Appendices

Appendix A

Lake Owasso Homeowners' Surveys and Responses

Dear Resident,

We are requesting your opinion. Please complete and return the enclosed survey by **April 12, 2007** or go on-line and fill out the survey electronically at www.glwmo.org.

The Board of the Grass Lake Water Management Organization (GLWMO), a joint powers organization comprised of representatives from Shoreview and Roseville, is undertaking a Water Quality Management Study for Lake Owasso. The GLWMO is studying the lake to identify the causes of recent changes in water quality and to identify current uses and user perceptions. Part of the work associated with the Lake Owasso Study includes the enclosed Lake User Survey to help assess Lake Owasso users' perceptions regarding the use and condition of the lake.

The survey is being mailed to property owners on and near Lake Owasso. It is also available at Shoreview and Roseville City Hall Offices and on-line at www.glwmo.org. The idea is to be as inclusive and broad-based as possible with regard to getting input from the public.

Survey results will be made available at the Shoreview and Roseville City Hall Offices and on the Grass Lake WMO website (www.glwmo.org) by April 27, 2007.

Thank You,

Grass Lake Water Management Organization

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1. Are you a Lake Owasso lakeshore or deeded access resident?

☐ Yes. Number of years: _____ ☐ No. Please indicate your zip code: _____

2. In the last 12 months, how have you used Lake Owasso? ***(check all that apply)***

Fishing:	*Boating:*	*Sports:*	*Viewing Nature:*
☐ On ice	☐ Pontoon	☐ Water Skiing	☐ Wildlife
☐ From shore	☐ Bass boat	☐ Jet skiing	☐ Scenic
☐ From a dock	☐ Runabout	☐ Swimming	
☐ From a boat	☐ Sail boat	☐ Canoe/kayaking	

☐ Other *(specify)* _____

a. How often during the past 12 months have you used the lake for recreation? _____
_____

3. Do aquatic plants in Lake Owasso interfere with your enjoyment of the lake?

☐ Yes ☐ No ☐ Sometimes

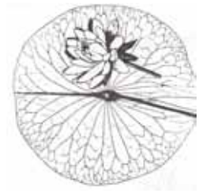
a. Please ***circle*** those activities listed in #2 above that are **most** affected by aquatic plants.

b. Over the last years, would you describe this interference as:
☐ Worse ☐ Better ☐ Unchanged?

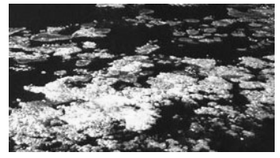
4. In the last 12 months, which aquatic plants do you feel are most problematic to your personal use of Lake Owasso? ***(check all that apply)***

☐ Coontail
(2% of actual size)

☐ White Water Lily
(10% of actual size)



☐ Filamentous Green Algae (Scum) (Actual size)



☐ Curlyleaf Pondweed
(10% of actual size)

☐ Northern Water Milfoil
(25% of actual size)

☐ Eurasian Water Milfoil
(25% of actual size)

☐ Elodea
(25% of actual size)

☐ Cattail
(2% of actual size)

☐ Purple Loosestrife
(5% of actual size)

☐ Duck Weed
(2 x actual size)

☐ Reed Canary Grass
(50% of actual size)

☐ Others *(specify)* _____

a. Please ***circle*** any aquatic plants in the list above that you feel are **beneficial** to your enjoyment of the lake, its wetlands and wildlife. Others *(specify)* _____
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5. **From your observations over the last two years, how would you describe the clarity of water in the open areas of Lake Owasso? *(select one)***
   ☐ Clearer ☐ Murkier ☐ About the same overall

   a. Check here if you are a former or current volunteer monitor of water clarity: ☐

   b. Which activity, if any, does water clarity impact for you?
      ☐ None ☐ Specify____

6. **In your opinion, during which summer month does Lake Owasso have the worst water clarity? *(select one)***
   ☐ May ☐ July ☐ September
   ☐ June ☐ August

7. **In your opinion, what are the <u>top 3</u> most important criteria for a quality lake?**
   ☐ Stable water levels ☐ Water clarity ☐ Diverse native aquatic plants
   ☐ Fish, variety and/or quantity ☐ Wildlife, variety and/or quantity ☐ No invasive (non-native) aquatic plants
   ☐ Other ____

8. **Have you noticed a change in Lake Owasso's fishery over the last 10 years?**
   ☐ Yes ☐ No ☐ I do not fish in Lake Owasso
   If yes, specify____

9. **Have you noticed any of the following relative the fish population in Lake Owasso? *(check all that apply)***
   ☐ Large numbers of small sunfish or bluegills
   ☐ Large rough fish populations such as carp
   ☐ Low predator fish (northern, bass, etc.) population

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FOR LAKESHORE AND DEEDED ACCESS RESIDENTS ONLY:

10. **What aquatic plant control methods do you support on Lake Owasso?**
    ☐ Chemical ☐ Mechanical ☐ None ☐ Other___________

11. **What do you do to help decrease phosphorous and sediments in the lake? *(check all that apply)***
    ☐ Maintain a shoreline buffer (non-mown)
    ☐ Keep leaves, grass clippings and chemicals off your street, driveway, and sidewalks
    ☐ Direct downspouts onto lawn or garden
    ☐ Use rain barrels to collect roof runoff
    ☐ Use phosphorous-free or no fertilizer
    ☐ Other (specify) ____

*(**PLEASE NOTE:** All survey results will be tallied anonymously, regardless of contact information provided.)*

To return this survey, simply refold the paper with the Grass Lake Water Management Organization address on the outside fold and secure the edge with tape where indicated.

Grass Lake Water Management Organization
c/o Barr Engineering Company
4700 W 77th St Ste 200
Minneapolis, MN 55435-9513

Please Place
Tape Here

Please Place
Tape Here

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 26675 MINNEAPOLIS MN
POSTAGE WILL BE PAID BY ADDRESSEE

GRASS LAKE WATER MANAGEMENT ORGANIZATION
C/O BARR ENGINEERING COMPANY
4700 W 77TH ST STE 200
MINNEAPOLIS MN 55435-9513
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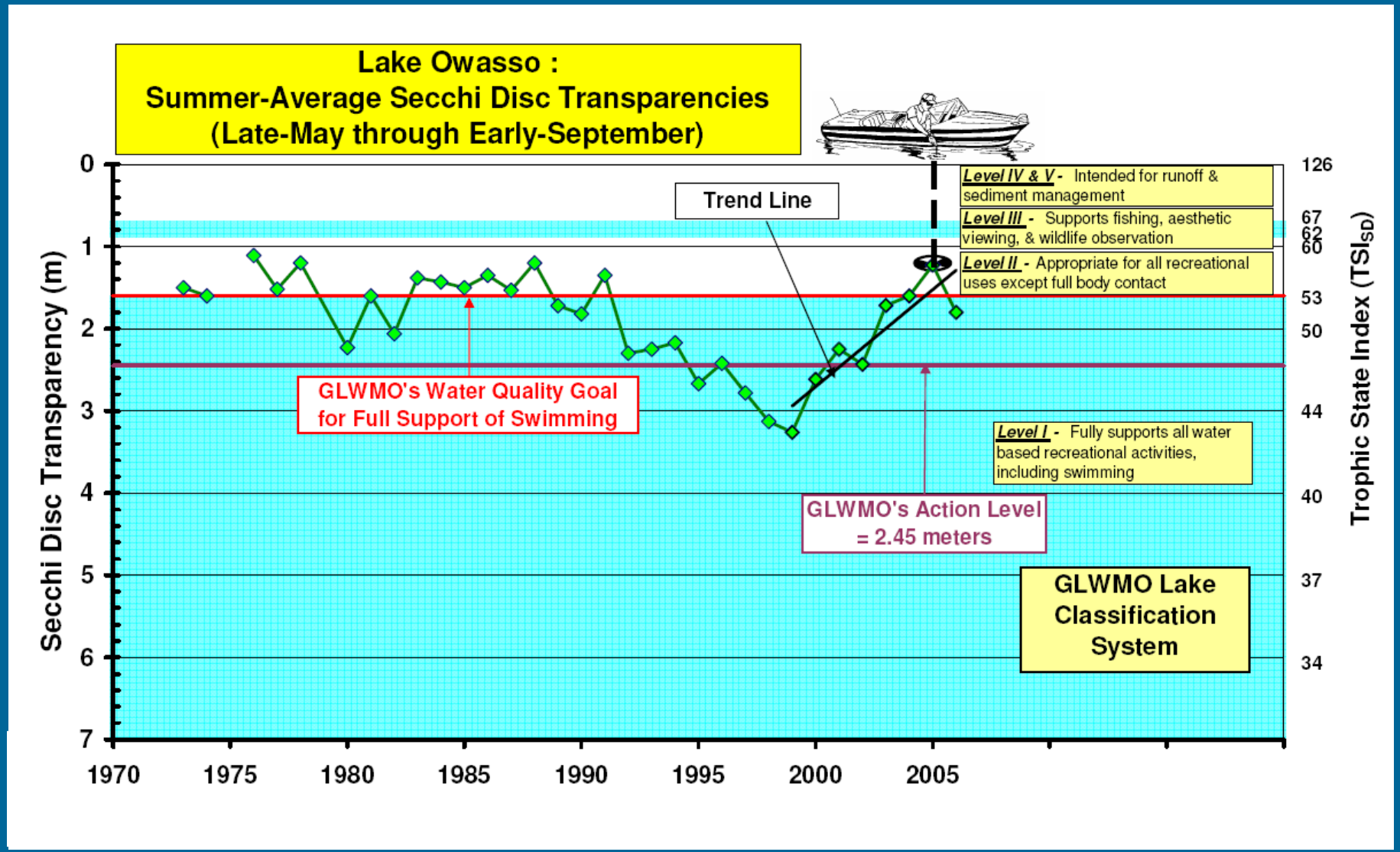
Lake Owasso User Survey Results

April 26, 2007

Presented By: Barr Engineering Company

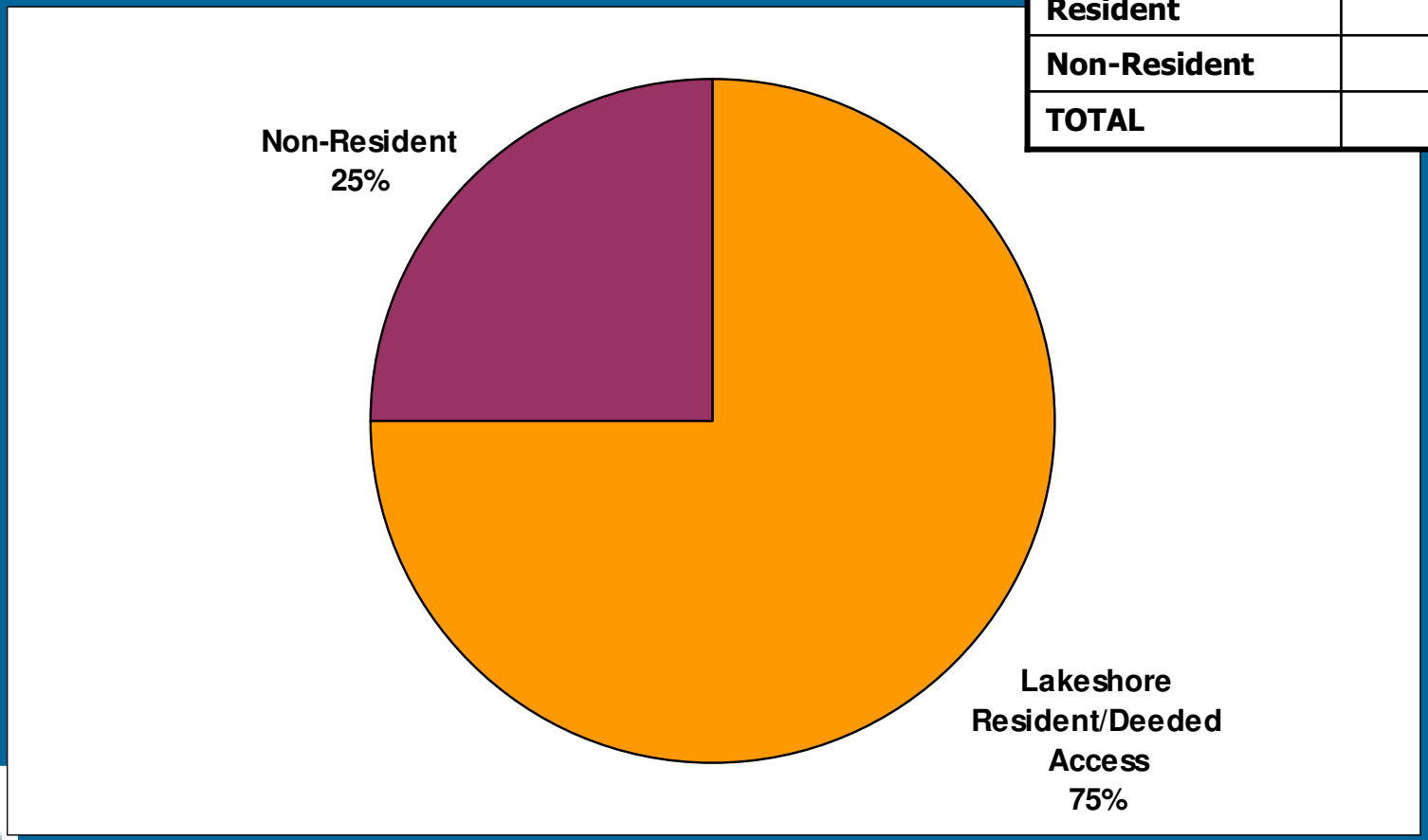
- Survey Conducted by GLWMO
  - By mail and internet
- Survey Dates : March 15 – April 16
- Number of Respondents: (188 total)
  - Mailed back surveys – 148
  - Internet surveys – 40
  - Lakeshore/Deeded Access – 141
  - Non-Resident – 47

Lake Owasso Water Quality (through 2006)



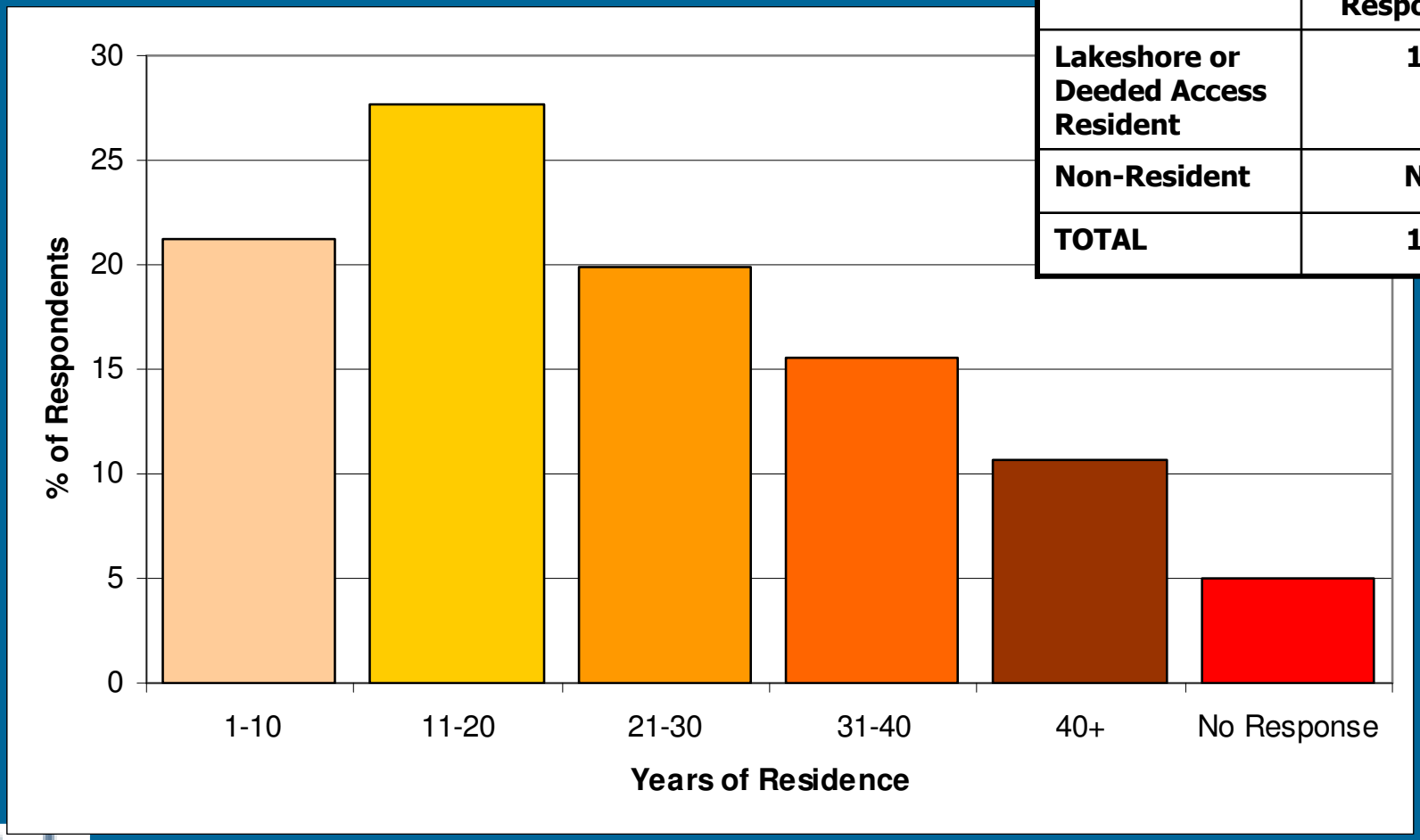
Q1: Are you a lakeshore or deeded access resident?

	Number of Respondents
Lakeshore or Deeded Access Resident	141
Non-Resident	47
TOTAL	188



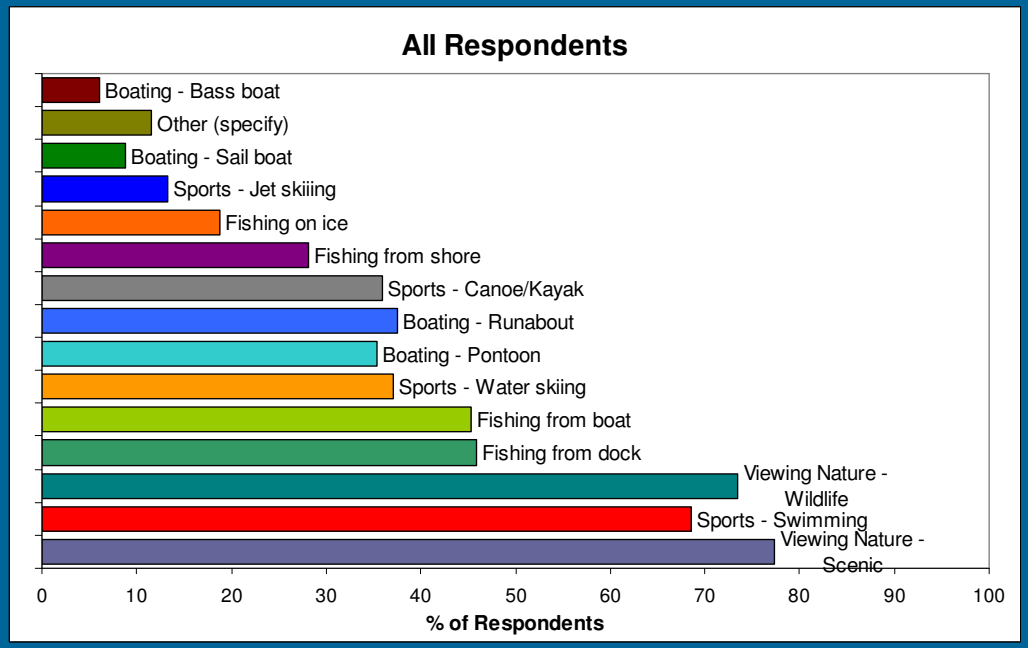
Q1: How long have you been a lakshore or deeded access resident?

	Number of Respondents
Lakeshore or Deeded Access Resident	141
Non-Resident	N/A
TOTAL	188

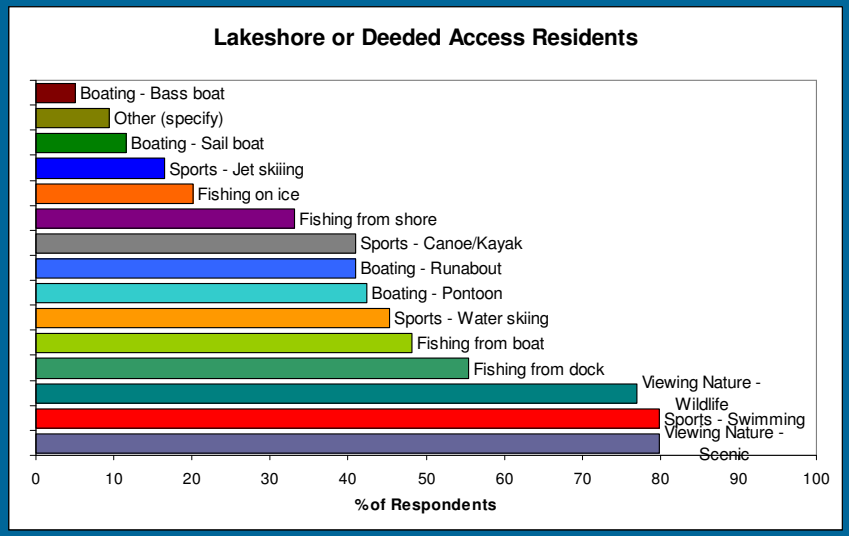


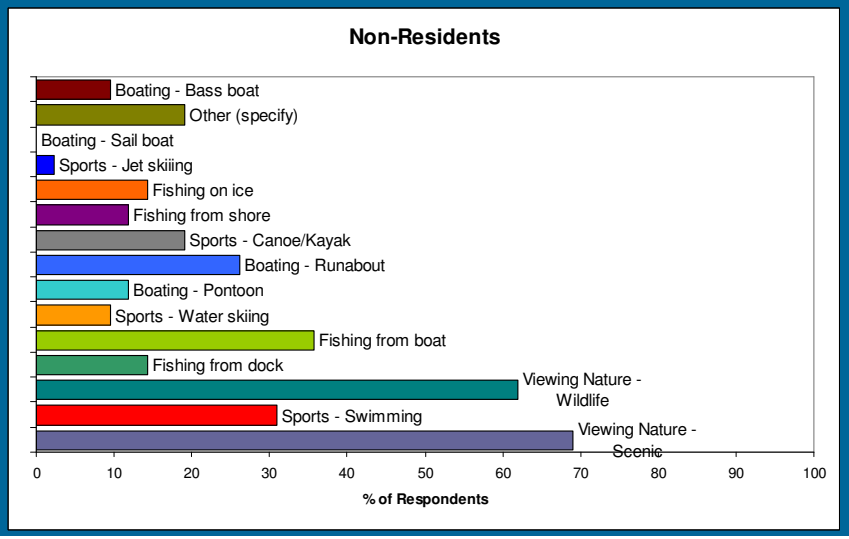
BARR

Q2: In the past 12 months, how have you used Lake Owasso?



	Number of Respondents
Lakeshore or Deeded Access Resident	139
Non-Resident	42
TOTAL	181



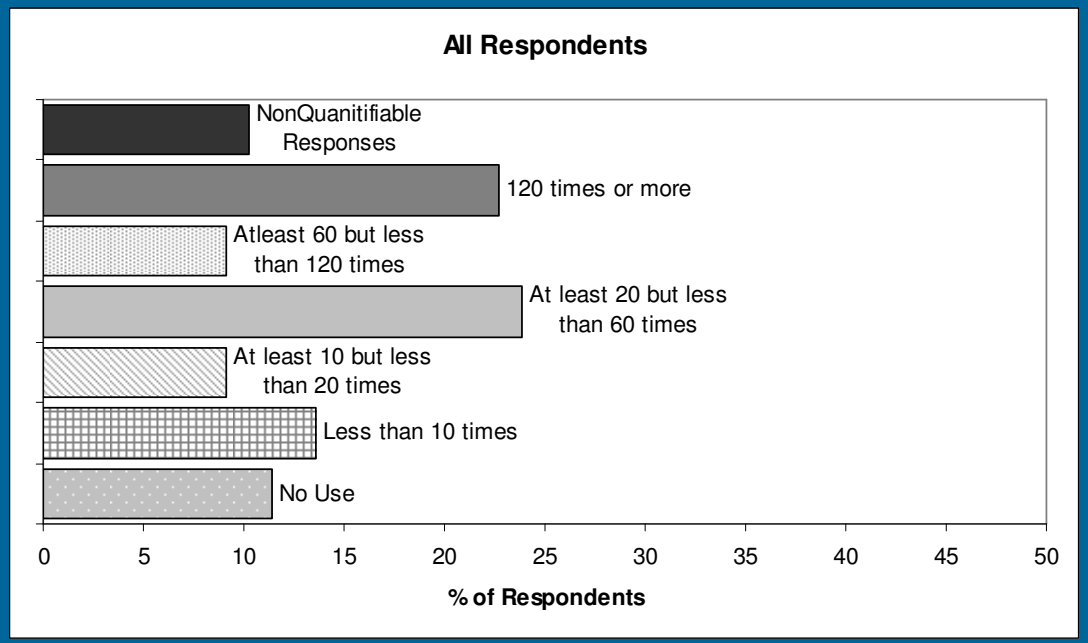


Q2: In the past 12 months, how have you used Lake Owasso?

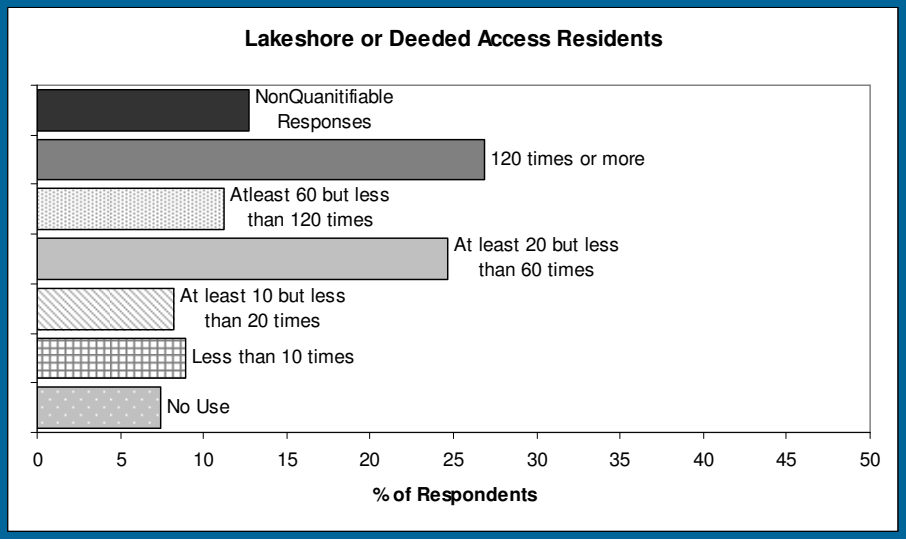
- Other uses included:
  - tubing,
  - ice skating,
  - cross-country skiing,
  - walking (on the ice in the winter),
  - paddle boating,
  - scuba diving,
  - snowmobiling, and
  - windsurfing

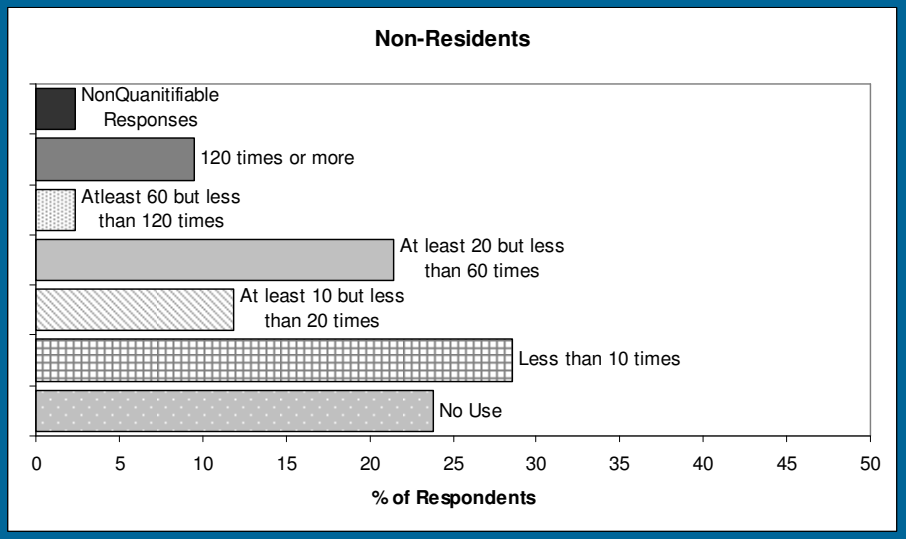
BARR

Q2a: How often in the past 12 months have you used Lake Owasso for recreation?

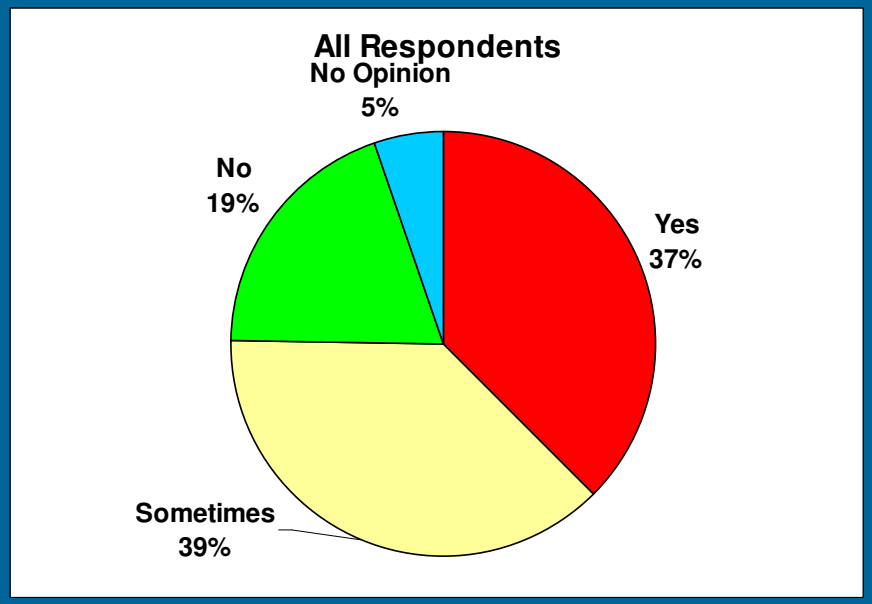


	Number of Respondents
Lakeshore or Deeded Access Resident	134
Non-Resident	42
TOTAL	176

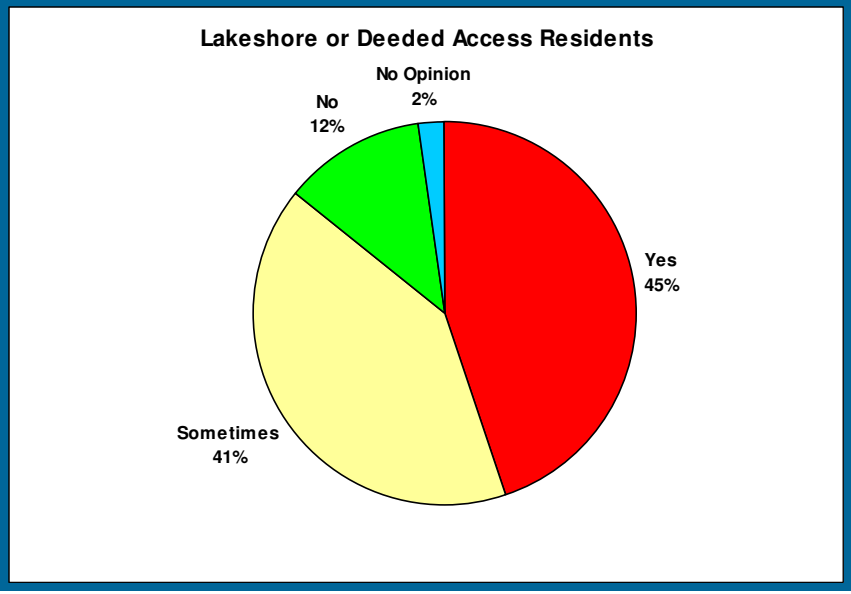


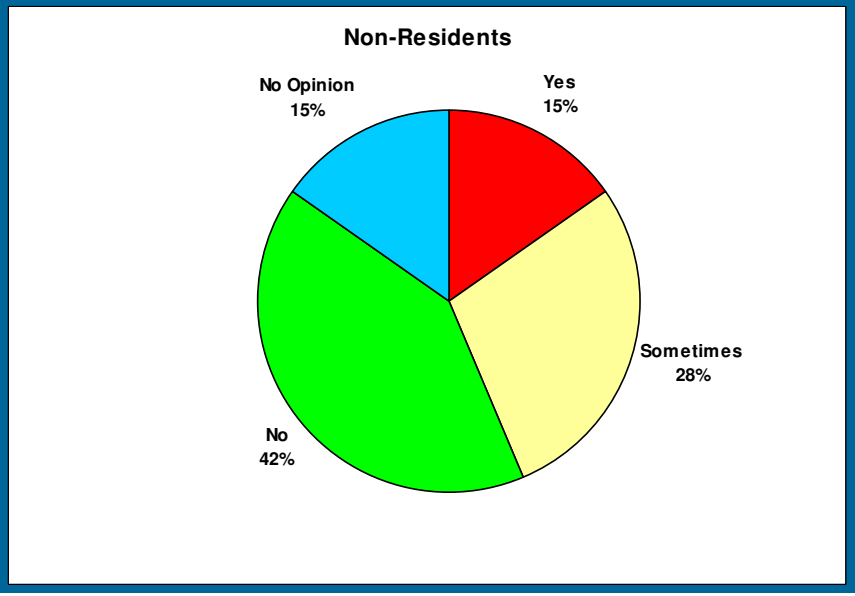


Q3: Do aquatic plants interfere with your enjoyment of Lake Owasso?

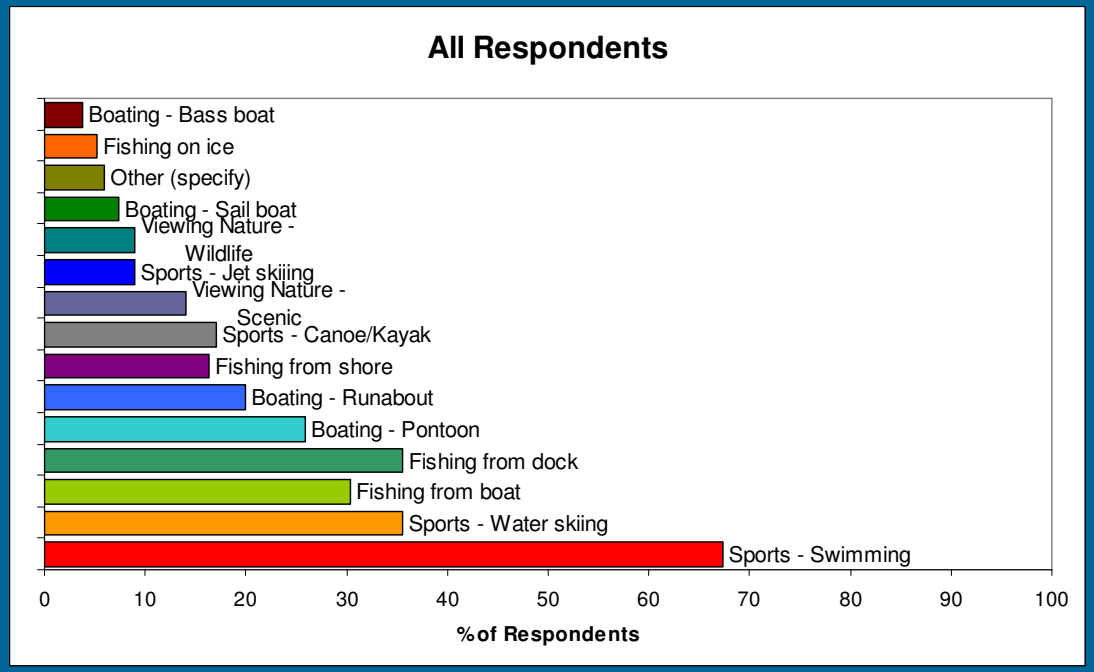


	Number of Respondents
Lakeshore or Deeded Access Resident	141
Non-Resident	46
TOTAL	187

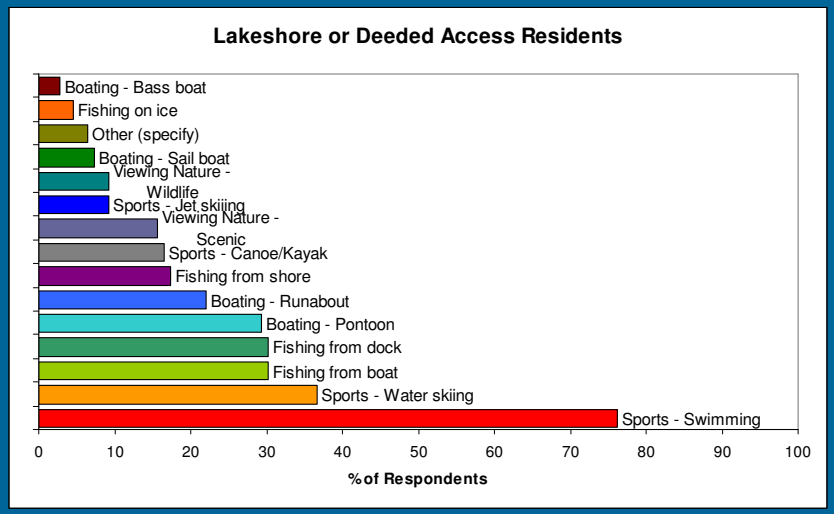


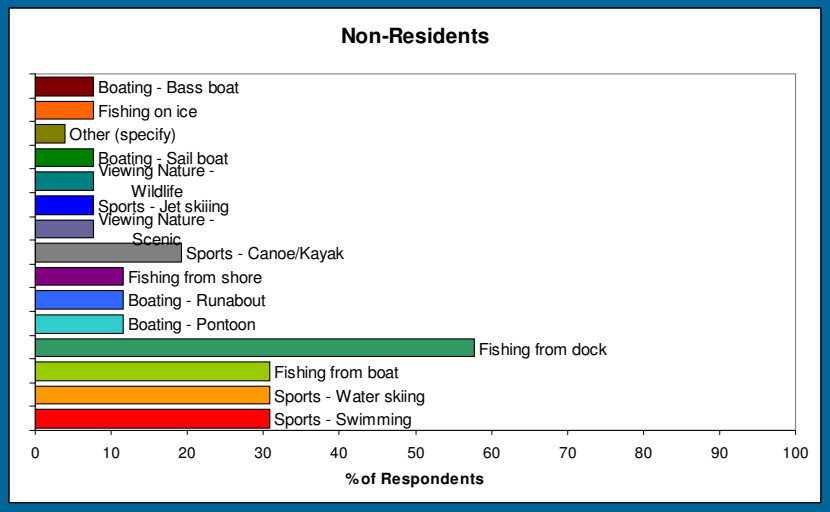


Q3a: Activities most affected by aquatic plants?



