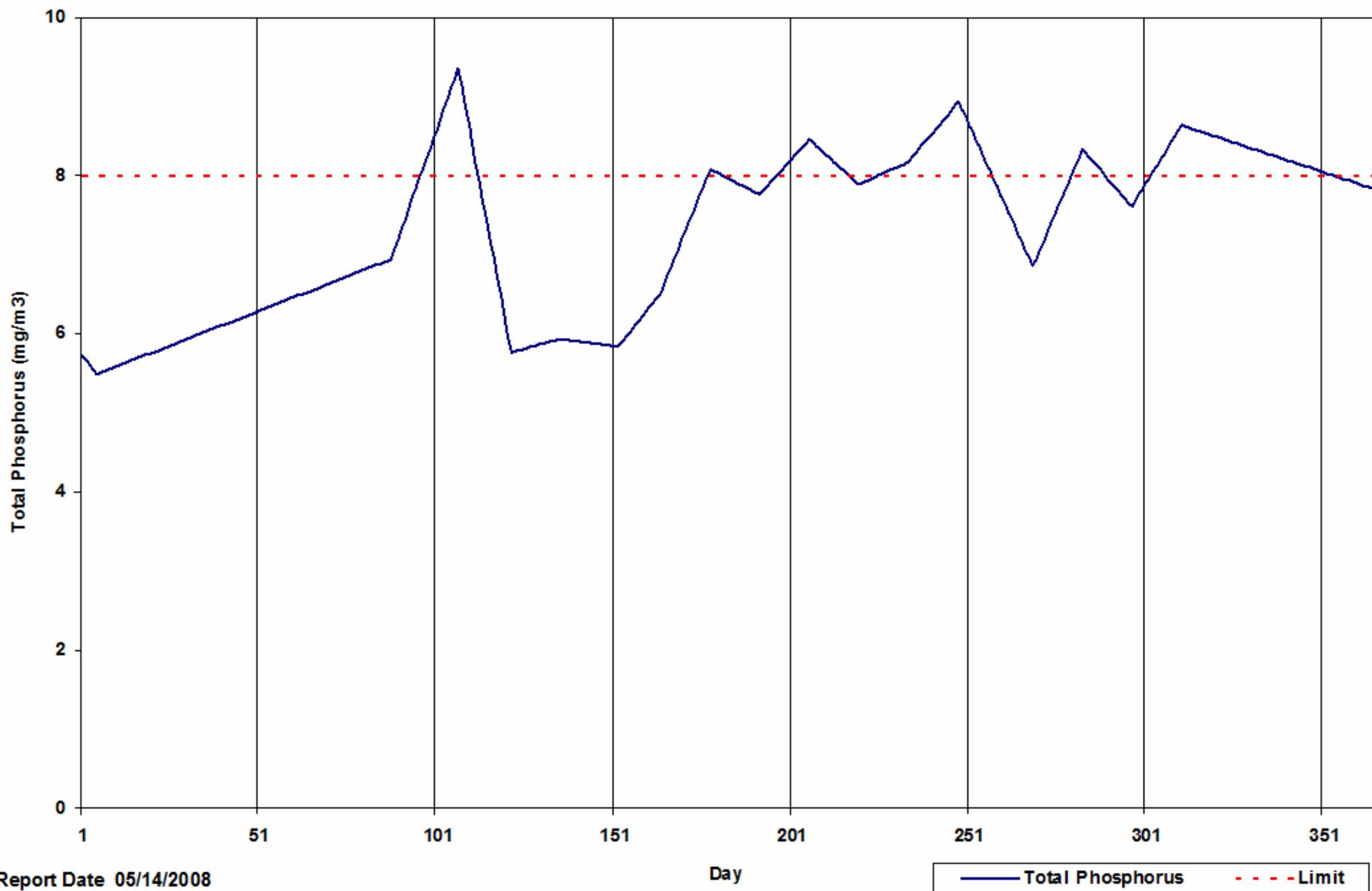


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Figure 24.

# Big Platte Lake - Median Phosphorus for Year 2007

Average Median Phosphorus for Year is 7.34 (Above Limit 134 of 365 Days, 37%)



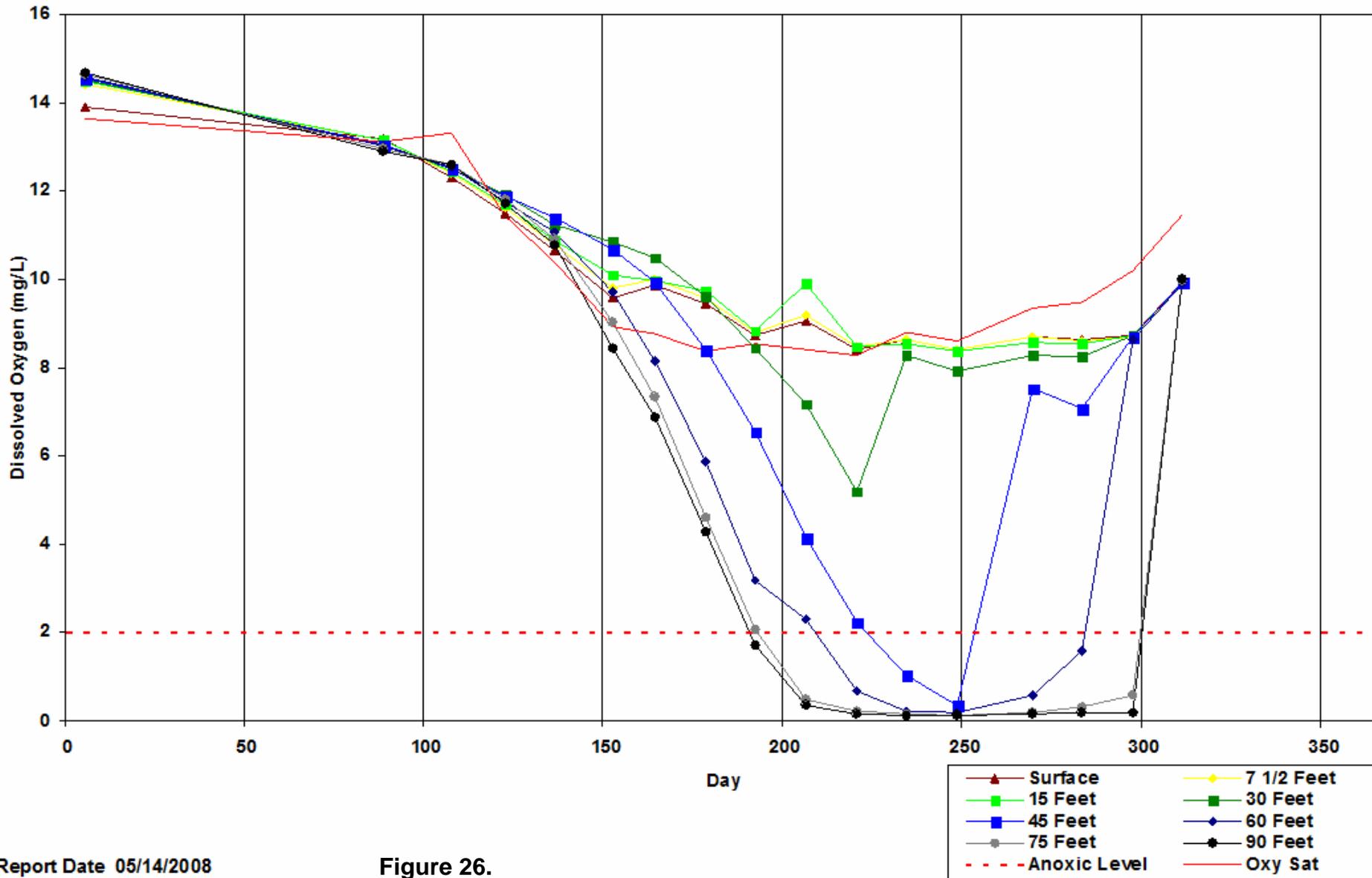
Report Date 05/14/2008

Figure 25.

— Total Phosphorus    - - - Limit

# Big Platte Lake Dissolved Oxygen (2007 at All Depths)

Anoxic at 45 Feet: 29.9 Days, 60 Feet: 75.1 Days, 75 Feet: 106.3 Days, 90 Feet: 109.2 Days

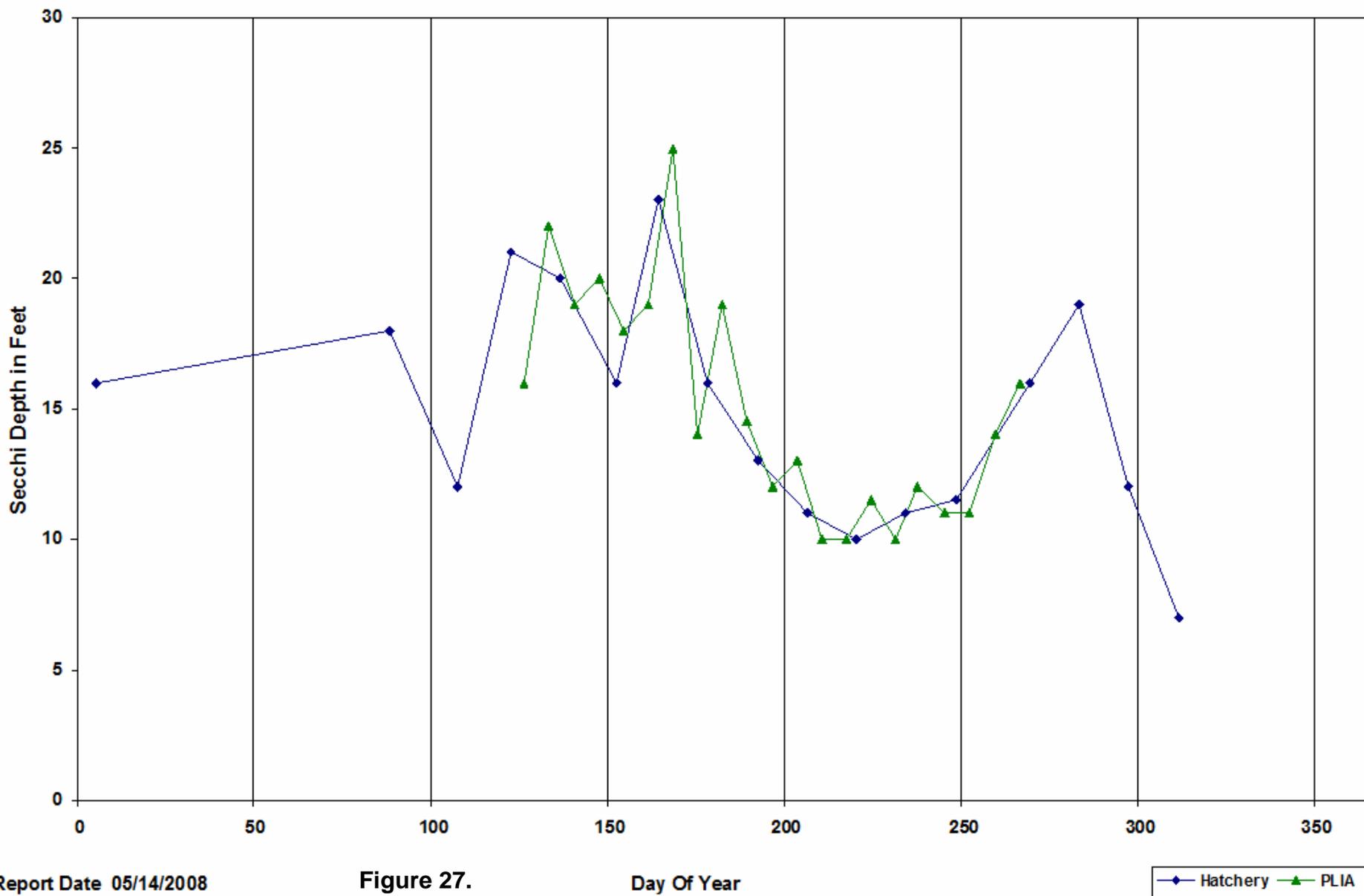


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Figure 26.