	Number of Respondents
Lakeshore or Deeded Access Resident	109
Non-Resident	26
TOTAL	135





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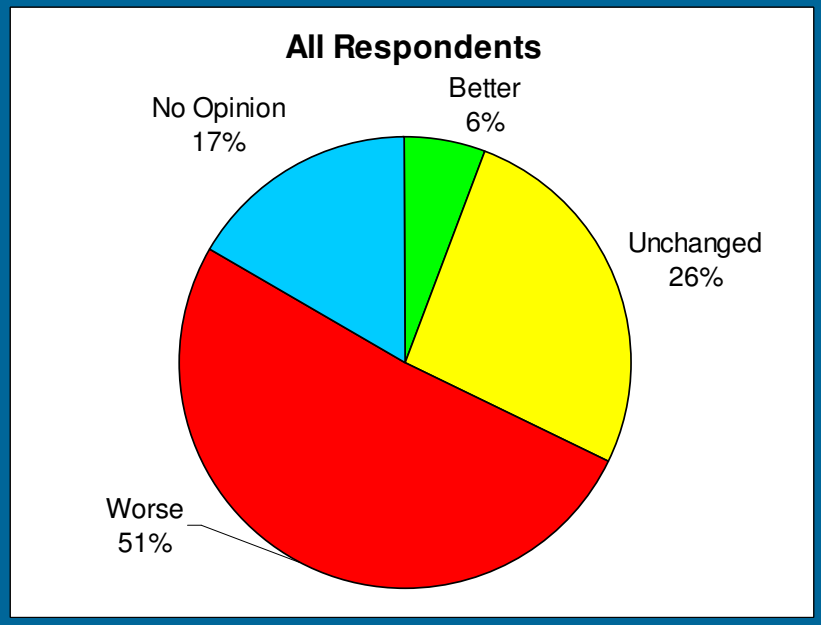
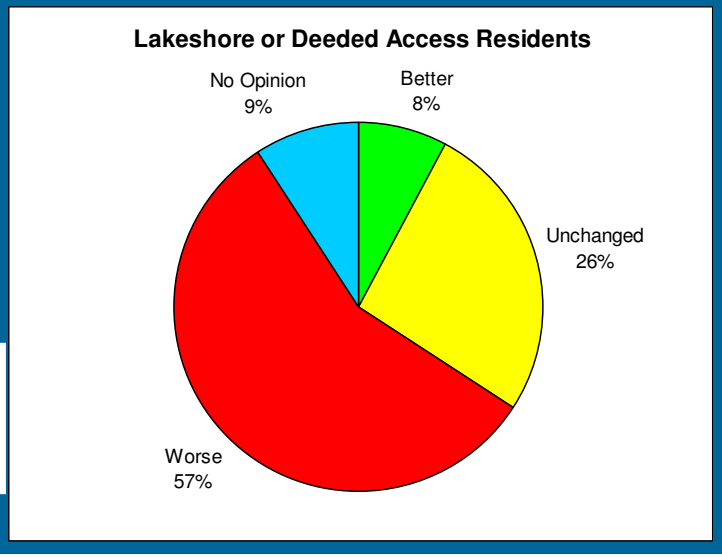
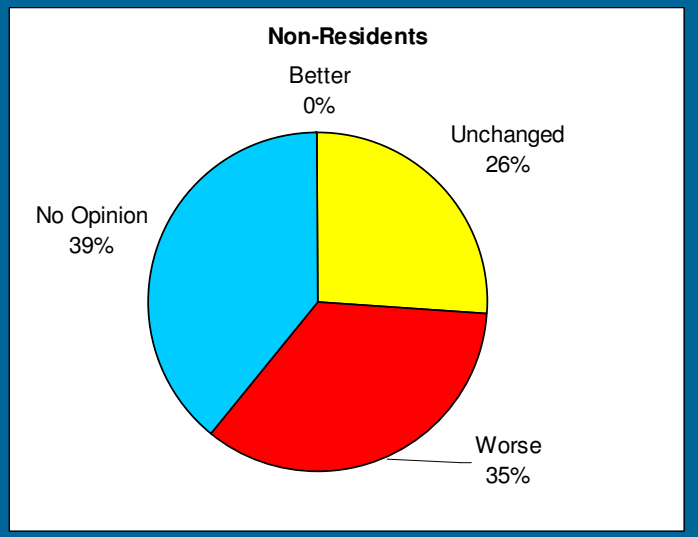
Q3b: How has aquatic plant interference changed over the past years?

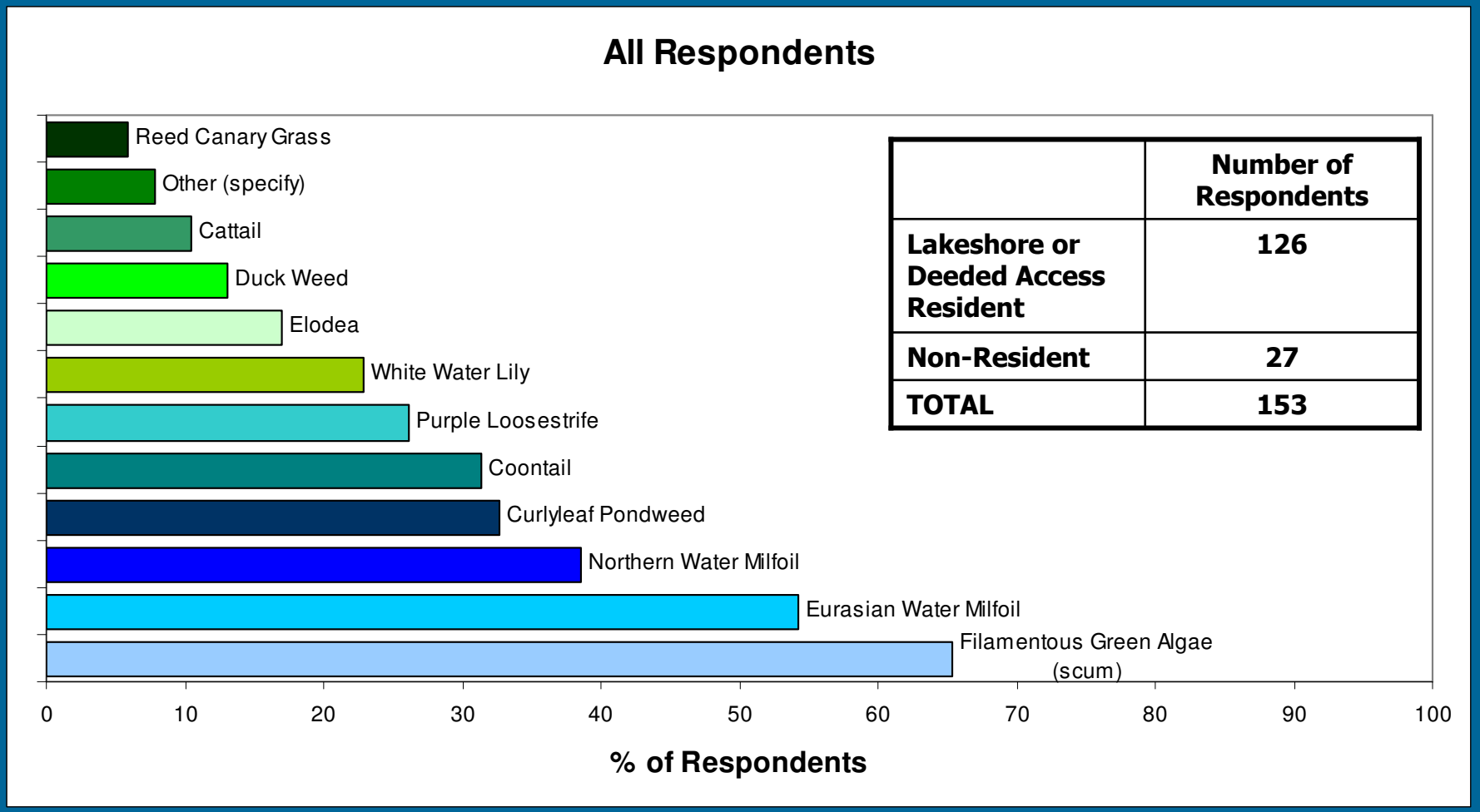


	Number of Respondents
Lakeshore or Deeded Access Resident	141
Non-Resident	46
TOTAL	187



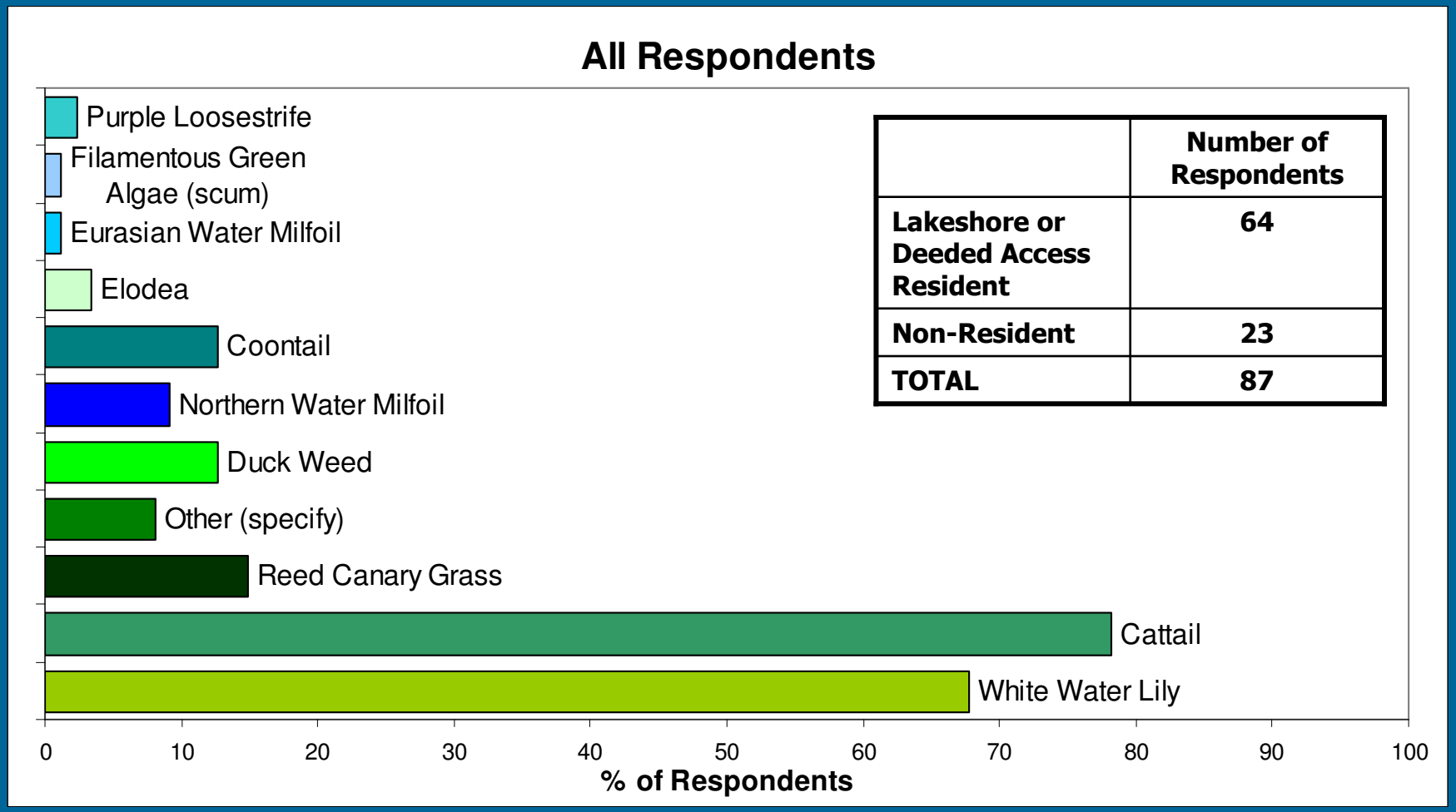


Q4: Which plants are most problematic to personal use of Lake Owasso?



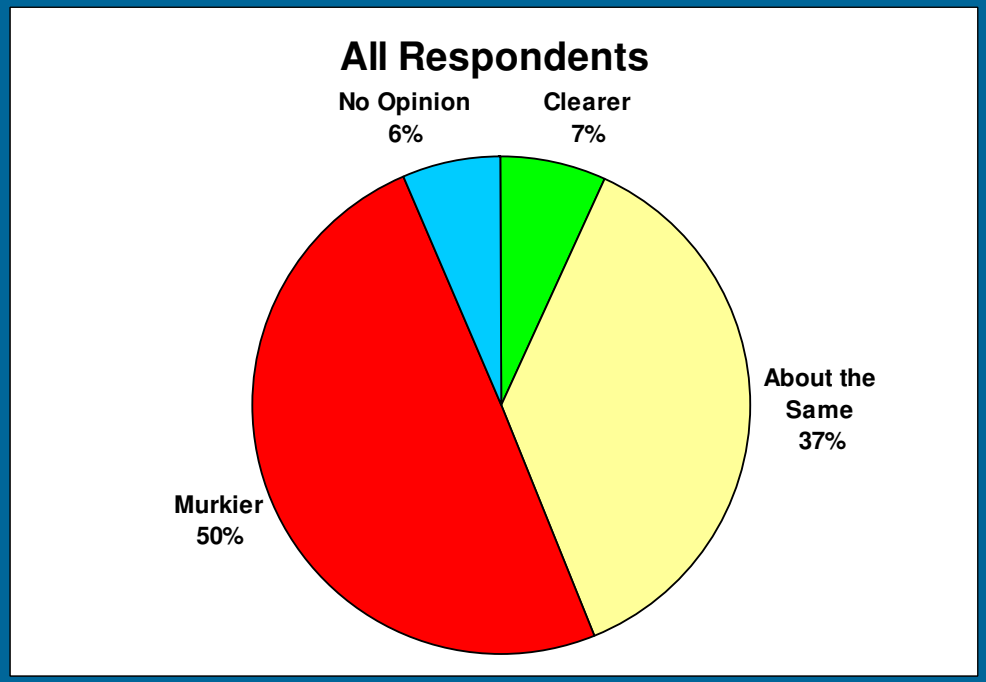
	Number of Respondents
Lakeshore or Deeded Access Resident	126
Non-Resident	27
TOTAL	153

Q4a: Which plants are most beneficial to personal use of Lake Owasso?

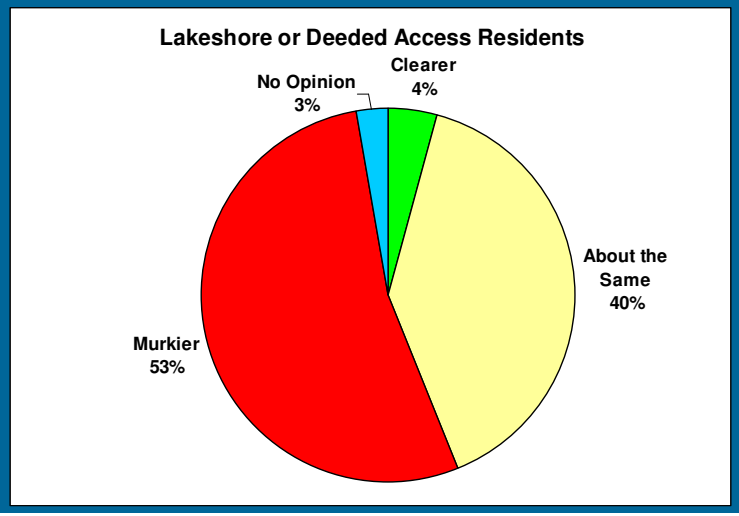


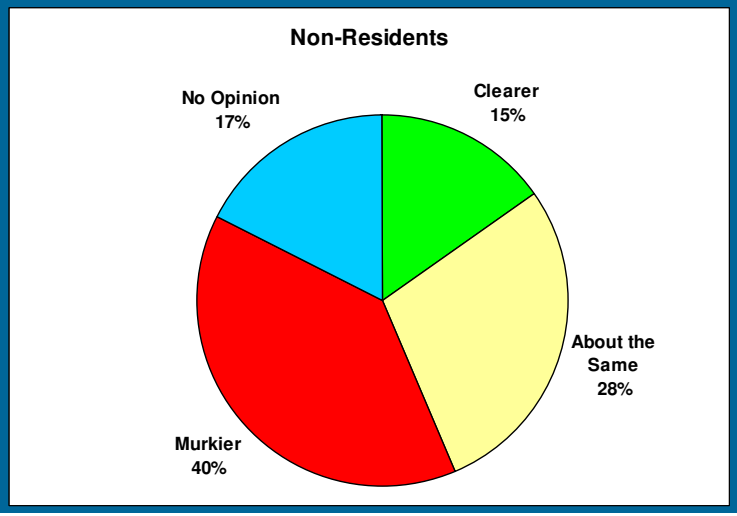
	Number of Respondents
Lakeshore or Deeded Access Resident	64
Non-Resident	23
TOTAL	87

Q5: How would you describe the clarity of Lake Owasso over the past 2 years?

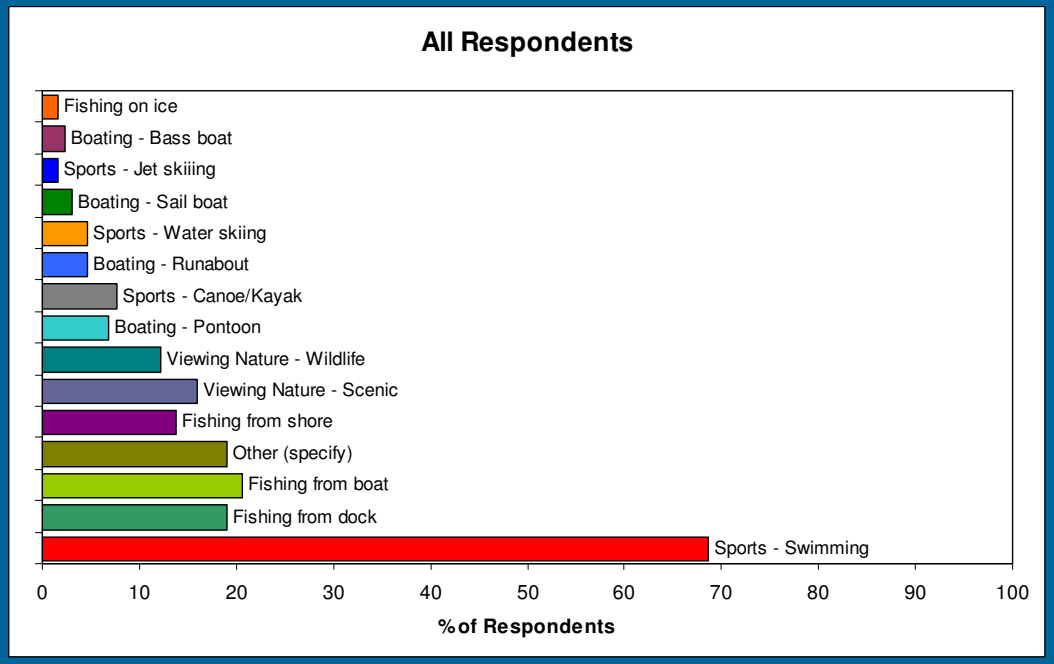


	Number of Respondents
Lakeshore or Deeded Access Resident	141
Non-Resident	46
TOTAL	187

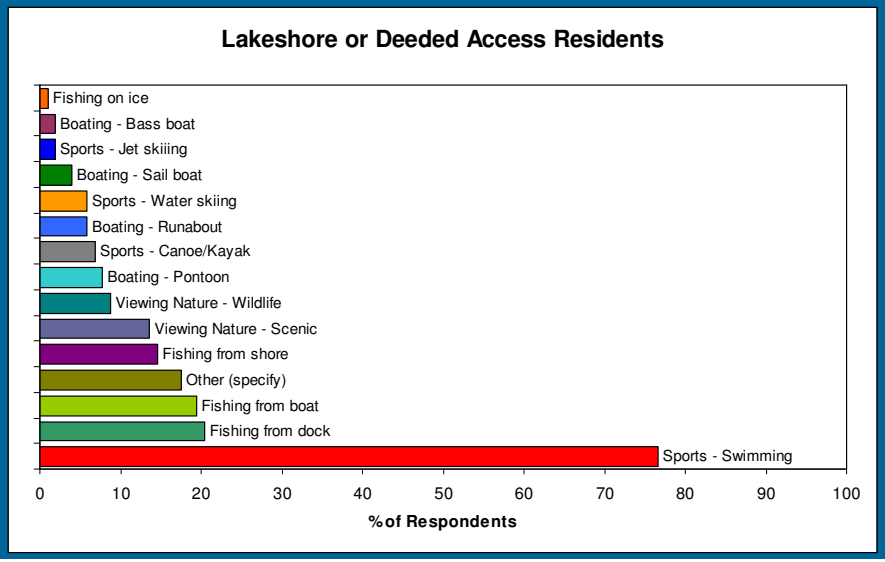


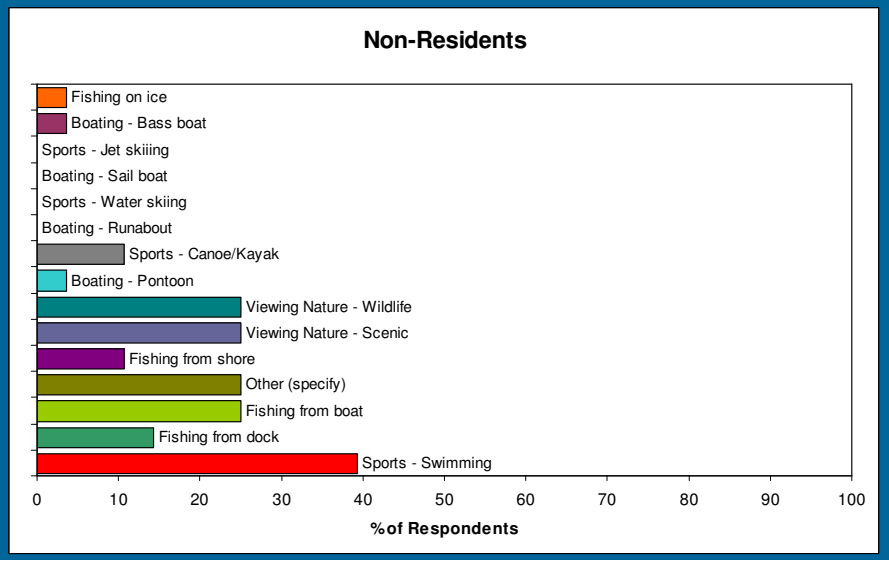


Q5a: Which activity does water clarity impact for you?

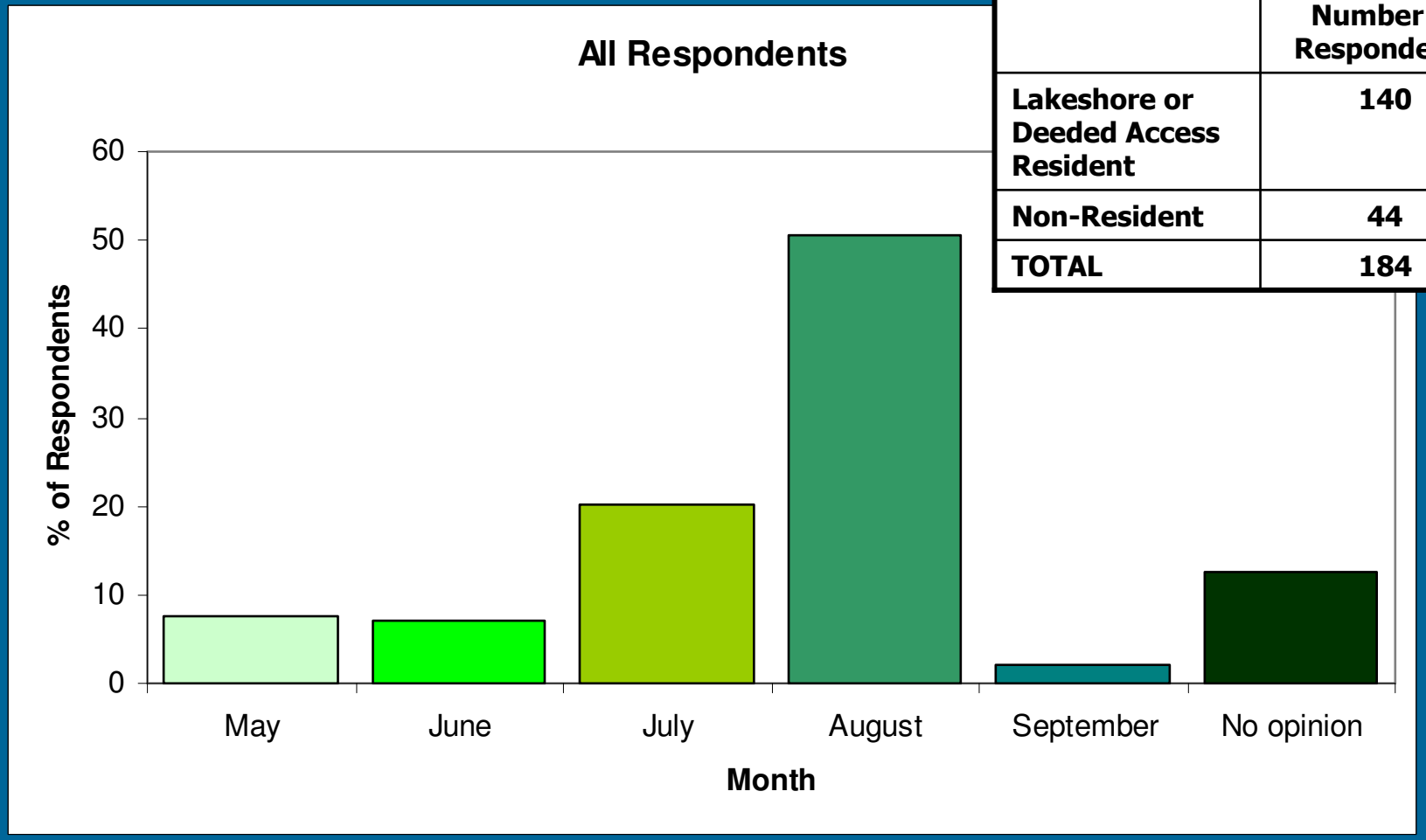


	Number of Respondents
Lakeshore or Deeded Access Resident	103
Non-Resident	28
TOTAL	131



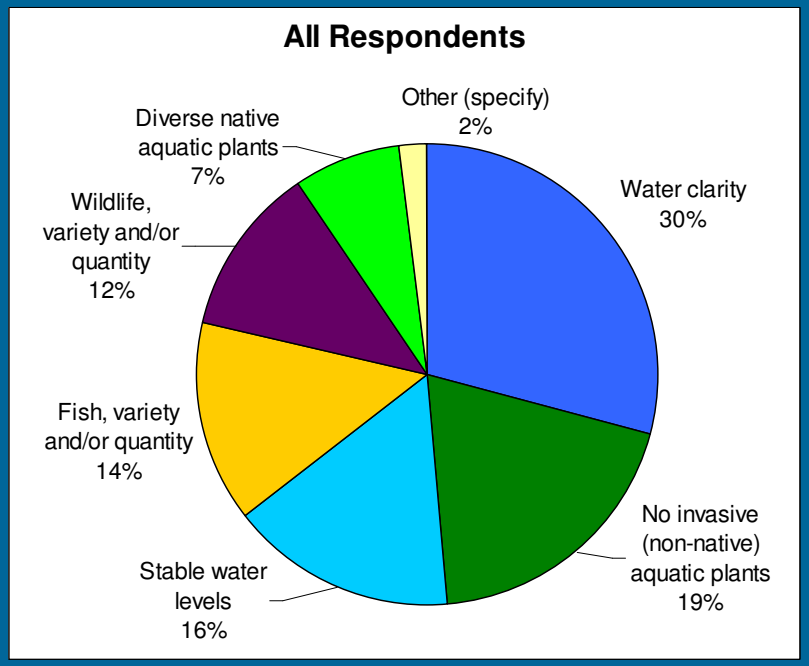


Q6: Which month does Lake Owasso have the worst water clarity?

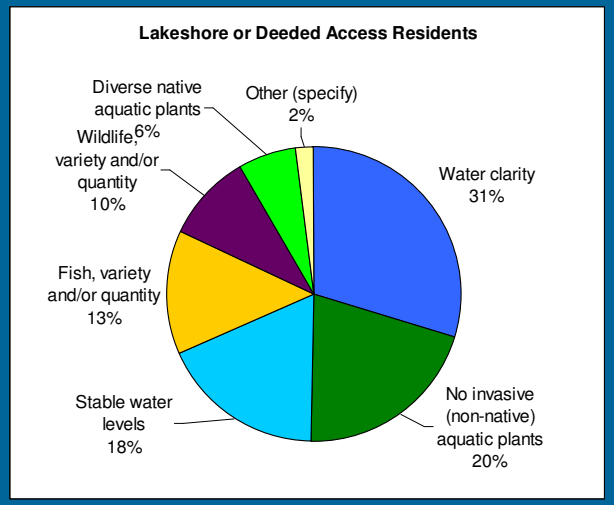


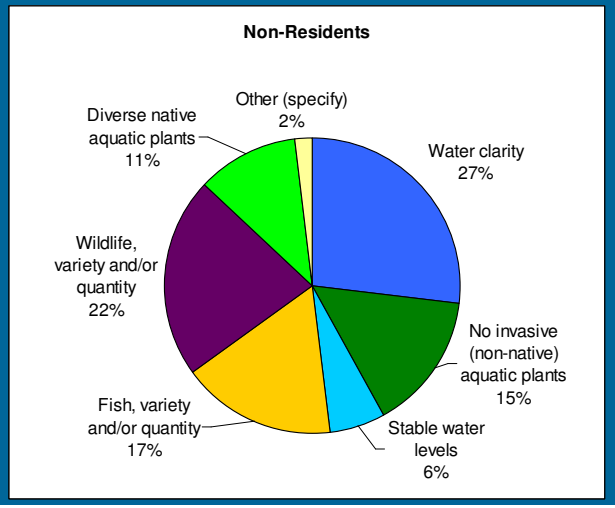
	Number of Respondents
Lakeshore or Deeded Access Resident	140
Non-Resident	44
TOTAL	184

Q7: What are the most important criteria for the quality of the lake?

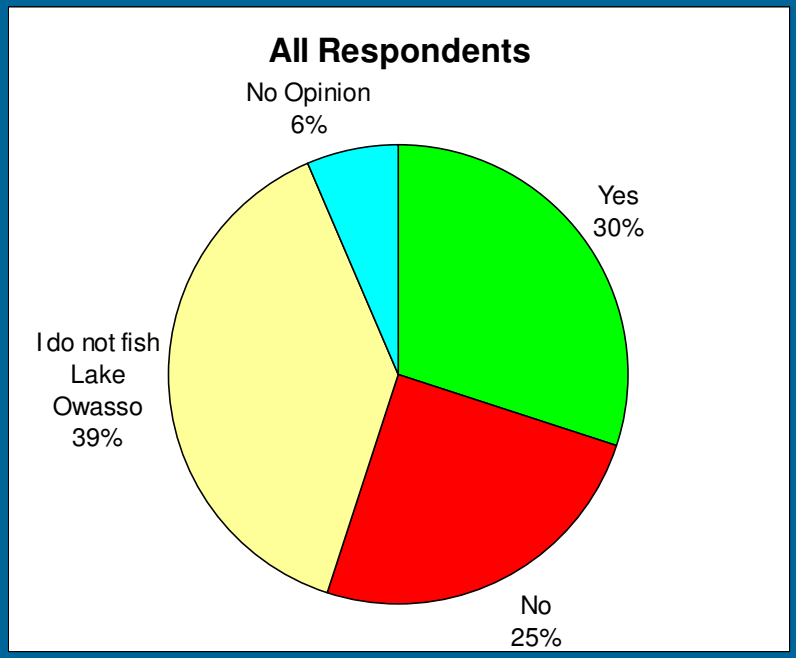


	Number of Respondents
Lakeshore or Deeded Access Resident	**139**
Non-Resident	**36**
TOTAL	**175**

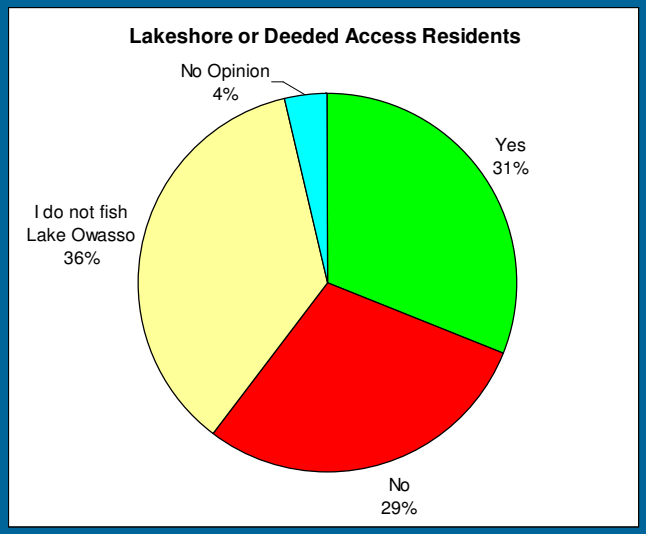


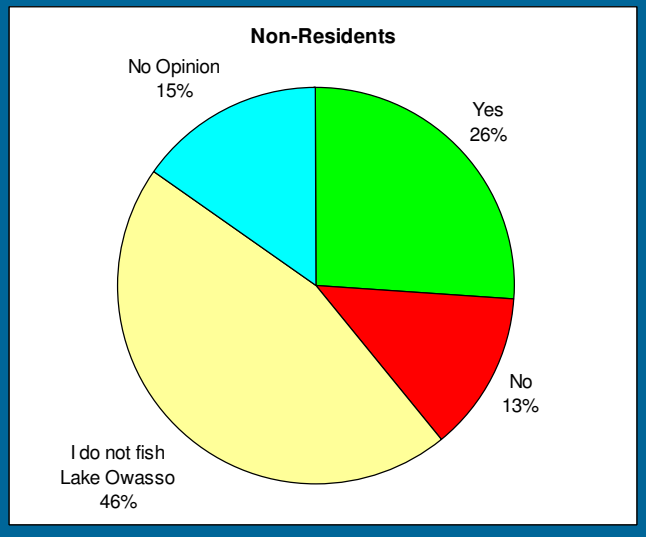


Q8: Have you noticed a change in Lake Owasso's fishery over the last 10 years?



	Number of Respondents
Lakeshore or Deeded Access Resident	141
Non-Resident	46
TOTAL	187

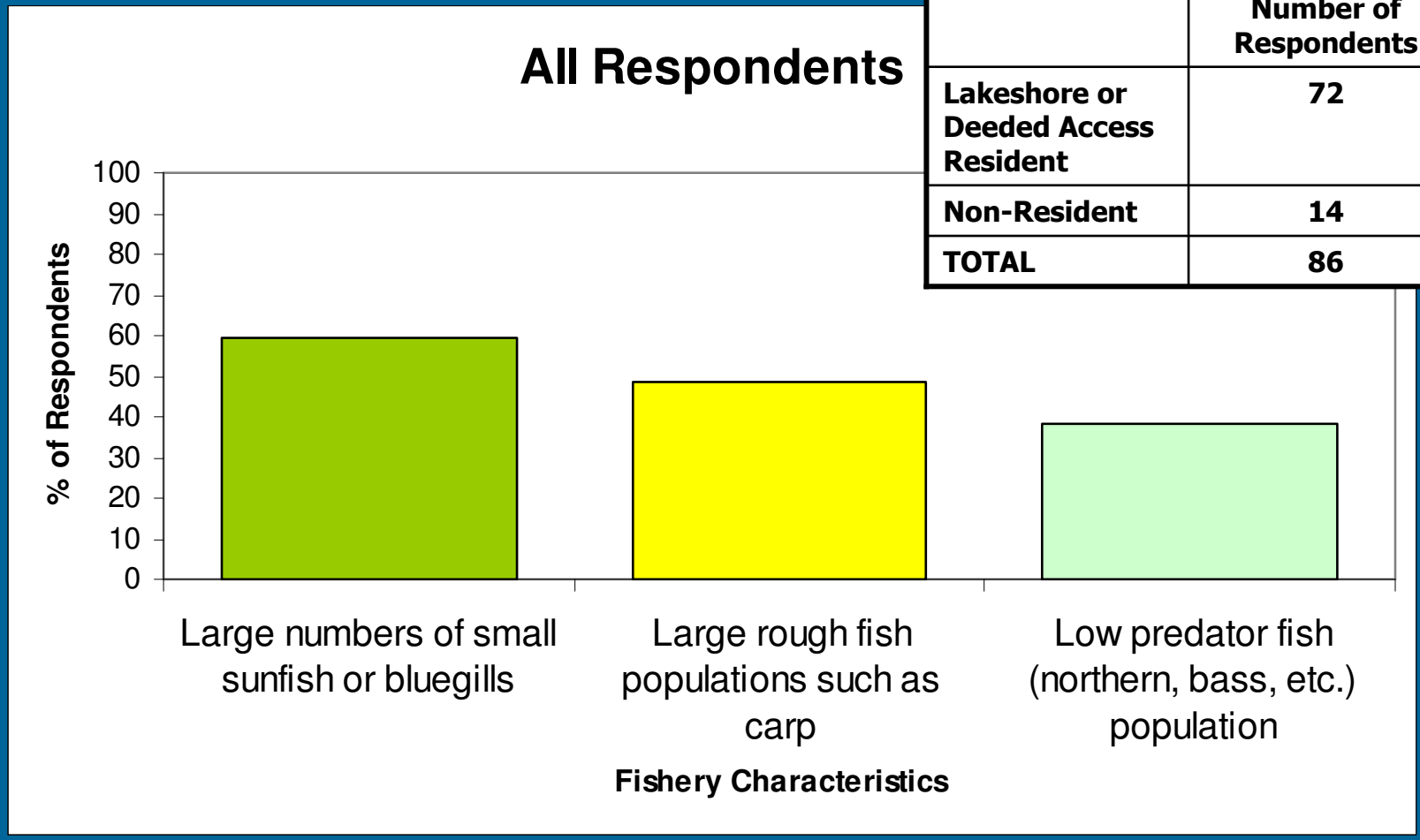




Q8: Have you noticed a change in Lake Owasso's fishery over the last 10 years?

In general, the comment with regards to change in the fishery is that there are smaller and fewer fish.