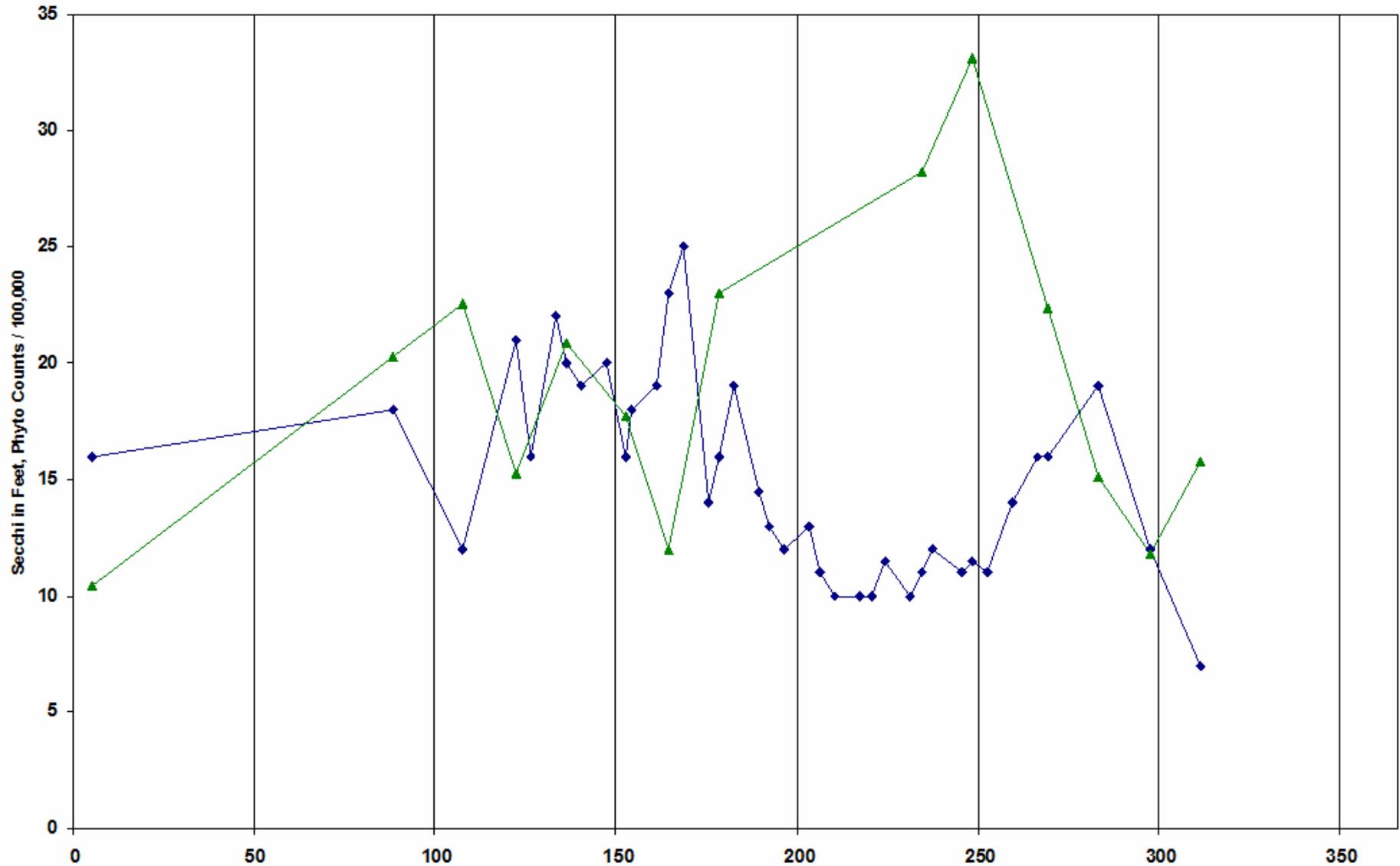
# Big Platte Lake Secchi Depth for 2007

Average Secchi Value: 14.987 (Minimum: 7, Maximum: 25, Hatchery Avg: 14.853, PLIA Avg: 15.095)



# Secchi Depth vs Phytoplankton Counts for Big Platte Lake in 2007

Phytoplankton Counts / 100,000 per liter for Depths 0 - 30



# Big Platte Lake - NOx for Year 2007

Average Value for Depth 0-30: 98.766, Average Value for Depth 45-90: 173.023

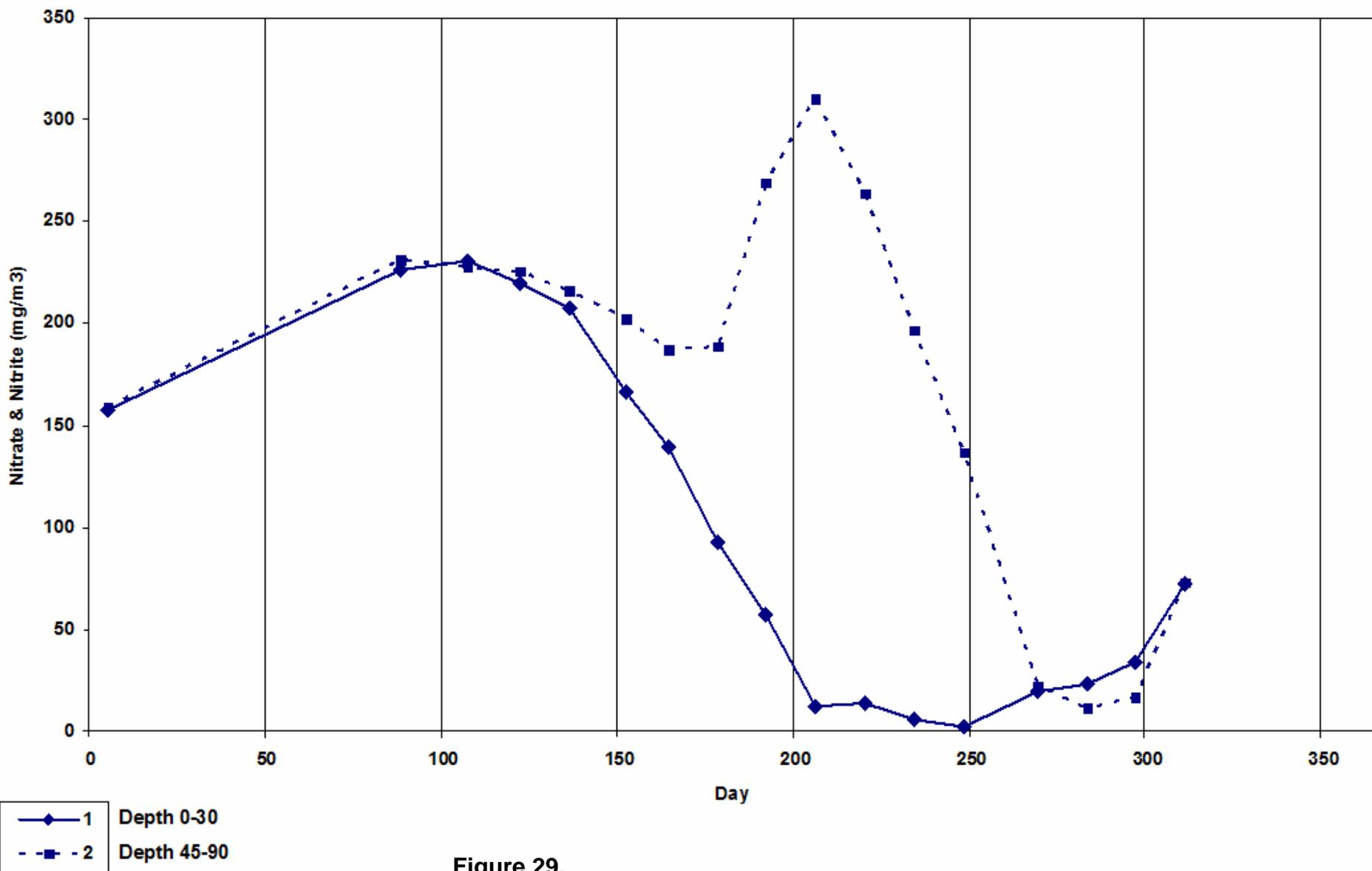
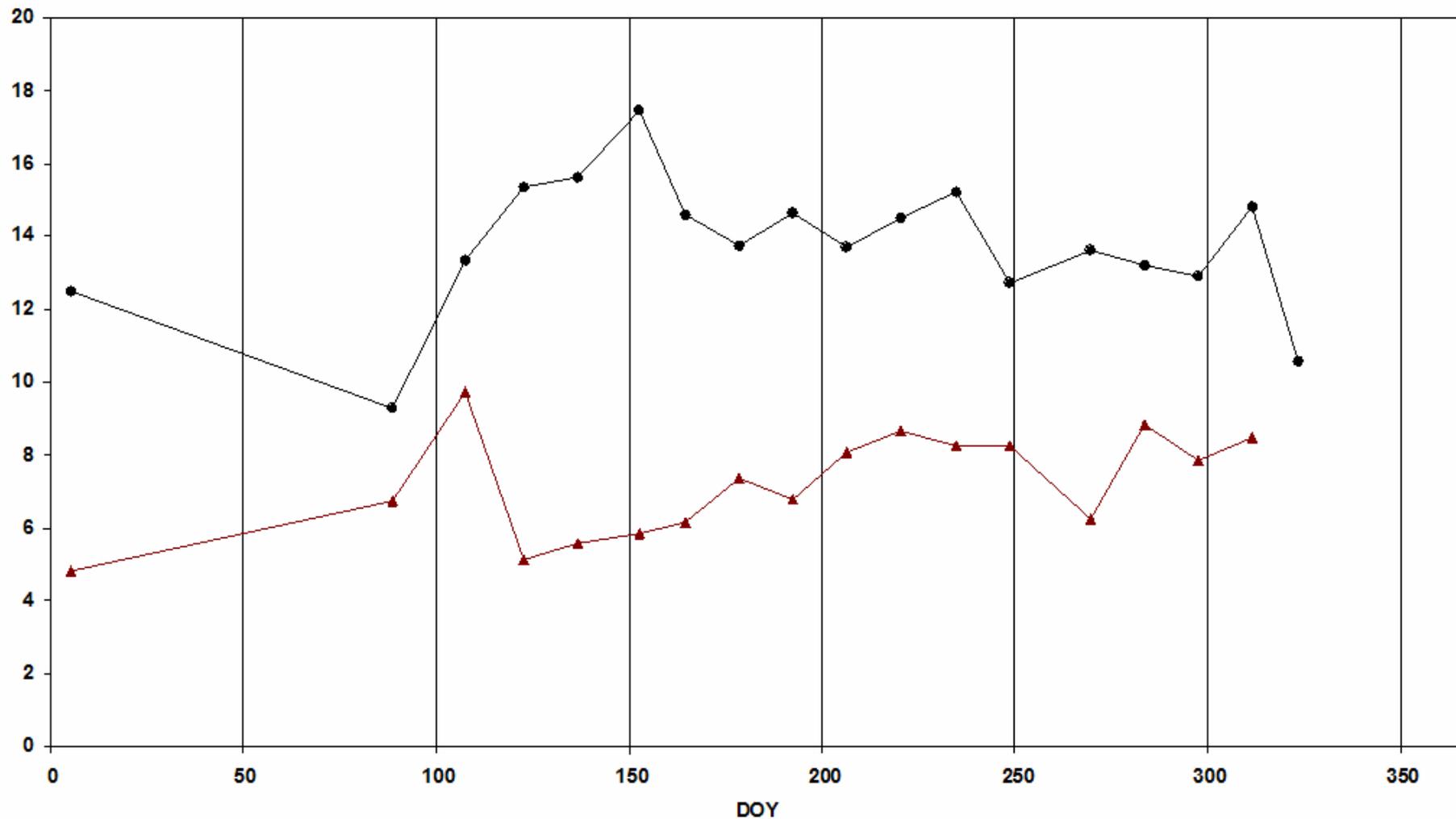


Figure 29.

# Big vs Little Platte Lake Total Phosphorus



- 1 Big Platte Lake, 0-30 Composite, Vertical Lake Composite or Mix, 2007, TP (mg/m<sup>3</sup>)
- 2 Little Platte Lake, Surface, Discrete Lake Sample, 2007, TP (mg/m<sup>3</sup>)

Figure 30.

# Big vs Little Platte Lake Chlorophyll

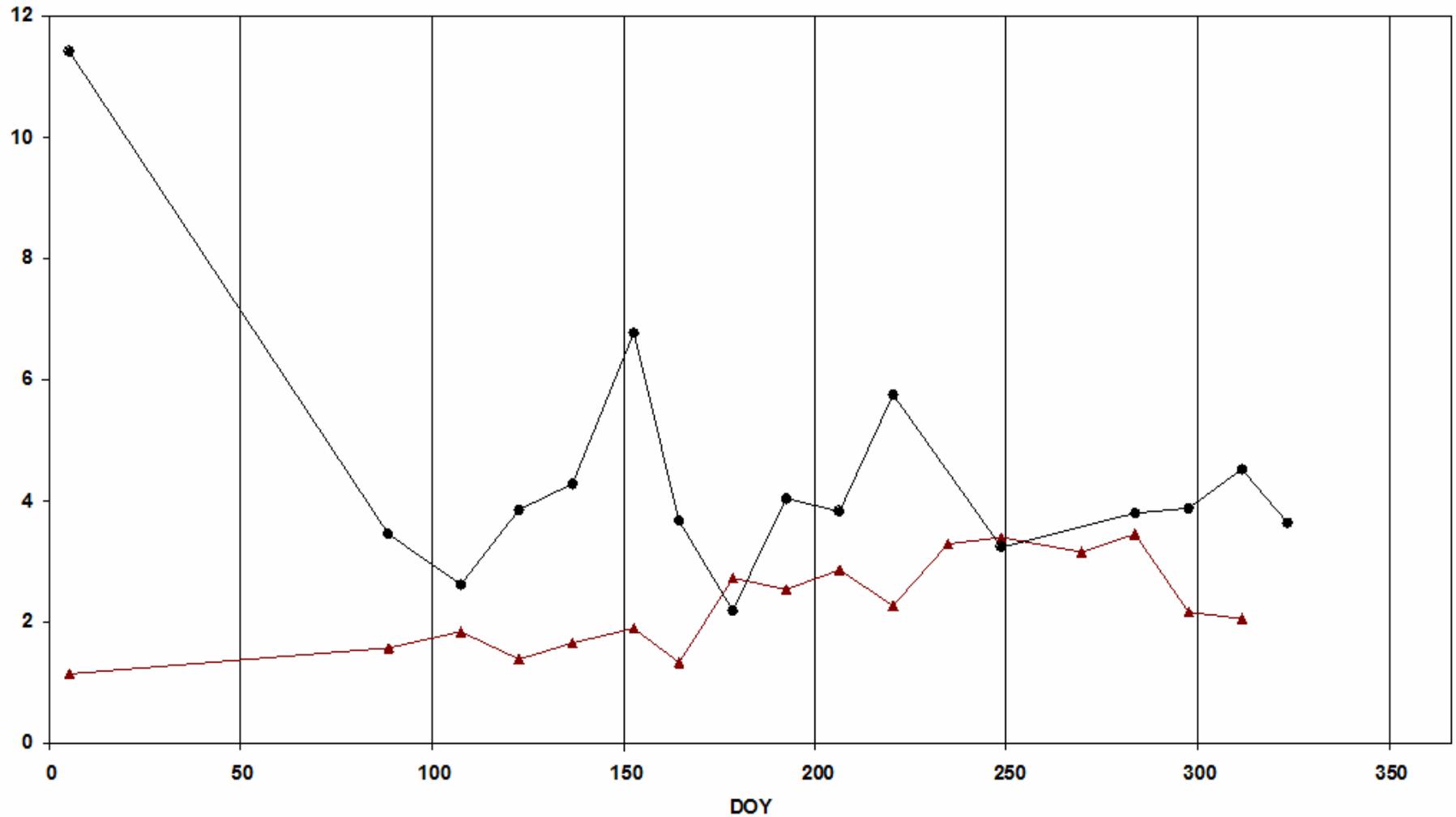
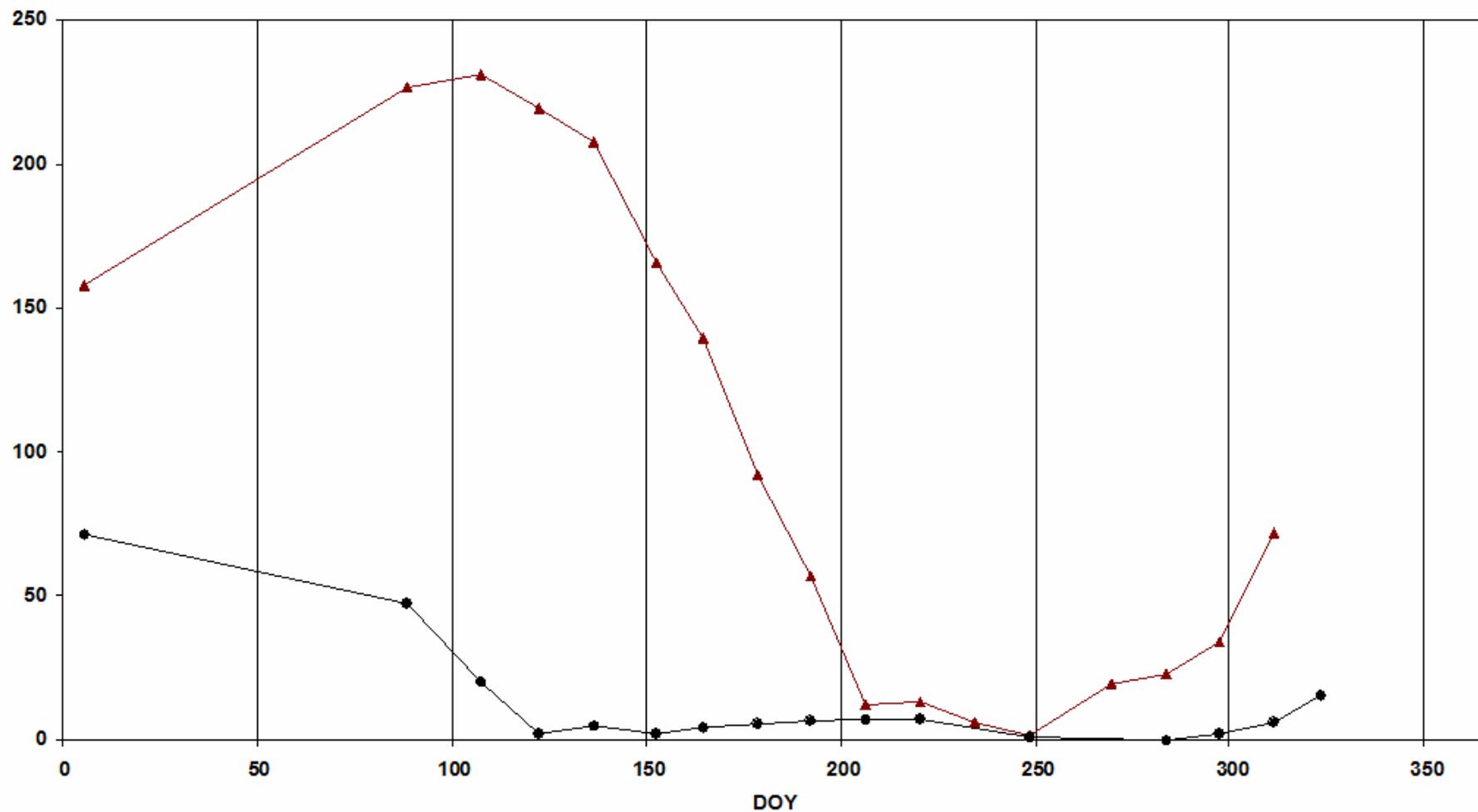


Figure 31.

- 1 Big Platte Lake, 0-30 Composite, Vertical Lake Composite or Mix, 2007, Chl (mg/m<sup>3</sup>)
- 2 Little Platte Lake, Surface, Discrete Lake Sample, 2007, Chl (mg/m<sup>3</sup>)

# Big vs Little Platte Lake Nox



1 Big Platte Lake, 0-30 Composite, Vertical Lake Composite or Mix, 2007, NOx (mg/m<sup>3</sup>)  
2 Little Platte Lake, Surface, Discrete Lake Sample, 2007, NOx (mg/m<sup>3</sup>)

Figure 32.

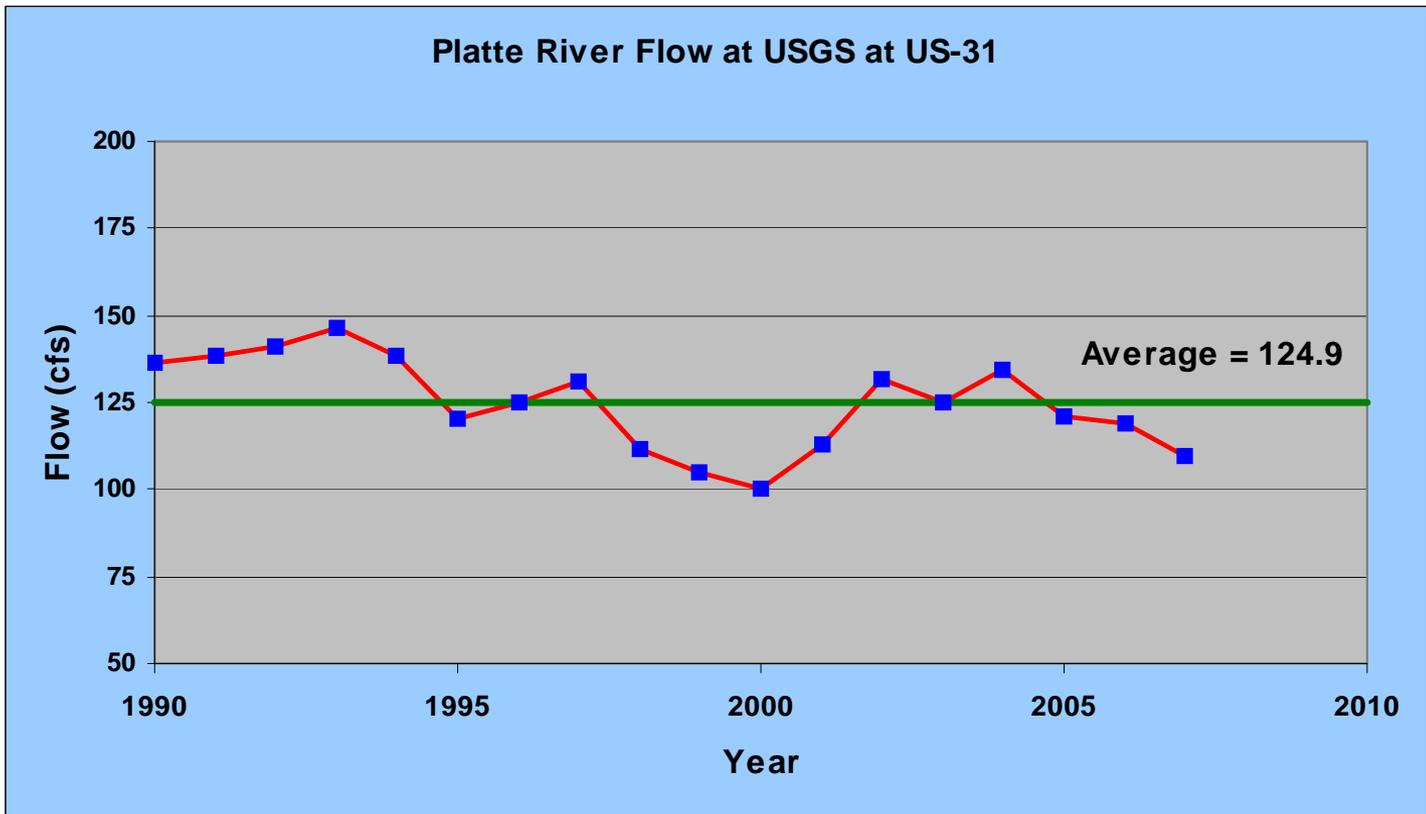


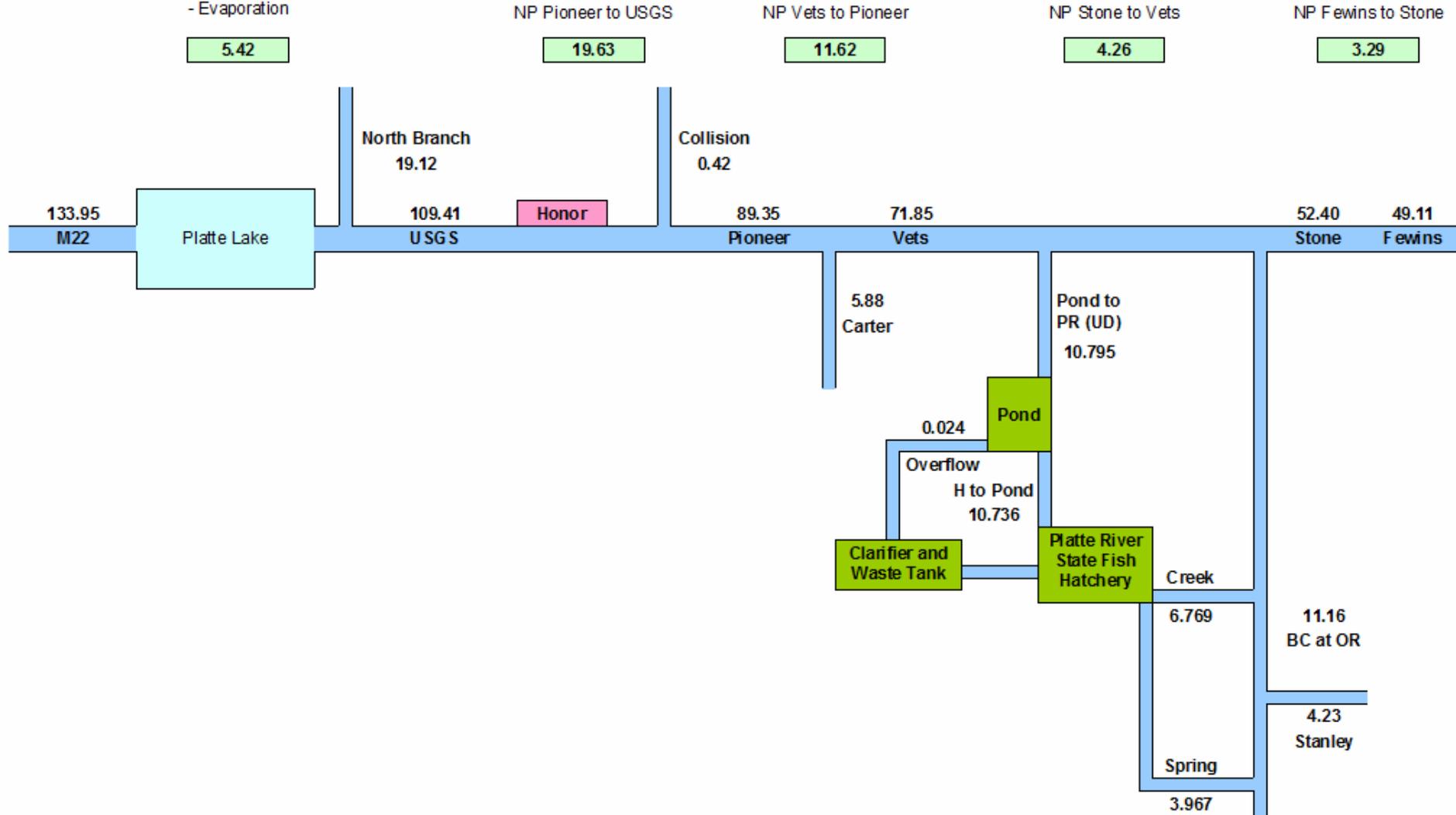
Figure 33. Annual Average USGS Flow of Platte River at US 31.