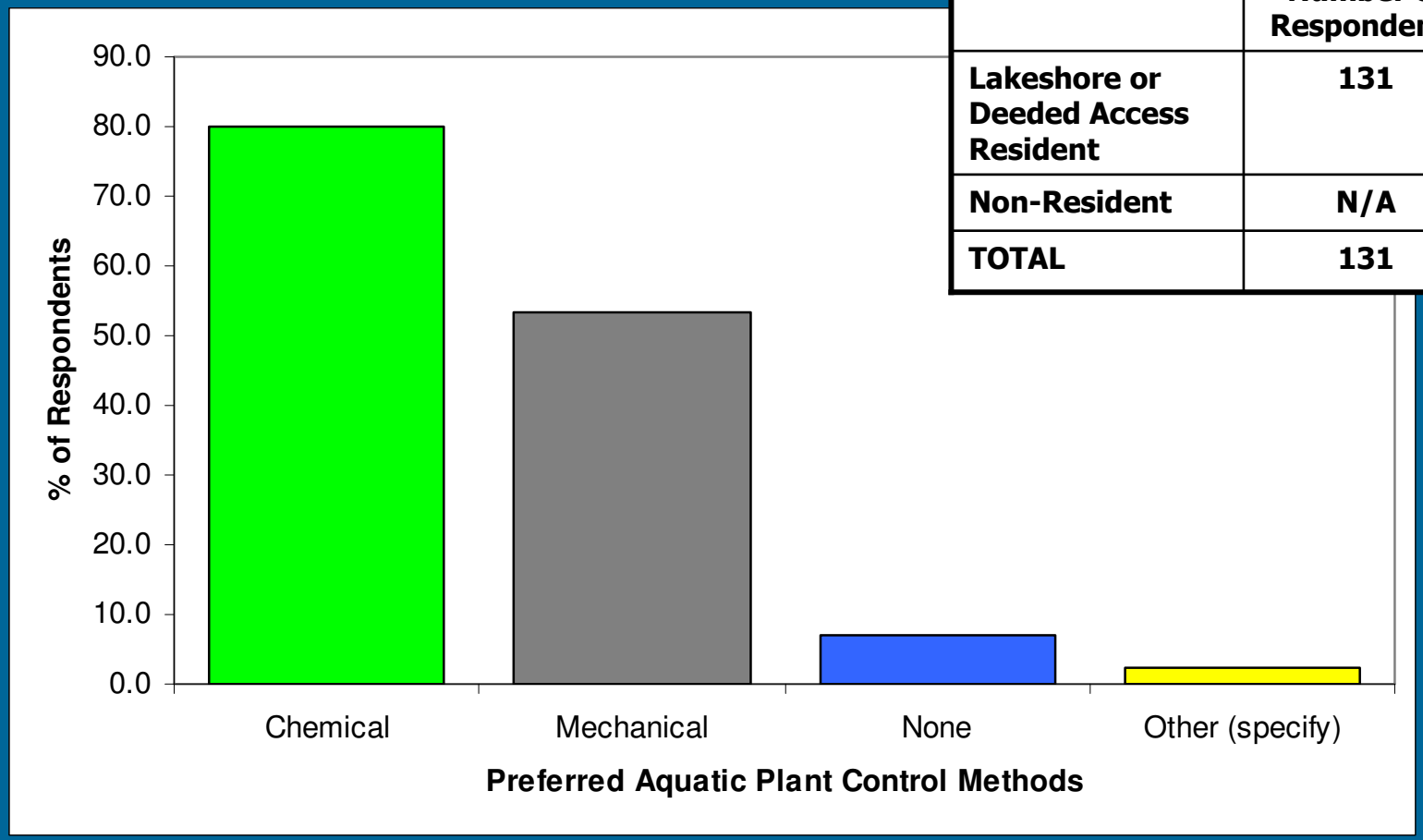
Q9: Have you noticed any of the following relative to the fish population in Lake Owasso?



	Number of Respondents
Lakeshore or Deeded Access Resident	72
Non-Resident	14
TOTAL	86

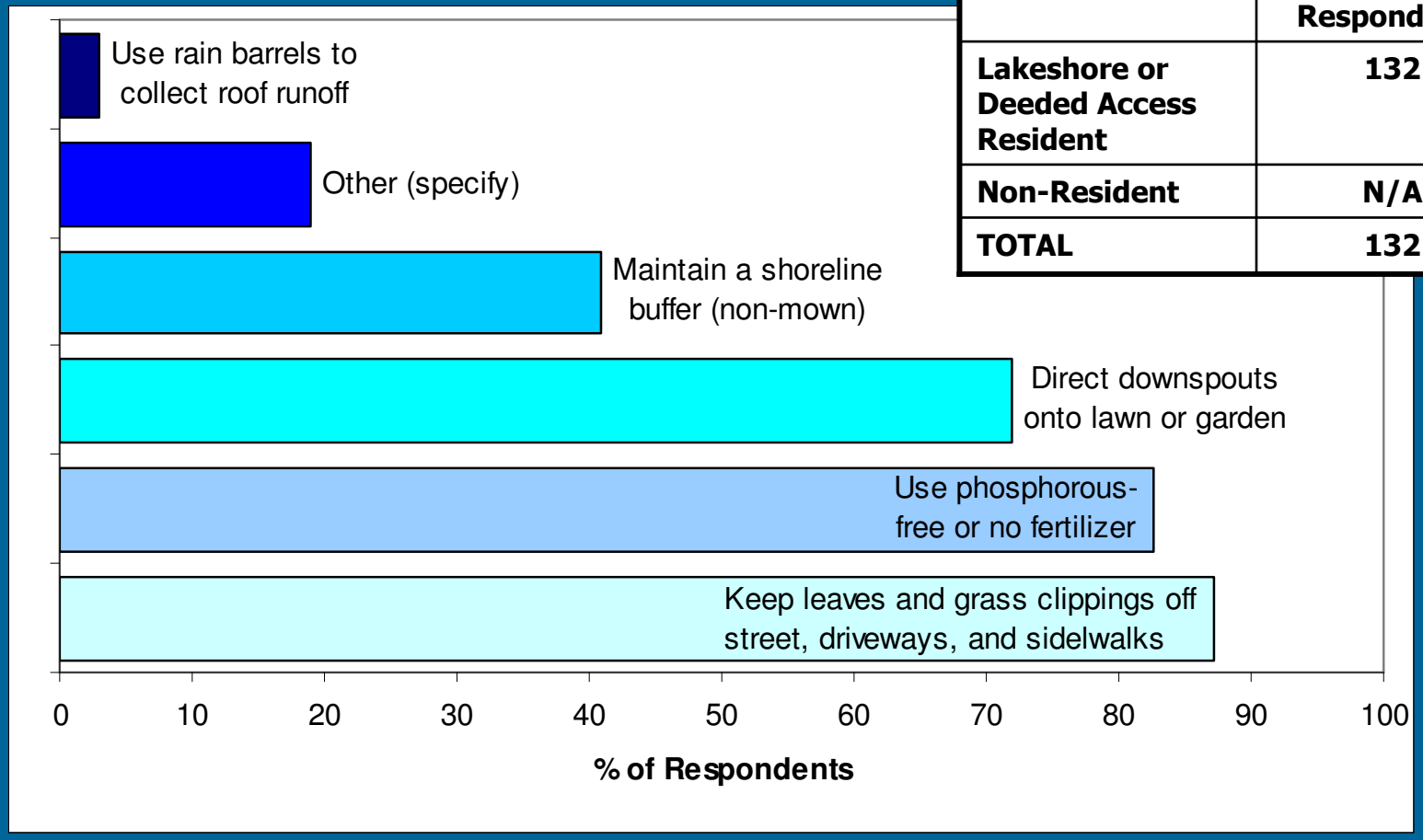
BARR

Q10: What aquatic plant control method do you support for Lake Owasso?



	Number of Respondents
Lakeshore or Deeded Access Resident	131
Non-Resident	N/A
TOTAL	131

Q11: What do you do to help decrease phosphorus and sediments to the lakes?



	Number of Respondents
Lakeshore or Deeded Access Resident	**132**
Non-Resident	**N/A**
TOTAL	**132**

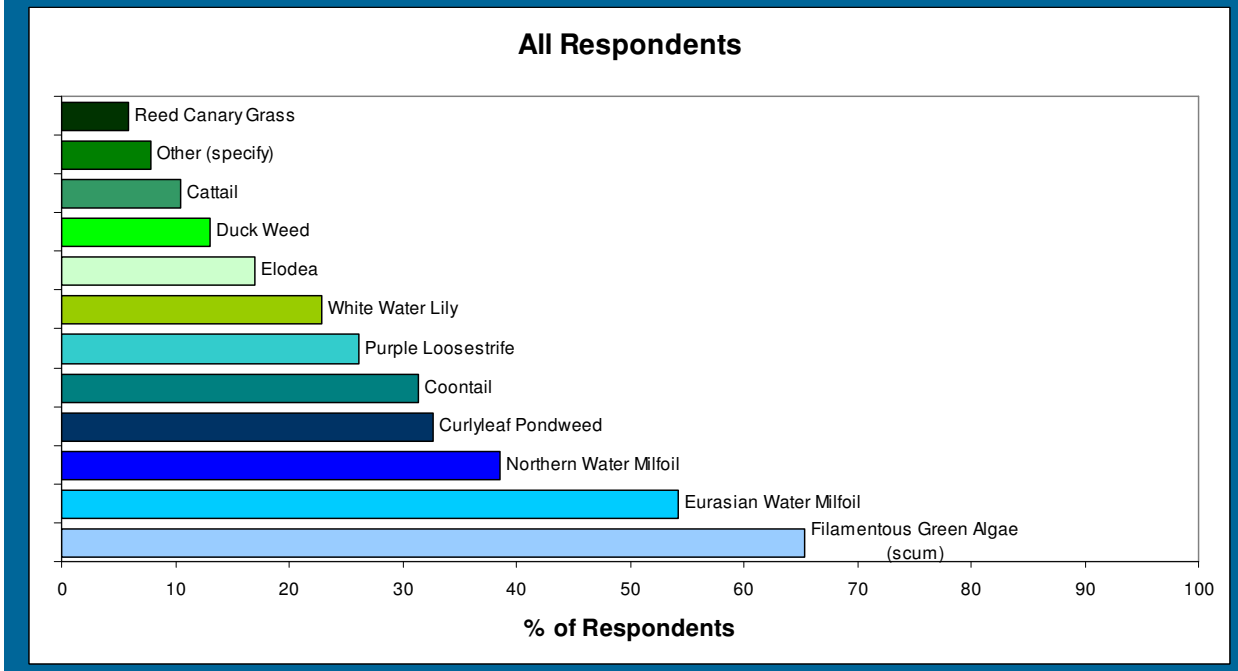
General comments:

- Sounds like there might be swimmer's itch
- There was a fishkill in Aug/Sept 2006
- Water levels are dropping
- Lake is filling in (could be the same as above? – JAK2)
- White water lily is taking over the lake (again, could be the result of above- JAK2)
- "They used to pump water into the lake on the north end.
A number of years ago the of supplemental water into the lake was stopped.
The timing coincides with the WQ concerns. Maybe restart pumps."
- Several mention eliminating direct discharges around the lake

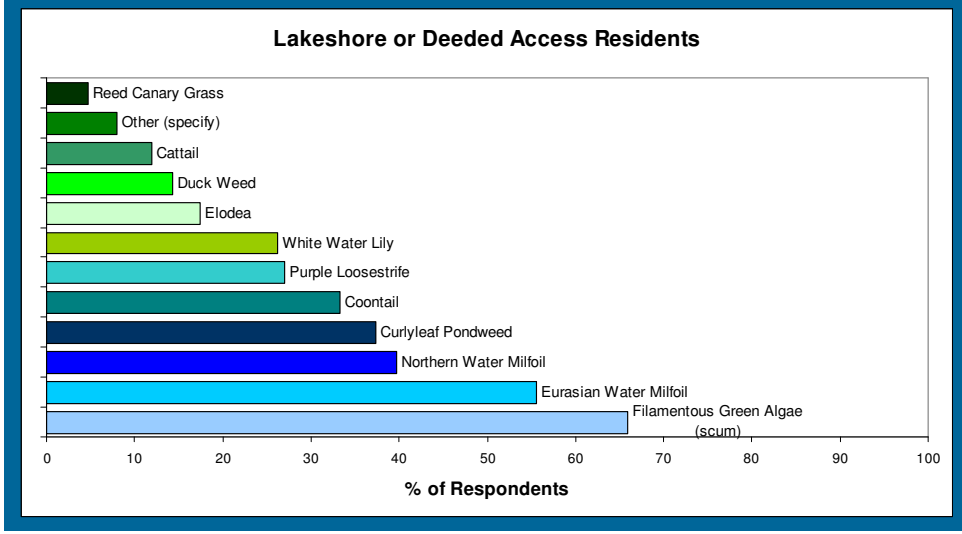
BARR

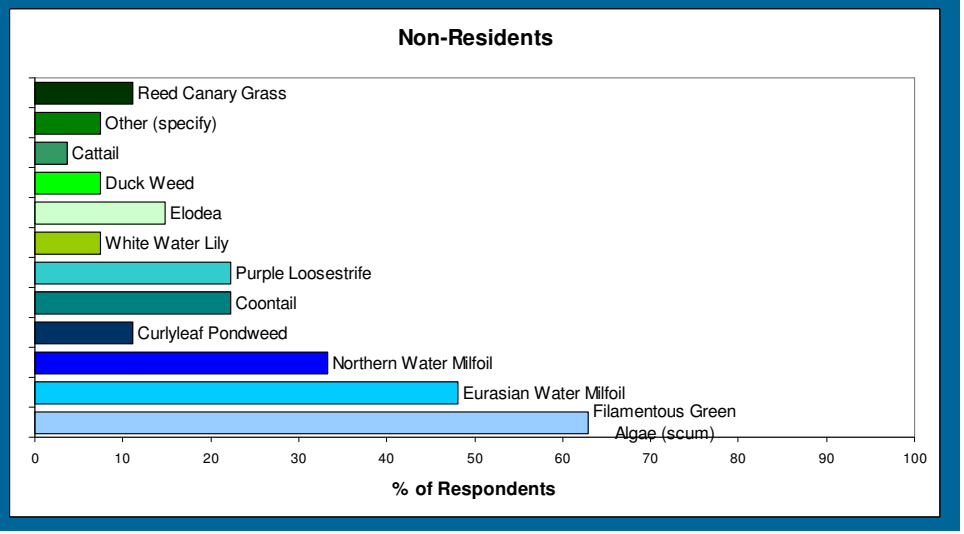
Grass Lake Watershed Management Organization

Q4: Which plants are most problematic to personal use of Lake Owasso?

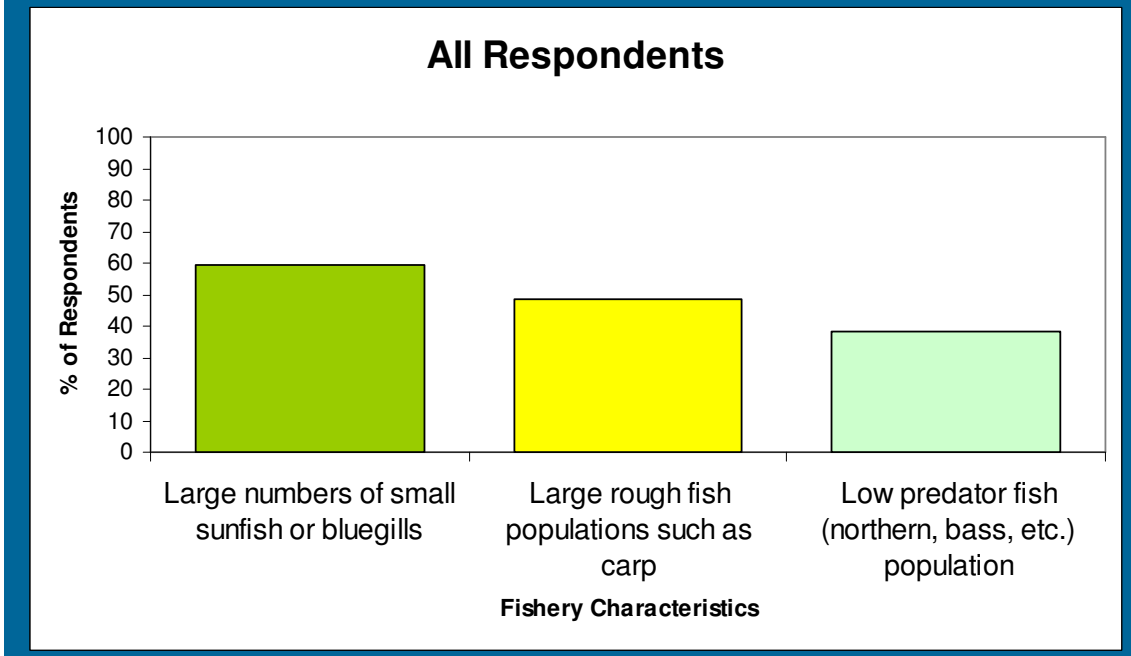


	Number of Respondents
Lakeshore or Deeded Access Resident	126
Non-Resident	27
TOTAL	153

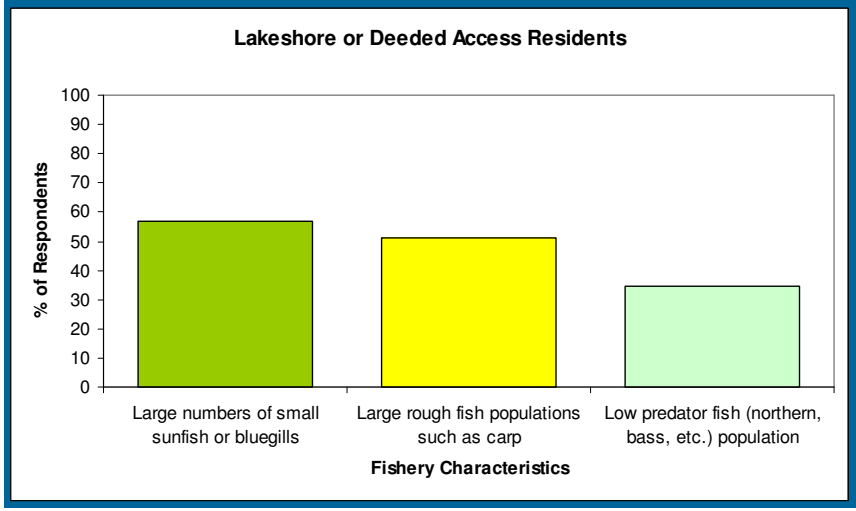


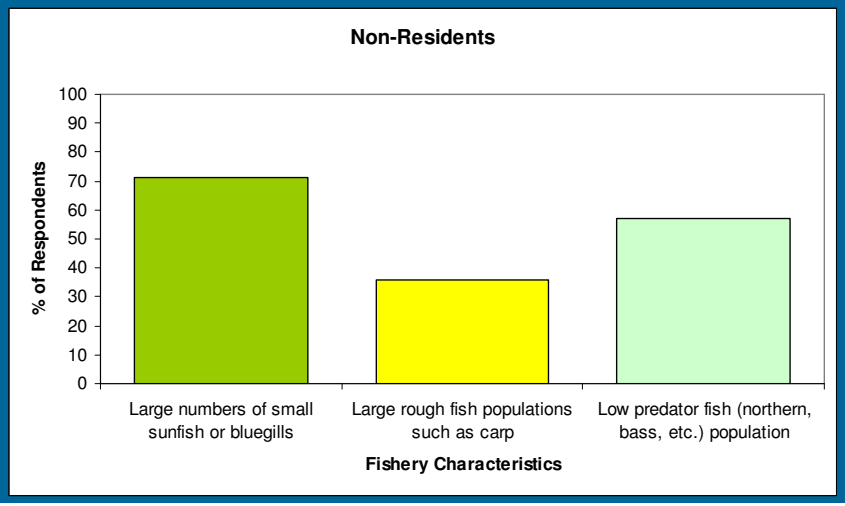


Q9: Have you noticed any of the following relative to the fish population in Lake Owasso?



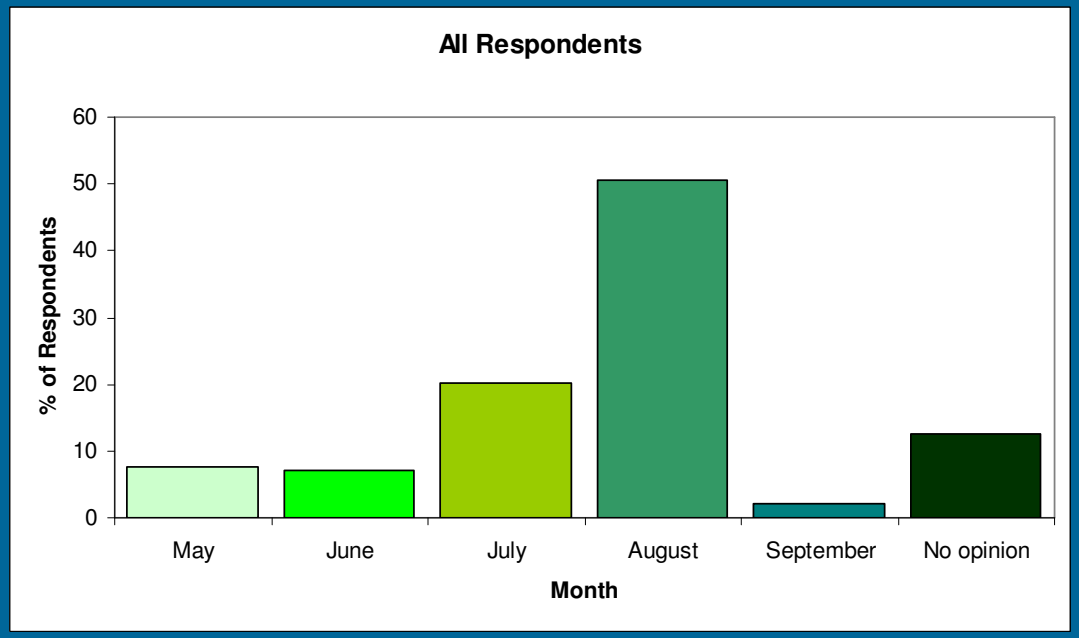
	Number of Respondents
Lakeshore or Deeded Access Resident	72
Non-Resident	14
TOTAL	86



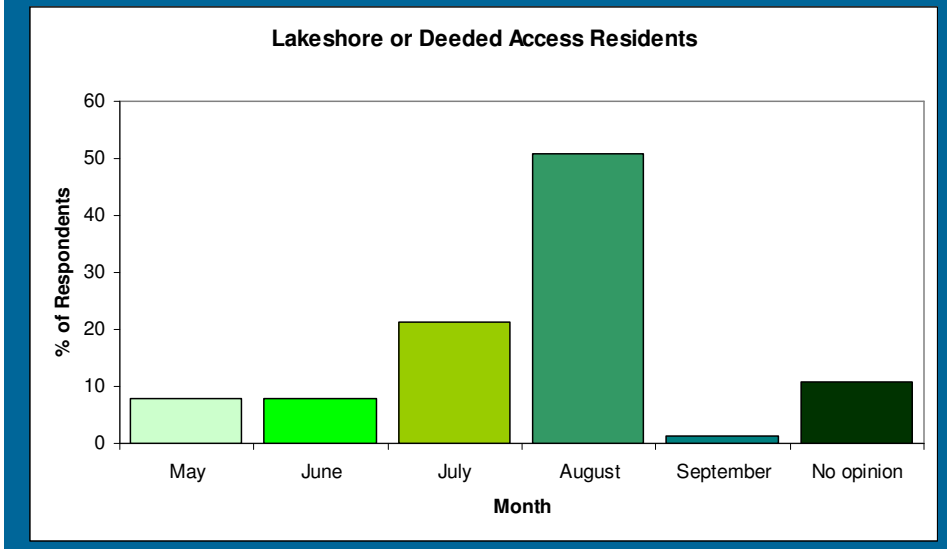


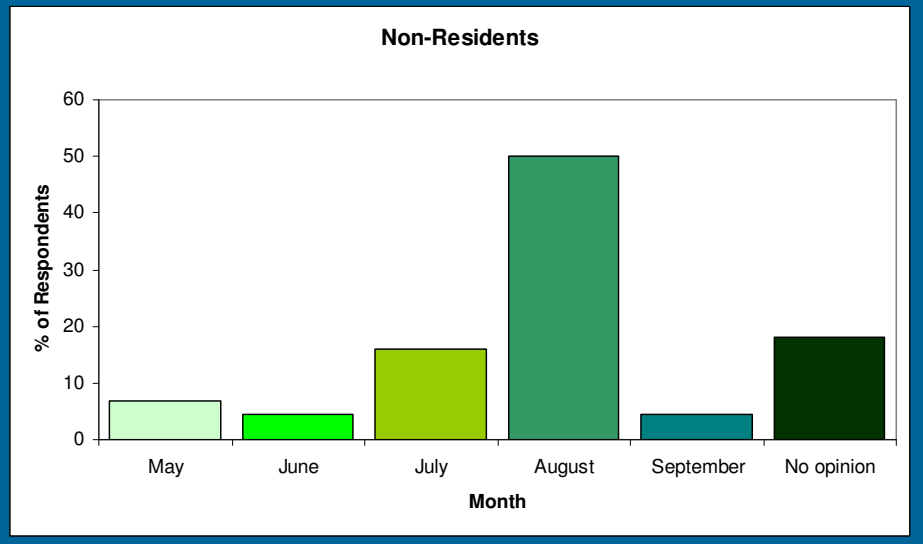
BARR

Q6: Which month does Lake Owasso have the worst water clarity?

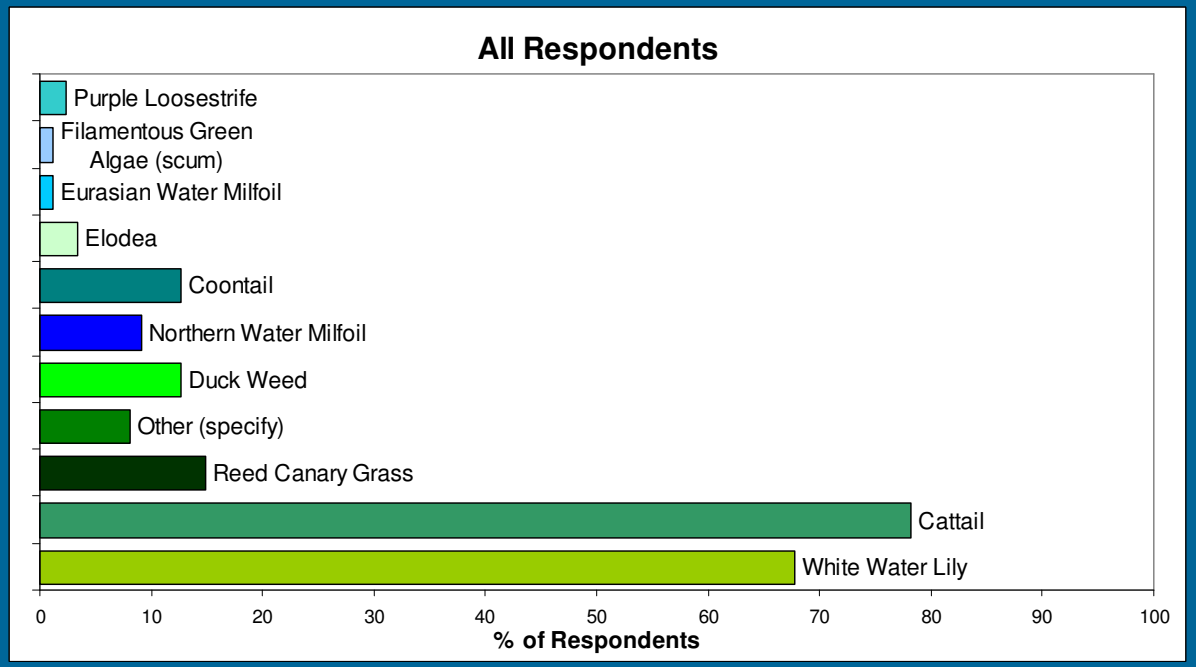


	Number of Respondents
Lakeshore or Deeded Access Resident	140
Non-Resident	44
TOTAL	184

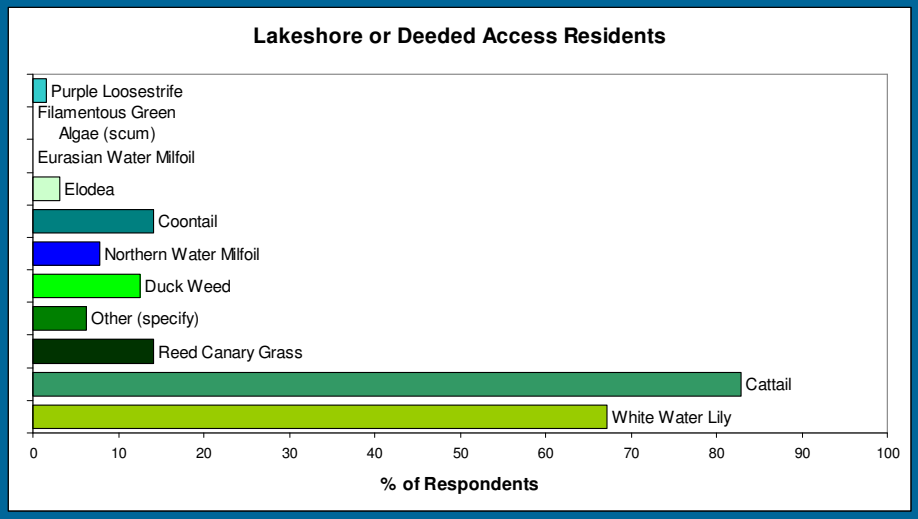


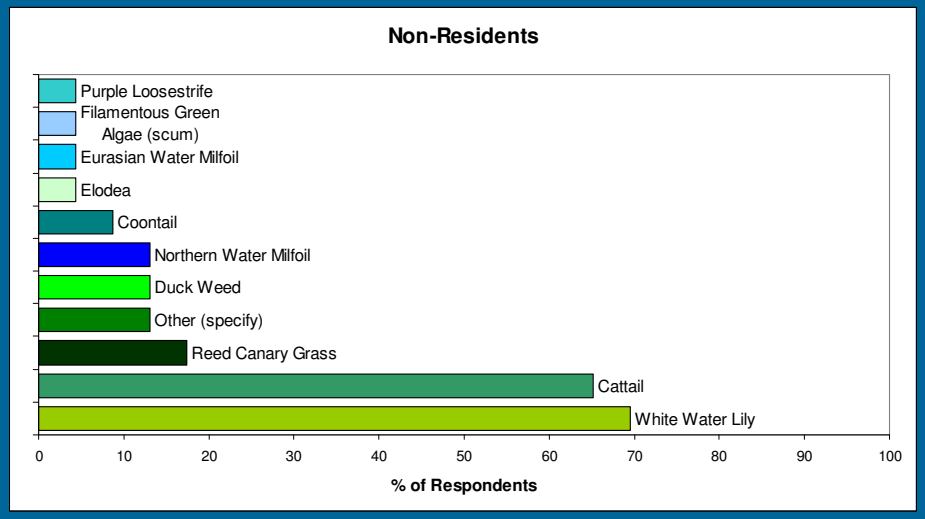


Q4a: Which plants are most beneficial to personal use of Lake Owasso?



	Number of Respondents
Lakeshore or Deeded Access Resident	64
Non-Resident	23
TOTAL	87

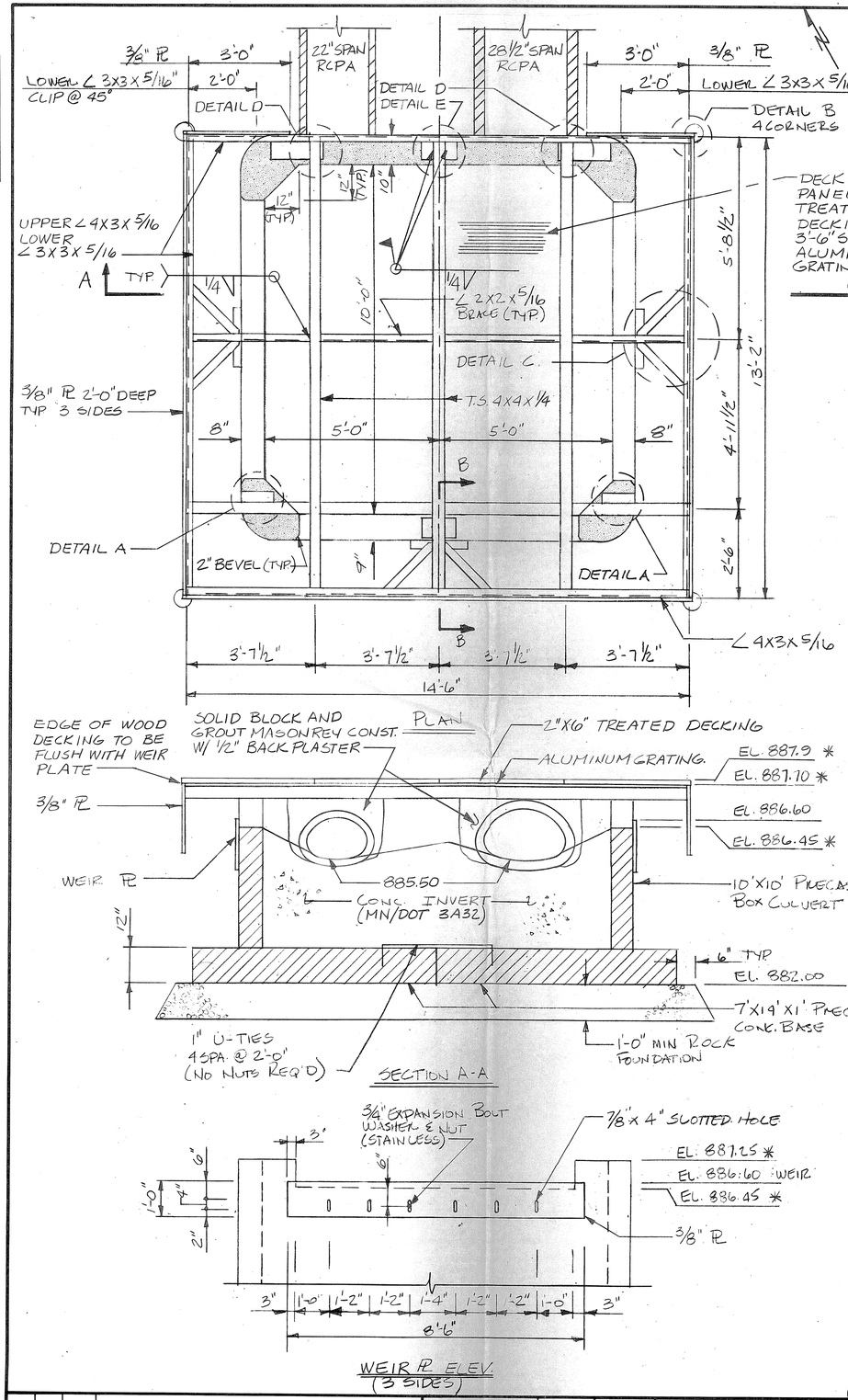




Appendix B

Lake Owasso Outlet Plans

BASE	OVERLAY	DRG. NO.



CONSTRUCTION NOTES

PRECAST CONCRETE BOX AND SLAB TO BE IN ACCORDANCE WITH MN/DOT 2412 AND SHALL BE REINFORCED BASED ON A 2' OVERFILL LOADING.

STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH MN/DOT 2471 AND 3306.
ALL STRUCTURAL STEEL TO BE CLEANED AND PAINTED AFTER FABRICATION IN ACCORDANCE WITH SECTION 258, PARAGRAPH 3.06 OF THE SPECIFICATIONS.

ALUMINUM GRATE SHALL BE IN ACCORDANCE WITH MN/DOT 2471 AND 3336. THE GRATE SHALL SUPPORT A LIVE LOAD OF 100 PSF WITH A DEFLECTION OF LESS THAN 1/4 INCH. FABRICATE GRATING FROM 1" MINIMUM BY 1/8" BEARING BARS AND CROSS BARS ON 4" CENTERS. HOLD DOWN BOLTS AND HARDWARE SHALL BE ALUMINUM AND STAINLESS STEEL DESIGNED TO FASTEN ENTIRE DECKING PANELS. FASTENERS SHALL BE APPROVED BY THE ENGINEER.

SPLICES AND FIELD WELDS NOT SHOWN IN THE DRAWING SHALL BE APPROVED BY THE ENGINEER. ANCHOR BOLTS SHALL BE IN ACCORDANCE WITH MN/DOT 3391.

** HOLES DRILLED IN ANGLE IRON TO BE DRILLED 1¼" FROM BOT. OF ANGLE TO ℄ OF HOLE.

* ELEVATION TOLERANCE ± 0.10' MAX.

ITEM "OUTLET STRUCTURE" INCLUDES PAYMENT FOR MATERIALS AND LABOR TO CONSTRUCT ALL ITEMS SHOWN ON THIS SHEET AND THE DECKING PANELS DETAILED ON SHEET 2.

NO.	BY	DATE	REVISIONS	ITEM	DESIGN	CHECKED

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota

Date _____ Reg No. 18789

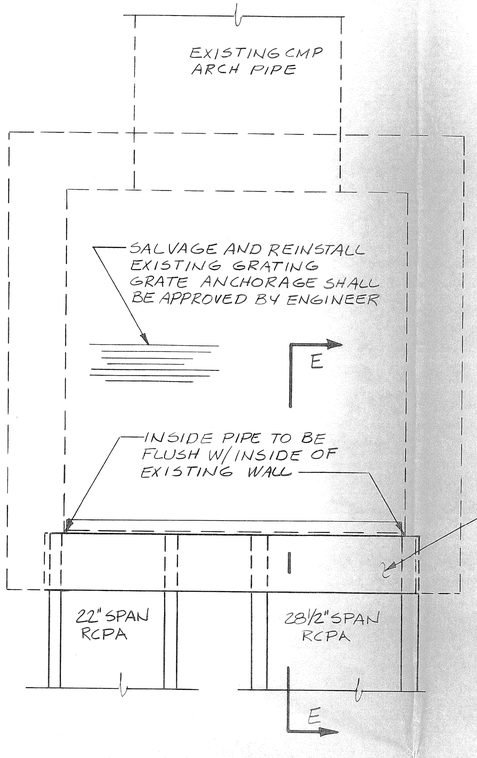
ENGINEERS ■ ARCHITECTS ■ PLANNERS

GRASS LAKE WATER MANAGEMENT ORGANIZATION

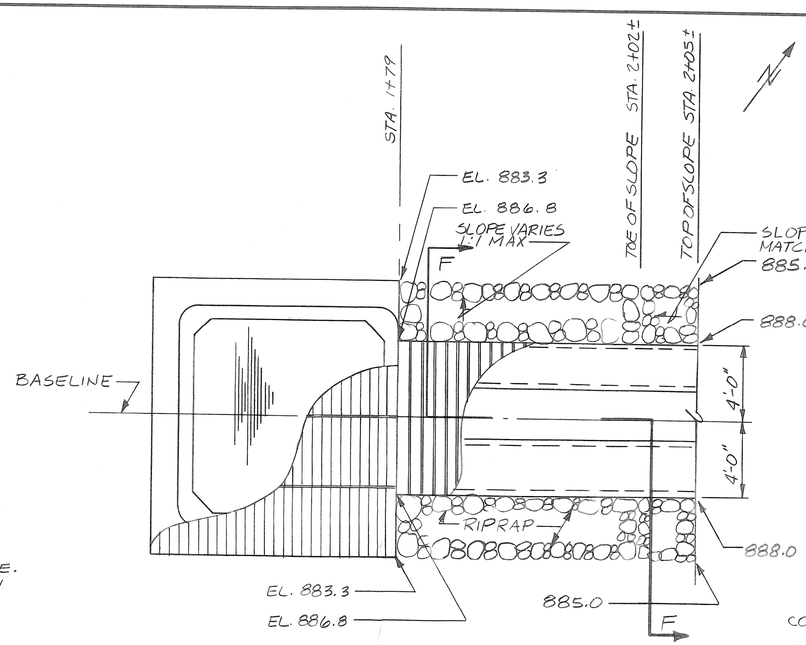
OUTLET STRUCTURE DETAILS

FILE NO. 90336 | DATE 8/7/90 | 2/5

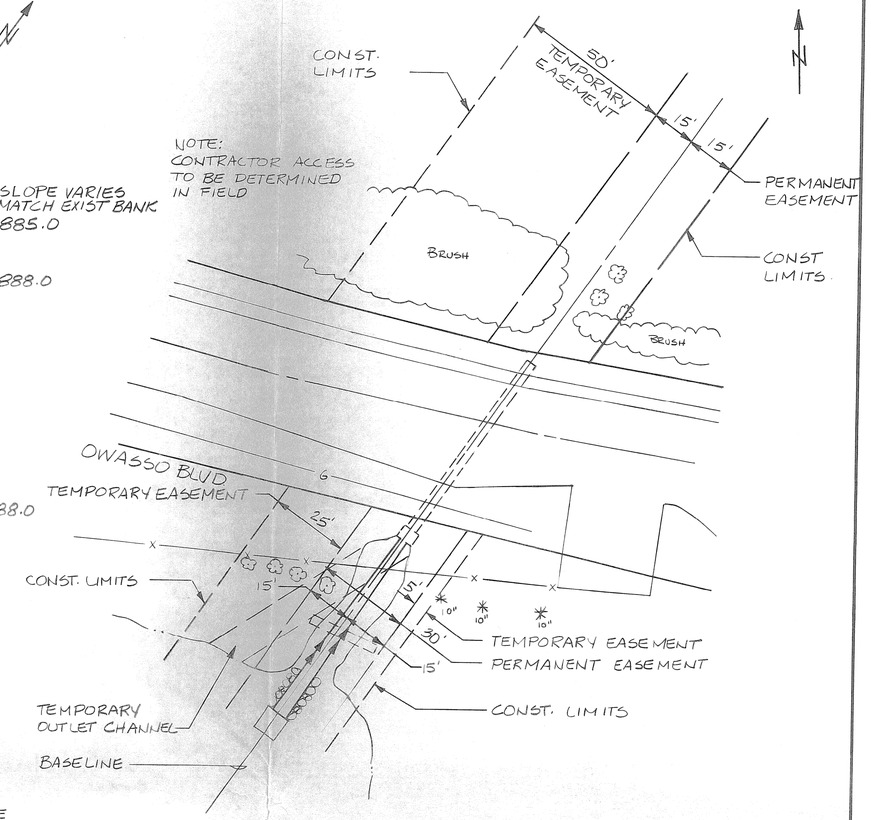
BASE	OVERLAY	DRG. NO.