# Annual Average Watershed Flow Balance for 2007

all flows cfs

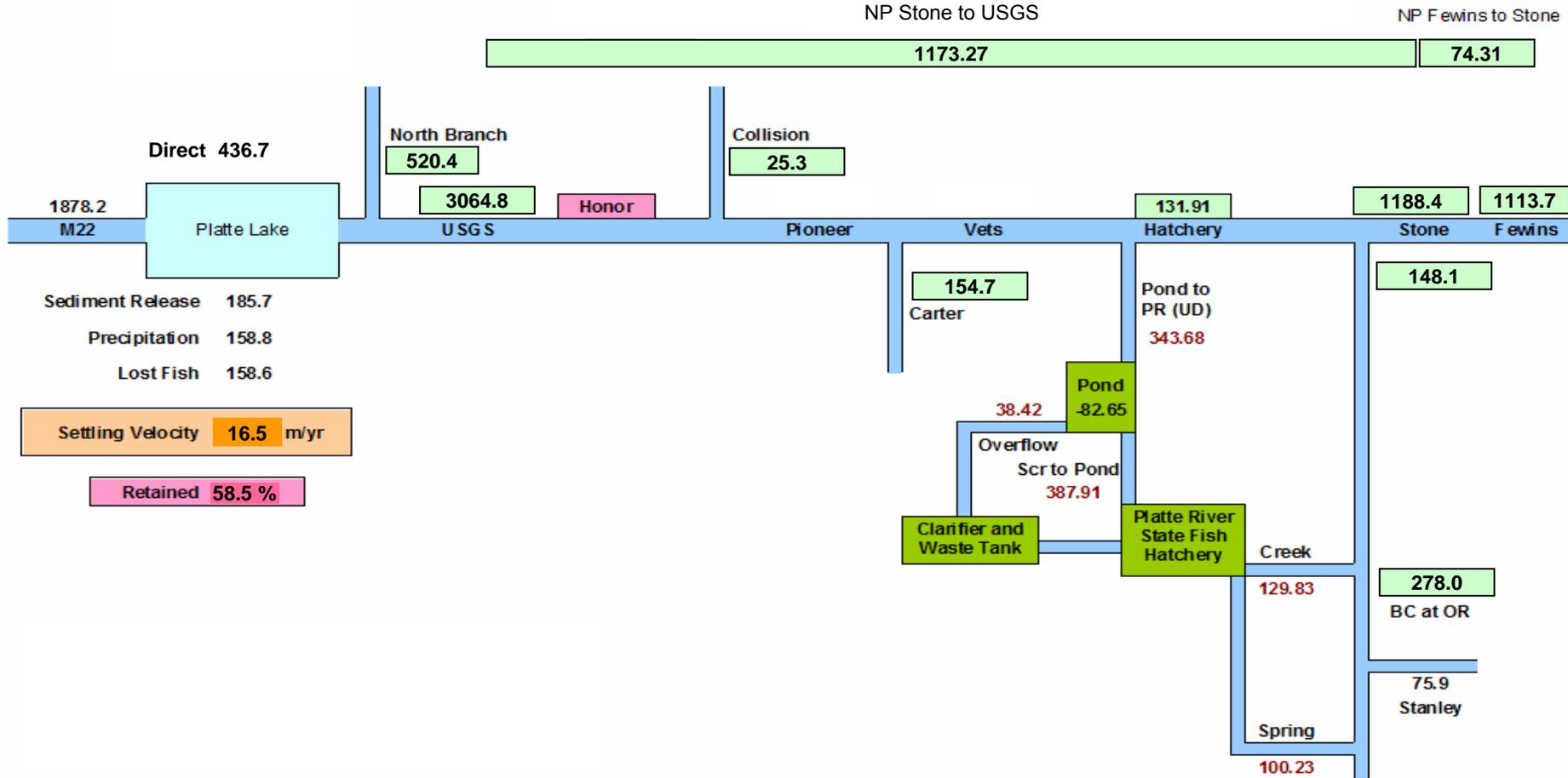
Total Annual Rainfall 22.0 Inches

NP USGS to Lake  
+ Direct Drainage  
+ Precipitation  
- Evaporation



# Annual Average Watershed Load Balance for 2007

all loads annual pounds



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Platte River Watershed

Figure 35.

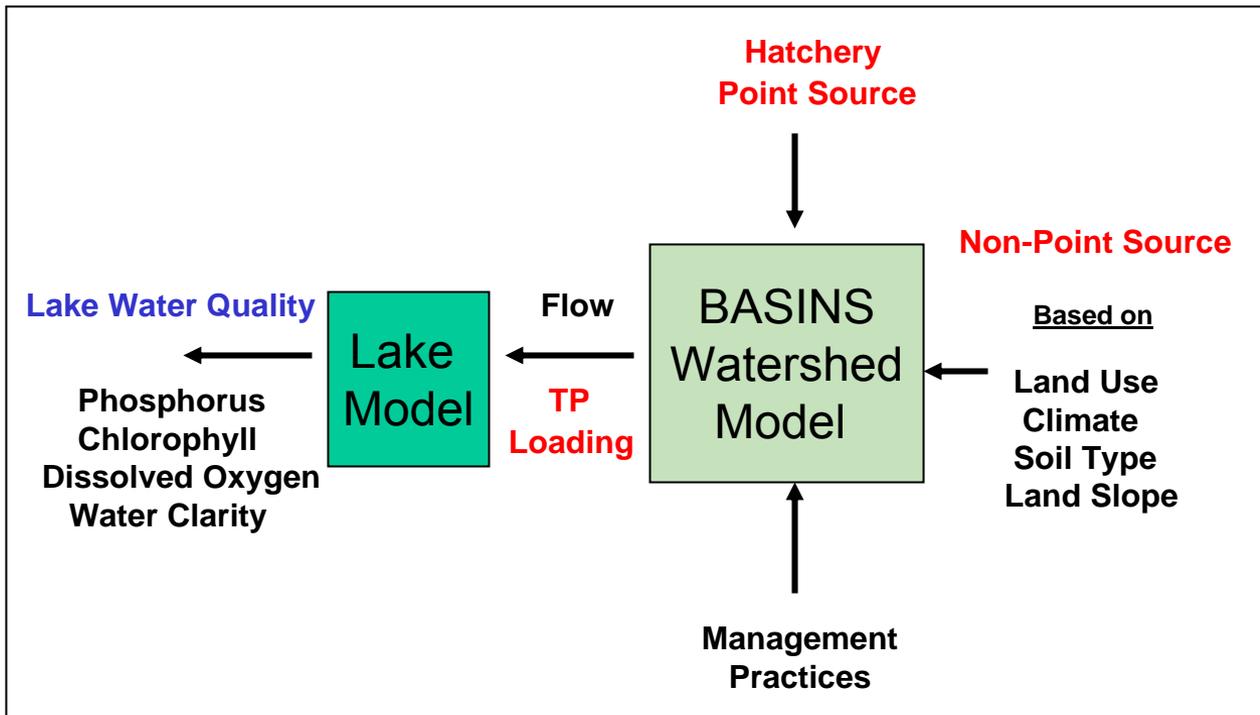


Figure 36. Components of BASINS and Lake Water Quality Model.

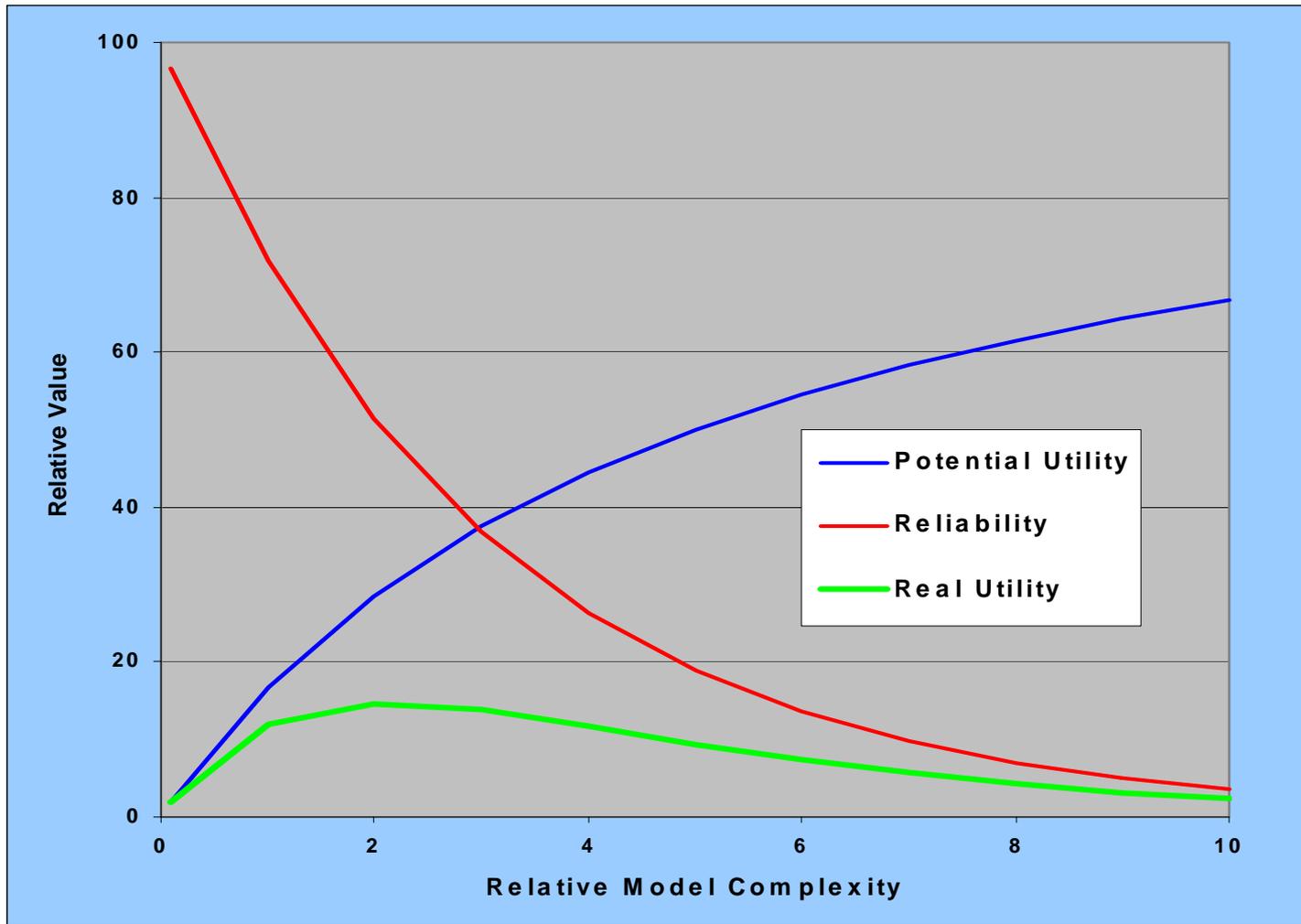
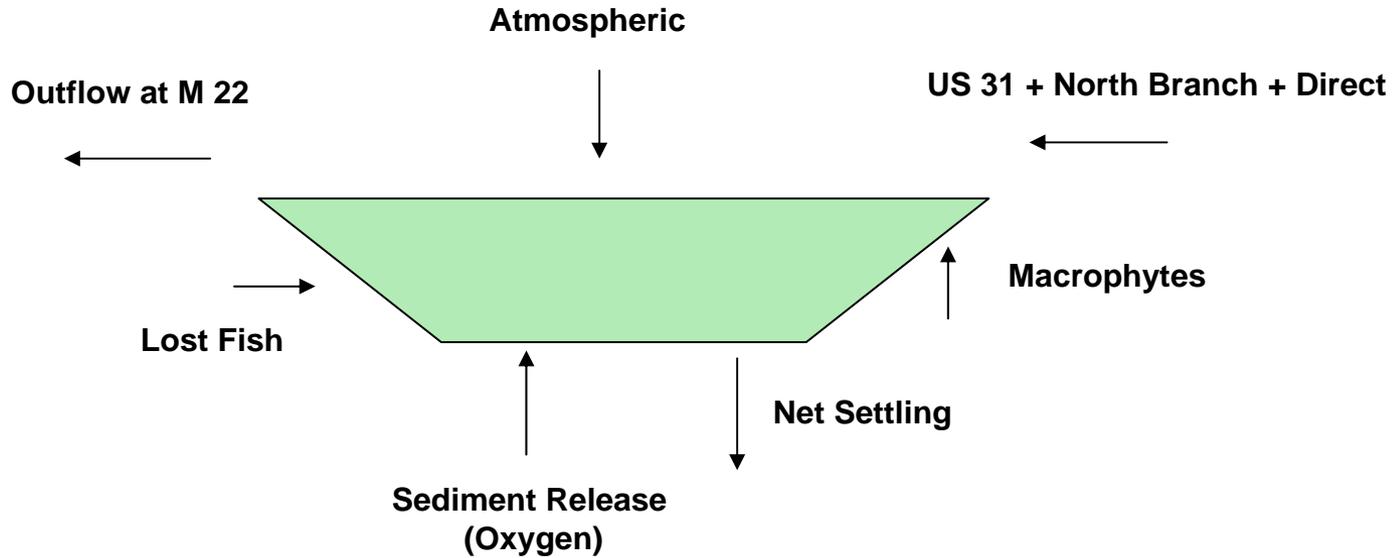


Figure 37. Relative Model Utility vs. Model Complexity.