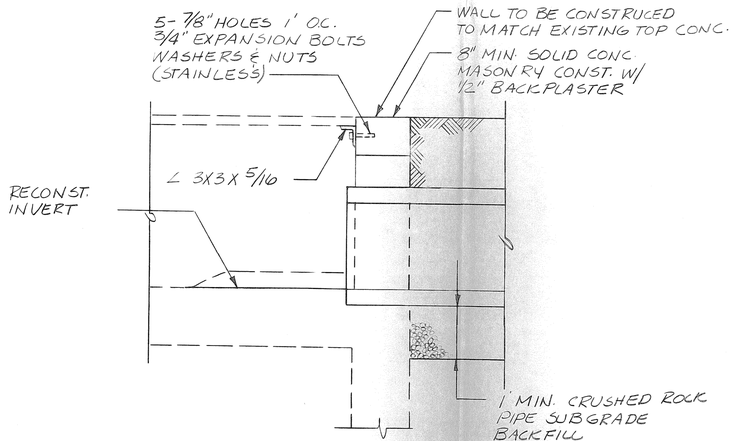
PLAN
(CONNECTION TO EXIST STRUCTURE)



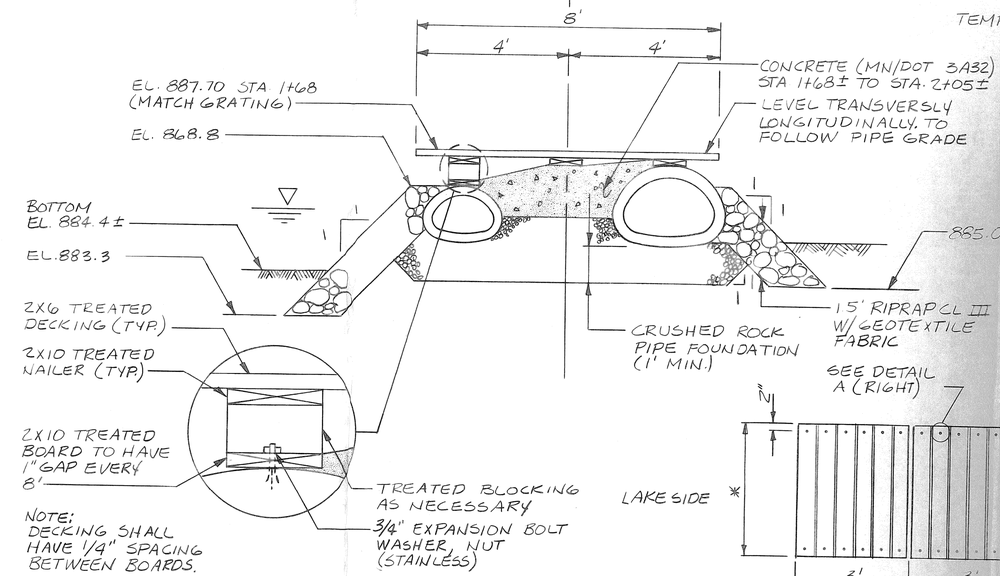
PLAN
NOTE: ELEVATIONS SHOWN IN THIS VIEW ARE RIPRAP ELEVATIONS.



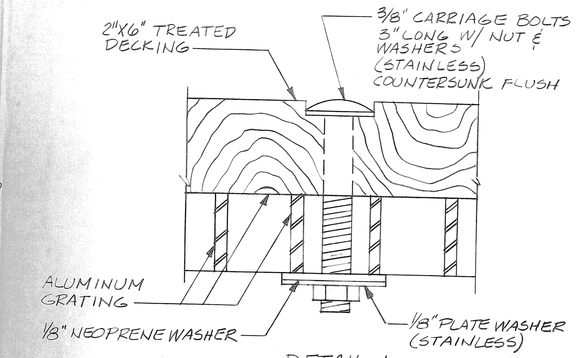
PLAN
TEMPORARY OUTLET CHANNEL & EASEMENTS



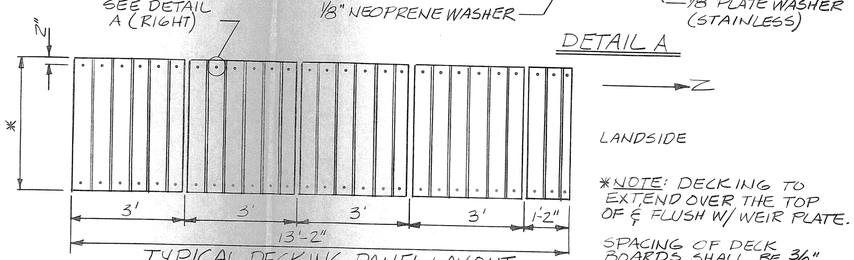
SECTION E-E



SECTION F-F



DETAIL A



TYPICAL DECKING PANEL LAYOUT

*NOTE: DECKING TO EXTEND OVER THE TOP OF & FLUSH W/ WEIR PLATE.

SPACING OF DECK BOARDS SHALL BE 3/8"

NO.	BY	DATE	REVISIONS	ITEM	DESIGN	CHECKED

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota

Date _____ Reg No. 18789

ENGINEERS ■ ARCHITECTS ■ PLANNERS

GRASS LAKE WATER MANAGEMENT ORGANIZATION

DETAILS

FILE NO. 90336

DATE 8/7/90

3/5

Appendix C

2007 Discharge Survey

Roseville Discharges to Lake Owasso

City-Owned Discharges	
ID	**Comments**
1	Outlet of Central Park Pond East
2	Discharge on West side of Bay
3	18 in RCP
8	18 in RCP
9	18 in CMP
13	12 in RCP
14	12 in RCP
15	12 in RCP
18	15 in RCP
19	15 in RCP
20	36 RCP
21	12 in CMP
24	18 in HDPE
32	18 in HDPE
33	12 in RCP
34	Outlet of Sed Ponds 1 & 2 Constructed in Oct 2006 along S. Owasso Blvd
Privately-Owned Discharges	
ID	**Comments**
4	4 in
5	6 in HDPE
6	4 in HDPE
7	12 in CMP
10	4 in
11	4 in PVC
12	12 in HDPE
16	6 in PVC
17	4 in HDPE
22	3 in
23	4 in PVC
25	6 in PVC
26	4 in HDPE
27	12 in CMP
28	4 in PVC
29	4 in PVC
30	15 in CMP
31	6 in PVC

Shoreview - Private Drains to Lake Owasso

ID37: 3137 Woodbrigde Street – 8” flexible plastic

NO PHOTO
ID36: 206 East Owasso Lane – 8” PVC

ID41: 212 East Owasso Lane – 2 – 6” flexible plastic

ID55: 454 West Horseshoe Drive – 4" flexible plastic

ID42: 458 West Horseshoe Drive – 4" PVC drains into 4" flexible plastic

ID43: 3320 Owasso Heights Road – 2 – 8” PVC pipes and 1 – 4” flexible plastic pipe

ID44: 3288 Owasso Heights Road – 4” flexible plastic pipe and 2” PVC

ID45: 3270 Owasso Heights Road – 2” PVC

ID46: 3240 Owasso Heights Road – 6” PVC and roof drain downspout

ID47: 3216/3212 West Owasso Blvd. – 3 – 8" flexible plastic pipes

ID54: 3212/3210 West Owasso Blvd. – 8" flexible plastic pipe

ID48: 3210/3206 West Owasso Blvd. – 4” flexible plastic pipe

ID49: 3198 West Owasso Blvd. – 2 – 4" flexible plastic pipes with some inlets in the yard

ID51: 3192 West Owasso Blvd. – 8” flexible plastic pipe

Shoreview City/County-Owned Outlets into Lake Owasso

ID36: 6-4-7 010 – Inlet at 206 Woodbridge Street

ID36: 6-4-7 011 – Outlet at 206 Woodbridge Street

ID38: 6-6-7 001 – Outlet for as-built 372. Owasso Blvd. N near Kent Street

ID53: 6-6-7 002 – As-built 441 toward lake

ID53: 6-6-7 003 – As-built 441 toward Owasso Blvd. N

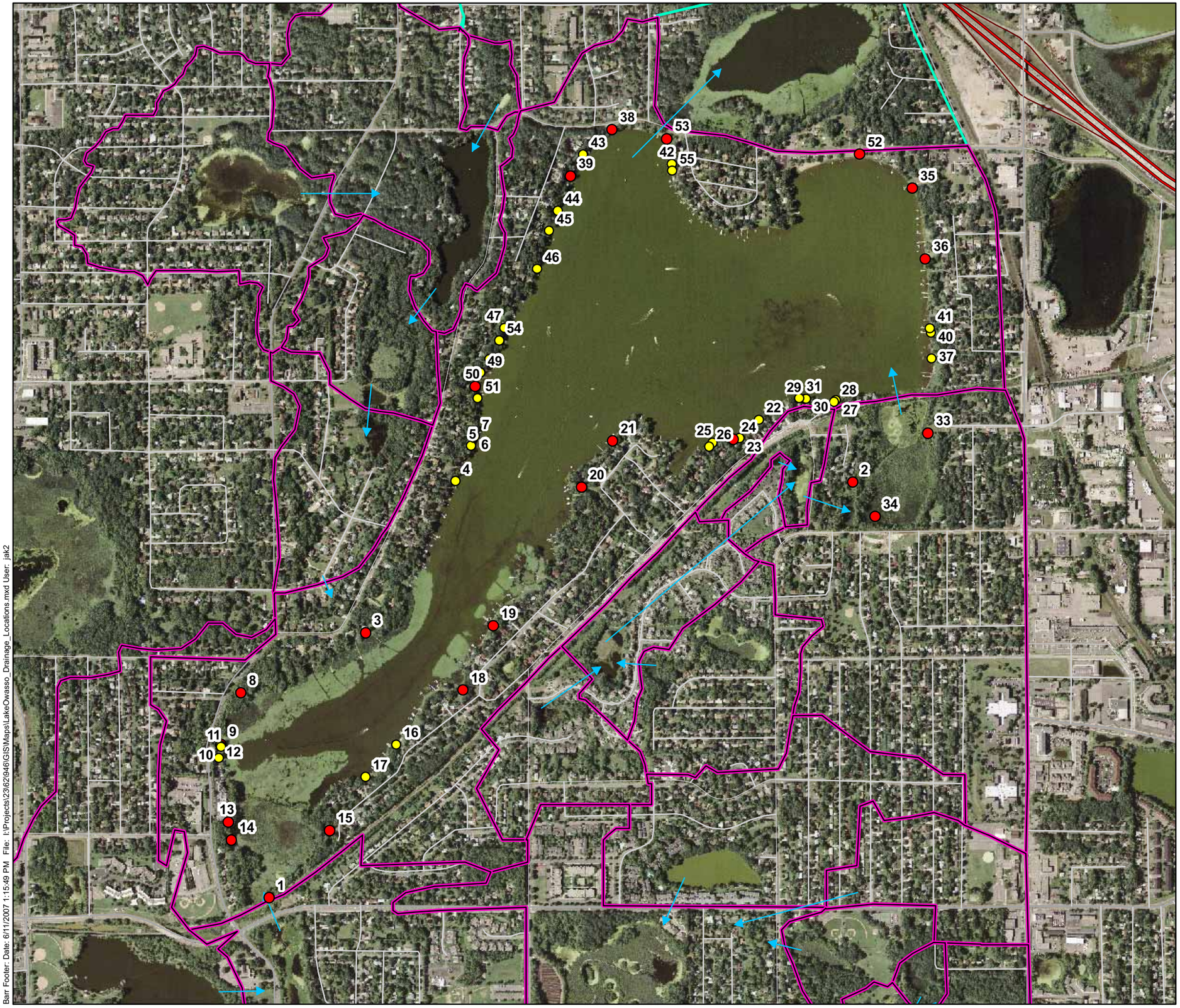
ID50: 6-6-7 004 – Drain from Owasso Blvd. N near 291. 12" CMP, plugged.

ID50: 6-6-7 005 – CB for picture 6-6-7 004

ID50: 3194 West Owasso Blvd. – 12" steel pipe (installed by either Ramsey County or the City many, many years ago. The pipe was capped at the road during a reconstruction project, so no water from the street drains through it. There are, however, a couple inlets and holes in the pipe that the water from the yard and driveways drain in to.)

ID35: 6-6-7 006 – Outlet from pond owned by Ramsey County, 210 Owasso Blvd. N

ID39: 3328/3320 Owasso Heights Road – 12" PVC (City owned. Will be converted to just an overflow during reconstruction of the road this summer. A 100,000 gallon storage tank, stormceptor and lift station will be installed to handle 80-90% of the storms, only the really heavy storms water will drain to the lake, but after the stoarage tank is filled.)



Barr Footer: Date: 6/11/2007 1:15:49 PM File: I:\Projects\23\62\946\GIS\Maps\LakeOwasso_Drainage_Locations.mxd User: jak2

Legend

Discharges

- City or County
- Resident
- Flow Direction

Watersheds

- Lake Owasso Subwatersheds
- Other GLWMO Watersheds

N

Feet

1,000 0 1,000

Discharge Locations

Lake Owasso UAA
Grass Lake Water Management Organization

Appendix D

2008 Pond Discharge Surveys

Lake Owasso Watershed - 2008 Pond Discharge Survey

Pond	Discharge Survey Date					
	5/7/2008	6/6/2008	6/17/2008	7/2/2008	7/18/2008	7/24/2008
Judy	N/A	N	Y	N	N	N
Emily	N/A	N	N	N	N	N
Charlie	N/A	Y	N	N	Y	Y
Willow	N/A	Y	Y	N	N	N
Bennett	Y	Y	Y	Y	Y	Y
Central Park - West	Y	Y	Y	Y	N	N
Central Park - East	Y	Y	Y	Y	N	N
Westwood Village	N/A	N	N	N	N	N
LO_LL_3	Y	N	N	N	N	N

Appendix E

P8/FLUX Model Parameters and Pond Data

Methodology for Watershed Water Quality Modeling (P8 and FLUX)

Phosphorus loadings to Lake Owasso were developed as part of the *Water Quality Management Alternatives: A Report for the Diagnostic-Feasibility Study of Lake Owasso, Lake Wabasso, and Snail Lake* (Barr, 1991). The watershed loads to Lake Owasso were simulated using the SWMM model. Both the water and phosphorus loads predicted by the SWMM model were not calibrated to actual monitoring data. Instead, water loads predicted by the model were checked against typical urban areal runoff water loads and typical urban watershed phosphorus loading rates were used to estimate the watershed phosphorus loads.

For this UAA, the Lake Owasso watershed was modeled using the P8 Urban Catchment Model (Program for Predicting Polluting Particle Passage thru Pits, Puddles, and Ponds), which is a model used for predicting the generation and transport of stormwater runoff and pollutants in urban watersheds. The model tracks the movement of particulate matter (fine sand, dust, soil particles, etc.) as it is carried along by stormwater runoff traveling over land and pavement. Particle deposition in ponds along the way is also tracked, so that the model can estimate the amount of pollutants—carried by the particles—that eventually reach a water body.

Two years (2007 and 2008) of runoff flow and water quality monitoring data were collected for the calibration of the current P8 water quality model. See Section 4.2 of the UAA for more information about the runoff monitoring data and calibration results. Additionally, to verify P8 phosphorus loads and to estimate internal phosphorus loads from waterbodies within the Lake Owasso watershed, the FLUX model was used (see Section 5.0 below).

1 Determination of Watershed Characteristics

Examination of the watershed characteristics for the Lake Owasso watershed involved evaluation of soil types, land use, and the impervious fraction of the land in the area

1.1 P8 Drainage Basins

The subwatershed delineations developed as part of the 1991 study, and as shown in the 2001 GLWMO *Watershed Management Plan*, were used as the base for the development of the P8 water quality model. These subwatershed divides were refined using 2-foot topographic information (obtained from the City of Roseville for both the Cities of Roseville and

Shoreview) and storm sewer data provided by each of the cities. The subwatersheds are shown in Figure 4-1 of the UAA, along with the locations of the Best Management Practices (BMPs) and other water bodies that were modeled in P8. The arrows in Figure 4-1 show the general drainage patterns within the Lake Owasso watershed.

1.2 Land Use – Existing Conditions

The existing (2006) land use used for the P8 model was developed using the existing (2001) and full-development (2020) land use information as included in the GLWMO *Watershed Management Plan*. The 2001 land use was updated based on comparison to a 2006 aerial photograph of the watershed. Because the Lake Owasso watershed is fully developed, there is very little change expected in the land use within the watershed.

The existing and full-development land use data include the following categories: commercial, developed park, high-density residential, highway, office/industrial, institutional, low-density residential, medium-density residential, natural/open space, railroad, and water/wetland. More information about the land use can be found in Section 3.2 of the UAA.

This land use information was used to estimate the total amount of impervious area within each subwatershed as well as the amount of directly-connected impervious area. The directly-connected impervious fraction consists of the impervious surfaces that are "connected" directly to stormwater conveyance systems, meaning that flows do not cross over pervious areas. The total impervious and directly-connected impervious percentages were based on a comparison of the existing land use coverage (2006) to the 2002 Metropolitan Council imperviousness coverage data for the Twin Cities Metropolitan Area. Table 1 summarizes the total percent impervious and the percent directly-connected impervious values used in the P8 model.

Table 1 Lake Owasso Watershed Impervious Assumptions by Land Use

Land Use	Total Percent Impervious[1]	Percent Directly-Connected Impervious
Natural/Park/Open	11	0
Low Density Residential	26	16
Medium Density Residential	43	20
High Density Residential	47	41
Institutional	52	36
Industrial/Office	64	56
Commercial	69	61
Highway	43	30
Railroad	22	0
Developed Park	20	0

1 - Percent Imperviousness based upon the Lake Owasso watershed existing land use and the 2002 Metropolitan Council Imperviousness Coverage data

1.3 Curve Numbers

The pervious curve number (a measure of how easily water can percolate into the soil) was also determined for each subwatershed within the Lake Owasso watershed. Data from the Ramsey County Digital Soils map (based on the NRCS soil survey) was used to determine the hydrologic soil group (HSG), which serves as an indicator of a soil's infiltration capacity. However, since both Roseville and Shoreview are older, fully-developed cities, soils throughout much of the area are typically classified as "undefined" or "urban" soils and have not been assigned a HSG. For areas where the HSG for is not classified in the soil survey, the HSG was assumed to be Type B, as the majority of the classified soils in the area were HSG Type B.

A pervious curve number was selected for each subwatershed based upon soil types, land use, and hydrologic conditions (e.g., if soils are Type B and pervious areas are comprised of grassed areas with 50% to 75% cover, then a Curve Number of 69 would be selected). An overall composite pervious curve number was determined by weighting the areas for the given soil groups within each drainage basin. This composite pervious curve number was then weighted with indirect (i.e., unconnected) impervious areas in each subwatershed as follows:

$$WCN = \frac{[(Indirect\ Impervious\ Area] * (98)] + [(Pervious\ Area) * (Pervious\ Curve\ Number)]}{(Indirect\ Impervious\ Area + Pervious\ Area)}$$

2 Drainage Patterns

The stormwater management system within the Lake Owasso watershed is a complex network of storm sewer, natural lakes, wetlands, and channels, as well as stormwater basins. To assist in identifying the drainage patterns within the district, the Lake Owasso watershed has been summarized into drainage districts based on outfall location and color coded accordingly (see Figure 5-9 and Section 5-4 of the UAA). Flow arrows show the general pattern of drainage in the watershed.

3 Pollutant Removal Device Information

The P8 water quality model can predict pollutant removal efficiency for a variety of treatment practices such as detention ponds and infiltration basins. The model can also be used to simulate pollutant removal from alternative BMPs such as underground treatment devices. The modeled treatment practices are referred to in the P8 model as pollutant removal 'devices'.

3.1 Ponds

Water quality ponds (also called detention ponds, stormwater ponds) are located throughout the Lake Owasso watershed. The "dead" storage volume (storage below the normal water level) is an important factor in the pollutant removal efficiency of water quality ponds. As such, it is important to represent this volume as accurately as possible. Digital two-foot topographic data, as-built development plans, and inputs into the original SWMM model were used to develop the storage volumes for the ponds being modeled in P8. Additionally, information from modeling performed for the development of the City of Roseville *Surface Water Management Plan* (as obtained for the 1991 study) was used for ponds that were not modeled as part of the 1991 study.

Information on the pond outlet configurations were obtained from the as-built development plans as well as the original SWMM model of the Lake Owasso watershed. Because P8 has a limited capacity to model complex outlet structures, outlet rating curves were developed based on the XP-SWMM model results for select outlet structures.

3.2 Infiltration Basins

Several infiltration basins/rainwater gardens have been constructed in the Lake Owasso watershed and were modeled in P8, including the rain gardens located near the intersection of South Owasso Boulevard and Galtier Street. The infiltration basins were modeled as detention pond 'devices', with an assumed infiltration rate of 0.0064 inches/hour, based on the predominance of Type D soils within the area.

3.3 Underground Stormwater Treatment Structures

Underground stormwater treatment structures are proprietary treatment devices often used when site constraints prevent the construction of conventional BMPs such as ponds or infiltration basins. There are several underground treatment structures have been installed throughout the Lake Owasso watershed. These include 3 proprietary treatment devices and an underground storage vault system. The proprietary treatment devices are located in the following subwatersheds: Dschg36, Dschg18, and LO_W_2a (installed September 2007). The underground storage vault is located along Owasso Heights Road in subwatershed Dschg50 (installed in the summer 2007).

4 P8 Model Parameters

The P8 model requires a variety of inputs beyond the watershed characteristics and pollutant removal device (ponds, etc.) characteristics. P8 also requires hourly precipitation and temperature data for either a single storm event or for a long-term climatic period. Additionally, pollutant characteristic information is needed. This pollutant and particle information is typically based on national average information unless more local data is available; however, because stormwater runoff flow and water quality data were available, the pollutant and particle parameters could be calibrated to actual data.

The parameters selected for the P8 model are discussed in the following paragraphs. P8 parameters not discussed in the following paragraphs were left at the default setting. As mentioned previously, Version 2.4 of the P8 model was used for this study.

4.1 Precipitation and Temperature Data

P8 reads hourly precipitation and daily average temperature data from a data file for a continuous simulation of watershed hydrology and the buildup/washoff of water quality constituents. For model calibration, a continuous hourly precipitation file was developed based on data from the National Weather Service (NWS) Downtown Saint Paul Airport

station for 2006 through 2008 and from the NWS Minneapolis-St. Paul International Airport station for years prior to 2006. Local daily precipitation data from the Minnesota High Density Network of rain gages (Vadnais) and results of the model calibration process were used to augment the observed hourly data from the Downtown Saint Paul Airport and Minneapolis-St. Paul International Airport NWS stations. Daily temperature data was obtained from the NWS station at the Minneapolis-St. Paul International Airport station.

- **9408Bm2.PCP.** The precipitation file is comprised of hourly precipitation measured at the Downtown St. Paul Airport and Minneapolis–St. Paul International Airport were used for the period between 1994 and the end of October 2008. Again, this data was adjusted based on local daily precipitation data.

- **MSP4908.tmp**. The temperature file was comprised of daily average temperature data from the Minneapolis–St. Paul International Airport during the period from 1949 through 2008.

4.2Time Step, Snowmelt, Runoff, & Evapotranspiration Parameters

- **Time Steps Per Hour (Integer)—** 15. Selection was based upon the number of time steps required to eliminate continuity errors greater than 5 percent. There are a few devices with continuity errors slightly higher than 5 percent. However, the volumes associated with those devices are insignificant when compared to the overall water load to Lake Owasso and therefore have been assumed to be okay.

- **Growing Season AMC—II = 1.4 and AMC—III = 2.1**. These parameters are the default parameters of P8.

- **Non-growing Season AMC—II = 0.5 and AMC—III = 1.1**. These parameters are the default parameters of P8.

- **Evapotranspiration Parameters** – Vegetative Cover Factor: Because an aquifer device was included in the P8 model to simulated base flow (see Section 4.4 below). To simulate some loss of percolation to evapotranspiration and to calibrate the predicted baseflow to observed flows, the vegetative cover factor was adjusted to increase losses from the aquifer. Table 2 summarizes the monthly vegetative cover factors selected for the P8 model.

Table 2 Estimated Vegetative Cover Factors for Evapotranspiration Estimates

Month	Vegetative Cover Factor
January	1
February	1
March	1
April	1
May	1.25
June	2
July	2
August	2.5
September	2.5
October	2.5
November	2.5
December	1

4.3 Particle File Selection

- **LkOwasso.PAR.** The LkOwasso.par file was developed based on the calibration to the 2007 stormwater runoff water quality data at the Galtier Street monitoring station. Table 3 summarizes the LkOwasso.par components.

Table 3 TSS & TP Calibration Results (LkOwasso.par)

Parameter Adjusted	Calibrated Value
Accumulation Rate (lb/ac/day) (P10%-P50%/P80%)	1.6 / 2.8
Accumulation Decay Rate (1/day)	0.35
Impervious Runoff Coefficient	5
Impervious Runoff Exponent	3
Pervious Runoff Concentration (mg/L) (P10%-P50%/P80%)	50
Pervious Runoff Exponent	1
TP P0% Particle Composition (mg TP/kg TSS)	99000
TP P10%-P80% Particle Composition (mg TP/kg TSS)	3850
TSS Scale Factor	1
TP Scale Factor	0.7

4.4 Devices Parameter Selection

- **Detention Pond— Permanent Pool— Area and Volume—** The surface area and dead storage volume of each detention pond were determined. Where available, Barr used outlet stage-discharge relationships or other rating information and pond volume information developed for the original SWMM modeling or from as-built development plans. If limited information was supplied, Barr assumed an average depth and estimated the surface area (based on digital two-foot topography) to determine the pond permanent pool volume.

- **Detention Pond— Flood Pool— Area and Volume—** The surface area and storage volume under flood conditions (i.e., the storage volume between the normal level and flood elevation) were determined. The areas and volumes were estimated based on information from the original SWMM modeling, digital two-foot topography, or as-built development plans).

- **Infiltration Rate (in/hr)—** Infiltration rates were only entered for infiltration basins and a select number of other devices. For some of the major water bodies and wetlands, infiltration rates were added to calibrate the P8 predicted discharge to flow monitoring data, lake level data, or discharge observation data. Appendix E includes a table summarizing the P8 device information, including the infiltration rate applied.

- **Detention Pond—** Orifice Diameter and Weir Length— The orifice diameter or weir length was determined from inputs to the original SWMM model or as-built development plans for each detention pond.

- **Detention Pond or Generalized Device—** Particle Removal Scale Factor— Particle Removal Scale Factor— 0.3 for all ponds less than 2 feet deep and 1.0 for ponds 3 feet deep or greater. For ponds with normal water depths between 2 and 3 feet, a particle removal factor of 0.6 was selected. Appendix E also includes a table summarizing the P8 device information, including the Particle Scale Removal factor.

- **Pipe/Manhole—** Several pipes were used in the Lake Owasso P8 model. All pipe devices used in the P8 model were used to track flows and pollutant loads at specific locations for calibration or to combine discharges from several locations to use as inputs into the Lake Owasso in-lake water quality model.

- **Aquifer –** Time of Concentration – The 2008 runoff flow monitoring data from the West Owasso Boulvard monitoring site indicated that there was a small amount of baseflow passing through the system between storm events. To simulate this baseflow condition, an aquifer device was used to direct percolation flows from the

watershed into Charlie Pond (in subwatershed LO_W_1c). A time of concentration of 10,000 hours resulted in the baseflow magnitude and timing similar to what was observed in the 2008 monitoring data.

4.5 Watersheds Parameter Selection

- **Pervious Curve Number**— An overall composite pervious curve number was determined by weighting the areas for the given soil groups within each subwatershed This composite pervious curve number was then weighted based on the indirect (i.e., unconnected) impervious areas in each drainage basin, based on the assigned land use type, as outlined in Section 1.3.

- **Connected Impervious Fraction—**The direct or connected impervious fraction for each subwatershed was determined. Connectivity estimation of the various impervious surface types was accomplished by associating each surface type with a land use category. See Section 1 above for additional information.

- **Swept/Not Swept—**An "Unswept" assumption was made for the entire impervious watershed area. A Sweeping Frequency of 0 was selected.

- **Depression Storage—** 0.06 inches for all subwatersheds, based on the runoff calibration to 2007 stormwater runoff flows at the Galtier Street monitoring station. See Section 4.2 of the UAA for additional information.

- **Impervious Runoff Coefficient**— 1 for all subwatersheds, based on the runoff calibration to 2007 stormwater runoff flows at the Galtier Street monitoring station. See Section 4.2 of the UAA for additional information.

4.6 Passes through the Storm File

- Passes through Storm File— The number of passes through the storm file was determined after the model had been developed and a preliminary run completed. The selection of the number of passes through the storm file was based upon the number required to achieve model stability. Multiple passes through the storm file were required because the model assumes that dead storage waters contain no pollutants. Consequently, the first pass through the storm file results in lower pollutant loading than occurs with subsequent passes. Stability occurs when subsequent passes do not result in a change in pollutant concentration in the pond waters. Five (5) passes through the storm file resulted in model stability for this model.

5 FLUX Modeling

FLUX is an interactive computer program designed for use in estimating the loadings of water quality components from tributary sampling. FLUX (Walker 1986) uses continuous flow records and parameter concentrations from sampled events to develop flow weighted mean concentrations and loading (in kg/yr) for sites where both flow and sample analysis data are available. FLUX uses six calculation techniques, based upon the flow/concentration relationship that is developed from the sample and flow record to calculate mass of pollutants and associated statistics. The program uses water quality information to estimate the mean (or total) loading that corresponds to flow record for the period of interest.

Uncertainty in the loading estimate is reflected by the reported coefficient of variation (CV) estimate. The CV equals the standard error of the mean loading divided by the mean loading. The CV reflects sampling error in the flow-weighted mean concentration. In practice, CV values <0.1 are usually adequate for use in mass-balance modeling, especially considering that uncertainty in flow measurements is usually in this range (Walker , 1996). The loading estimate that provides the minimum CV can usually be selected for use in budget development if: the sampling is representative, sample and total flows are equal within each stratum, residuals are independent of date and flow, and sample event data has been summarized.

FLUX was used at all the runoff monitoring stations including the County Road C (2008), Dale Street (2008), and West Owasso Boulevard (2007 & 2008) monitoring stations as well as the Galtier Street (2007) monitoring station which was originally used to calibrate the P8 watershed runoff volume and water quality parameters. The loads predicted by FLUX compared to the loads predicted by P8 were used to estimate the internal loading rates in the County Road C (Central Park – West wetland), Dale Street (Central Park – East wetland), and for the wetlands contributing to West Owasso Blvd. (Charlie Ponds).

Lake Owasso P8 Device Data

Device Name	P8 Device Number	Description	P8 Device Type	2007 Conditions Direct Watersheds	2008 Conditions Direct Watersheds	2007 DS Devices	2008 DS Devices	Bottom Elevation (feet MSL)	Bottom Area (ac)	Outlet Elevation (feet MSL)	Outlet Type	Overflow Elevation (feet MSL)	Perm Pool Area (ac)	Perm Pool Storage (acre-ft)	Flood Pool Area (ac)	Flood Pool Storage (ac-ft)	Outlet Rating Curve[1]	Infiltration Rate (in/hr)[2]	Particle Scale Removal Factor[3]
LO_S_13	1	Pond	Det Pond	LO_S_13	LO_S_13	7	7	912.0	0.00	915	18 inch RCP	919.2	0.9	1.4	2.7	9.7	NA	0	0.6
LO_S_11	2	Pond	Det Pond	LO_S_11	LO_S_11	7	7	898.0	2.30	901	12 inch FES	908.5	2.6	7.3	4.1	23.0	NA	0	0.6
LO_S_10	3	Pond	Det Pond	LO_S_10, LO_S_12	LO_S_10, LO_S_12	7	7	896.5	1.60	900.5/897.25	36 inch RCP Stand Pipe/24 inch RCP	903	1.9	7.1	2.1	3.0	NA	0	1
LO_S_9	4	Pond	Det Pond	LO_S_9	LO_S_9	7	7	898.0	1.30	900.5	12 inch RCP with a check valve	908.3	1.4	3.4	5.4	20.6	NA	0	0.6
LO_S_8	5	Willow Pond	General Device	LO_S_8	LO_S_8	7	7	901.1	0.00	904.5/907.5/ 900.75	Concrete/Woodplanks (10ft wide)/ 65 inch Span RCP arch	908.3	12.0	NA	14.6	NA	Yes	0.00177	1
LO_S_7	6	Bennett Lake & Frog Pond	General Device	LO_S_7, LO_S_6a	LO_S_7, LO_S_6a	9	9	879.0	0.00	887.66	24 inch RCP with Gate Valve downstream	890	32.4	NA	42.6	NA	Yes	0.0031	1
LO_S_6b	8	Pond	Det Pond	LO_S_6b	LO_S_6b	7	7	885.0	1.55	888	18 inch RCP	893.5	1.7	4.9	3.5	14.6	NA	0	0.6
LO_S_1	9	Central Park West - Wetland (County Road C)	General Device	LO_S_1	LO_S_1	39	39	881.5	0.00	885.64	60 inch x 65 inch concrete box to 48 in CMP under RR	891.7	11.6	NA	36.0	NA	Yes	0.00255	1
LO_S_2a	10	Central Park East - Pond/Wetland (Dale Street)	Det Pond	LO_S_2a, LO_S_4	LO_S_2a, LO_S_4	9	9	885.0	0.00	887.13	24 inch CMP	891.7	20.3	19.9	44.2	177.7	NA	0.00047	0.6
LO_S_2b	11	Pond	Det Pond	LO_S_2b	LO_S_2b	10	10	949.5	2.10	952	21 inch RCP	957	2.3	5.5	3.3	14.3	NA	0.00	0.6
LO_S_2c	12	Pond	Det Pond	LO_S_2c	LO_S_2c	10	10	947.0	2.60	949.52	24 inch RCP	955	2.8	6.7	5.0	22.1	NA	0.00	0.6
LO_S_3a	13	Pond	General Device	LO_S_3a	LO_S_3a	10	10	948.0	4.30	948	Beehive to 27 inch RCP	950	6.4	NA	11.1	NA	Yes	0.00	0.3
LO_S_3b	14	Pond	Det Pond	LO_S_3b	LO_S_3b	10	10	923.8	1.90	923.82	18 inch RCP	928	1.9	0.0	3.3	11.1	NA	0.00	0.3
LO_S_5	15	Westwood Village Pond	General Device	LO_S_5	LO_S_5	10	10	895.2	0.00	899.84	24 inch RCP	909	6.5	NA	9.5	75.0	Yes	0.00069	1
LO_W_1d	40	Charlie Pond d	Det Pond	LO_W_1d	LO_W_1d	16	16	898.9	0.00	898.92	15 inch HDPE	906	0.0	0.0	9.8	27.2	NA	0	0.3
LO_W_1a	16	Charlie Pond a	Det Pond	LO_W_1a	LO_W_1a	17	17	902.0	0.00	909	15 inch RCP	909	0.9	3.1	1.0	0.9	NA	0	1
LO_W_1b	17	Charlie Pond b	General Device	LO_W_1b	LO_W_1b	18	18	898.0	0.67	902/904	12 inch RCP to Weir Manhole (Bottom Elev = 900, 24 inch permanent weir with adjustable boards up to 904)	906	1.1	NA	1.4	NA	Yes	0	1
LO_W_1c	18	Charlie Pond c	General Device	LO_W_1c	LO_W_1c	43	43	889.0	0.00	894	12 inch pipe to Weir	906	1.5	3.8	3.8		Yes	0.00056	1
Dschg36	19	CDS Structure	Det Pond	Dschg36	Dschg36	43	43	882.7	0.00	892.3	24 inch RCP	898.4	0.0	0.0	0.0	0.0	NA	--	1
Dschg36_3	43	Flow Combination	Pipe	--	--	38	38	NA	NA	NA	24 inch RCP	NA	NA	NA	NA	NA	NA	--	
LO_W_2	20	Lake Emily	General Device	LO_W_2, LO_W_2a	LO_W_2	16	16	910.0	0.00	918/916.50	Weir to 30 inch Casing	928	14.0	NA	21.4 (at 924)	NA	Yes	0.002597	1
LO_W_2a	41	Stormceptor - Installed Fall 2007	Pipe (2007) / Det Pond (2008)	LO_W_2a	LO_W_2a	20	20	912.3	0.00	918.25	18 inch pipe	920.75	0.0	0.0	0.0	0.0	NA	--	1
Dschg50	44	Underground Detention Vault with force main - Began Operating Fall 2007	Pipe (2007) / General Device (2008)	Dschg50	Dschg50	38	16/ 38 Overflow	902.0	0.03	902.1	2 cfs capacity pumps	907.6	0.0	NA	0.0	NA	Yes	--	0.6
LO_W_4	22	Lake Judy	General Device	LO_W_4	LO_W_4	20	20	938.3	0.00	943.25/941.5	Sharp Crested weir to 18 inch RCP	???	16.9	NA	??	NA	Yes	0.00208	1
LO_W_3	23	Wetland/Pond - Landlocked	Det Pond	LO_W_3	LO_W_3	20	20	922.0	0.00	931	Landlocked	931	1.6	7.4	1.6	0.0	NA	0.1	1
Dschg23	24	Roseville Park Pond	Det Pond	Dschg23	Dschg23	38	38	884.1	0.00	886.1	18 inch	892	0.3	0.3	1.7	5.9	NA	0.0064	0.6
Dschg18	25	CDS Structure	General Device	Dschg18	Dschg18	38	38	881.2	0.00	887.61	18 inch HDPE	900.75	0.0	0.0	0.0	0.0	NA	--	1

Lake Owasso P8 Device Data

Device Name	P8 Device Number	Description	P8 Device Type	2007 Conditions Direct Watersheds	2008 Conditions Direct Watersheds	2007 DS Devices	2008 DS Devices	Bottom Elevation (feet MSL)	Bottom Area (ac)	Outlet Elevation (feet MSL)	Outlet Type	Overflow Elevation (feet MSL)	Perm Pool Area (ac)	Perm Pool Storage (acre-ft)	Flood Pool Area (ac)	Flood Pool Storage (ac-ft)	Outlet Rating Curve[1]	Infiltration Rate (in/hr)[2]	Particle Scale Removal Factor[3]
LO_LL_1	26	Wetland/Pond	General Device	LO_LL_1	LO_LL_1	27	27	876.8	0.00	879.3	48 inch Riser RCP to 15 inch RCP	890	1.1	NA	3.9	NA	Yes	0.00053	0.6
LO_LL_2a	27	Pond with Pumped Outlet	General Device	LO_LL_2a	LO_LL_2a	30	30	869.0	0.00	871/869	24 inch RCP/Lift Station (14in Force Main)	892	2.1	NA	7.6	NA	Yes	0.00053	0.3
LO_LL_2b	28	Wetland/Pond	General Device	LO_LL_2b	LO_LL_2b	27	27	881.7	0.00	882.7	48 inch Riser to 12 in RCP	888	0.5	NA	2.5	NA	Yes	0.00053	0.3
LO_LL_2c	29	Wetland/Pond	Det Pond	LO_LL_2c	LO_LL_2c	28	28	897.6	0.00	900.1	12 inch RCP	905.5	5.6	7.0	6.5	32.5	NA	0.0064	0.6
LO_LL_3	30	Wetland/Pond	General Device	LO_LL_3	LO_LL_3	36	36	887.8	0.00	889.8	24 inch x 24 inch weir with board in middle to a 24 inch pipe	895	2.1	NA	3.0	NA	Yes	0.00055	0.3
LO_LL_4	31	Wetland/Pond	Det Pond	LO_LL_4	LO_LL_4	30	30	900.0	0.00	910.23	12 inch RCP	910.23	0.2	0.8	0.2	0.8	NA	0.0064	1
LO_E_1c	32	Rain Garden	General Device	LO_E_1c	LO_E_1c	36	36	887.0	0.00	887	24 inch CMP	889	0.004	0.000	0.034	0.034	NA	0.00053	0.3
LO_E_1e	33	Rain Garden	Det Pond	LO_E_1e	LO_E_1e	36	36	888.0	0.10	888	12 inch CMP	890	0.1	0.0	0.3	0.4	NA	0.0064	0.3
LO_E_1f	21	Galtier Street Monitoring Station	Pipe	LO_E_1f	LO_E_1f	40	40	--	--	--	--	--	--	--	--	--	--	--	--
LO_E_1g	34	Rain Garden	Det Pond	LO_E_1g	LO_E_1g	36	36	886.5	0.01	887.34	22 inch Conc. Span	890	0.0	0.0	0.1	0.1	NA	0.0064	0.3
LO_E_1h	35	Sedimentation Pond	Det Pond	LO_E_1h	LO_E_1h	36	36	883.0	0.07	887	Channel/Weir	887	0.3	0.8	0.3	0.0	NA	0.0064	1
LO_E_1j	36	Sedimentation Pond	Det Pond	LO_E_1j, LO_E_1a, LO_E_1b, LO_E_1d	LO_E_1j, LO_E_1a, LO_E_1b, LO_E_1d	37	37	881.0	0.11	886	Channel/Weir	886.6	1.4	4.5	1.4	0.0	NA	0.0064	1
LO_E_1k	37	Lake Owasso Bay	Det Pond	LO_E_1k, LO_E_1i	LO_E_1k, LO_E_1i	38	38	883.0	0.00	886.1	Channel/Weir	888	4.9	7.5	18.6	29.9	NA	0.0064	1
Site 5403	39	Discharges to Site 5403	Pipe	Dschg27, Dschg29, Dschg30, Dschg34, Dschg35	Dschg27, Dschg29, Dschg30, Dschg34, Dschg35	42	42	--	--	--	--	--	--	--	--	--	--	--	--
Site 5401	38	Discharges to Site 5401	Pipe	Dschg1, Dschg2, Dschg3, Dschg21, Dschg22, Dschg42, Dschg52, LkOwasso	Dschg1, Dschg2, Dschg3, Dschg21, Dschg22, Dschg42, Dschg52, LkOwasso	42	42	--	--	--	--	--	--	--	--	--	--	--	--
LakeOwasso	42	Combines Flows and Loads from Sites 5403 and 5401	Pipe	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

1 - Rating curves required for General Devices
2 - Infiltration rates based on Rawls, et al. 1998 or based on calibration to actual monitoring data - For water bodies that area not infiltration basins or raingardens, infiltration was set to a very low rate to an elevation about 0.5 to 0.25 feet below the normal outlet elevation.
3 - Particle Scale Removal Factor based on the depth of the water body.