$W = \text{Total Load} = \text{US31} + \text{NB} + \text{Direct} + \text{Atmospheric} + \text{Sediment} + \text{Lost fish} + \text{Macrophytes}$

$p = \text{volume weighted annual average TP of lake}$

$Q = \text{average annual outflow at M22}$

$A = \text{bottom area of lake}$

$v_s = \text{apparent settling velocity (m/y)}$

At steady state  $IN = OUT$        $W = Q p + v_s A p$

$$p = \frac{W}{(Q + v_s A)}$$

Figure 38. Steady state lake model.

	cfs	lbs TP	lbs TP	lbs TP	lbs TP	lbs TP	lbs TP	lbs TP	lbs TP	measure	vs	lbs
	Out Flow	Hatchery	USGS	NB	Direct	Fish	Sediment	Macro	Rain	mg/m3	m/yr	Total
										Lake		
1990	131.1	755	5,398	589	522	361	153	85	227	9.1	24.3	7,335
1991	148.6	746	5,026	567	456	342	159	85	225	7.9	25.5	6,860
1992	170.8	708	5,960	735	615	7	239	85	238	8.3	27.2	7,880
1993	185.3	272	4,390	579	443	278	180	85	220	7.8	18.9	6,175
1994	172.2	188	3,857	522	408	239	217	85	200	7.9	16.0	5,528
1995	161.9	308	4,404	597	468	275	205	85	219	8.2	19.7	6,253
1996	166.2	251	4,410	612	486	243	200	85	215	7.2	24.0	6,251
1997	163.8	170	3,325	493	367	113	170	85	168	6.5	17.9	4,720
1998	144.3	190	3,408	509	397	32	225	85	219	6.3	21.7	4,874
1999	140.5	199	2,982	464	344	315	136	85	184	6.3	19.5	4,510
2000	124.4	203	2,729	437	326	203	175	85	173	6.5	17.3	4,129
2001	132.2	212	4,083	627	508	98	372	85	240	7.5	24.0	6,013
2002	166.3	206	4,826	695	567	55	170	85	168	8.4	20.4	6,566
2003	151.1	169	3,220	473	369	120	164	85	179	8.1	12.0	4,611
2004	160.9	158	3,915	577	444	84	169	85	227	7.1	20.3	5,500
2005	157.9	226	4,178	599	475	28	213	85	156	8.2	17.3	5,733
2006	143.5	122	4,158	567	450	99	211	85	204	8.0	19.5	5,773
Average	154					170	198	85	204		20.3	
										Grant	13.6	
										K&E	21.8	
										Walker	17.4	
										Lung	22.9	
										Chapra	20.5	
										Average	19.2	

Figure 39. Calculated settling velocity.

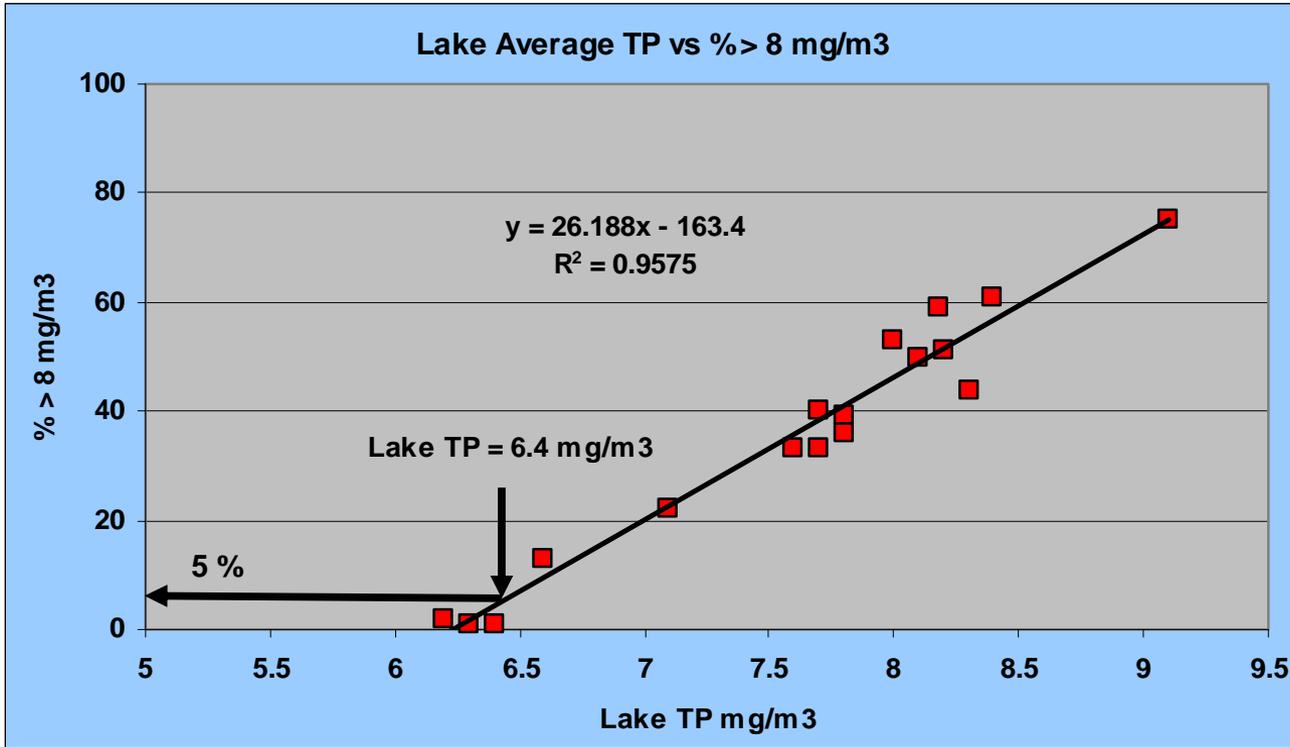


Figure 40. Volume weighted lake phosphorus concentration vs. % less than 8 mg/m<sup>3</sup>.

(a) (b) (c) (d) (e)

Flow Conditions	Typical		Typical	Low	High	
	Scenario	Goal	2004	2000	1992	
Out Flow Rate	161 cfs	161	161	115	170	cfs
Upstream	2,033 Lbs		2,033	1,451	2,237	Lbs
Hatchery	175		175	175	175	
Lower Watershed	1,727		1,727	1,124	2,743	
North Branch	1,105		606	437	869	
Direct	468		468	325	717	
Lost Fish	170		170	170	170	
Sediment Release	198		198	198	198	
Macrophytes	85		85	85	85	
Atmospheric	204		204	204	204	
Total Phosphorus Load	6,165 Lbs	4997	5,666	4,169	7,398	Lbs
Exceeds Goal by	1,168 Lbs		669	-828	2,401	Lbs
Lake Phosphorus	7.9 mg/m3	6.4	7.3	6.1	9.3	mg/m3
Percent < 8 mg/m3	55 %	95	72	100	19	%

Figure 41. Model prediction for Lake phosphorus.

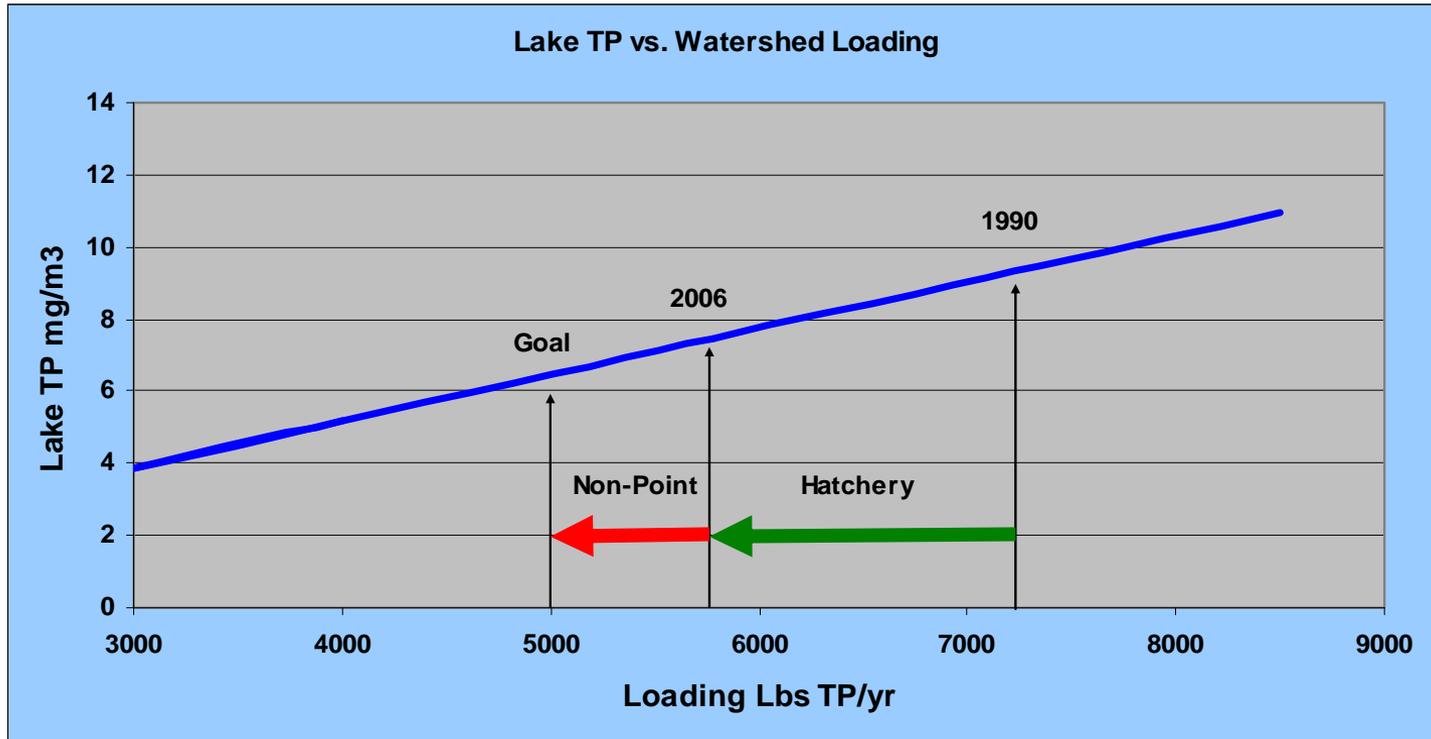


Figure 42. History of loading reductions vs. lake phosphorus.

## PLATTE RIVER WATERSHED MODEL - Subwatershed Editor

NB02: North Branch Platte River (Little Platte Lake) ▼

Baseline Loading Condition: Typical (2004) ▼

		Base	Change	New Area	New Load before BMPs	BMP Acres	Removal Efficiency	Mass Removed
<b>Total Load</b>	(lb P/yr)	<b>314.6</b>	<b>498.7</b>		<b>813.3</b>			<b>0.0</b>
<b>Land Use</b>								
Forest	(acres)	2358.0	-1000	1358.0	48.6			0.0
Barren	(acres)	0.0		0.0	0.0			0.0
Orchards	(acres)	109.0		109.0	5.9			0.0
Pasture	(acres)	414.0		414.0	29.2			0.0
Cropland	(acres)	160.0		160.0	12.6			0.0
LD Residential	(acres)	161.0	700	861.0	188.4			0.0
Commercial	(acres)	8.0	300	308.0	211.9			0.0
Wetland	(acres)	70.0		70.0	2.7			0.0
Feed Operation	(acres)	0.0		0.0	0.0			0.0
<b>Non-Point Loads</b>	(lb P/yr)	<b>175.6</b>			<b>499.3</b>			
<b>Point Sources</b>	(lb P/yr)	<b>139.0</b>	<b>+175.0</b>		<b>314.0</b>			
<b>Upstream Load</b>	(lb P/yr)	<b>0.0</b>			<b>0.0</b>			

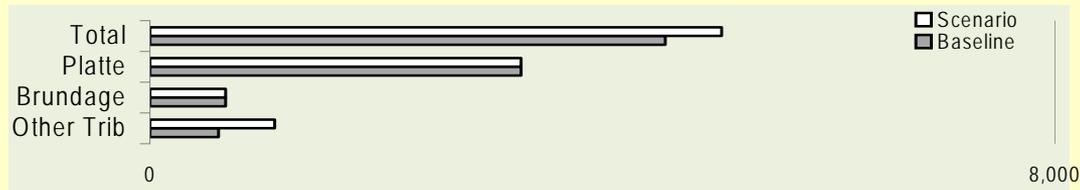
Scenario 01 Title

*Baseline scenario*



Figure 43. GUI editor for North Branch.

## PLATTE RIVER WATERSHED MODEL - Load Summary



	Scenario (lb P/yr)	<i>Change</i>	Base (lb P/yr)
00 Upstream to Fewins Rd.	2,033		2,033
01 Fewins Rd. to Brundage Ck.	27		27
02 Brundage Ck. to Vets Park	329		329
03 Vets Park to Carter Ck.	206		206
04 Carter Ck. to Collision Ck.	92		92
05 Collision Ck. to USGS Gage	127		127
06 USGS Gage to lake + direct	468		468
<b>Platte River (upstream+direct)</b>	<b>3,282</b>		<b>3,282</b>
01 Kinney Creek	101		101
02 Kinney Creek (to Brundage Ck.)	29		29
03 Brundage Creek (to Kinney Ck.)	136		136
04 Brundage Creek (Kinney to Stanley)	12		12
05 Stanley Creek	363		363
06 Brundage Creek (Stanley Ck. to PR)	28		28
<b>Brundage Creek</b>	<b>669</b>		<b>669</b>
01 Carter Creek (upstream)	127		127
02 Carter Creek (to Platte R.)	152		152
<b>Carter Creek</b>	<b>279</b>		<b>279</b>
01 Collision Creek (upstream)	112		112
02 Collision Creek (to Platte R.)	61		61
<b>Collision Creek</b>	<b>173</b>		<b>173</b>
01 North Branch Platte River (upstream)	291		291
02 North Branch Platte River (LPL)	813	<b>+499</b>	315
<b>North Branch Platte River</b>	<b>1,105</b>	<b>+499</b>	<b>606</b>
	Scenario-Typical	<i>Change</i>	Base-Typical
<b>Total Phosphorus Load</b>	<b>5,508</b>	<b>+499</b>	<b>5,009</b>

Figure 44. Summary sheet for GUI.