Appendix F

Lake Owasso 2007 and 2008 In-Lake and Stormwater Runoff Water Quality Data

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
2008														
5/5/2008	0.0	11.6	10.8	320	6.99	3.1	0.033	0.009	0.012	13.6	46	80	86	1.5
	1.0	11.7	10.7	321	7.21		0.033	0.009	0.009					
	2.0	11.6	10.3	320	7.26	2.8	0.035	0.009	0.014	15.8	48	81	84	
	3.0	11.4	10.3	320	7.28		0.039	0.009	0.009					
	4.0	11.2	10.3	319	7.34		0.035	0.009	0.010					
	5.0	11.2	10.0	320	7.38		0.033	0.009	0.009					
	6.0	10.6	9.7	320	7.35	2.6	0.044	0.009	0.009		48	80	87	
	7.0	10.5	9.7	319	7.29		0.035	0.009	0.009					
	8.0	10.4	9.6	319	7.25	3	0.030	0.009	0.011		51	82	86	
	9.0	9.9	9.5	320	7.19		0.032	0.009	0.009					
	10.0	9.8	9.4	319	7.16	2.8	0.029	0.009	0.009		46	78	88	
	10.7	5.1	9.1	323	6.86									
5/28/2008	0.0	16.6	9.0	365	7.55	1	0.024	0.009	0.011	1.8	56	82	86	4.7
	1.0	16.6	9.2	364	7.79	2.1	0.028	0.009	0.011					
	2.0	16.6	8.9	364	7.82	1	0.033	0.009	0.011	2.2	55	82	86	
	3.0	16.6	8.9	364	7.84	1.6	0.024	0.009	0.011					
	4.0	16.6	8.8	364	7.85	2.2	0.026	0.009	0.011					
	5.0	16.4	8.5	364	7.82	1.6	0.021	0.009	0.011					
	6.0	15.1	7.0	362	7.59	0.9	0.025	0.009	0.013					
	7.0	12.9	4.6	360	7.33	1.6	0.031	0.012	0.018		60	82	86	
	8.0	10.8	0.6	362	7.08	1.6	0.043	0.019	0.024					
	9.0	10.0	0.2	363	6.93									
	9.6					2.8	0.080	0.032	0.032		60	86.4	86	
	10	9.7	0.3	364	6.86									
	10.3	9.6	0.2	385	6.53									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
6/18/2008	0.0	10.9	21.8	350	8.49	4.4	0.022	0.009	0.010	10.2	52	82	86	2.5
	1.0	11.4	21.6	350	8.56	3.9	0.023	0.009	0.010					
	2.0	11.1	21.0	349	8.58	4.3	0.033	0.009	0.014	13.6		80	88	
	3.0	10.7	20.8	349	8.51	4.1	0.025	0.009	0.010		58			
	4.0	9.7	20.3	350	8.38	2.8	0.026	0.009	0.011					
	5.0	9.0	20.1	350	8.24	2.4	0.023	0.009	0.012					
	6.0	7.0	19.1	351	7.96	1.3	0.023	0.009	0.010					
	7.0	3.5	16.5	351	7.63	1.4	0.019	0.009	0.012		53	82	86	
	8.0	0.4	14.1	353	7.32	1.4	0.054	0.023	0.027					
	9.0	0.2	11.6	354	7.18									
	9.5					1.8	0.202	0.068	0.070		54	90	90	
	10.0	0.2	10.4	362	6.86									
	10.2	0.2	10.4	370	6.69									
7/7/2008	0.0	9.1	25.7	359	8.26	4.4	0.032	0.009	0.009	13.2	56	86	90	1.5
	1.0	9.1	25.7	359	8.31	5.8	0.034	0.009	0.010					
	2.0	9.0	25.7	359	8.32	5.8	0.037	0.009	0.010	11.8	56	86	91	
	3.0	7.7	24.5	358	8.18	5	0.042	0.014	0.009					
	4.0	6.6	24.1	357	7.97	3.6	0.027	0.009	0.012					
	5.0	5.7	23.5	356	7.8	2.9	0.033	0.009	0.009		55	85	88	
	6.0	0.6	20.1	346	7.53	2.1	0.028	0.009	0.010		55	84	88	
	7.0	0.3	16.0	347	7.33	2.1	0.048	0.012	0.021					
	8.0	0.3	12.9	349	7.09	2.2	0.080	0.031	0.038		50	88	92	
	9.0	0.3	11.4	356	6.9									
	9.8					6.8	0.288	0.047	0.054		50	93	96	
	10.0	0.2	10.9	361	6.75									
	10.5	0.2	10.9	370	6.54									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
7/28/2008	0.0	9.5	26.9	365	8.42	4.0	0.043	0.009	0.009	12.5	61	86	90	1.6
	1.0	9.6	26.7	364	8.45	4.3	0.037	0.009	0.009					
	2.0	9.8	26.3	364	8.48	4.1	0.033	0.009	0.009	12.8	63	84	91	
	3.0	9.7	26.2	364	8.48	4.6	0.032	0.009	0.009					
	4.0	3.5	24.4	365	7.88	3.5	0.035	0.009	0.009		64	86	90	
	5.0	0.4	23.2	363	7.5	2.6	0.039	0.009	0.009					
	6.0	0.2	20.1	359	7.29	1.8	0.023	0.009	0.009		61	88	90	
	7.0	0.1	17.3	354	7.06	2.3	0.031	0.009	0.010					
	8.0	0.1	14.6	356	6.82	3.0	0.084	0.034	0.038					
	9.0	0.1	12.6	363	6.62	6.3	0.273	0.063	0.070		60	97	94	
	9.2													
	9.9	0.1	12.1	378	6.34									
8/20/2008	0.0	11.7	26.3	368	8.18	9.4	0.031	0.009	0.010	25.9	63	88	96	0.8
	1.0	11.8	26.3	368	8.31		0.032	0.009	0.009					
	2.0	11.5	26.2	368	8.3	9.2	0.029	0.009	0.009	24.5	63	93	107	
	3.0	11.1	25.9	368	8.3		0.028	0.009	0.012					
	4.0	6.1	24.2	370	7.76		0.025	0.009	0.009					
	5.0	1.9	23.1	368	7.29	1.7	0.021	0.009	0.009		65	94	115	
	6.0	0.6	20.6	366	7.09		0.023	0.009	0.009					
	7.0	0.2	18.1	365	6.81	3.5	0.063	0.022	0.003		66	97	95	
	8.0	0.1	15.3	360	6.52		0.075	0.031	0.037					
	9.0	0.1	12.7	374	6.28									
	9.5					9.9	0.297	0.056	0.072		57	106	108	
	10.2	0.1	12.3	391	6.04									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
9/8/2008	0.0	7.3	19.5	367	6.51	3.4	0.032	0.009	0.009	16.7	67	96	94	1.5
	1.0	7.3	19.5	367	6.8	3.6	0.038	0.009	0.009					
	2.0	7.3	19.5	367	6.9	3.6	0.032	0.009	0.009	16.2	66	93	100	
	3.0	7.3	19.5	367	6.96	3.8	0.028	0.009	0.009					
	4.0	7.3	19.5	367	7.02	3.8	0.030	0.009	0.009					
	5.0	7.2	19.5	367	7.05	3.7	0.027	0.009	0.009		64	90	93	
	6.0	6.1	19.1	367	6.99	3.3	0.029	0.009	0.009					
	7.0	6.8	18.9	367	7	3.2	0.040	0.009	0.009		65	90	102	
	8.0	0.9	18.3	367	6.84									
	8.7					18.0	0.163	0.029	0.037		65	95	100	
	9.0	0.3	13.4	382	6.45									
	9.4	0.3	13.0	398	6.22									
9/30/2008	0.0	7.8	18.1	376	7.03	3.6	0.022	0.009	0.009	11.0	59	90	91	1.8
	1.0	7.9	18.1	376	7.09	3.6	0.028	0.009	0.009					
	2.0	8.0	17.9	376	7.13	3.8	0.024	0.009	0.009	15.3	51	92	95	
	3.0	7.9	17.8	376	7.17	3.5	0.025	0.009	0.009					
	4.0	7.8	17.8	376	7.19	3.4	0.023	0.009	0.009					
	5.0	7.8	17.8	376	7.2	3.5	0.023	0.009	0.009					
	6.0	7.5	17.7	376	7.2	3.9	0.023	0.009	0.009		51	92	93	
	7.0	6.8	17.2	378	7.15	3.4	0.036	0.009	0.009					
	8.0	6.6	17.2	378	7.11	3.2	0.035	0.009	0.009					
	9.0	4.3	16.9	380	6.99									
	9.2					3.6	0.040	0.009	0.009		60	92	94	
	10.0	0.6	15.3	413	6.42									
	10.1	0.4	15.0	423	6.23									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
2007														
3/29/07	0.0	9.6	6.5	330	6.76		0.063	0.009	0.062	4.4	52	88	92	2.9
	1.0	9.6	6.5	329	6.71		0.075	0.009	0.029					
	2.0	9.6	6.5	329	6.64		0.068	0.009	0.025	4.4				
	3.0	9.6	6.5	329	6.61		0.061	0.009	0.024		52	88	90	
	4.0	9.6	6.5	329	6.62		0.054	0.009	0.025					
	5.0	9.5	6.5	329	6.62		0.054	0.009	0.032					
	6.0	9.5	6.5	330	6.62		0.067	0.009	0.033					
	7.0	9.4	6.4	331	6.61		0.058	0.009	0.030					
	8.0	9.5	6.4	330	6.65		0.057	0.009	0.029		50	88	90	
	9.0	9.3	6.4	330	6.66									
	9.8						0.058	0.009	0.029					
	10.0	9.3	6.3	332	6.67									
	10.7	7.1	6.1	336	6.54									
5/2/07	0.0	9.8	16.0	340	7.12	1.8	0.024	0.009	0.013	1.6	54	84	90	5.1
	1.0	10.0	16.0	340	7.04		0.025	0.009	0.013					
	2.0	9.8	15.9	340	7.07	1.7	0.028	0.009	0.012	1.4	54	82	88	
	3.0	9.8	15.8	340			0.022	0.009	0.012					
	4.0	9.7	15.4	340	7.10		0.021	0.009	0.011					
	5.0	9.1	13.8	340			0.022	0.009	0.011					
	6.0	7.4	12.6	339	7.14	1.6	0.030	0.011	0.010		54	82	86	
	7.0	6.1	10.4	339			0.024	0.009	0.009					
	8.0	5.2	7.5	339			0.044	0.009	0.012					
	9.0	3.7	6.9	336	7.11	3.4	0.061	0.012	0.018		52	86	88	
	9.6					3.0	0.069	0.012	0.017					
	10.0	3.4	6.8	338										
	10.5	0.9	6.8	346										

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
5/30/07	0.0	10.3	20.1	338	9.21	2.0	0.030	0.009		6.7	55	82	84	3.2
	1.0	10.2	20.1	338	9.21	1.6	0.023	0.009				82		
	2.0	10.2	20.1	338	9.21	1.6	0.030	0.009		5.6		82	84	
	3.0	10.3	19.9	338	9.21	1.7	0.024	0.009						
	4.0	10.3	19.7	337	9.22	1.8	0.028	0.009			55	82		
	5.0	10.2	19.4	339	9.16	1.7	0.019	0.009						
	6.0	9.8	18.1	341	8.99	1.7	0.019	0.009				82	86	
	7.0	7.7	16.4	344	8.44	2.7	0.015	0.009						
	8.0	4.8	14.6	349	7.71									
	8.5					1.3	0.074	0.024			50	90	90	
	9.0	2.5	9.5	361	7.34									
	9.3	0.3	9.4	379	7.05									
6/19/07	0.0	8.2	23.9	345	8.21	3.2	0.040	0.009	0.015	14.7	55	84	88	1.9
	1.0	8.1	24.0	345	8.55	3.0	0.036	0.009	0.013					
	2.0	8.1	24.0	345	8.56	3.3	0.039	0.009	0.011	13.8				
	3.0	8.1	23.9	345	8.57	4.0	0.036	0.009	0.011					
	4.0	8.1	23.9	345	8.58	3.7	0.029	0.009	0.009			84	86	
	5.0	8.1	23.7	345	8.54	2.7	0.028	0.009	0.011		55			
	6.0	3.8	20.2	337	7.74	1.9	0.024	0.009	0.009		55			
	7.0	2.3	18.6	339	7.61	1.2	0.025	0.009	0.009			84	86	
	8.0	0.2	14.9	348	7.33									
	8.1					2.4	0.159	0.055	0.064		55	90	92	
	9.0	0.2	12.6	405	6.72									
	8.7	0.2	12.8	420	6.74									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

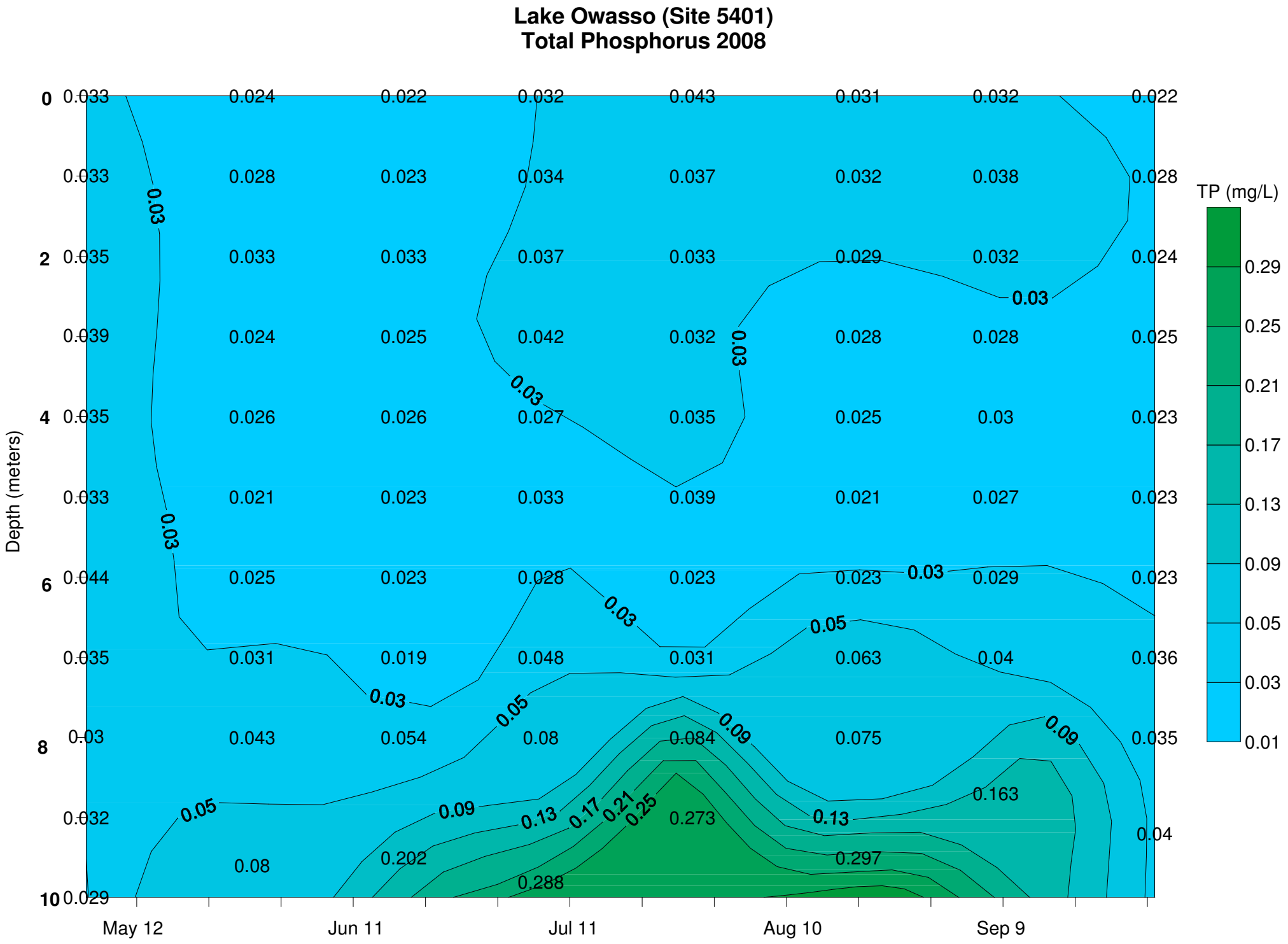
Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
7/5/07	0.0	10.6	25.2	373	8.26	4.6	0.032	0.011	0.012	23.4	55	86	90	1.3
	1.0	9.9	25.2	373	8.43	4.3	0.030	0.012	0.009					
	2.0	9.8	25.0	373	8.45	4.7	0.030	0.009	0.010	22.7	55	86	90	
	3.0	9.3	24.9	374	8.37	4.4	0.031	0.009	0.009					
	4.0	7.6	24.3	376	8	3.2	0.029	0.009	0.009		55			
	5.0	2.7	23.5	373	7.58	1.5	0.032	0.009	0.010					
	6.0	0.8	21.2	365	7.31	1.8	0.025	0.009	0.016		55	86	90	
	7.0	0.3	18.7	362	7.08									
	7.3					7.0	0.049	0.017	0.017		60	88	90	
	8.0	0.3	16.1	375	6.65									
	8.1	0.3	16.0	400	6.58									
7/25/07	0.0	8.3	26.3	372	8.6	4.7	0.031	0.009	0.009	19.9	55	86	92	1.0
	1.0	10.1	26.3	373	8.75	4.7	0.030	0.009	0.009					
	2.0	9.9	26.1	373	8.72	5.0	0.028	0.009	0.009	19.9	55	86	92	
	3.0	8.6	24.9	375	8.46	5.0	0.027	0.009	0.009					
	4.0	6.0	24.3	375	8.05	4.5	0.023	0.009	0.009			86	92	
	5.0	2.5	23.7	374	7.6	3.0	0.035	0.009	0.009					
	6.0	0.2	21.3	369	7.09	2.2	0.029	0.009	0.009		50	88	92	
	7.0	0.2	18.1	364	6.98	1.9	0.023	0.009	0.009					
	8.0	0.2	14.8	375	6.77	4.2	0.146	0.048	0.051			92	94	
	9.0	0.2	13.0	387	6.64	8.2	0.315	0.045	0.054		50	98	98	
	9.7	0.2	12.4	400	6.28									

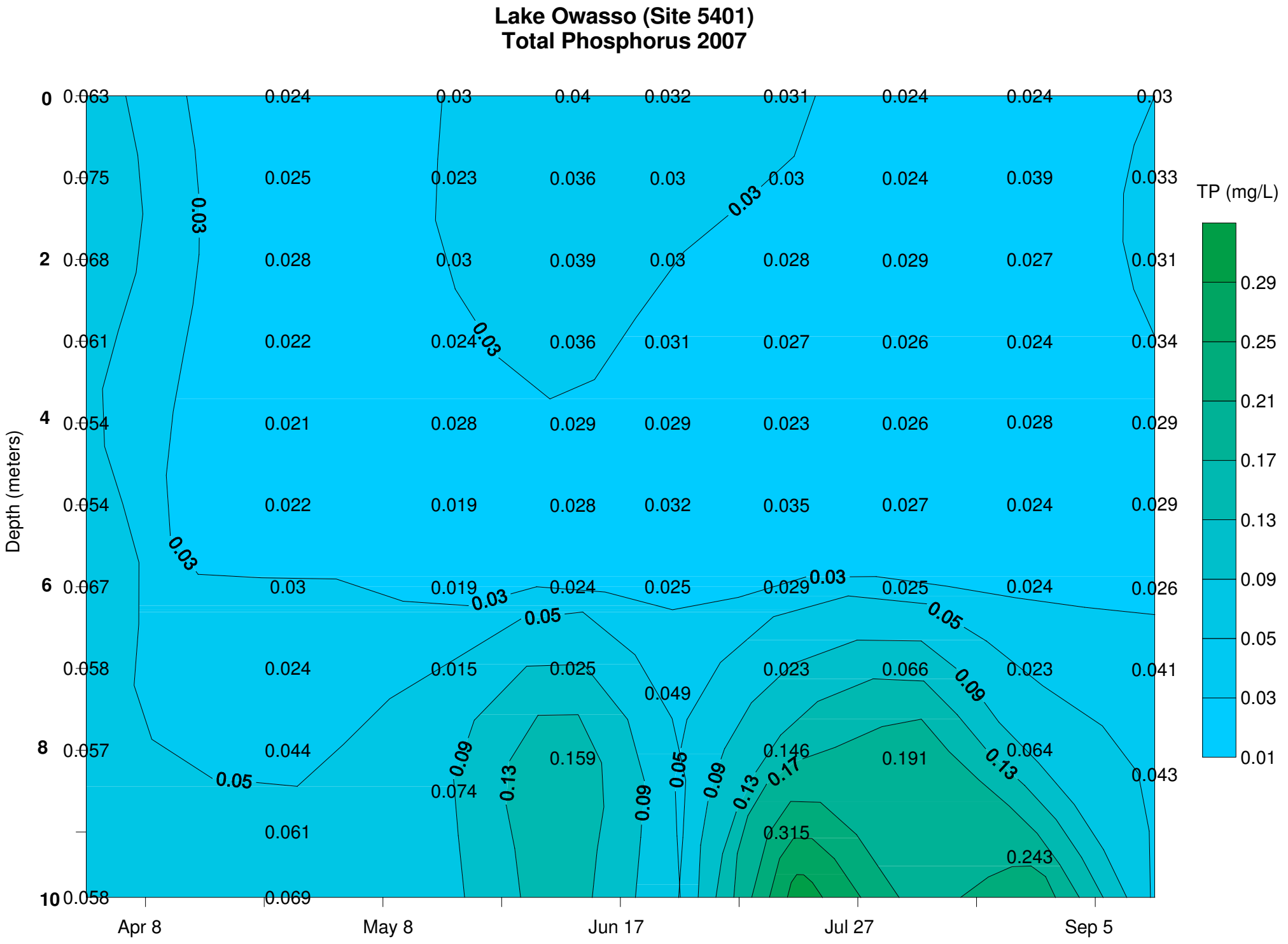
Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
8/14/07	0.0	6.8	26.0	363	8.39	5.2	0.024	0.009	0.009	20.5	60	82	94	0.9
	1.0	7.9	26.0	363	8.66	4.7	0.024	0.009	0.009					
	2.0	7.8	26.0	364	8.64	4.7	0.029	0.009	0.009	17.5	60	86	94	
	3.0	7.4	25.9	364	8.58	4.7	0.026	0.009	0.012					
	4.0	6.3	25.5	366	8.33	4.5	0.026	0.009	0.009		60	86	92	
	5.0	0.9	24.4	364	7.73	2.5	0.027	0.009	0.009					
	6.0	0.3	22.5	370	7.36	2.1	0.025	0.009	0.009		60	88	96	
	7.0	0.3	17.8	366	7.15	3.2	0.066	0.021	0.023					
	8.0	0.3	14.3	378	6.86									
	8.1					7.9	0.191	0.030	0.032		50	102	102	
	8.7	0.3	13.9	391	6.48									
9/4/07	0.0	8.8	24.2	360	7.98	4.7	0.024	0.009	0.009	14.2	60	86	92	1.4
	1.0	8.8	24.2	360	8.04		0.039	0.009	0.009					
	2.0	8.8	24.2	360	8.04	4.7	0.027	0.009	0.009	13.6	60	88	92	
	3.0	8.5	24.1	360	8.01		0.024	0.009	0.009					
	4.0	7.4	23.6	360	7.77	5.4	0.028	0.009	0.009		57	86	92	
	5.0	4.5	22.5	360	7.47		0.024	0.009	0.009					
	6.0	0.4	21.5	357	7.14		0.024	0.009	0.009					
	7.0	0.2	20.2	365	6.99	5.2	0.023	0.009	0.009		56	88	92	
	8.0	0.2	17.8	375	6.71		0.064	0.013	0.019					
	9.0	0.2	14.7	395	6.5									
	9.3					20.0	0.243	0.016	0.026		52	104	104	
	10.0	0.2	14.1	407	6.21									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5401)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
9/25/07	0.0	9.0	19.4	364	7.62	3.0	0.030	0.009	0.009	15.6	55	84	92	1.6
	1.0	8.9	19.4	364	7.66	2.5	0.033	0.009	0.009					
	2.0	8.9	19.4	363	7.67	2.2	0.031	0.009	0.009	16.0	55	86	94	
	3.0	8.8	19.4	364	7.67	2.7	0.034	0.009	0.009					
	4.0	8.8	19.4	364	7.68	2.1	0.029	0.009	0.012		56	86	92	
	5.0	8.8	19.4	364	7.67	2.7	0.029	0.009	0.009					
	6.0	7.3	18.9	367	7.5	2.1	0.026	0.009	0.009					
	7.0	4.2	18.0	369	7.22	2.0	0.041	0.009	0.009		56	88	92	
	8.0	2.8	17.7	370	7.08									
	8.3					2.7	0.043	0.009	0.009					
	9.1	0.5	17.2	406	6.43									


Lake Owasso (Site 5401)
Total Phosphorus 2008
Depth (meters)
0
2
4
6
8
10
May 12
Jun 11
Jul 11
Aug 10
Sep 9
TP (mg/L)
0.29
0.25
0.21
0.17
0.13
0.09
0.05
0.03
0.01
0.033 0.024 0.022 0.032 0.043 0.031 0.032 0.022
0.033 0.028 0.023 0.034 0.037 0.032 0.038 0.028
0.035 0.033 0.033 0.037 0.033 0.029 0.032 0.024
0.039 0.024 0.025 0.042 0.032 0.028 0.028 0.025
0.035 0.026 0.026 0.027 0.035 0.025 0.03 0.023
0.033 0.021 0.023 0.033 0.039 0.021 0.027 0.023
0.044 0.025 0.023 0.028 0.023 0.023 0.029 0.023
0.035 0.031 0.019 0.048 0.031 0.063 0.04 0.036
0.03 0.043 0.054 0.08 0.084 0.075 0.035
0.032 0.08 0.202 0.273 0.297 0.163 0.04
0.029 0.288


Lake Owasso (Site 5401)
Total Phosphorus 2007
Depth (meters)
0
2
4
6
8
10
Apr 8
May 8
Jun 17
Jul 27
Sep 5
TP (mg/L)
0.29
0.25
0.21
0.17
0.13
0.09
0.05
0.03
0.01
0.063 0.024 0.03 0.04 0.032 0.031 0.024 0.024 0.03
0.075 0.025 0.023 0.036 0.03 0.03 0.024 0.039 0.033
0.068 0.028 0.03 0.039 0.03 0.028 0.029 0.027 0.031
0.061 0.022 0.024 0.036 0.031 0.027 0.026 0.024 0.034
0.054 0.021 0.028 0.029 0.029 0.023 0.026 0.028 0.029
0.054 0.022 0.019 0.028 0.032 0.035 0.027 0.024 0.029
0.067 0.03 0.019 0.024 0.025 0.029 0.025 0.024 0.026
0.058 0.024 0.015 0.025 0.049 0.023 0.066 0.023 0.041
0.057 0.044 0.074 0.159 0.146 0.191 0.064 0.043
0.061 0.315 0.243
0.058 0.069
0.03
0.05
0.09
0.13
0.17

Lake Owasso 2007 & 2008 Water Quality Data (Site 5403)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
2008														
5/5/2008	0.0	11.0	12.3	339	7.08	2.7	0.031	0.009	0.009	11.1	60	76	80	1.8
	1.0	10.9	12.2	334	7.04		0.037	0.009	0.009					
	2.0	11.3	11.9	333	7.08	3.3	0.037	0.009	0.009	11.9	55	76	82	
	3.0	10.8	10.1	329	7.07		0.044	0.009	0.009					
	4.0	9.5	9.2	330	7.08	3	0.043	0.009	0.009			77	82	
	5.0	8.7	8.5	333	7.05		0.054	0.011	0.019		58			
	6.0	4.8	7.4	451	6.83	4.5	0.174	0.054	0.062			84	90	
	6.1													
	6.8	3.7	6.4	709	6.38									
5/28/2008	0.0	12.1	16.5	373	8.99	2.4	0.035	0.009	0.015	1.4	63.0	78	84	2.9
	1.0	12.1	16.5	374	9.06	2.5	0.036	0.009	0.015					
	2.0	12.8	16.2	373	9.17	2.9	0.032	0.009	0.016	1.1	61.5	80		
	3.0	8.8	15.7	379	8.76	2.8	0.041	0.009	0.017					
	4.0	0.4	11.7	383	7.57	2.3	0.063	0.009	0.021		64.5	80		
	5.0	0.2	8.7	421	7.21	4.5	0.069	0.01	0.023					
	6.0	0.2	7.4	596	6.72	7	0.283	0.117	0.132		95.5	96		
	6.7	0.3	7.1	732	6.31									
6/18/2008	0.0	9.4	24.1	367	7.91	3.5	0.034	0.009	0.015	6.0	60	83	86	2.2
	1.0	9.7	23.6	368	8.02	3.2	0.044	0.009	0.015					
	2.0	12.1	21.4	363	8.25	3.5	0.047	0.009	0.018	10.2		83	86	
	3.0	4.1	18.9	360	7.72	3.2	0.030	0.009	0.014		59			
	4.0	0.7	13.9	381	7.26	2.5	0.060	0.009	0.019			83	86	
	5.0	0.3	9.7	442	6.94	8.4	0.160	0.023	0.035					
	6.0	0.2	8.0	551	6.33									
	6.2					15.5	0.540	0.040	0.057		103.5	99	100	
	6.9	0.2	7.5	694	6.09									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5403)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
7/7/2008	0.0	7.6	26.1	369	7.43	3.5	0.048	0.009	0.012	11.4	60	86	88	1.4
	1.0	7.5	26.1	369	7.42	3.6	0.054	0.009	0.013	16.2	60	86	91	
	2.0	1.1	24.2	372	7.07	2.7	0.049	0.009	0.015					
	3.0	0.5	21.1	369	6.97	2.8	0.062	0.009	0.013		60	86	90	
	4.0	0.4	14.7	391	6.81	6.3	0.121	0.014	0.026					
	5.0	0.4	10.6	463	6.53									
	5.6					15.0	0.565	0.030	0.040		89	102	104	
	6.0	0.3	8.7	546	6.29									
	6.3	0.3	8.6	573	6.09									
7/28/2008	0.0	9.0	27.6	372	6.95	3.3	0.038	0.009	0.015	10.5	61	85	90	1.6
	1.0	8.9	27.1	373	7	2.5	0.041	0.009	0.015	11.8	65	83	92	
	2.0	1.9	24.2	371	6.59	2.2	0.042	0.009	0.015					
	3.0	2.9	21.8	373	6.43	1.5	0.040	0.009	0.011		64	86	91	
	4.0	0.5	15.7	410	5.98	8.5	0.151	0.009	0.015					
	5.0	0.2	11.6	488	5.68	23.0	0.726	0.010	0.011		93	116	106	
	5.8													
	6.0	0.2	9.6	551	5.54									
	6.5	0.2	9.4	573	5.43									
8/20/2008	0.0	9.4	26.5	377	7.07	4.1	0.034	0.009	0.011	11.5	67	92	96	1.5
	1.0	9.3	26.4	377	7.1	4	0.036	0.009	0.010	9.8	67	94	103	
	2.0	1.1	24.1	377	6.68		0.044	0.009	0.011					
	3.0	0.5	22.0	381	6.5	2.5	0.042	0.009	0.011		68	92	112	
	4.0	0.3	17.7	421	6.13		0.169	0.014	0.031					
	5.0	0.2	13.2	495	5.62									
	5.3					17.0	0.560	0.009	0.032		90	120	100	
	6.0	0.2	10.7	559	5.44									
	6.1	0.2	10.7	583	5.36									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5403)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
9/8/2008	0.0	5.8	17.5	371	6.67	1.8	0.041	0.009	0.009	6.5	67	93	98	2.1
	1.0	5.8	17.5	371	6.67	1.8	0.039	0.009	0.012					
	2.0	5.6	17.4	371	6.68	1.9	0.038	0.009	0.010	8.0	68	91	100	
	3.0	5.2	17.4	372	6.68	1.7	0.037	0.009	0.009					
	4.0	5.2	17.2	371	6.67	2.2	0.039	0.009	0.009		65	90	96	
	5.0	0.4	14.4	501	6.04									
	5.9					18.0	0.768	0.366	0.393		93	144	105	
	6.0	0.3	11.5	567	5.84									
	6.6	0.3	11.0	597	5.7									
9/30/2008	0.0	7.0	17.0	378	6.83	1.4	0.029	0.009	0.009	4.0	58	92	95	3.0
	1.0	7.0	17.0	379	6.84	2.0	0.029	0.009	0.009					
	2.0	6.4	16.4	379	6.82	1.9	0.036	0.009	0.009	5.0	58	96	94	
	3.0	5.5	16.2	381	6.77	1.8	0.026	0.009	0.009					
	4.0	5.8	16.1	379	6.77	2.0	0.027	0.009	0.009		59	92	97	
	5.0	0.7	15.1	434	6.39									
	5.7					32.0	0.840	0.009	0.009		78	134	111	
	6.0	0.4	12.3	605	5.98									
	6.7	0.3	12.0	624	5.84									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5403)