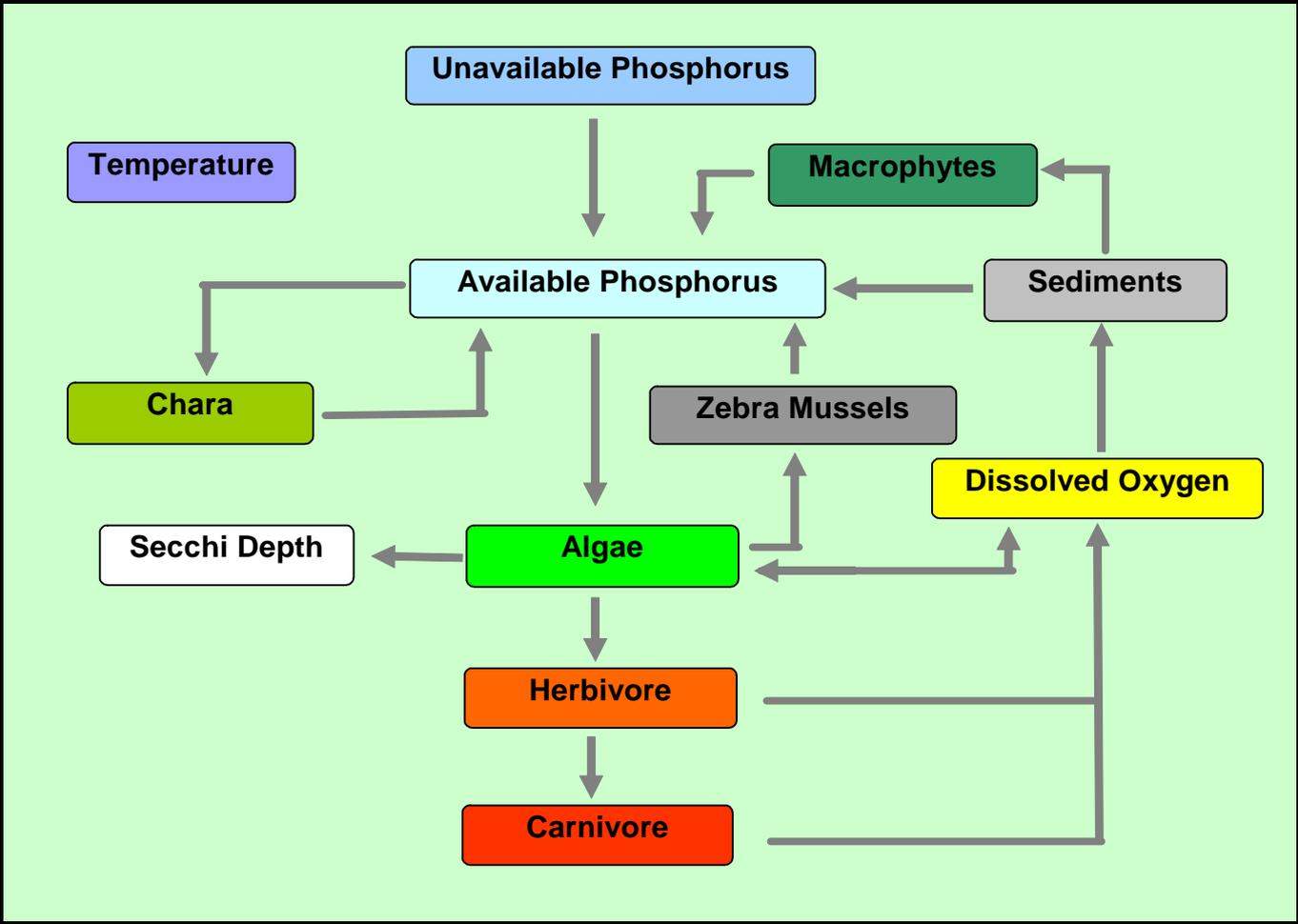


Figure 45. Kinetic Components of Lake Water Quality Model.

## Advantages of One-Parameter Model:

One model coefficient (apparent settling velocity) estimated using extensive data  
Simple to understand and apply.  
Easy to defend.

## Limitations:

Cannot distinguish between warm and cold years  
Does not account for vertical gradients  
Does not increase  $v_s$  when sediment release of TP decreases  
Does not decrease Sediment Oxygen Demand when TP loads decrease  
Does not predict changes dissolved oxygen  
Does not predict changes in water clarity (the most difficult modeling task)  
Does not provide insight into seasonal changes in water quality  
Does not explicitly include the effects of macrophytes, Chara, zebra mussels, etc  
Does not account for bio-availability of different phosphorus sources [Special Study](#)

**Figure 46. Comparison of One – Parameter vs. Ecosystem Model.**

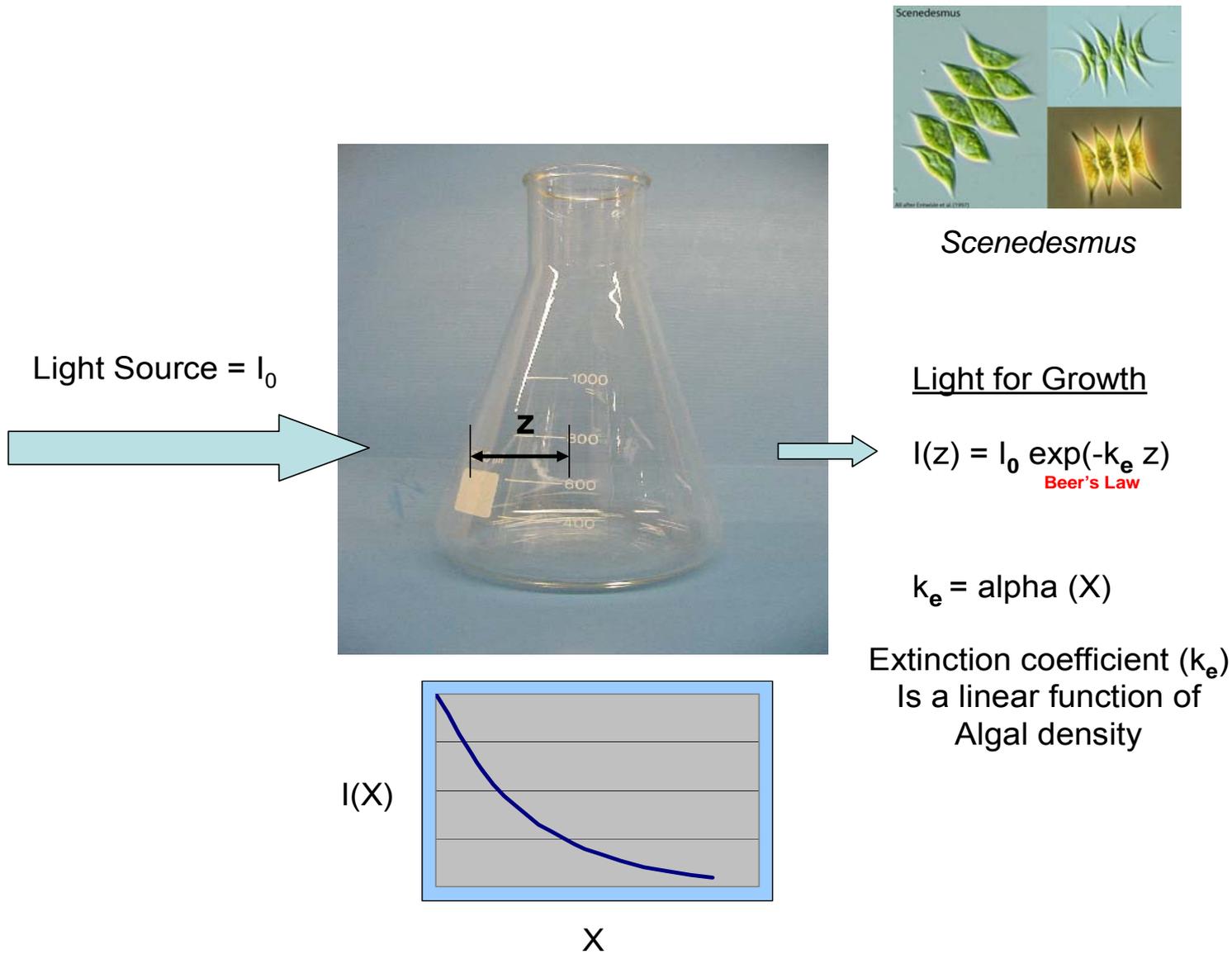
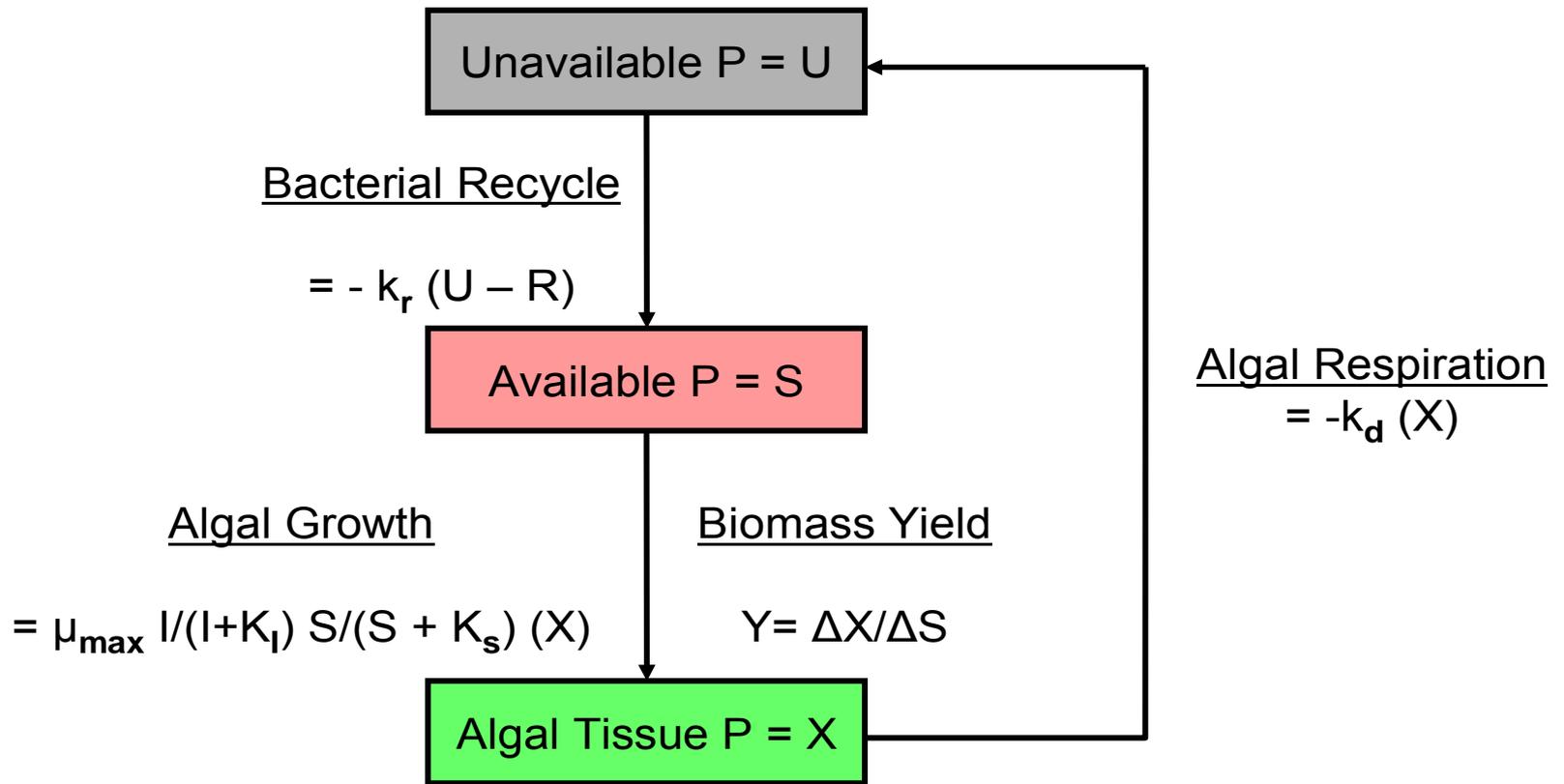


Figure 47. Bio-availability Experiments Setup.



In a closed system like the test flask,  
the total phosphorus concentration remains constant:

$$X(t) + S(t) + U(t) = X_0 + S_0 + U_0 = \text{Constant}$$

Where  $X_0$ ,  $S_0$ , and  $U_0$  are the initial concentrations at  $t = 0$

Figure 3

Figure 48. Bio-availability model mechanisms.