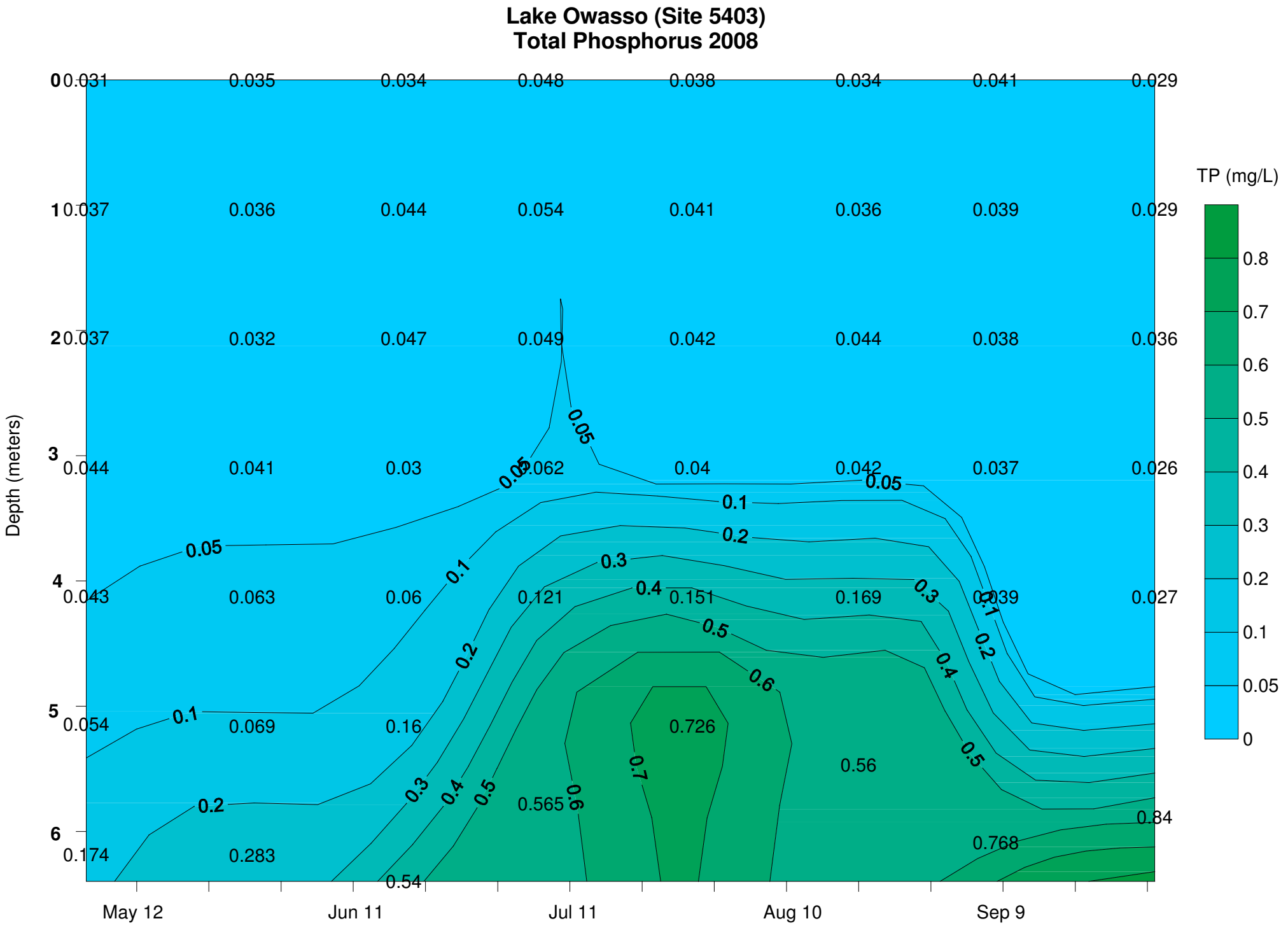
Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
2007														
3/29/07	0.0	11.7	7.9	305	7.08		0.068	0.009	0.022	15.0	52	68	72	1.5
	1.0	11.8	7.9	305	6.99		0.070	0.009	0.022					
	2.0	11.4	7.7	307	6.96		0.068	0.009	0.025	14.9				
	3.0	11.4	7.6	308	6.95		0.061	0.009	0.020					
	4.0	11.2	7.6	308	6.97		0.074	0.009	0.024					
	4.9	10.3	7.2	329	6.97		0.073	0.009	0.021		56	68	84	
	6.0	7.9	6.5	416	6.93									
	6.2						0.467	0.144	0.161		175	102	108	
	6.7	1.7	4.4	983	6.61									
	6.9	1.2	4.4	992	6.53									
5/2/07	0.0	12.9	16.9	345	7.76	3.0	0.030	0.009	0.012	4.1	54	82	86	2.1
	1.0	12.9	16.8	345			0.034	0.009	0.010					
	2.0	13.2	16.3	346	7.88	3.5	0.035	0.009	0.009	4.6	54	82	86	
	3.0	12.1	15.0	349			0.042	0.009	0.012					
	4.0	5.2	9.5	360	7.89	3.5	0.060	0.009	0.012					
	5.0	4.8	6.7	360	7.83	3.4	0.054	0.009	0.010		56	84	88	
	5.4					2.0	0.060	0.009	0.009					
	6.0	1.6	6.4	363										
	6.2	0.9	6.3	393										
5/30/07	0.0	9.5	21.6	327	9.33	2.2	0.044	0.009		1.7	55	72	74	3.6
	1.0	9.6	21.5	328	9.34	2.4	0.050	0.009						
	2.0	9.0	18.2	329	9.13	1.8	0.078	0.009		1.3		72	76	
	3.0	2.4	16.3	338	8.29	2.0	0.051	0.009						
	4.0	1.1	14.2	358	7.89	3.9	0.067	0.009			60	76	82	
	5.0	0.5	10.3	388	6.83									
	5.6					6.5	0.265	0.055			60	96	98	
	6.0	0.3	8.2	448	6.27									
	6.4	0.4	8.0	511	6.44									

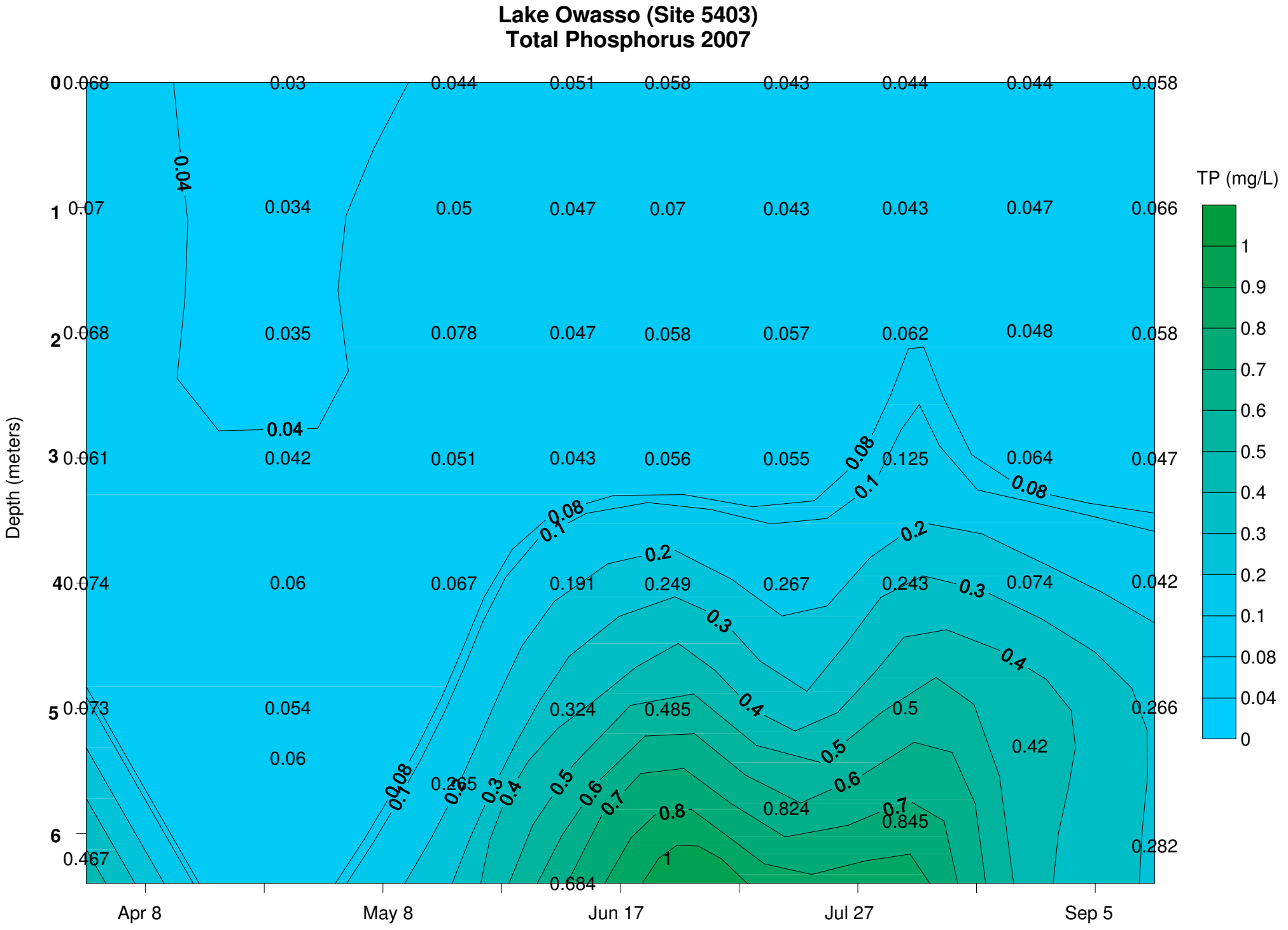
Lake Owasso 2007 & 2008 Water Quality Data (Site 5403)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
6/19/07	0.0	5.1	22.8	357	7.5	2.7	0.051	0.009	0.010	13.1	200	86	92	1.6
	1.0	4.6	22.7	356	7.34	3.0	0.047	0.009	0.013					
	2.0	4.7	22.1	355	7.38	3.0	0.047	0.009	0.015	12.8		84	90	
	3.0	4.6	21.5	354	7.41	3.2	0.043	0.009	0.009		155			
	4.0	3.0	15.3	353	7.24	15.0	0.191	0.045	0.065		70	84	86	
	5.0	0.4	11.7	394	6.58	16.0	0.324	0.136	0.159					
	6.0	0.3	9.7	435	6.27									
	6.4					18.0	0.684	0.188	0.252		90	104	106	
	7.0	0.3	9.1	466	6.17									
	7.1	0.3	9.2	492	6.13									
7/5/07	0.0	6.3	25.3	385	7.18	4.0	0.058	0.012	0.016	19.2	55	86	94	1.2
	1.0	4.9	24.9	385	6.96	3.8	0.070	0.009	0.018					
	2.0	3.5	24.3	385	6.88	3.5	0.058	0.009	0.018	13.2	60	90	94	
	3.0	1.1	21.7	385	6.73	2.8	0.056	0.009	0.018					
	4.0	0.5	15.8	396	6.39	9.1	0.249	0.105	0.114		55			
	5.0	0.4	12.1	429	5.89	16.0	0.485	0.101	0.115			100	100	
	6.0	0.4	10.9	464	5.69									
	6.2					22.0	1.00	0.147	0.175		60	110	110	
	7.0	0.3	10.2	671	5.34									
	7.1	0.4	10.4	924	5.31									
7/25/07	0.0	8.4	26.6	380	7.58	3.8	0.043	0.009	0.012	11.1	55	86	92	1.3
	1.0	8.1	25.9	380	7.5	3.5	0.043	0.009	0.009					
	2.0	2.5	24.0	378	6.95	3.5	0.057	0.009	0.009	15.1	55	88	94	
	3.0	1.0	21.2	387	6.71	4.0	0.055	0.009	0.009					
	4.0	0.6	16.5	408	6.25	9.5	0.267	0.081	0.090			94	96	
	5.0	0.4	12.5	452	5.7									
	5.8					23.0	0.824	0.132	0.143		55	116	118	
	6.0	0.3	10.9	482	5.37									
	6.5	0.2	10.9	514	5.34									

Lake Owasso 2007 & 2008 Water Quality Data (Site 5403)

Date	Sample Depth (m)	D.O. (mg/l)	Temp. (oC)	Sp. Cond. (µmho/cm @25C)	pH (S.U.)	Turbidty (NTU's)	TP (mg/L)	SRP (mg/L)	TDP (mg/L)	Chla - Correct (mg/L)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Hardness (mg/L)	Secchi Depth (m)
8/14/07	0.0	12.2	25.3	373	7.22	2.8	0.044	0.009	0.009	12.1	60	88	94	1.4
	1.0	4.7	25.3	374	7.16	2.8	0.043	0.009	0.009					
	2.0	4.5	25.0	360	7.11	2.8	0.062	0.009	0.009	6.2	60	88	94	
	3.0	1.3	22.0	381	6.9	4.4	0.125	0.009	0.011					
	4.0	0.7	17.5	403	6.59	16.0	0.243	0.032	0.045		60	104	104	
	5.0	0.4	13.8	448	6.15	20.0	0.500	0.045	0.055					
	5.9					24.0	0.845	0.088	0.101		60	113	114	
	6.0	0.4	12.4	473	6.01									
	6.5	0.3	12.4	488	5.94									
9/4/07	0.0	8.1	24.1	357	7.12	4.9	0.044	0.009	0.012	17.8	61	86	90	1.7
	1.0	6.9	23.8	357	7.06	3.9	0.047	0.009	0.015		55	86	94	
	2.0	3.2	22.9	355	6.82		0.048	0.009	0.010	18.5				
	3.0	0.6	20.3	369	6.59	4.4	0.064	0.009	0.012		55	94	94	
	4.0	0.3	17.3	396	6.26		0.074	0.009	0.009					
	5.0	0.3	14.8	452	5.97									
	5.3					25.0	0.420	0.217	0.234		61	116	114	
	6.0	0.4	13.2	503	5.77									
	6.1	0.4	13.4	517	5.79									
9/25/07	0.0	7.0	19.0	347	7.11	1.7	0.058	0.009	0.022	27.5	54	78	82	1.5
	1.0	7.0	19.0	347	7.09	2.2	0.066	0.009	0.026					
	2.0	1.3	17.7	338	6.81	1.8	0.058	0.009	0.021	4.2	54	78	84	
	3.0	0.2	15.4	381	6.69	1.5	0.047	0.009	0.018					
	4.0	0.2	14.5	386	6.64	1.3	0.042	0.009	0.018		55	90	94	
	5.0	0.2	14.0	404	6.5	4.1	0.266	0.087	0.099					
	6.0	0.2	13.4	441	6.27									
	6.1					6.4	0.282	0.063	0.081		55	106	104	
	6.7	0.3	13.2	458	6.01									


Lake Owasso (Site 5403)
Total Phosphorus 2008
Depth (meters)
0
1
2
3
4
5
6
0.031 0.035 0.034 0.048 0.038 0.034 0.041 0.029
0.037 0.036 0.044 0.054 0.041 0.036 0.039 0.029
0.037 0.032 0.047 0.049 0.042 0.044 0.038 0.036
0.044 0.041 0.03 0.062 0.04 0.042 0.037 0.026
0.043 0.063 0.06 0.121 0.151 0.169 0.039 0.027
0.054 0.069 0.16 0.726 0.56
0.174 0.283 0.565 0.54 0.768 0.84
0.05
0.1
0.2
0.3
0.4
0.5
0.6
0.7
May 12
Jun 11
Jul 11
Aug 10
Sep 9
TP (mg/L)
0
0.05
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8


Lake Owasso (Site 5403)
Total Phosphorus 2007
Depth (meters)
0
1
2
3
4
5
6
Apr 8
May 8
Jun 17
Jul 27
Sep 5
TP (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.08
0.04
0
0.068 0.03 0.044 0.051 0.058 0.043 0.044 0.044 0.058
0.07 0.034 0.05 0.047 0.07 0.043 0.043 0.047 0.066
0.068 0.035 0.078 0.047 0.058 0.057 0.062 0.048 0.058
0.061 0.042 0.051 0.043 0.056 0.055 0.125 0.064 0.047
0.074 0.06 0.067 0.191 0.249 0.267 0.243 0.074 0.042
0.073 0.054 0.324 0.485 0.5 0.266
0.06 0.265 0.42
0.824 0.845
0.467 1 0.282
0.684

2007 Galtier St. Runoff Water Qaulity Data

Ramsey-Washington Metro Watershed District
Water Quality Data

Sampler Location	Sample ID	Date Sample Taken	TP	SRP	Chlorides	TSS	VSS	Flow	TP	SRP	Chlorides	Tss	Vss	Start Date	End Date	Samples Taken
		m/d/y	mg/L	mg/L	mg/L	mg/L	mg/L	L	g	g	g	g	g			
Galtier Street	2007010	05/09/07	0.375	0.018	8	**221.1**	**68.0**	756,505	284	0	0	167,296	11,376	5/7/07 6:53 PM	5/9/07 1:01 AM	13
Galtier Street	2007071	05/25/07	0.148	0.021	0	**46.7**	**22.3**	270,148	40	6	0	12,607	6,033	5/24/07 12:59 PM	5/24/07 3:42 PM	4
Galtier Street	2007077	05/29/07	0.770	0.156	20	**447.0**	**164.0**	86,257	66	13	1,725	38,557	14,146	5/29/07 2:38 PM	5/29/07 3:00 PM	2
Galtier Street	2007085	05/30/07	0.265	0.009	10	**133.5**	**40.5**	582,969	154	5	5,830	77,826	23,610	5/29/07 8:48 PM	5/29/07 11:26 PM	8
Galtier Street	2007099	06/01/07	0.219	0.036	10	LOST	LOST	533,412	117	19	5,334			5/30/07 6:18 PM	5/30/07 8:23 PM	7
Galtier Street	2007109	06/05/07	0.279	0.038	10	**120.3**	**39.0**	1,858,456	519	71	18,585	223,634	72,480	6/2/07 2:35 PM	6/4/07 6:05 PM	22
Galtier Street	2007154	06/18/07	0.216	0.080	0	**152.6**	**46.6**	1,258,240	272	101	0	192,007	58,634	6/15/07 11:34 PM	6/18/07 1:56 PM	15
Galtier Street	2007221	07/05/07	0.240	0.063	5	**243.0**	**74.8**	534,168	128	34	2,671	129,803	39,929	7/3/07 2:22 PM	7/3/07 3:12 PM	8
Galtier Street	2007231	07/10/07	0.274	0.070	5	**50.8**	**20.6**	1,024,070	281	72	5,120	52,023	21,096	7/8/07 3:56 PM	7/8/07 7:56 PM	13
Galtier Street	2007264	07/16/07	0.268	0.123	20	**38.1**	**22.7**	Missing Data						7/13/07 2:07 PM		1
Galtier Street	2007272	07/20/07	0.204	0.040	5	**67.3**	**14.8**	811,635	166	32	4,058	54,637	11,977	7/18/07 4:12 PM	7/18/07 5:31 PM	15
Galtier Street	2007314	08/06/07	0.267	0.045	5	**120.0**	**34.4**	172,216	46	8	861	20,666	5,924	8/4/07 1:51 PM	8/5/07 3:48 AM	3
Galtier Street	2007340	08/14/07	0.178	0.046	5	**68.3**	**20.7**	1,478,238	263	68	7,391	101,013	30,550	8/13/07 11:16 PM	8/14/07 12:40 AM	16
Galtier Street	2007383	08/21/07	0.125	0.020	5	**41.4**	**11.1**	440,038	55	9	2,200	18,218	4,884	8/21/07 3:07 AM	8/21/07 4:49 AM	7
Galtier Street	2007397	08/24/07	0.129	0.026	5	**35.0**	**16.5**	339,528	44	9	1,698	11,883	5,602	8/23/07 2:36 PM	8/23/07 3:54 PM	4
Galtier Street	2007451	08/28/07	0.151	0.034	5	**56.5**	**16.0**	1,698,732	257	58	8,494	95,978	27,180	8/28/07 2:52 AM	8/28/07 3:31 AM	24
Galtier Street	2007473	09/07/07	0.248	0.054	5	**43.0**	**17.2**	1,463,753	363	79	7,319	62,941	25,128	9/6/07 8:58 PM	9/7/07 1:59 AM	19
Galtier Street	2007528	09/20/07	0.189	0.042	1	Missing	Missing	2,015,419	381	85	2,015			9/18/07 6:31 AM	9/18/07 5:04 AM	24
Galtier Street	2007529	09/21/07	0.153	0.017	1	**83.8**	**25.5**	1,953,052	299	33	1,953	163,568	49,803	9/20/07 6:01 PM	9/20/07 6:40 PM	24
Galtier Street	2007538	09/25/07	0.172	0.009	1	**394.0**	**138.0**	742,430	128	7	742	292,517	102,455	9/24/07 6:02 PM	9/24/07 7:04 PM	12
Galtier Street	2007576	09/28/07	0.178	0.013	0	**59.5**	**28.3**	282,528	50	4	0	16,810	7,981	9/26/07 7:32 PM	9/26/07 8:18 PM	6
Galtier Street	2007597	10/02/07	0.121	0.027	0	**31.0**	**12.8**	2,036,602	246	55	0	63,135	25,967	9/30/07 4:29 AM	9/30/07 3:56 PM	24
Galtier Street	2007612	10/03/07	0.117	0.032	0	**122.2**	**28.9**	1,892,485	221	61	0	231,304	54,672	10/2/07 11:53 AM	10/2/07 9:21 PM	22
Galtier Street	2007621	10/05/07	Missing	Missing	Missing	**65.1**	**20.6**	2,497,947				162,723	51,386	10/5/07 2:29 AM	10/5/07 6:58 AM	24
Galtier Street	2007627	10/08/07	0.174	0.145	5	**18.2**	**8.0**	667,419	116	97	3,337	12,147	5,339	10/6/07 6:09 AM	10/8/07 9:05 AM	20

2007 County Road C Runoff Water Quality Data

Ramsey-Washington Metro Watershed District
Water Quality Data

Sampler Location	Sample ID	Date Sample Taken	TP	SRP	Chlorides	TSS	VSS	Flow	TP	SRP	Chlorides	Tss	Vss	Start Date	End Date	Samples Taken
		m/d/y	mg/L	mg/L	mg/L	mg/L	mg/L	L	g	g	g	g	g			
County C	2007136	06/08/07	64.40	0.009	0	Lost	Lost	e Sample Taken						6/7/07 3:29 PM		1
County C	2007152	06/18/07	1.110	0.046	0	**1888.3**	**151.7**	e Sample Taken						6/18/07 12:18 PM		1
County C	2007274	07/20/07	0.336	0.066	25	**306.6**	**84.6**	e Sample Taken						7/18/07 4:10 PM		1
County C	2007406	08/27/07	0.241	0.022	15	**139.7**	**38.0**	e Sample Taken						8/27/07 2:12 AM		1
County C	2007450	08/28/07	0.206	0.042	75	**25.5**	**12.3**	1,387,229	286	58	104,042	35,374	17,109	8/28/07 2:51 AM	8/28/07 12:21 PM	24
County C	2007535	09/21/07	0.172	0.049	58	**27.4**	**10.4**	1,507,375	259	74	87,428	41,302	15,677	9/20/07 6:02 PM	9/20/07 10:20 PM	24

2008 County Road C Runoff Water Quality Data

Note for Eric Korte (RWMWD): All results highlighted in yellow should be discarded (Per Ramsey County Labs)

Sample Date	Sample Description	Sample Number	# of Sample in Composite	TP (mg/L)	SRP (mg/L)	Chlorides (mg/L)	pH	turbid (JTU)	Total Dissolved Phosphorus (mg/L)	TPM mg/L	OPM mg/L	Lab Notes	Site Notes
6/6/08	County C Storm	2008105	15	0.26	0.06	108	7.09		0.056	271	148		on bottle 6 1/3 - Rained ~1.0 inches
6/13/08	County C Storm	2008143	See Note	0.26	0.06	94	7.19		0.102	98	59		sampler complete - manually triggered samplers..level was above enable (pseudo grab)
7/21/08	County C Storm	2008283	See Note	0.25	0.03	45	7.13		0.064	1428	605		on bottle 1 2/3 - pond went dry and water is going the wrong way through pipe
8/14/08	County C Storm	2008385	See Note	0.37	0.04	29	7.15		0.055	354	105		on bottle 1 2/3 - pond went dry and water is going the wrong way through pipe
6/9/08	County C Grab	2008108	1	0.092		101			0.093			yellow lost data	
6/13/08	County C Grab	2008146	1	0.44	0.25	79	7.37		0.286	131	72		
6/16/08	County C Grab	2008157	1	0.50	0.20	104	6.56	14	0.241	140	50		
6/20/08	County C Grab	2008180	1	0.50	0.24	127			0.254	483	260		
6/23/08	County C Grab	2008182	1	0.37	0.17	135			0.182	314	174		
6/27/08	County C Grab	2008192	1	0.58	0.18	145	7.00		0.192	622	300		
6/30/08	County C Grab	2008194	1	0.55	0.27	150	7.51		0.280	1279	565		
7/3/08	County C Grab	2008220	1	0.47	0.01	160	7.05		0.049	80	59		

2007 West Owasso Blvd Runoff Water Quality Data

Ramsey-Washington Metro Watershed District
Water Quality Data

Sampler Location	Sample ID	Date Sample Taken	TP	SRP	Chlorides	TSS	VSS	Flow	TP	SRP	Chlorides	Tss	Vss	Start Date	End Date	Samples Taken
		m/d/y	mg/L	mg/L	mg/L	mg/L	mg/L	L	g	g	g	g	g			
W. Owasso	2007073	05/25/07	0.335	0.023	40	**62.4**	**26.9**	Missing Data						5/23/07 3:41 PM	5/24/07 4:34 PM	8
W. Owasso	2007078	05/29/07	0.710	0.009	10	**284.0**	**101.0**	Missing Data						5/29/07 2:44 PM	5/29/07 3:22 PM	2
W. Owasso	2007100	06/01/07	0.290	0.024	15	**92.3**	**29.0**	Missing Data						5/30/07 6:16 PM	5/31/07 8:16 AM	8
W. Owasso	2007110	06/05/07	0.294	0.028	35	**91.3**	**24.3**	402,468	118	11	14,086	36,759	9,793	6/2/07 3:05 PM	6/2/07 11:19 PM	24
W. Owasso	2007155	06/18/07	0.297	0.025	5	Missing	Missing	147,745	44	4	739			6/15/07 10:24 PM	6/18/07 2:46 PM	7
W. Owasso	2007222	07/05/07	0.210	0.033	10	**503.8**	**129.6**	37,769	8	1	378	19,030	4,895	7/3/07 2:23 PM	7/3/07 2:32 PM	3
W. Owasso	2007232	07/10/07	0.254	0.052	1	**98.4**	**29.0**	80,741	21	4	81	7,945	2,341	7/8/07 3:58 PM	7/8/07 5:48 PM	5
W. Owasso	2007273	07/20/07	0.318	0.025	5	**190.2**	**53.5**	199,337	63	5	997	37,914	10,674	7/18/07 4:06 PM	7/19/07 3:49 AM	13
W. Owasso	2007311	08/02/07	0.321	0.242	28	**37.4**	**16.0**	e Sample Taken						8/1/07 8:31 PM		1
W. Owasso	2007329	08/13/07	0.240	0.050	5	**243.1**	**63.3**	73,414	18	4	367	17,850	4,646	8/11/07 3:42 AM	8/11/07 4:06 AM	7
W. Owasso	2007341	08/14/07	0.198	0.019	20	**96.8**	**25.4**	147,461	29	3	2,949	14,274	3,746	8/13/07 11:14 PM	8/14/07 8:10 AM	14
W. Owasso	2007371	08/20/07	0.238	0.023	35	**23.3**	**9.8**	499,423	119	11	17,480	11,653	4,911	8/18/07 9:39 AM	8/19/07 3:30 PM	24
W. Owasso	2007384	08/21/07	0.237	0.009	40	**65.5**	**23.8**	88,031	21	1	3,521	5,766	2,091	8/21/07 3:17 AM	8/21/07 5:22 PM	5
W. Owasso	2007399	08/24/07	0.210	0.017	40	**25.6**	**11.1**	189,433	40	3	7,577	4,849	2,103	8/23/07 2:22 PM	8/24/07 11:12 AM	14
W. Owasso	2007408	08/27/07	0.198	0.017	30	**132.3**	**37.3**	309,677	61	5	9,290	40,981	11,561	8/27/07 2:09 AM	8/27/07 11:36 AM	17
W. Owasso	2007452	08/28/07	0.745	0.085	25	**146.5**	**36.0**	467,984	349	40	11,700	68,560	16,847	8/28/07 2:51 AM	8/28/07 4:29 AM	24
W. Owasso	2007474	09/07/07	0.252	0.025	19	**66.3**	**16.5**	235,168	59	6	4,468	15,599	3,880	9/6/07 9:05 PM	9/7/07 2:26 PM	12
W. Owasso	2007531	09/21/07	0.268	0.040	5	**50.7**	**11.7**	525,499	141	21	2,627	26,625	6,131	9/18/07 11:43 AM	9/18/07 5:48 PM	24
W. Owasso	2007572	09/28/07	0.138	0.010	24	**27.0**	**9.4**	348,679	48	3	8,368	9,414	3,278	9/26/07 7:41 PM	9/27/07 10:22 AM	24
W. Owasso	2007613	10/03/07	0.153	0.031	12.5	**19.8**	**7.4**	458,030	70	14	5,725	9,069	3,389	10/2/07 12:05 PM	10/2/07 7:25 PM	24
W. Owasso	2007622	10/05/07	Missing	Missing	Missing	**75.6**	**22.8**	439,291				33,210	10,016	10/5/07 2:33 AM	10/5/07 7:06 AM	24

2008 West Owasso Blvd Runoff Water Quality Data

Note for Eric Korte (RWMWD): All results highlighted in yellow should be discarded (Per Ramsey County Labs)

Sample Date	Sample Description	Sample Number	# of Samples in Composite	TP (mg/L)	SRP (mg/L)	Chlorides (mg/L)	pH	turbid (JTU)	Total Dissolved Phosphorus (mg/L)	TPM mg/L	OPM mg/L	Lab Notes	Site Notes
5/30/08	West Owasso Storm	2008070	23	0.26	0.06	40	7.26						on sample 8 3/3
6/3/08	West Owasso	2008092	8	0.32	0.04	115	7.43		0.070				
6/6/08	West Owasso Storm	2008104	24	0.26	0.06	34	7.13		0.059	77	31		sampler complete
6/11/08	West Owasso Storm	2008126	14	0.25	0.02	45	7.12		0.068	12	9		sampler complete
7/11/08	West Owasso Storm	2008250	13	0.34	0.04	62	7.41		0.091	420	143		on bottle 4 3/3
7/14/08	West Owasso Storm	2008252	13	0.27	0.07	9	6.90		0.103	69	29		on bottle 5 2/3 - all samples past 2 1/3 were 'no liquid detected (flow was taken just for first 3 s
7/21/08	West Owasso Storm	2008284	24	0.17	0.02	5	7.04		0.033	195	49		on bottle 8 3/3
8/4/08	West Owasso Storm	2008326	???	0.35	0.13	23	7.45		0.164	97	36		
8/14/08	West Owasso Storm	2008384	24	0.30	0.03	9	6.89		0.041	780	114		sampler complete - no liquid detected for all of bottle 8 and bottle 1 1/3,1 2/3
8/18/08	West Owasso Storm	2008387	12	0.22	0.12	20	7.02		0.150	39	10		
8/27/08	West Owasso Storm	2008451	3	0.26	0.15	35	6.92		0.196	81	20		on sample 2 1/3
8/28/08	West Owasso Storm	2008453	24	0.24	0.04	12	6.85		0.065	100	28		on sample 8 3/3
9/8/08	West Owasso Storm	2008472	5	0.48	0.01	10	7.35	100	0.023	210	49		
9/12/08	West Owasso Storm	2008526	24	0.20	0.01	60		25		82	19		sampler complete - didn't take sample 1 1/3
9/15/08	West Owasso Storm	2008532	24	0.14	0.04	16	7.11			34	10		sampler complete - some errors…no liq. Detected and no more liquid (did not write down wha
9/24/08	West Owasso Storm	2008584	23	0.22		37	7.04		0.052				on bottle 6 3/3 - bottles 4 and 5 only filled half way…composited anyway
10/6/08	West Owasso Storm	2008609		0.33		10	6.16		0.152				on bottle 3 2/3 - no liquid detected after bottle 1…only took level and flow from bottle 1
10/8/08	West Owasso Storm	2008624		0.21		5	7.46		0.078				sampler complete
6/13/08	West Owasso Grab	2008145		0.15	0.02	64	7.45		0.061	4	7		

2008 Dale Street Runoff Water Quality Data

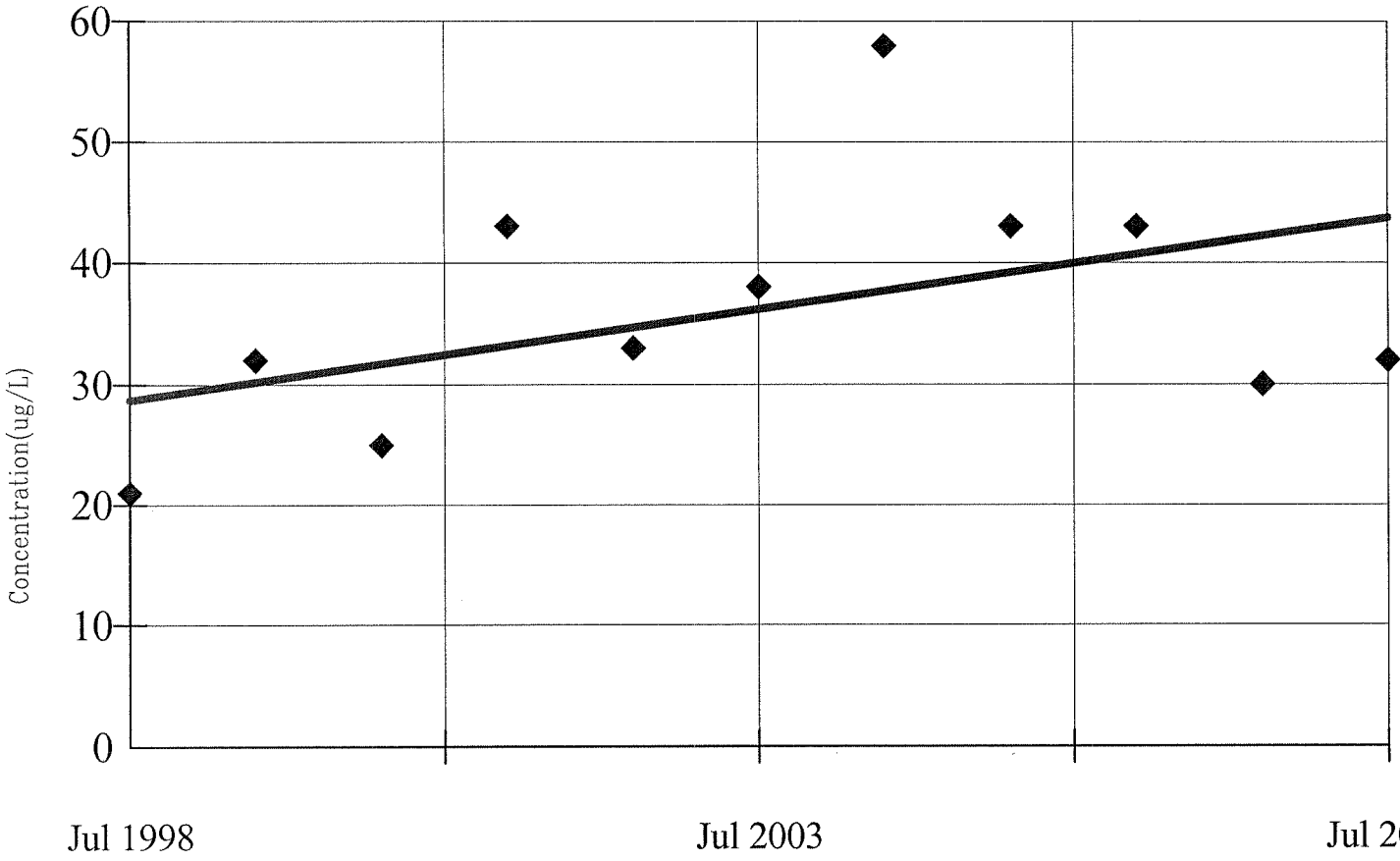
Note for Eric Korte (RWMWD): All results highlighted in yellow should be discarded (Per Ramsey County Labs)

Sample Date	Sample Description	Sample Number	# of Sample in Composite	TP (mg/L)	SRP (mg/L)	Chlorides (mg/L)	pH	turbid (JTU)	Total Dissolved Phosphorus (mg/L)	TPM mg/L	OPM mg/L	Lab Notes	Site Notes
5/30/08	Dale Street storm	2008069	16	1.34	0.16	50	7.48						on bottle 5 2/3 - sampler stopped due to low power
6/6/08	Dale Street Storm	2008103		1.26	0.10	25	7.25			1216	377		sampler complete - power failed on last sample, sampler water is extremely cloudy..almost black in color
6/9/08	Dale Street Storm	2008106		0.184		50			0.182			yellow lost	sampler complete - also took grab sample
6/11/08	Dale Street Storm	2008125		0.50	0.10	25	6.25		0.130	170	62		sampler complete - changed pacing to 1000cf
6/13/08	Dale Street Storm	2008142		0.21	0.11	60	7.25		0.149	30	18		sampler complete - also took grab sample
6/16/08	Dale Street Storm	2008155		0.34	0.13	51	6.46	6	0.161	33	14		sampler complete - also took grab sample
7/11/08	Dale Street Storm	2008249	23	0.30	0.08	36	7.79		0.109	346	250		on bottle 8 3/3
7/14/08	Dale Street Storm	2008251	11	0.24	0.06	19	7.01		0.076	140	40		on sample 3 2/3 - sampler stopped due to low power
7/18/08	Dale Street Storm	2008278	2	0.26	0.07	12	7.58		0.105	98	40		on bottle 1 3/3
7/21/08	Dale Street Storm	2008282	24	0.30	0.08	37	7.31		0.115	204	43		sampler complete
8/4/08	Dale Street Storm	2008325		0.28	0.07	71	6.63		0.100	205	67		on bottle 1 3/3 - removed mouse nest on sampler
8/14/08	Dale Street Storm	2008383	19	0.28	0.06	72	6.77		0.091	187	54		on bottle 7 2/3
8/18/08	Dale Street Storm	2008386	3	0.43	0.24	210	6.62		0.286	67	23		on bottle 2 1/3
8/27/08	Dale Street Storm	2008450	2	0.33	0.03	28	6.84		0.082	107	46		on bottle 2 1/3
8/28/08	Dale Street Storm	2008452	24	0.21	0.05	24	7.01		0.077	82	26		sampler complete
9/2/08	Dale Street Storm	2008458	3	0.29	0.04	65	7.13			222	70		on bottle 2 1/3
9/12/08	Dale Street Storm	2008525	11	0.16	0.04	15		12		50	19		on bottle 4 3/3
9/15/08	Dale Street Storm	2008531	14	0.21	0.07	14	7.29			82	27		on bottle 5 3/3
9/24/08	Dale Street storm	2008583	24	0.28		10	7.39		0.081				sampler complete
10/6/08	Dale Street storm	2008608	10	0.24		12	5.97		0.115				on bottle 4 2/3
10/8/08	Dale Street storm	2008623	24	0.18		6	7.58		0.071				sampler complete
10/10/08	Dale Street storm	2008667	1	0.28		114	7.68		0.228				on bottle 1 2/3
10/14/08	Dale Street storm	2008671	12							29	13		on bottle 5 1/3
6/9/08	Dale Street Grab	2008107		0.225		80			0.227			yellow lost data	
6/13/08	Dale Street Grab	2008144		0.26	0.16	48	6.95		0.192	6	7		
6/16/08	Dale Street Grab	2008156		0.54	0.15	56	6.36	9	0.188	49	19		
6/20/08	Dale Street Grab	2008179		0.65	0.01	640			0.060	328	124		
6/23/08	Dale Street Grab	2008181		0.06	0.01	2310			0.042	241	98		
6/27/08	Dale Street Grab	2008191		0.05	0.01	215	6.61		0.050	317	117		
6/30/08	Dale Street Grab	2008193		0.10	0.01	171	6.46		0.060	715	261		
7/3/08	Dale Street Grab	2008219		0.08	0.01	145	6.44		0.063	166	62		

Appendix G

Trend Analysis

SEN'S SLOPE ESTIMATOR
Owsso



n = 11

Slope = 1.499 units per year.

Mann Kendall statistic = 15

Alpha	Critical	Signif.
0.01	34	No
0.05	27	No
0.1	23	No
0.2	18	No

Constituent: TP (ug/L)

Date: 1/15/09

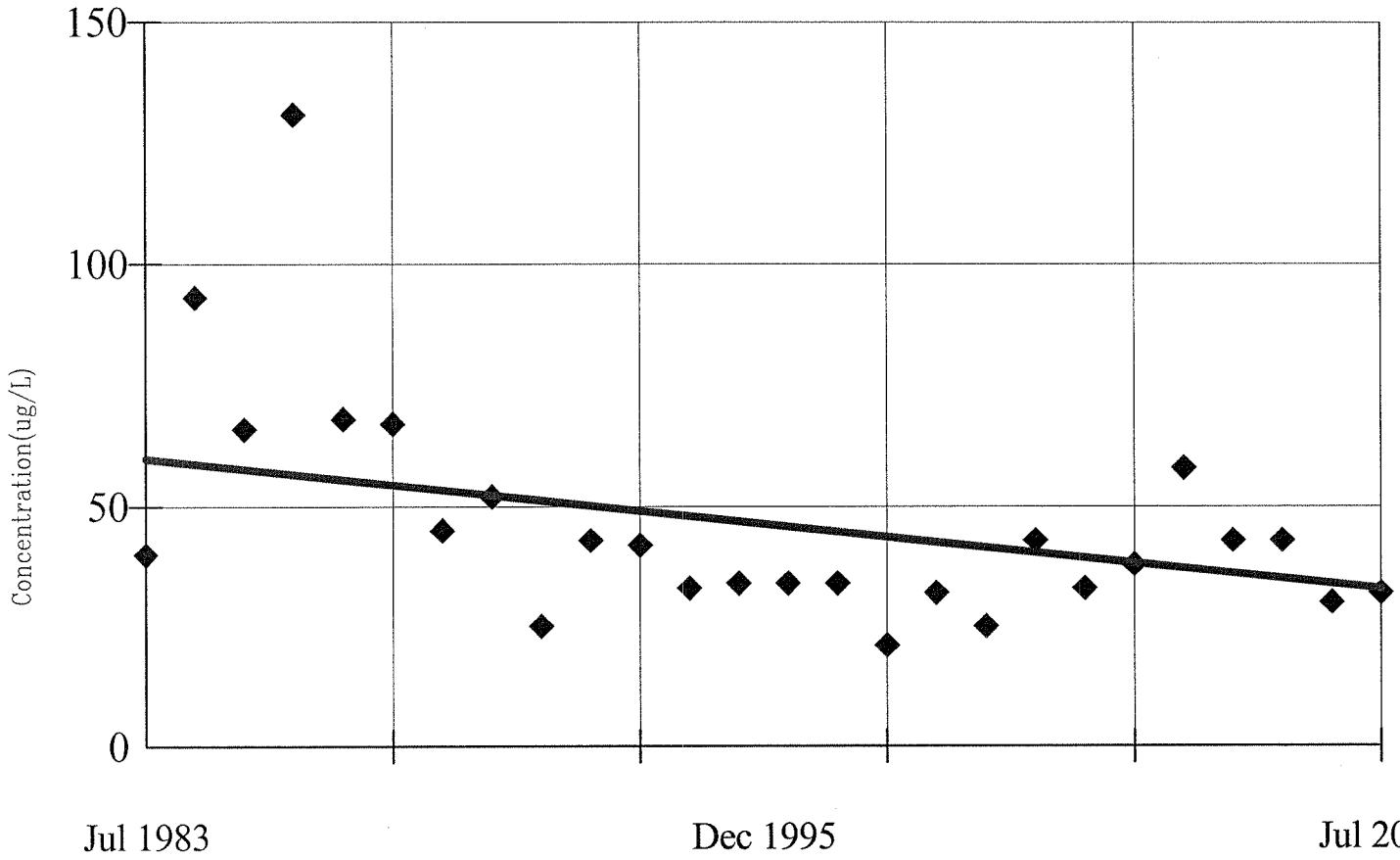
Facility: Lake Trend Analysis

Time: 3:35 PM

Data File: OWASSO

View: owsso

SEN'S SLOPE ESTIMATOR
Owsso



n = 26

Slope = -1.076 units per year.

Mann Kendall statistic = -121

Alpha	Critical	Signif.
0.01	-118	Down
0.05	-90	Down
0.1	-76	Down
0.2	-60	Down

Constituent: TP (ug/L)

Date: 1/15/09

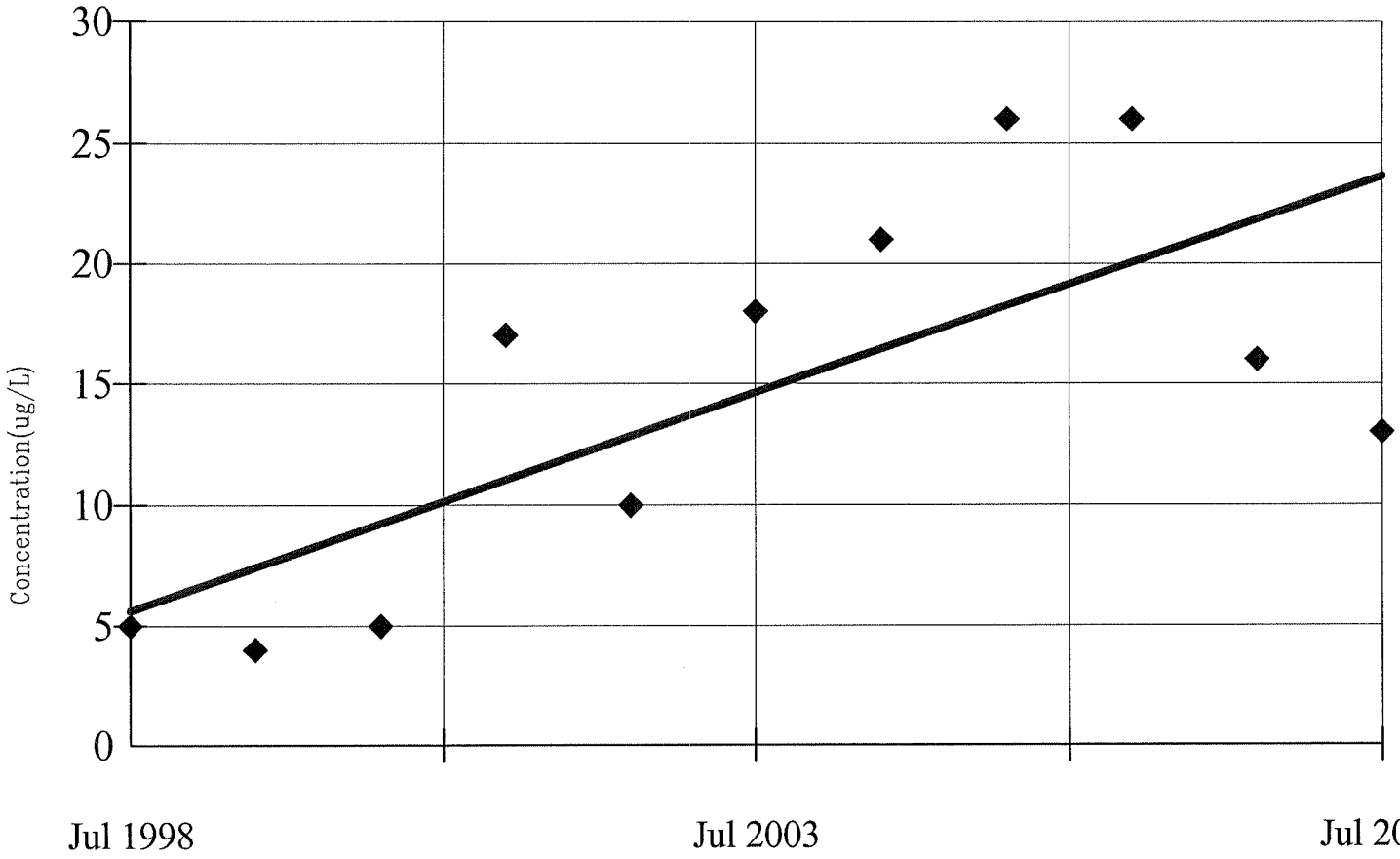
Facility: Lake Trend Analysis

Time: 3:35 PM

Data File: OWASSO

View: owsso

SEN'S SLOPE ESTIMATOR
Owsso



n = 11

Slope = 1.799 units per year.

Mann Kendall statistic = 27

Alpha	Critical	Signif.
0.01	34	No
0.05	27	Up
0.1	23	Up
0.2	18	Up

Constituent: Chl a (ug/L)

Date: 1/15/09

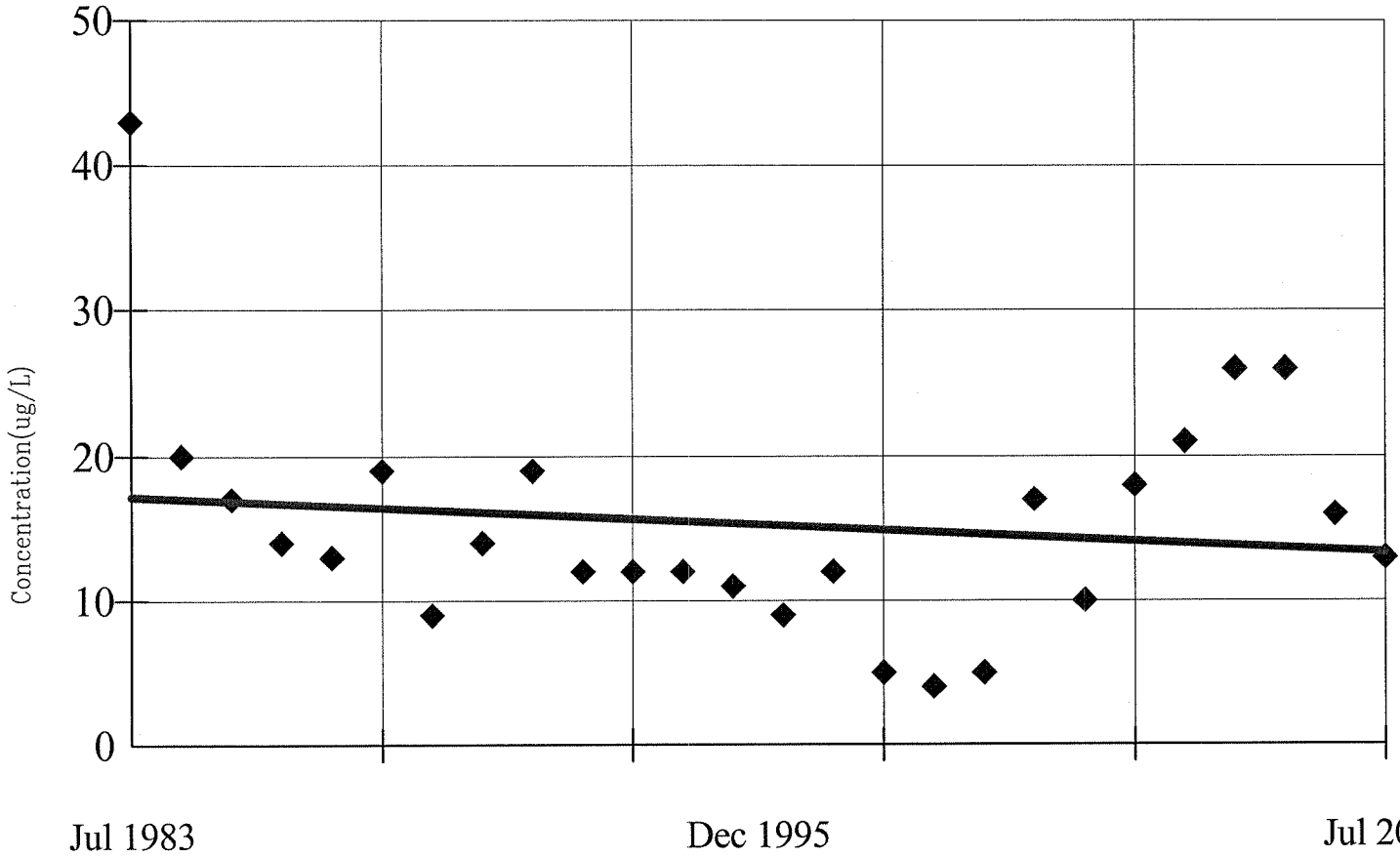
Facility: Lake Trend Analysis

Time: 3:36 PM

Data File: OWASSO

View: owsso

SEN'S SLOPE ESTIMATOR
Owsso



n = 26

Slope = -0.154 units per year.

Mann Kendall statistic = -34

Alpha	Critical	Signif.
0.01	-118	No
0.05	-90	No
0.1	-76	No
0.2	-60	No

Constituent: Chl a (ug/L)

Date: 1/15/09

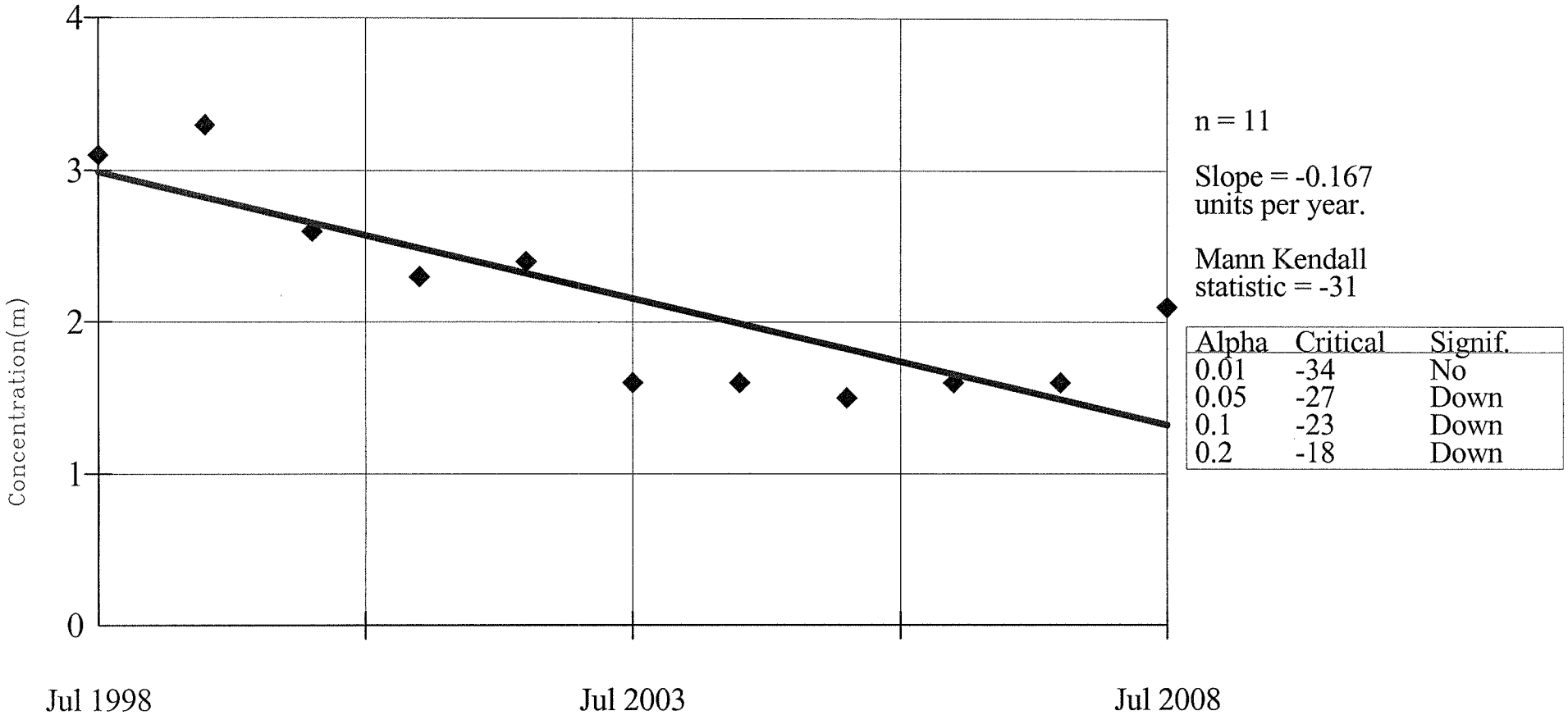
Facility: Lake Trend Analysis

Time: 3:36 PM

Data File: OWASSO

View: owsso

SEN'S SLOPE ESTIMATOR
Owsso



n = 11

Slope = -0.167 units per year.

Mann Kendall statistic = -31

Alpha	Critical	Signif.
0.01	-34	No
0.05	-27	Down
0.1	-23	Down
0.2	-18	Down

Constituent: SD (m)

Date: 1/15/09

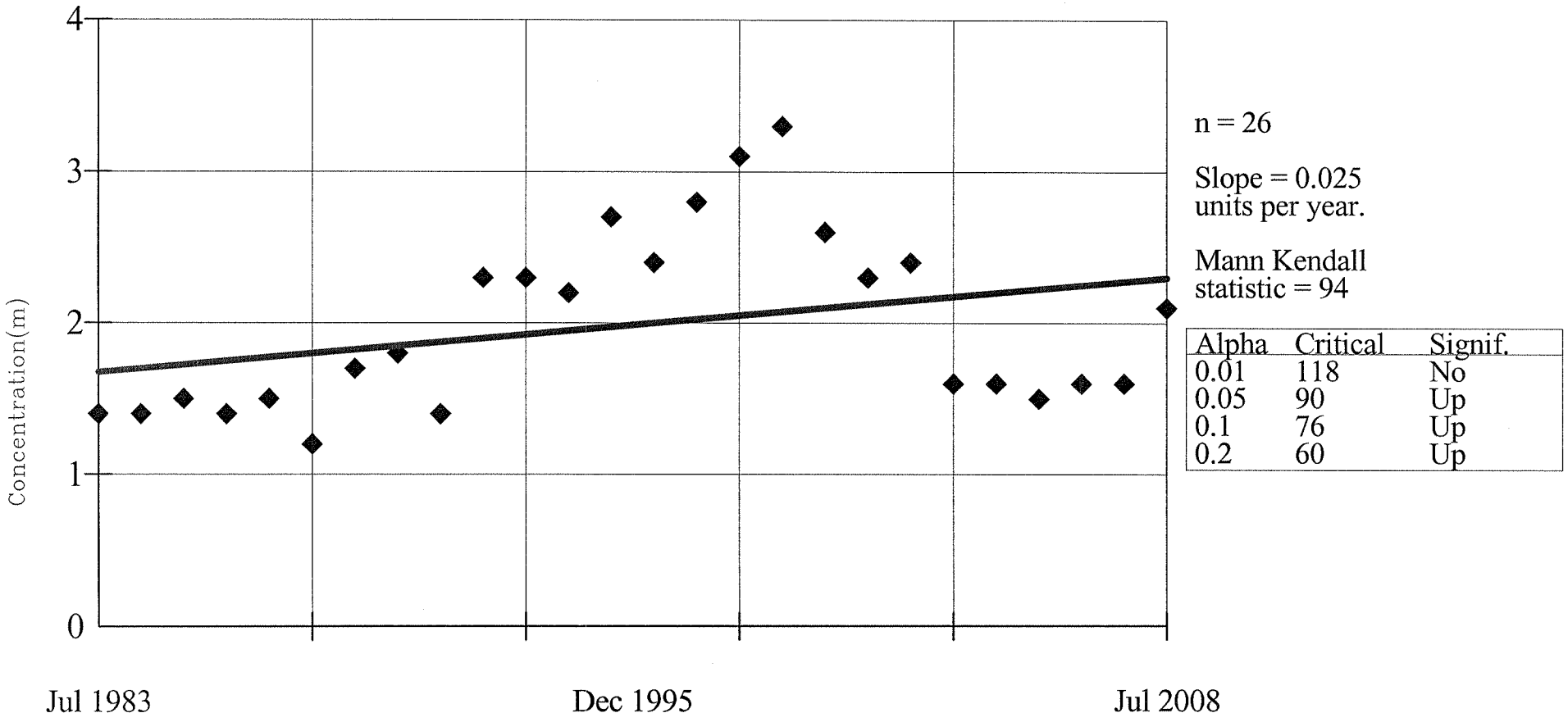
Facility: Lake Trend Analysis

Time: 3:34 PM

Data File: OWASSO

View: owsso

SEN'S SLOPE ESTIMATOR
Owsso



n = 26

Slope = 0.025 units per year.

Mann Kendall statistic = 94

Alpha	Critical	Signif.
0.01	118	No
0.05	90	Up
0.1	76	Up
0.2	60	Up

Constituent: SD (m)

Date: 1/15/09

Facility: Lake Trend Analysis

Time: 3:34 PM

Data File: OWASSO

View: owsso

Appendix H

Zooplankton and Phytoplankton Data

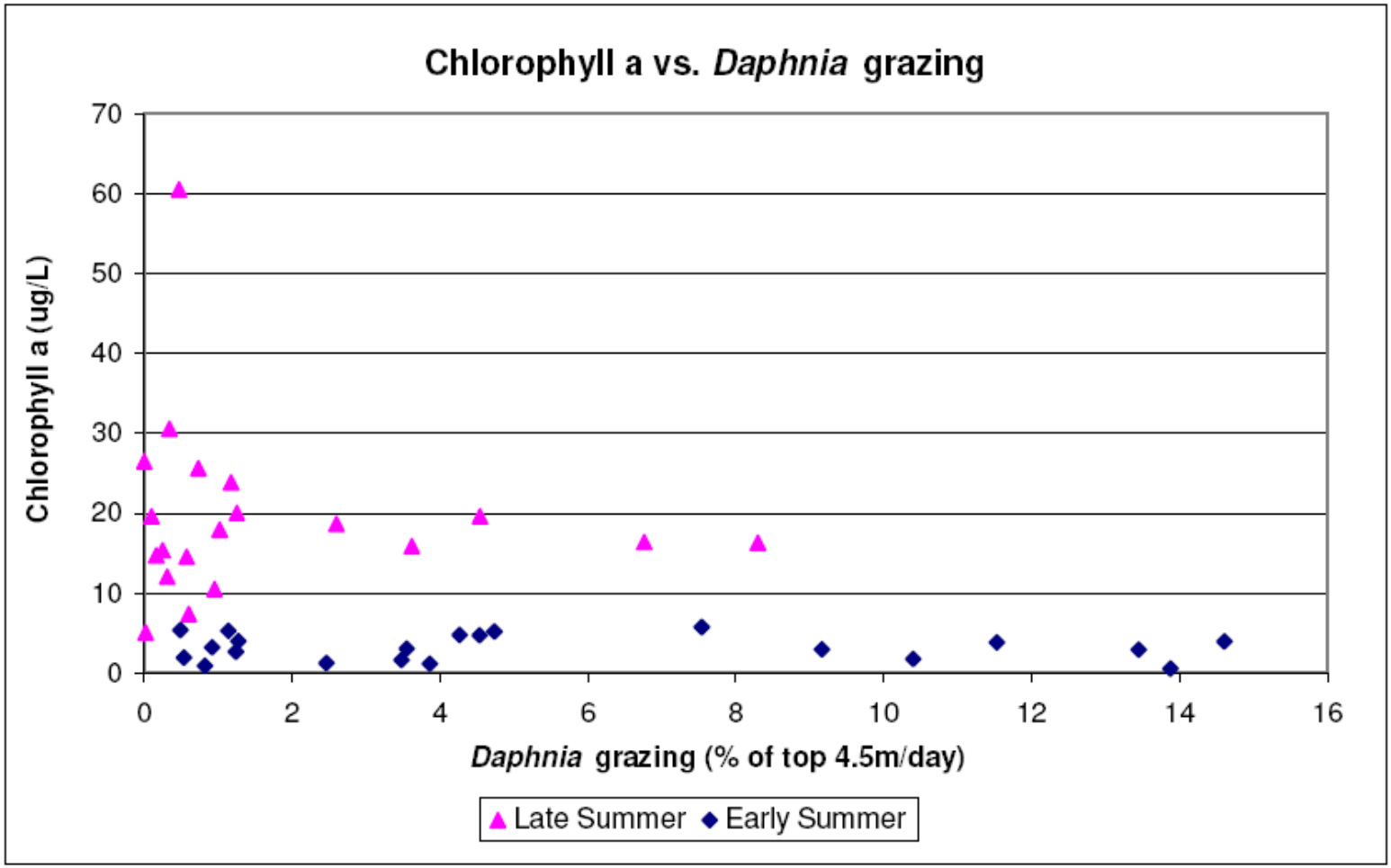
MEMO

To: Hal Runke, Barr Engineering Co.
From: Joseph Shapiro
Date: January 21, 2008
Subject: Lake Owasso Zooplankton Grazing Rates

As noted previously, there doesn't seem to be a great relationship between chlorophyll and grazing intensity when the two are plotted against each other (see following graph and tables). However, when both are plotted vs year, several years, 1985, 1990, and 1994 in the spring data, do show an inverse relation; and in the later data, 1987, 1993 and 2006 show the same. I don't think these are accidental. However, the zooplankton data you sent to me show that the zooplankters, including Daphnia, are really small. As grazing rate is proportional to the cube of body length, I am not surprised by the lack of more relations.

Whether the lack of larger grazing zooplankters results from destruction of refuges by eliminating macrophytes is moot. The lake is large enough that most daphnids would be distant from such refuges, and would probably instead migrate downwards at night to try to avoid predation by the fish. To my mind, I suspect the fish population, which I remember as comprising innumerable small zooplanktivores, is a much greater influence in maintaining small-bodied zooplankters. This winter may, because of the heavy snow, result in many of the planktivorous fish dying under the ice, leading to increased transparency in 2008, as the grazers respond by become larger, or possibly as D. pulex shows up, as it often does in winter-kill lakes. The data show that the highest transparencies in L. Owasso often are linked to low chlorophyll values (i.e. the transparency is more a function of chlorophyll rather than being controlled by suspended silt, or by water color,so the lake may look better next spring and summer.

I suspect that the Secchi Disc program has a lot of data on the lake, and comparing these with snowfall records may be illuminating.

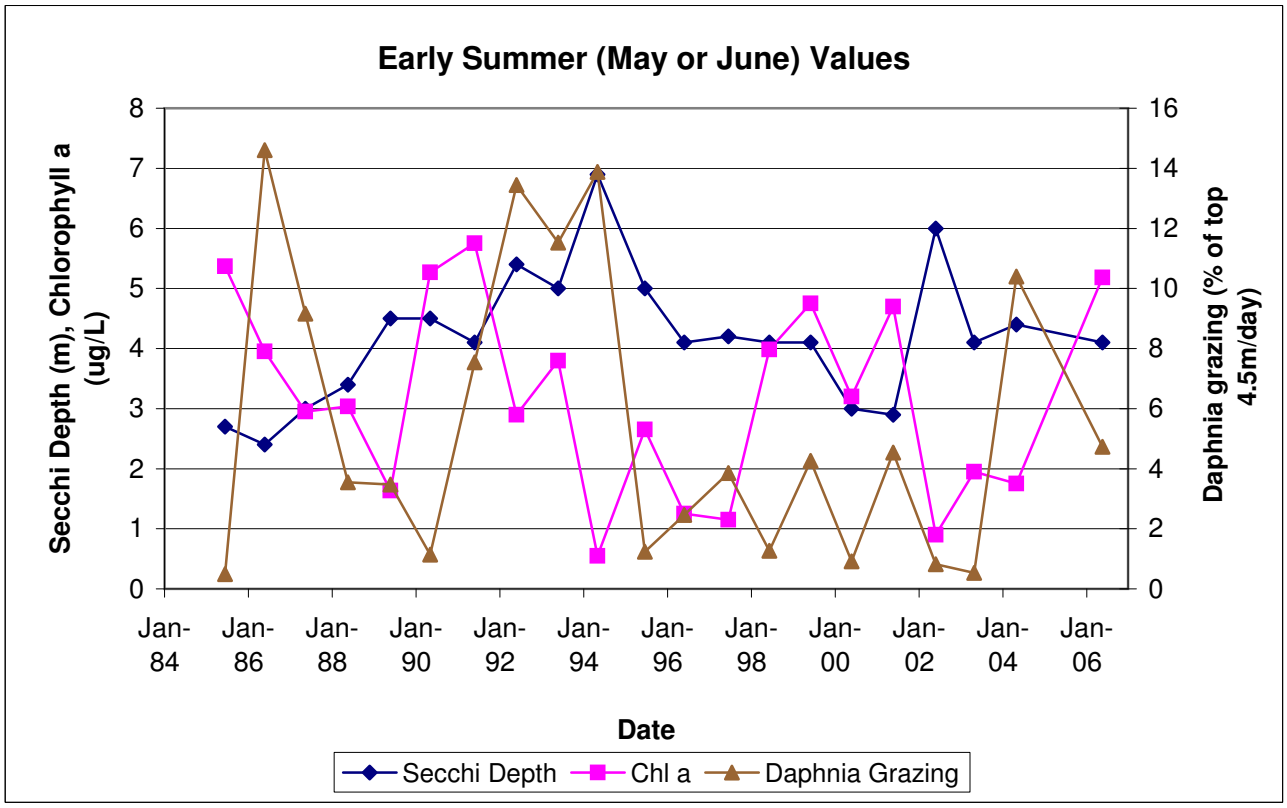

Chlorophyll a vs. Daphnia grazing
Chlorophyll a (ug/L)
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
Daphnia grazing (% of top 4.5m/day)
Late Summer
Early Summer

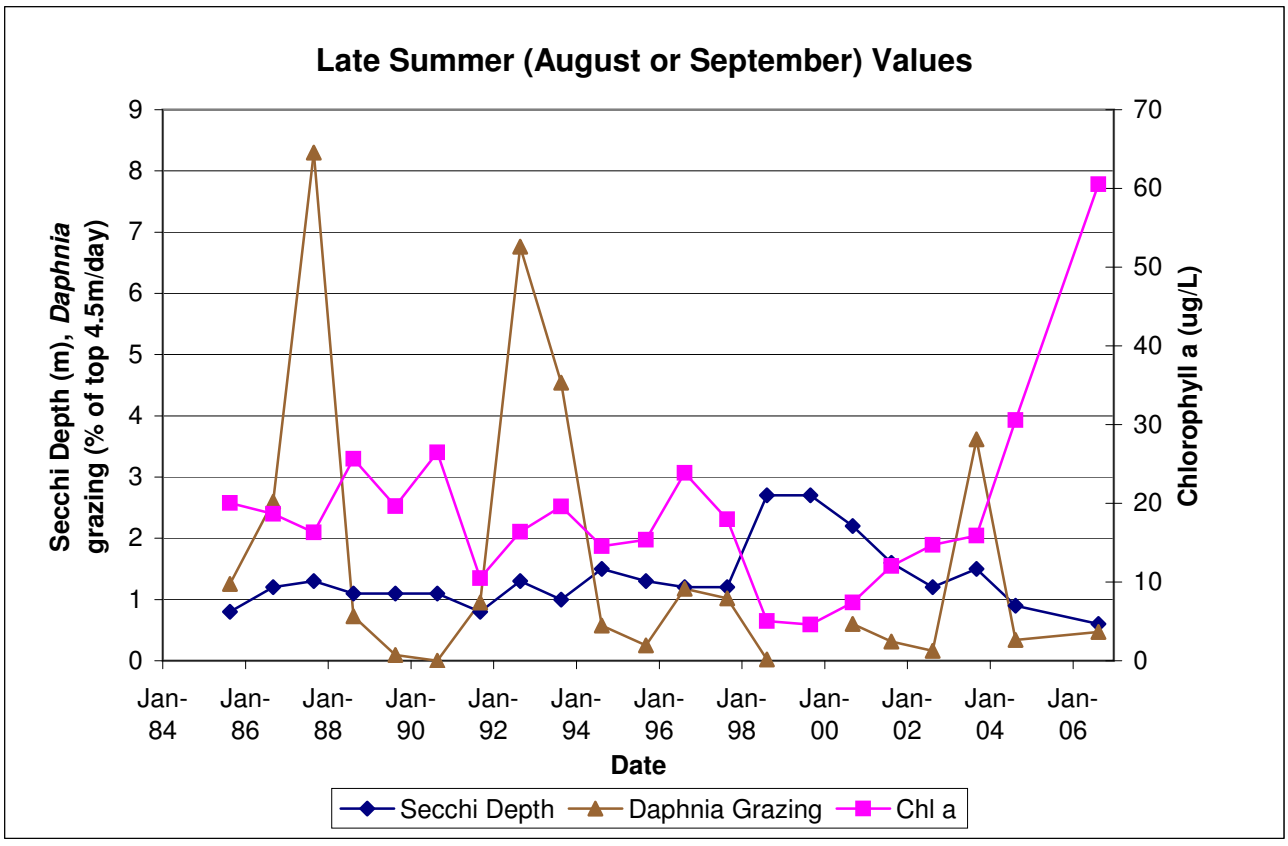
Early Summer (May or June) Secchi Depth Maximum Valu

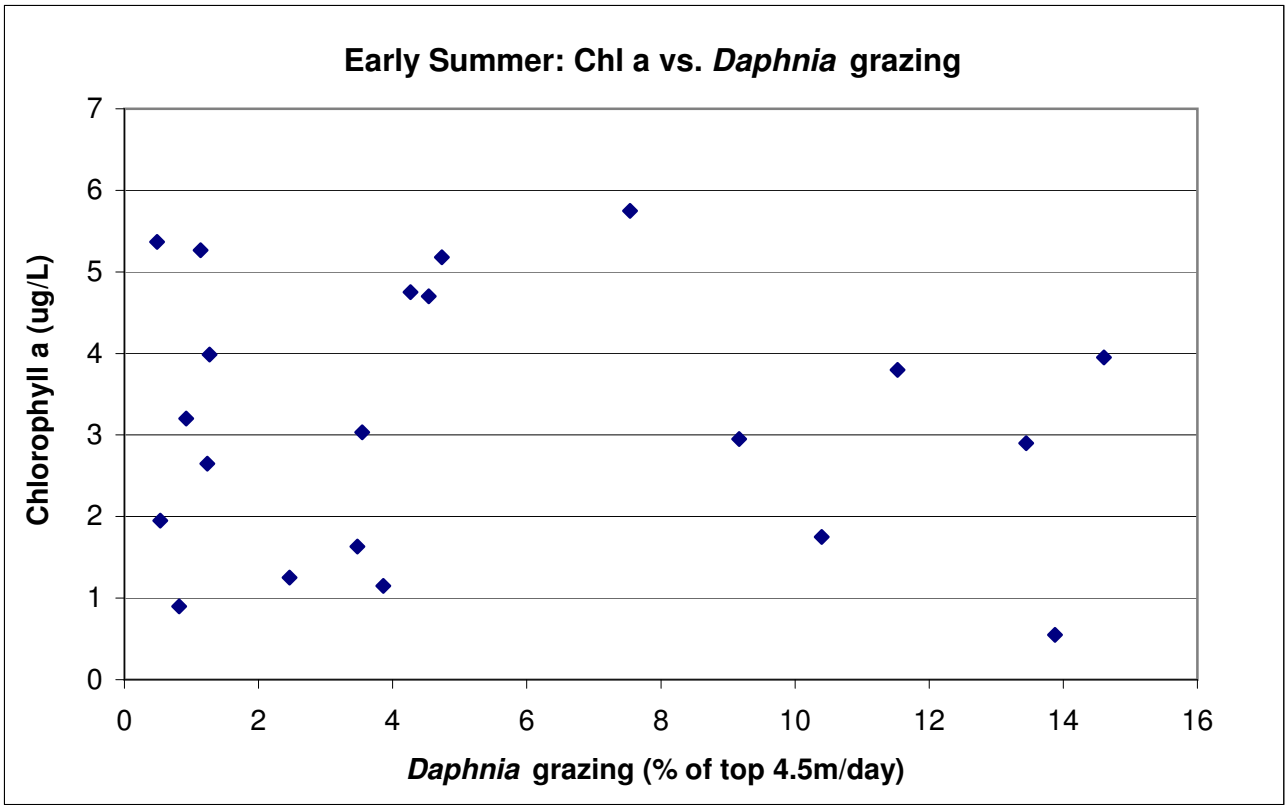
Date	Secchi Depth	Chl a	Daphnia Grazing
6/11/1985	2.7	5.37	0.489
5/22/1986	2.4	3.95	14.609
5/12/1987	3	2.95	9.166
5/18/1988	3.4	3.03	3.547
5/24/1989	4.5	1.63	3.476
5/4/1990	4.5	5.27	1.138
5/29/1991	4.1	5.75	7.539
5/26/1992	5.4	2.90	13.448
5/24/1993	5	3.80	11.529
5/2/1994	6.9	0.55	13.875
6/19/1995	5	2.65	1.237
5/28/1996	4.1	1.25	2.464
6/16/1997	4.2	1.15	3.860
6/9/1998	4.1	3.99	1.270
6/4/1999	4.1	4.75	4.265
5/25/2000	3	3.2	0.919
5/23/2001	2.9	4.7	4.536
5/29/2002	6	0.9	0.818
5/1/2003	4.1	1.95	0.535
5/3/2004	4.4	1.75	10.398
5/23/2006	4.1	5.18	4.734

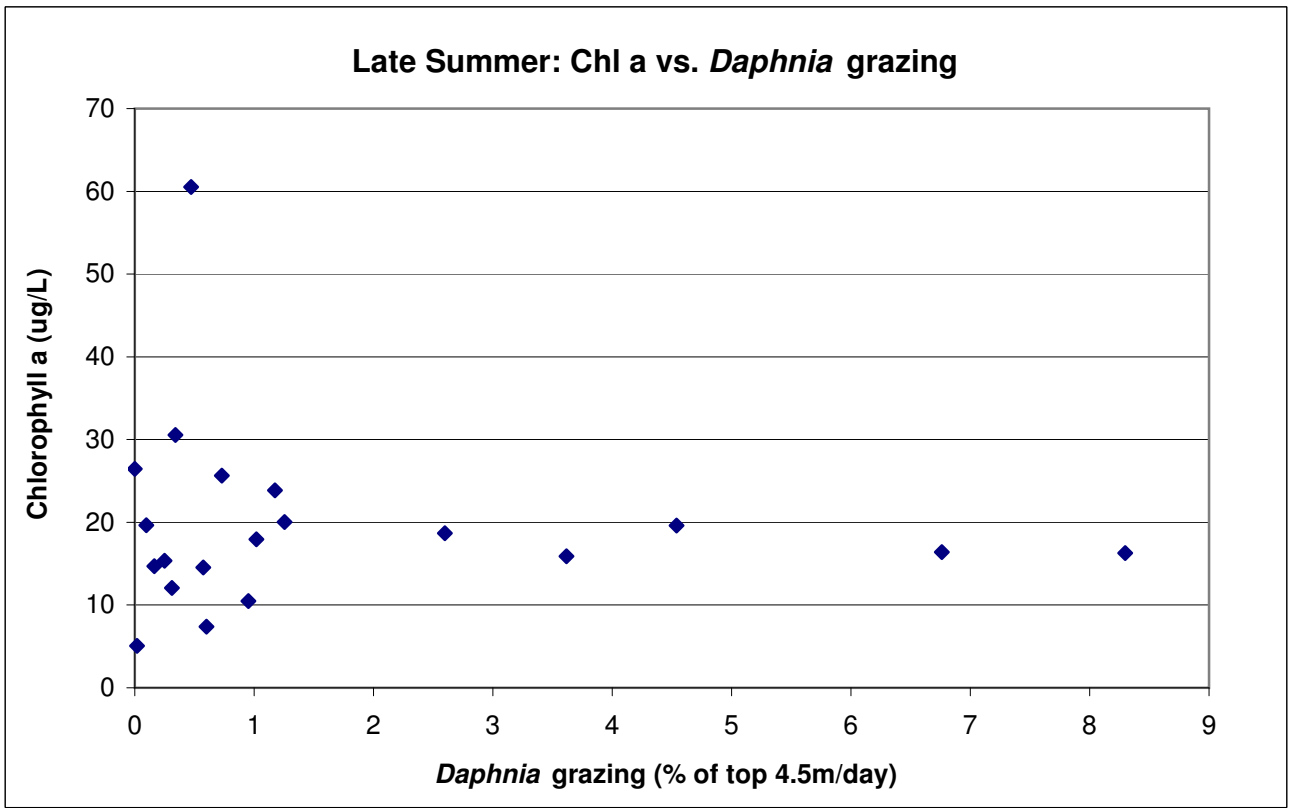
Late Summer (August or Sept) Chl a Maximum Values