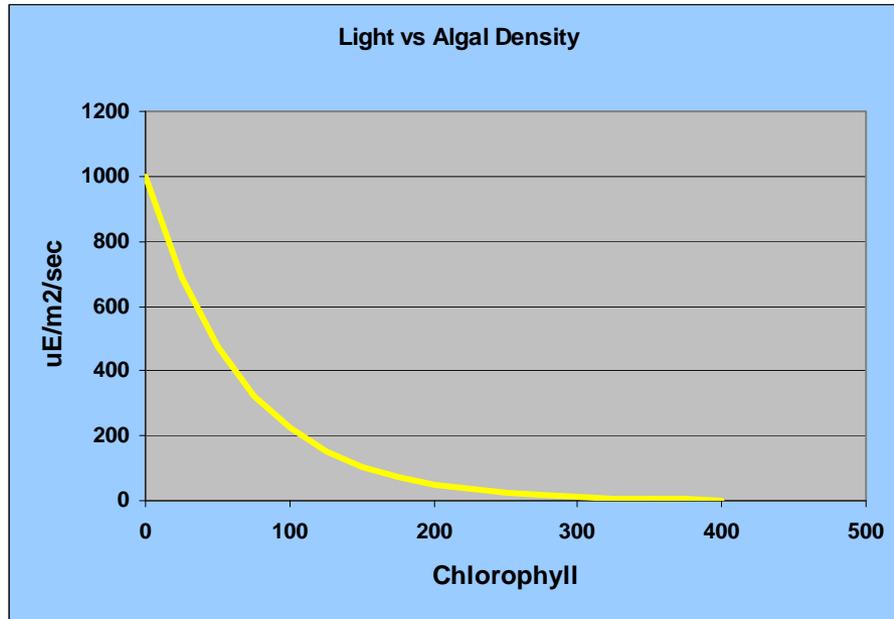
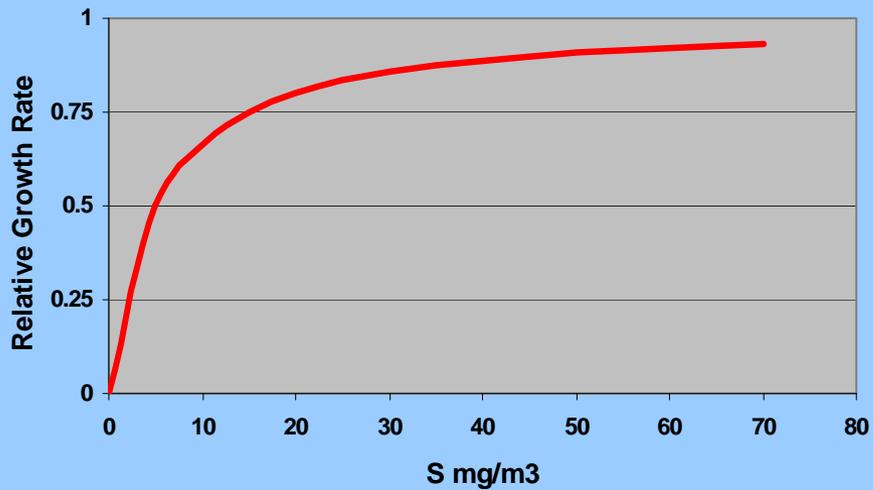
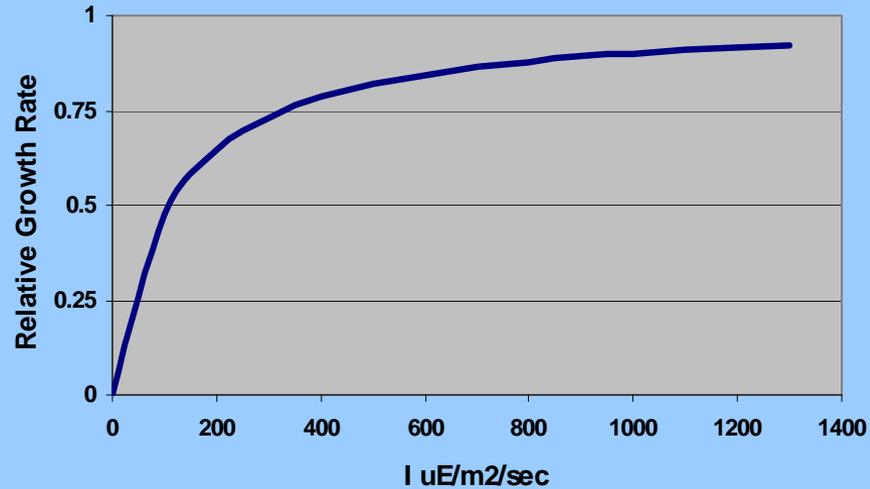


Figure 49. Light as function of algal density.

**Growth vs Substrate**



**Growth vs Light**



**Figure 50. Algal Growth as function of Light and Phosphorus Concentration.**

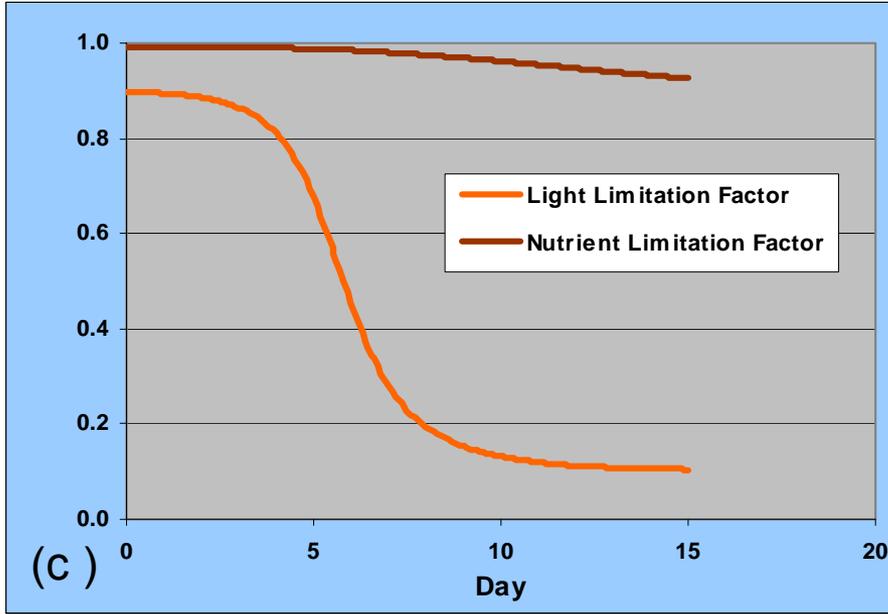
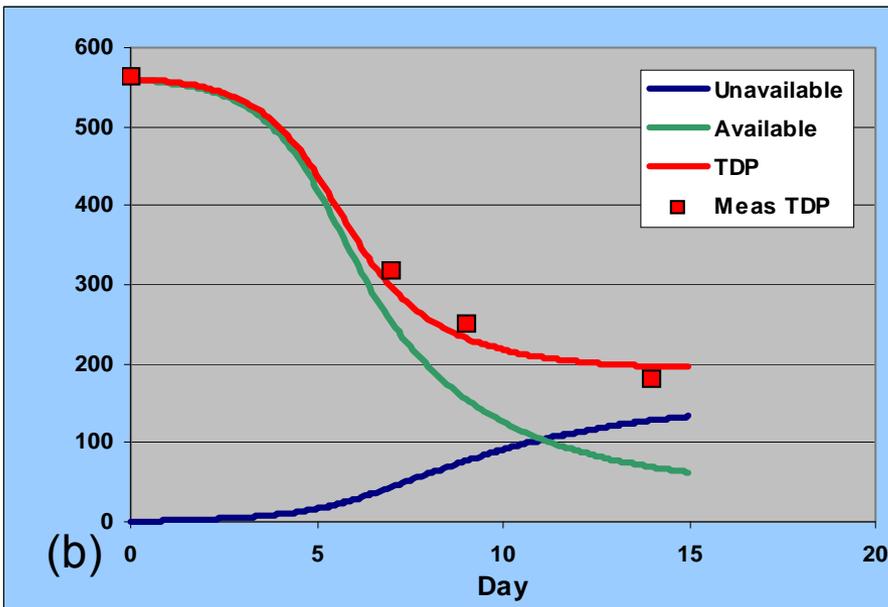
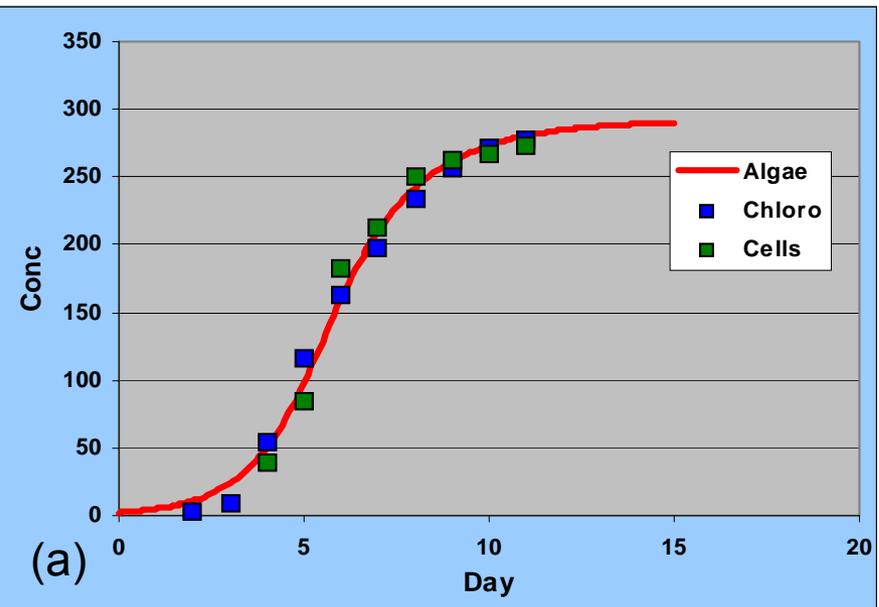


Figure 51. Preliminary results of bio-availability model simulations and data.

Maximum Specific Growth Rate	<b><math>\mu_{max}</math></b>	1.05	1/day
Phosphorus Half Saturation Coefficient	<b>Ks</b>	5	mg/m <sup>3</sup>
Light Half Saturation Coefficient	<b>KI</b>	110	uE/m <sup>2</sup> /sec
Algal Respiration Rate	<b>kd</b>	0.1	1/day
Algal Yield Coefficient	<b>Y</b>	0.79	mgX/mgS
Bacterial Recycle Rate Coefficient	<b>kr</b>	0.25	1/day
Light Attenuation Coefficient	<b>alpha z</b>	0.015	m <sup>3</sup> /mg
Incident Light Intensity	<b>I0</b>	1000	uE/m <sup>2</sup> /sec
Refractory Phosphorus Concentration	<b>R</b>	5	mg/m <sup>3</sup>

**Figure 52. Bio-availability Model Parameter Values.**

### **Experiment 1**

Grow algae in typical stream flow groundwater (TP =10mg/m<sup>3</sup>) and storm water flow (50 mg/m<sup>3</sup>).

### **Experiment 2**

Grow algae in typical Hatchery effluent (15 mg/m<sup>3</sup>).

### **Experiment 3**

Grow algae in mixtures to determine if the Hatchery effluent accelerates algal growth rate or algal yield of otherwise relatively unavailable phosphorus.

Use model to simulate experiments and evaluate changes in kinetic coefficients to facilitate analysis.

**Figure 53. Bio-availability Experiments.**

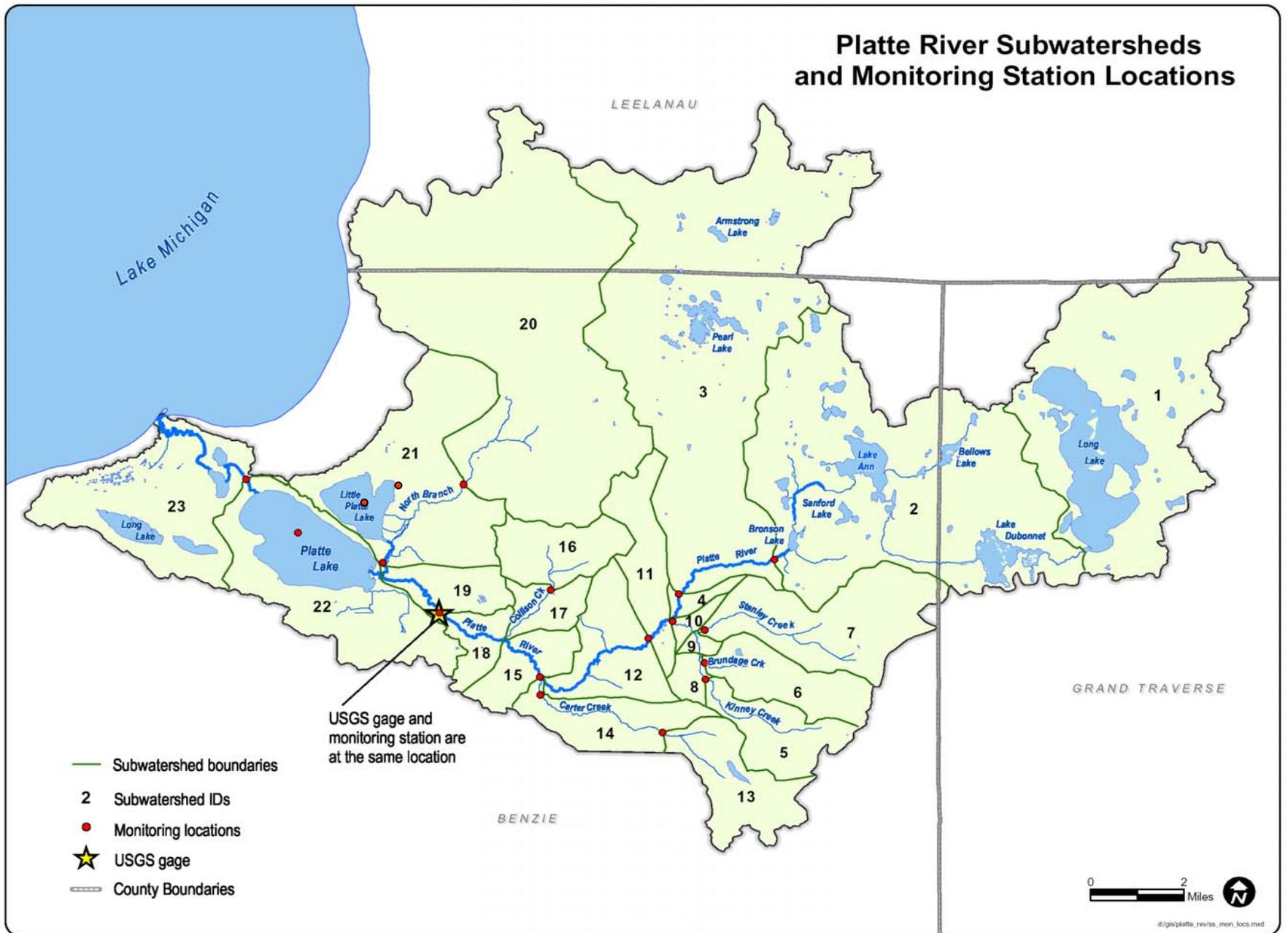
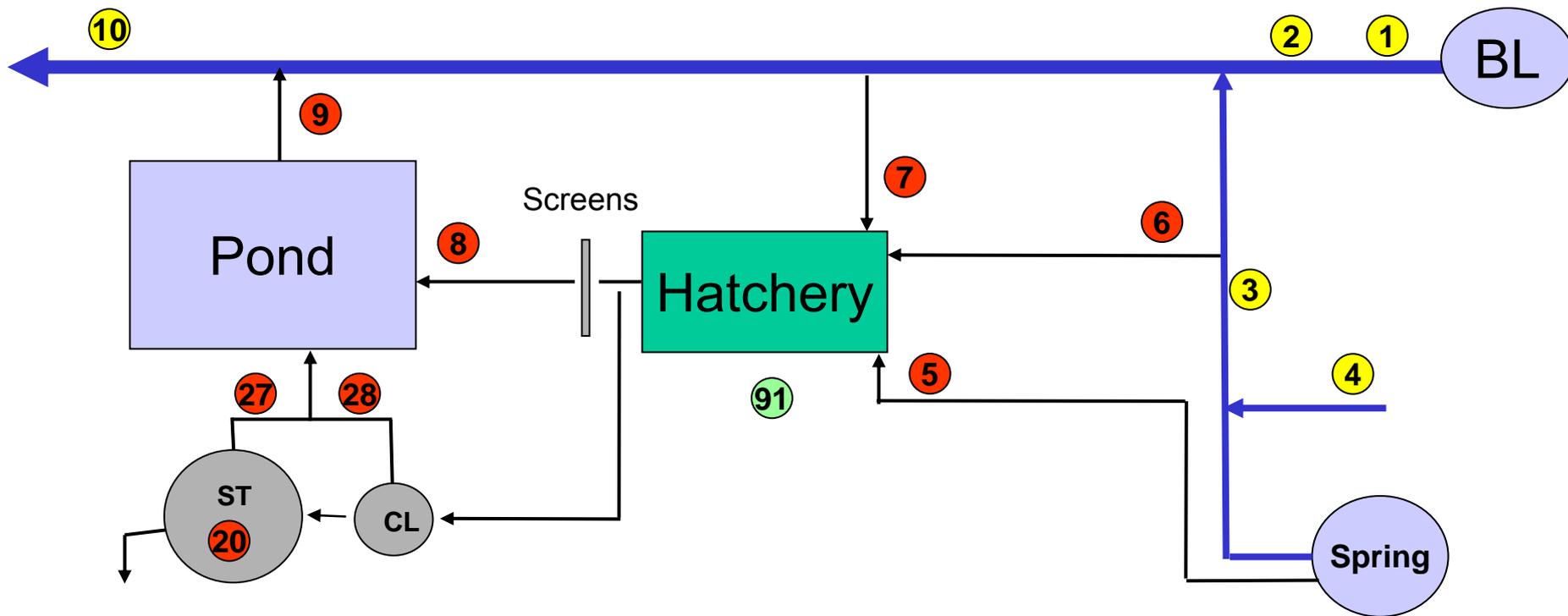
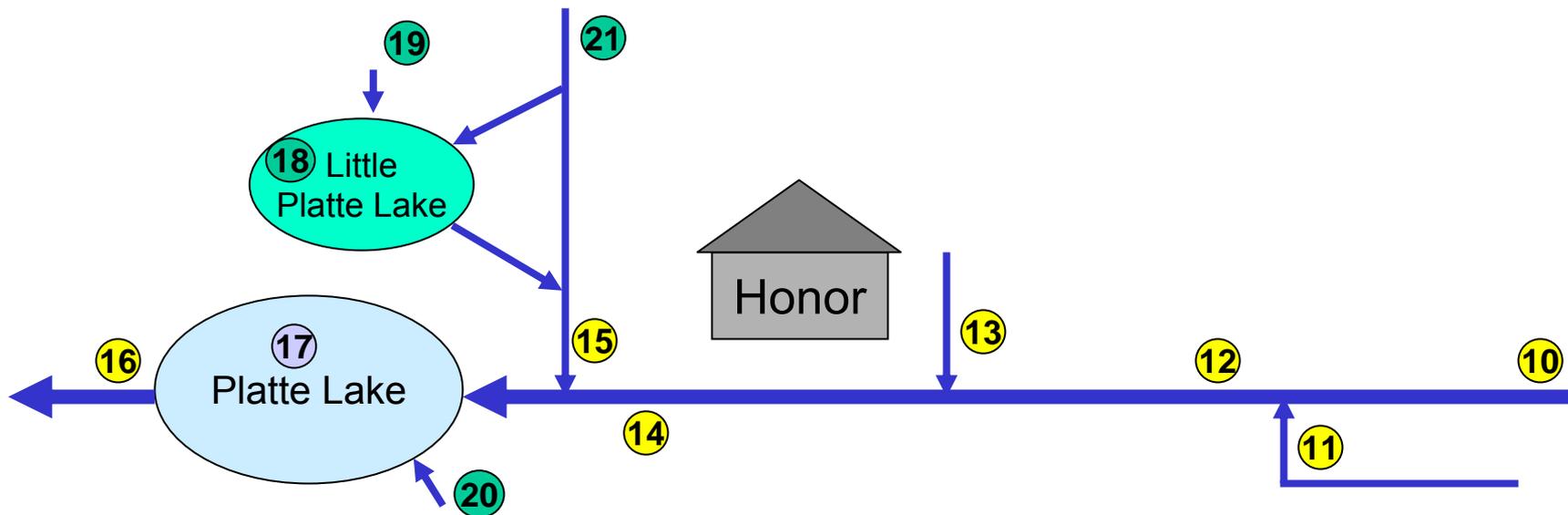


Figure 54. Platte River Sub-Watersheds and Monitoring Locations.



- |    |                              |    |                              |
|----|------------------------------|----|------------------------------|
| ①  | Platte River at Fewins Rd    | ②⑧ | Input to pond from Clarifier |
| ②  | Platte River at Stone Bridge | ⑥  | B. Creek to Hatchery         |
| ③  | Brundage Cr at Old Residence | ⑦  | Platte River to Hatchery     |
| ④  | Stanley Creek                | ⑧  | Inlet to Pond after Screens  |
| ⑤  | B. Spring to Hatchery        | ⑨  | Pond Outlet                  |
| ②⑦ | Solids Retention Tank        | ⑩  | Platte River at Vets Park    |
| ②⑦ | Input to pond from Tank      | ⑨① | Weather Station              |

Figure 55. Hatchery and Upstream Sampling Stations



- |   |                            |   |                            |
|---|----------------------------|---|----------------------------|
| ⑩ | Platte River at Vets Park  | ⑭ | Platte River at USGS       |
| ⑪ | Carter Creek at mouth      | ⑮ | North Branch at Deadstream |
| ⑫ | Platte River at Pioneer Rd | ⑯ | Platte Lake at Center      |
| ⑬ | Collison Creek             | ⑰ | Little Platte Lake         |
| ⑱ | North Branch at Hooker     | ⑲ | Featherstone Creek         |
| ⑳ | Tamarack Creek             | ㉑ | North Branch at Hooker     |

Figure 56. Lake and Lower Tributary Sampling Stations for 2005.

	BPL Dates	BPL Depths	BPL Reps	LPL Dates	LPL Depths	LPL Reps	Trib Dates	Trib Sites	Trib Reps	Count	Unit Cost	Sub Total
Alkalinity	20	1	1	20	1	1				40	\$ 5.90	\$ 236
Calcium	20	1	1	20	1	1				40	\$ 9.44	\$ 378
TDS	20	1	1	20	1	1				40	\$ 5.90	\$ 236
TP	20	10	3	20	1	3	20	6	3	1020	\$ 7.67	\$ 7,823
TDP	20	2	3	20	1	3				180	\$ 7.67	\$ 1,381
mg P/mg DW										0	\$ 17.50	\$ -
% water										0	\$ 11.80	\$ -
NO2 + NO2	20	2	3	20	1	3	20	6	3	540	\$ 12.39	\$ 6,691
TN	20	2	3	20	1	3	20	6	3	540	\$ 32.50	\$ 17,550
Chlorophyll	20	2	3	20	1	3				180	\$ 14.75	\$ 2,655
Phytoplankton	20	1	4	20	1	3				140	\$ 76.70	\$ 10,738
Zooplankton	20	1	3							60	\$ 76.70	\$ 4,602
												<b>\$ 52,289</b>

	H Dates	H Sites	H Reps	Tank Dates	Tank Sites	Tank Reps	Special Dates	Special Sites	Special Reps	Count	Unit Cost	Sub Total
TP	100	6	6	2	30	3	10	20	3	4380	\$ 7.67	\$ 33,595
mg P/mg DW	12	2	3							72	\$ 17.50	\$ 1,260
% water	12	2	3							72	\$ 11.80	\$ 850
												<b>\$ 35,704</b>

Figure 57. Stations, Sampling Frequency, and Measured Parameters.

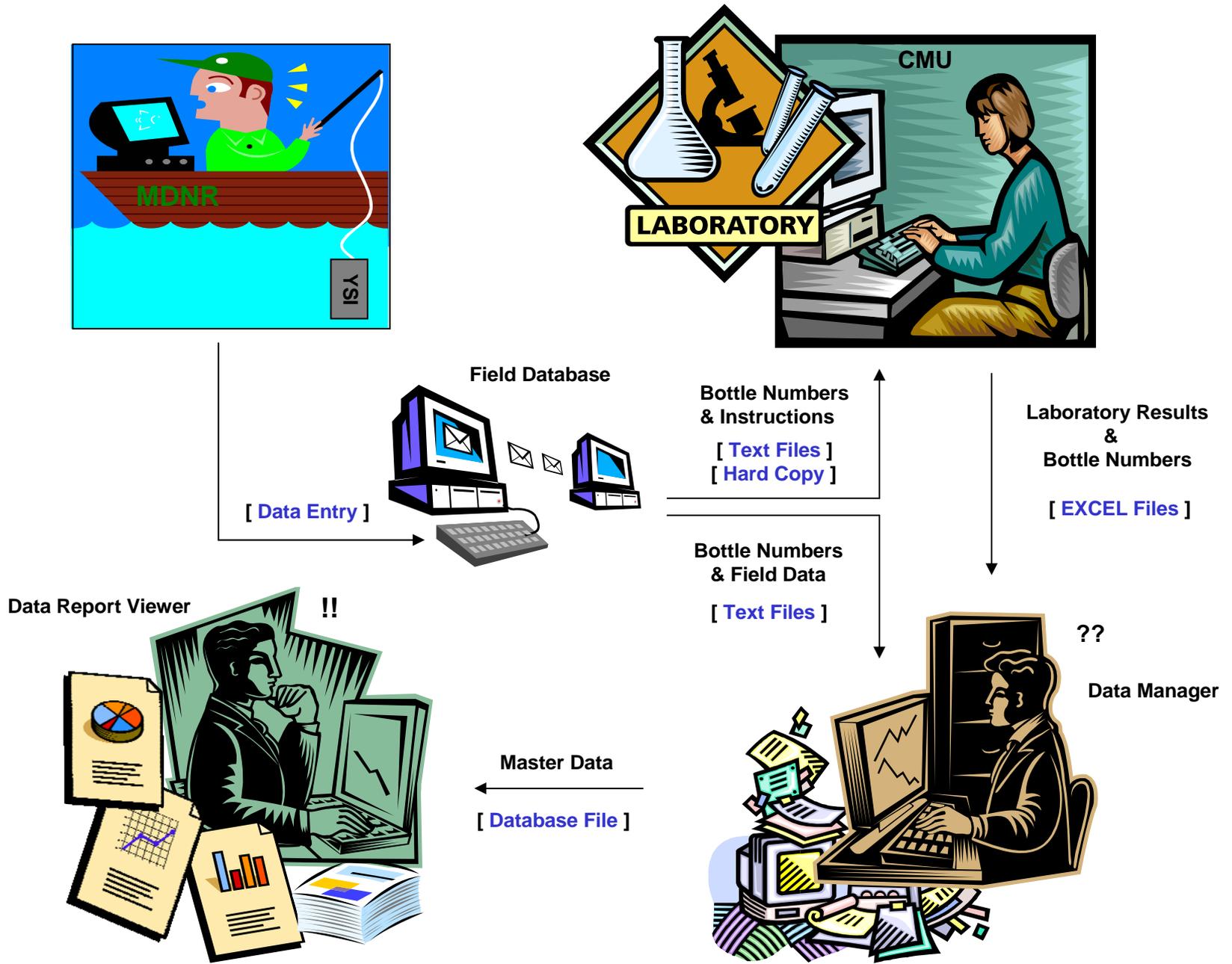


Figure 58. Database Components and Information Flow.