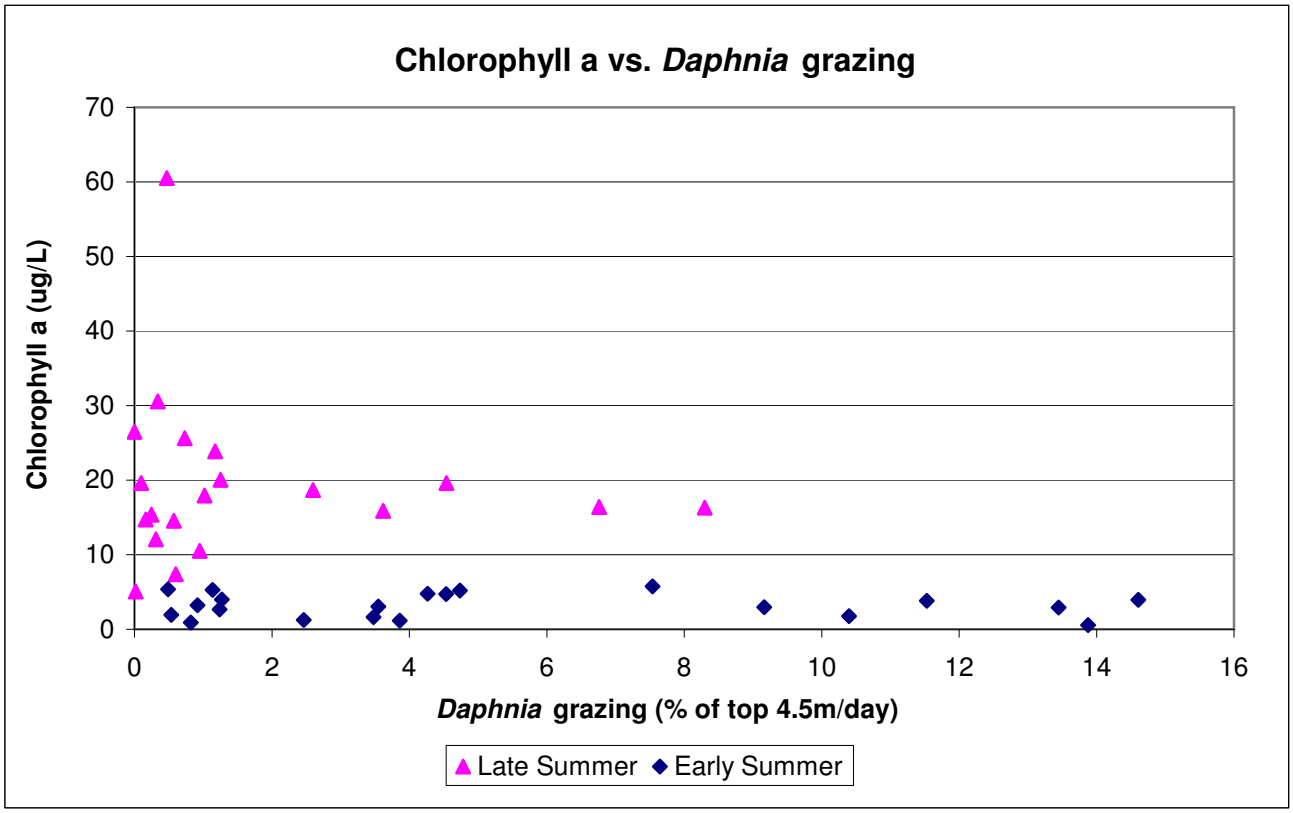
Date	Secchi Depth	Chl a	Daphnia Grazing
8/16/1985	0.8	20.03	1.254
9/2/1986	1.2	18.67	2.599
8/28/1987	1.3	16.30	8.297
8/11/1988	1.1	25.63	0.729
8/18/1989	1.1	19.63	0.096
8/22/1990	1.1	26.47	0.000
9/4/1991	0.8	10.50	0.951
8/24/1992	1.3	16.40	6.762
8/19/1993	1	19.60	4.539
8/15/1994	1.5	14.55	0.574
9/7/1995	1.3	15.35	0.249
8/15/1996	1.2	23.85	1.175
8/27/1997	1.2	17.95	1.018
8/12/1998	2.7	5.05	0.019
8/31/1999	2.7	4.60	
9/7/2000	2.2	7.40	0.600
8/16/2001	1.6	12.05	0.311
8/16/2002	1.2	14.70	0.163
9/5/2003	1.5	15.90	3.616
8/16/2004	0.9	30.55	0.341
8/18/2006	0.6	60.51	0.472


Early Summer (May or June) Values
Secchi Depth (m), Chlorophyll a (ug/L)
Daphnia grazing (% of top 4.5m/day)
0
1
2
3
4
5
6
7
8
0
2
4
6
8
10
12
14
16
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Date
Secchi Depth
Chl a
Daphnia Grazing


Late Summer (August or September) Values
Secchi Depth (m), Daphnia grazing (% of top 4.5m/day)
Chlorophyll a (ug/L)
0
1
2
3
4
5
6
7
8
9
0
10
20
30
40
50
60
70
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Date
Secchi Depth
Daphnia Grazing
Chl a


Early Summer: Chl a vs. Daphnia grazing
Chlorophyll a (ug/L)
0
1
2
3
4
5
6
7
0
2
4
6
8
10
12
14
16
Daphnia grazing (% of top 4.5m/day)


Late Summer: Chl a vs. Daphnia grazing
Chlorophyll a (ug/L)
0
10
20
30
40
50
60
70
0
1
2
3
4
5
6
7
8
9
Daphnia grazing (% of top 4.5m/day)

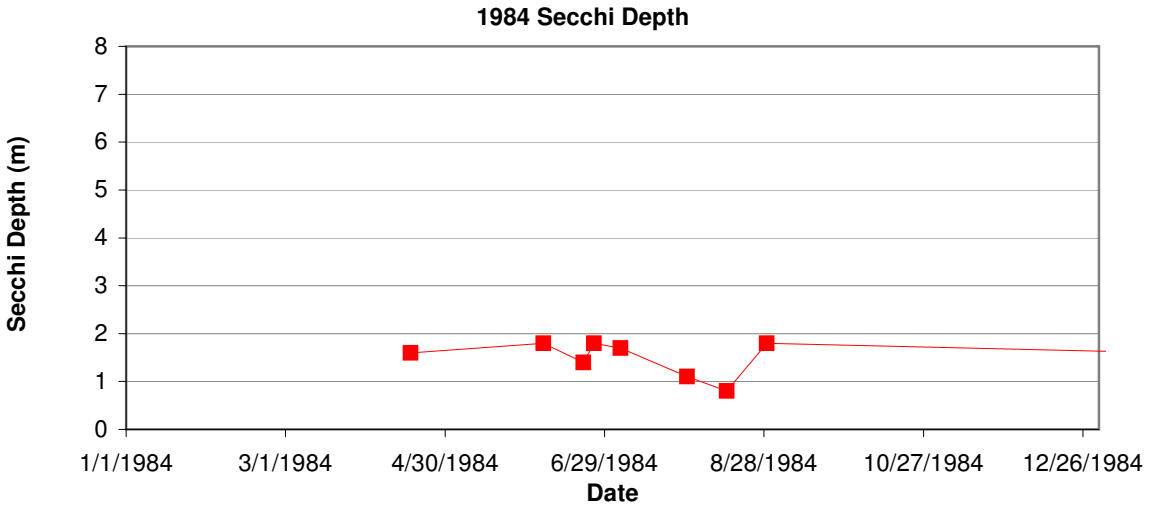

Chlorophyll a vs. Daphnia grazing
Chlorophyll a (ug/L)
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
Daphnia grazing (% of top 4.5m/day)
Late Summer
Early Summer

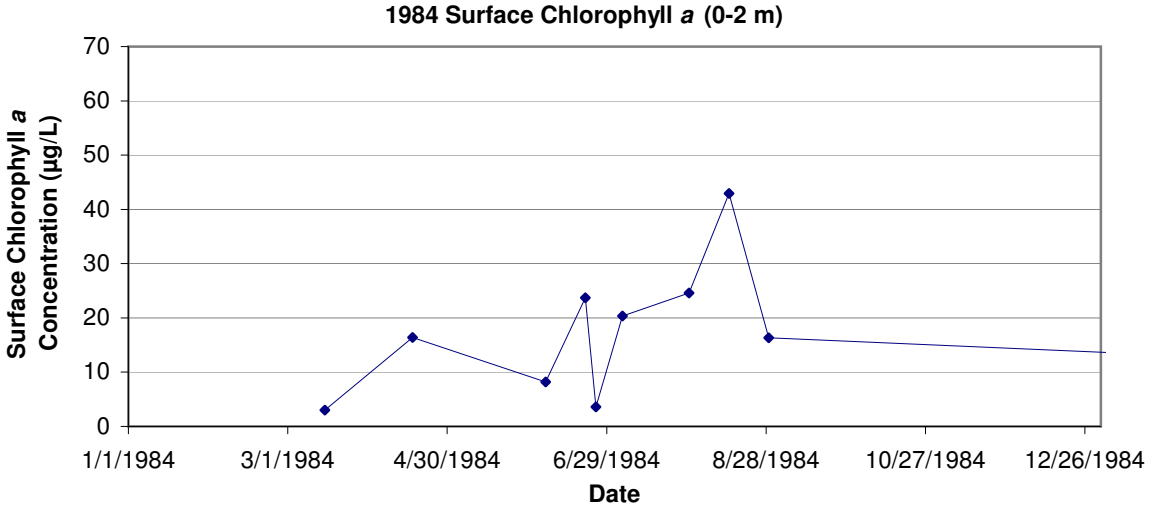
Early Summer (May or June) Secchi Depth Maximum Values

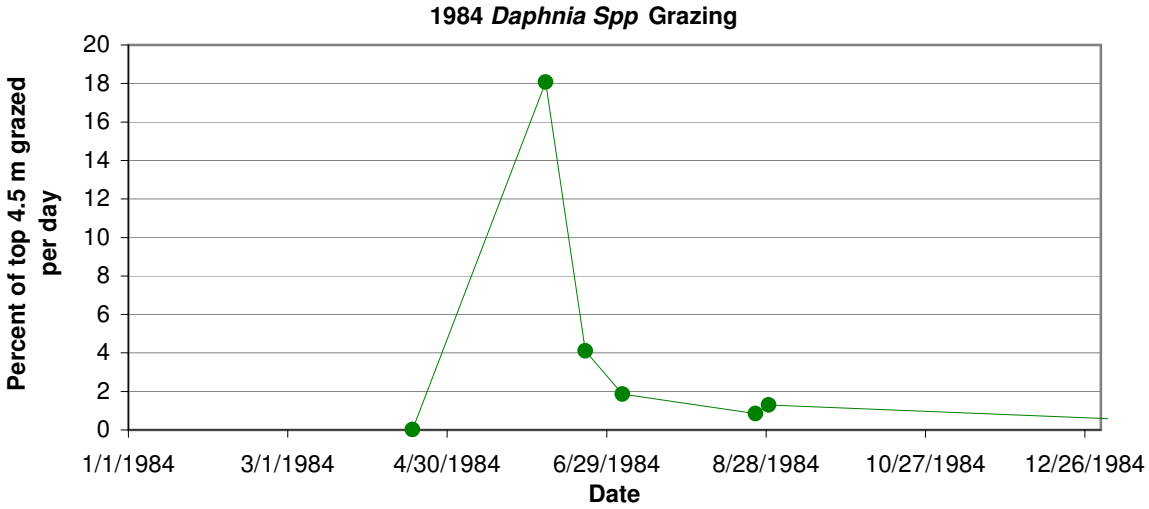
Date	Secchi Depth	Chl a	Daphnia Grazing
6/11/1985	2.7	5.37	0.489
5/22/1986	2.4	3.95	14.609
5/12/1987	3	2.95	9.166
5/18/1988	3.4	3.03	3.547
5/24/1989	4.5	1.63	3.476
5/4/1990	4.5	5.27	1.138
5/29/1991	4.1	5.75	7.539
5/26/1992	5.4	2.90	13.448
5/24/1993	5	3.80	11.529
5/2/1994	6.9	0.55	13.875
6/19/1995	5	2.65	1.237
5/28/1996	4.1	1.25	2.464
6/16/1997	4.2	1.15	3.860
6/9/1998	4.1	3.99	1.270
6/4/1999	4.1	4.75	4.265
5/25/2000	3	3.2	0.919
5/23/2001	2.9	4.7	4.536
5/29/2002	6	0.9	0.818
5/1/2003	4.1	1.95	0.535
5/3/2004	4.4	1.75	10.398
5/23/2006	4.1	5.18	4.734

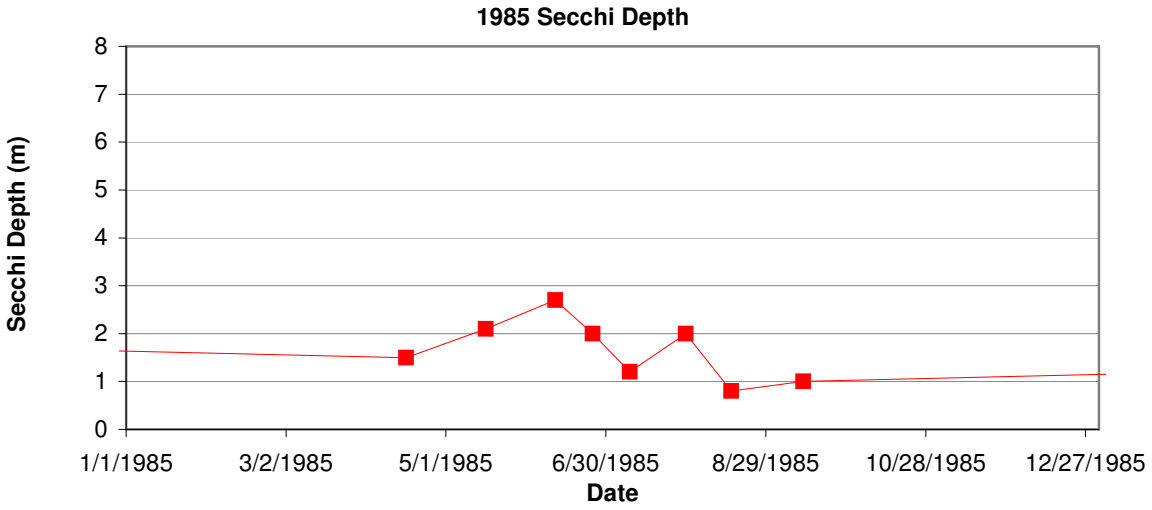
Late Summer (August or Sept) Chl a Maximum Values

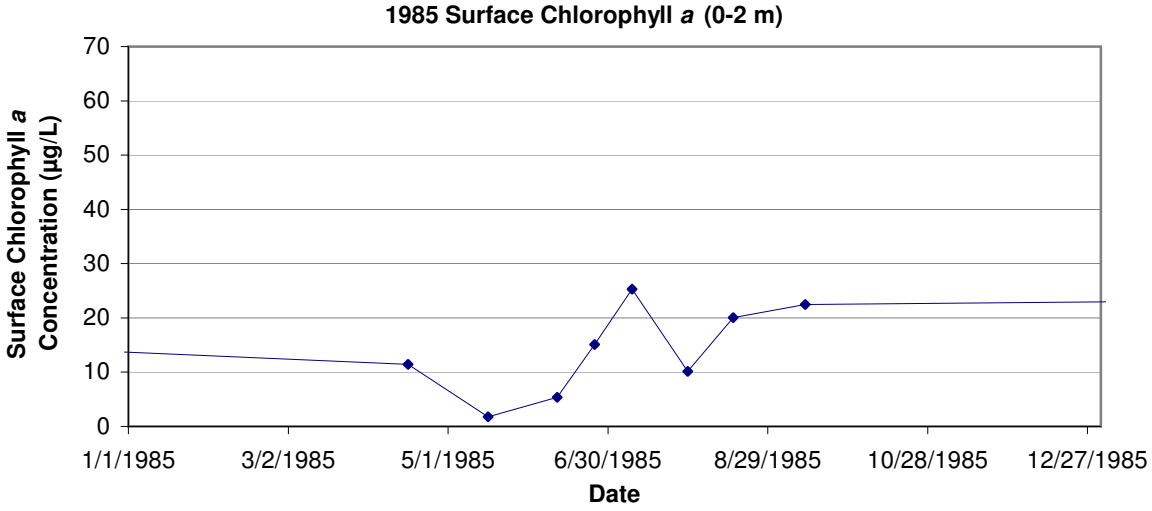
Date	Secchi Depth	Chl a	Daphnia Grazing
8/16/1985	0.8	20.03	1.254
9/2/1986	1.2	18.67	2.599
8/28/1987	1.3	16.30	8.297
8/11/1988	1.1	25.63	0.729
8/18/1989	1.1	19.63	0.096
8/22/1990	1.1	26.47	0.000
9/4/1991	0.8	10.50	0.951
8/24/1992	1.3	16.40	6.762
8/19/1993	1	19.60	4.539
8/15/1994	1.5	14.55	0.574
9/7/1995	1.3	15.35	0.249
8/15/1996	1.2	23.85	1.175
8/27/1997	1.2	17.95	1.018
8/12/1998	2.7	5.05	0.019
8/31/1999	2.7	4.60	
9/7/2000	2.2	7.40	0.600
8/16/2001	1.6	12.05	0.311
8/16/2002	1.2	14.70	0.163
9/5/2003	1.5	15.90	3.616
8/16/2004	0.9	30.55	0.341
8/18/2006	0.6	60.51	0.472

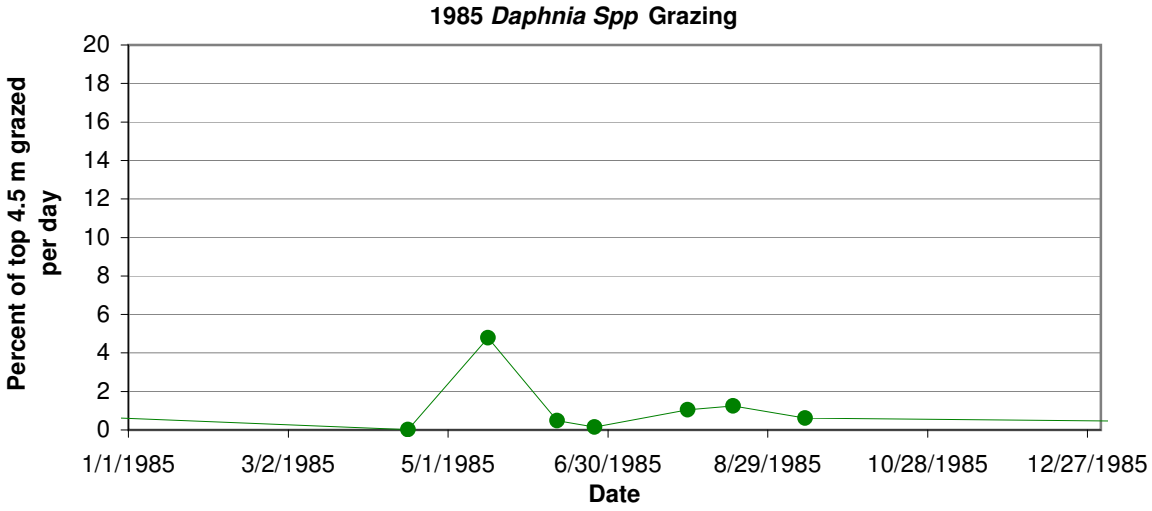

1984 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1984
3/1/1984
4/30/1984
6/29/1984
8/28/1984
10/27/1984
12/26/1984
Date

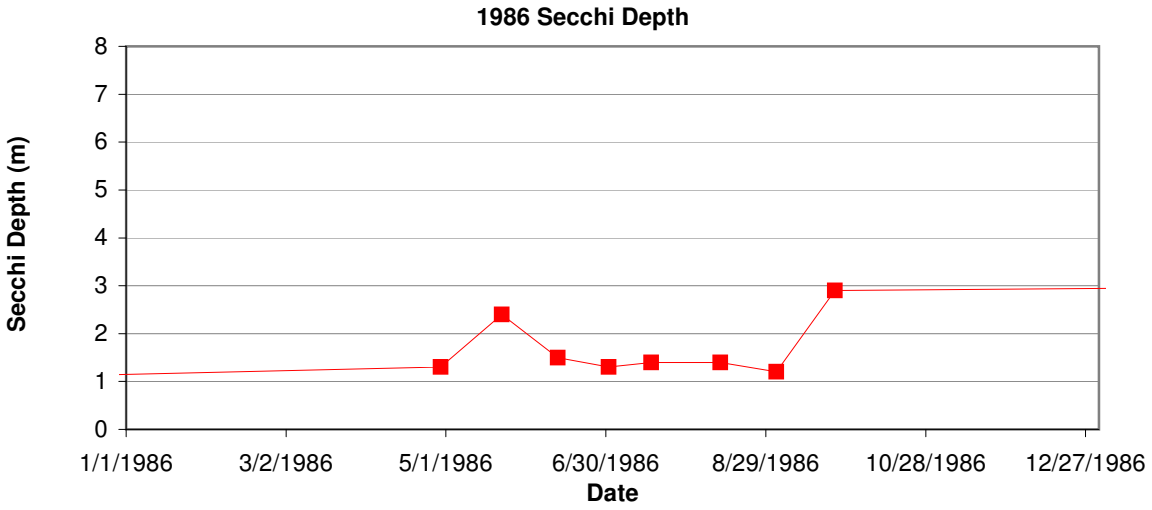

1984 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1984
3/1/1984
4/30/1984
6/29/1984
8/28/1984
10/27/1984
12/26/1984
Date

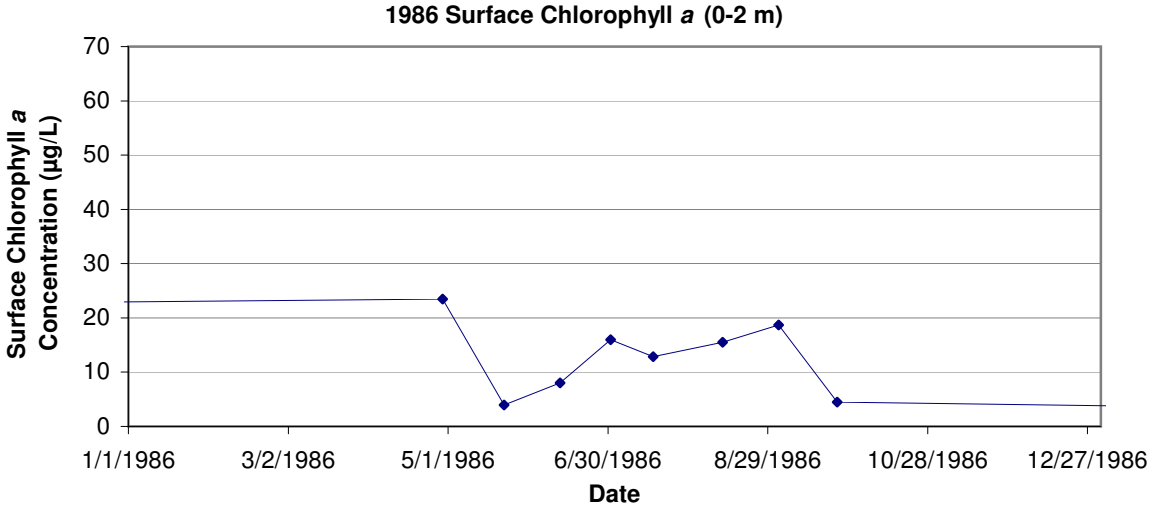

1984 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1984
3/1/1984
4/30/1984
6/29/1984
8/28/1984
10/27/1984
12/26/1984
Date

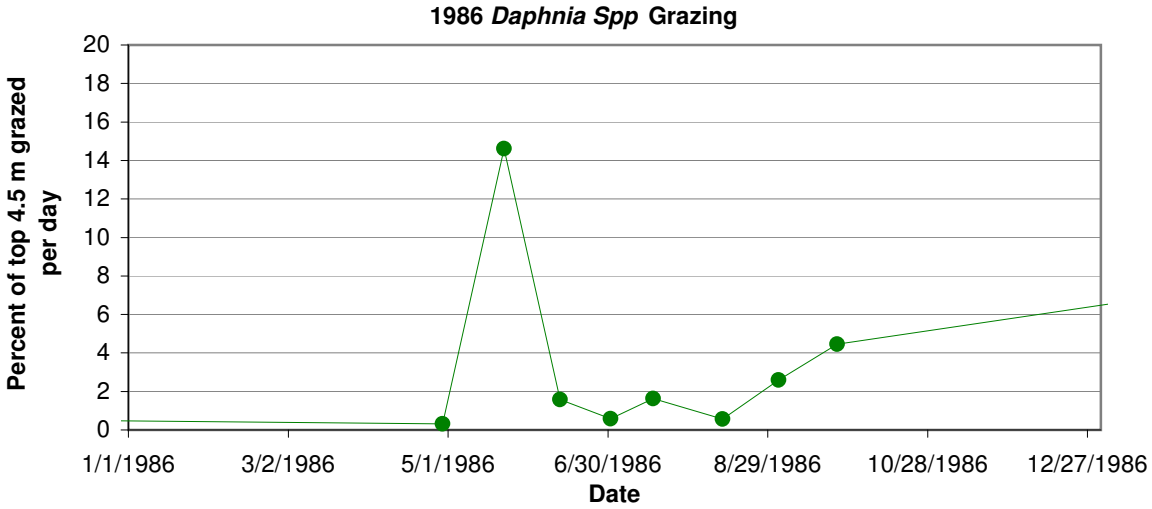

1985 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1985
3/2/1985
5/1/1985
6/30/1985
8/29/1985
10/28/1985
12/27/1985
Date

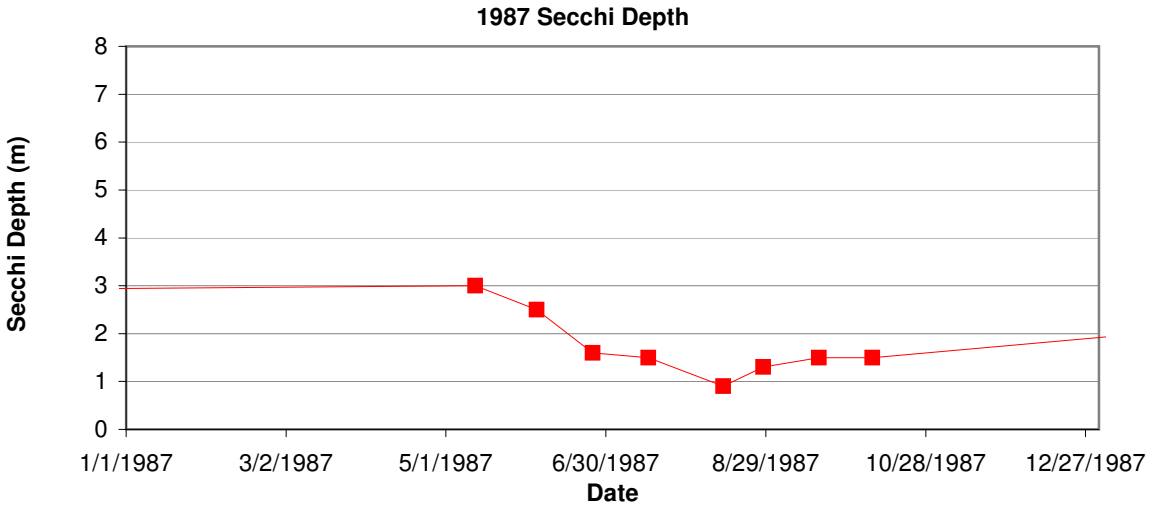

1985 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1985
3/2/1985
5/1/1985
6/30/1985
8/29/1985
10/28/1985
12/27/1985
Date

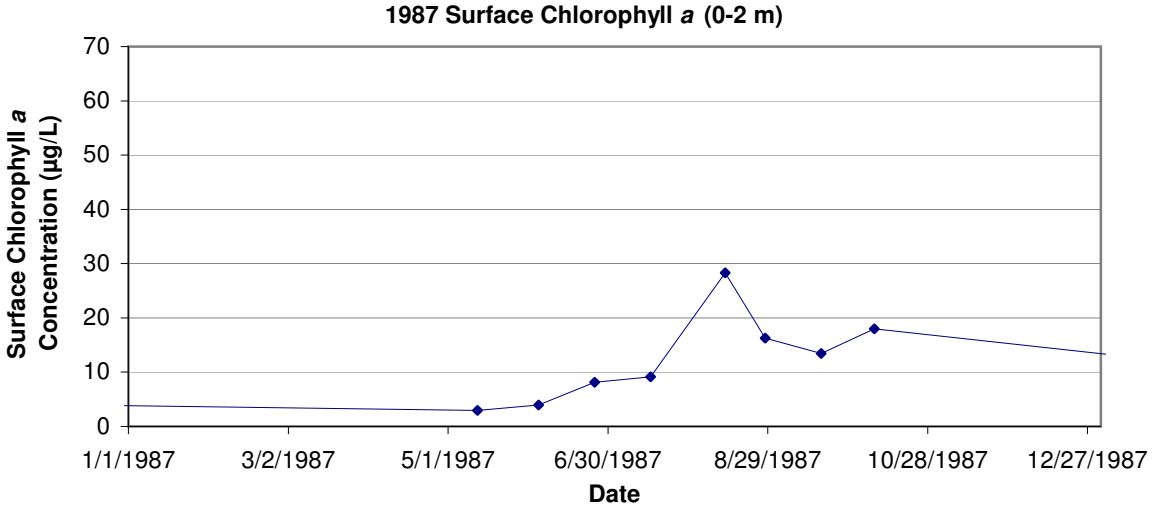

1985 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1985
3/2/1985
5/1/1985
6/30/1985
8/29/1985
10/28/1985
12/27/1985
Date

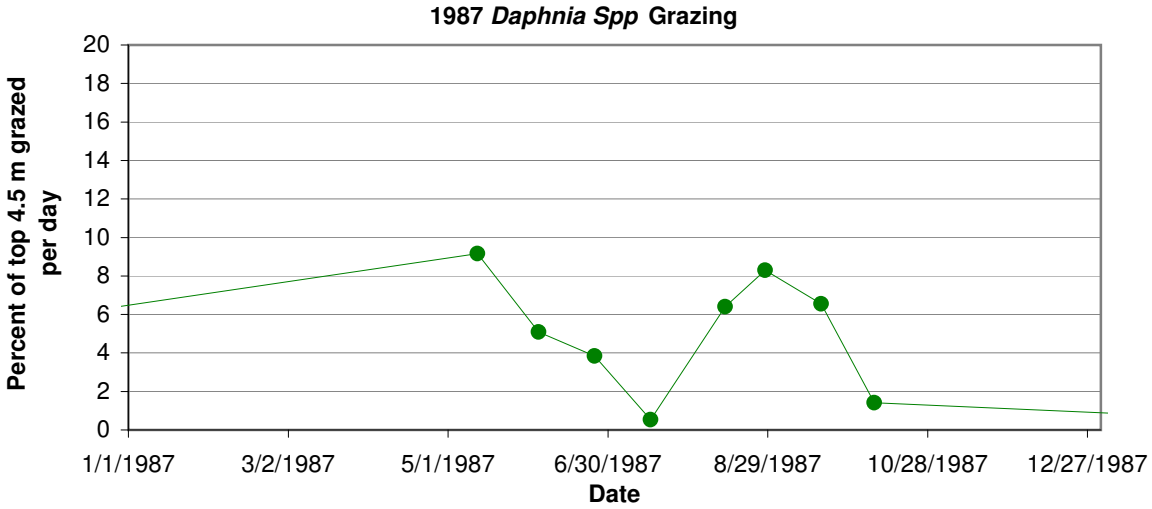

1986 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1986
3/2/1986
5/1/1986
6/30/1986
8/29/1986
10/28/1986
12/27/1986
Date

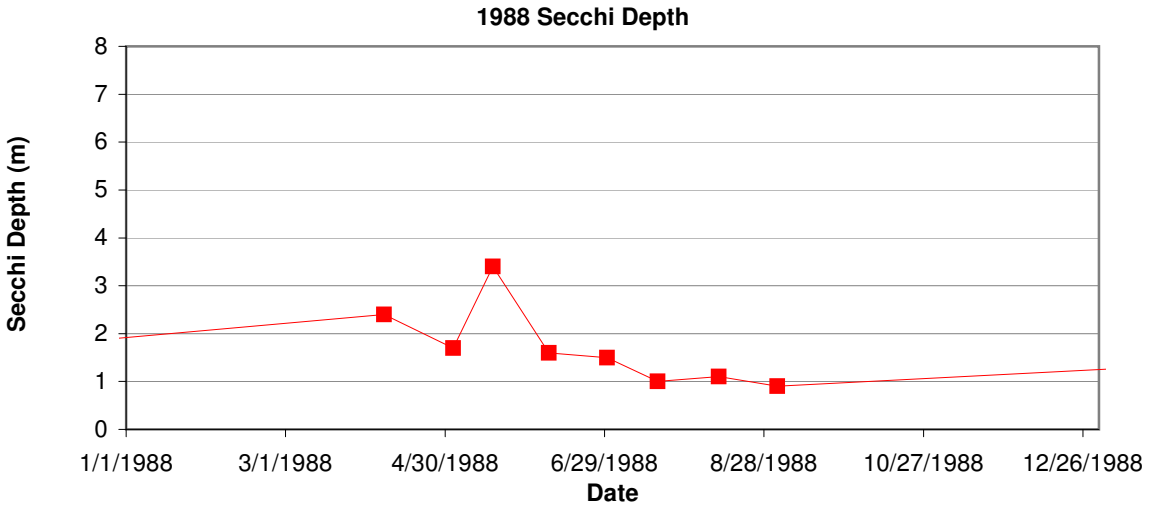

1986 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1986
3/2/1986
5/1/1986
6/30/1986
8/29/1986
10/28/1986
12/27/1986
Date

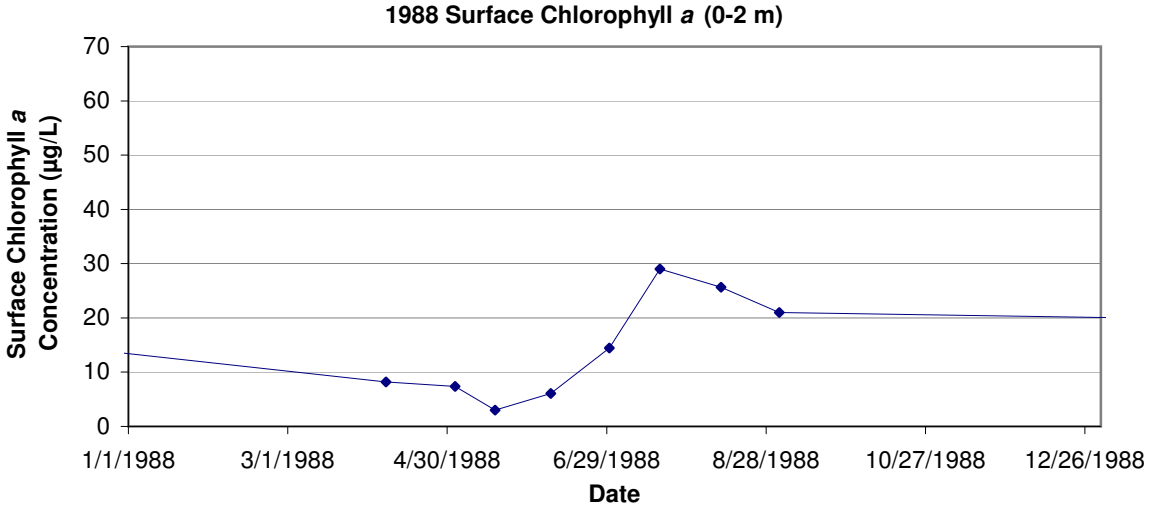

1986 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1986
3/2/1986
5/1/1986
6/30/1986
8/29/1986
10/28/1986
12/27/1986
Date

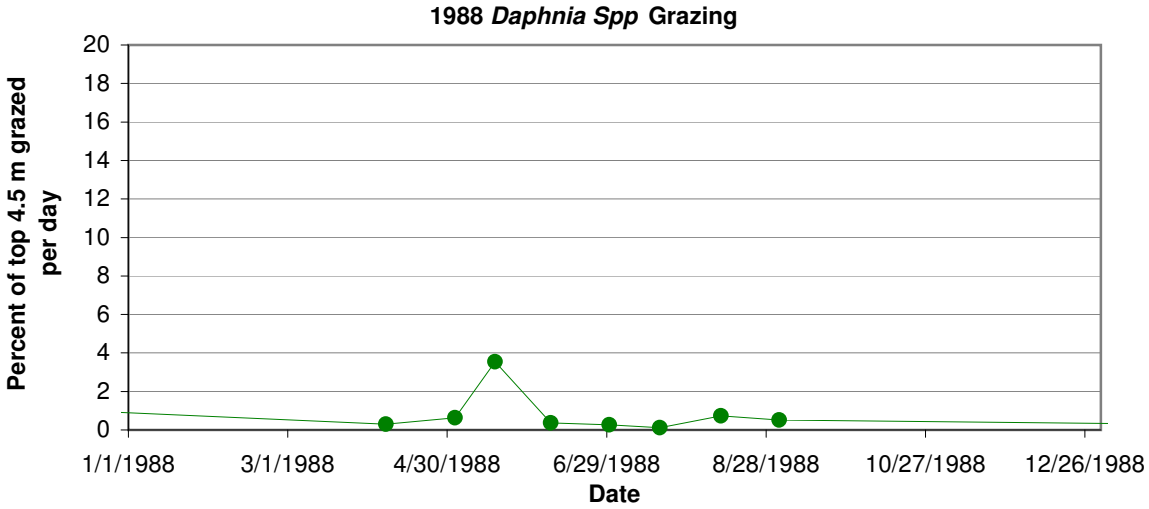

1987 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1987
3/2/1987
5/1/1987
6/30/1987
8/29/1987
10/28/1987
12/27/1987
Date

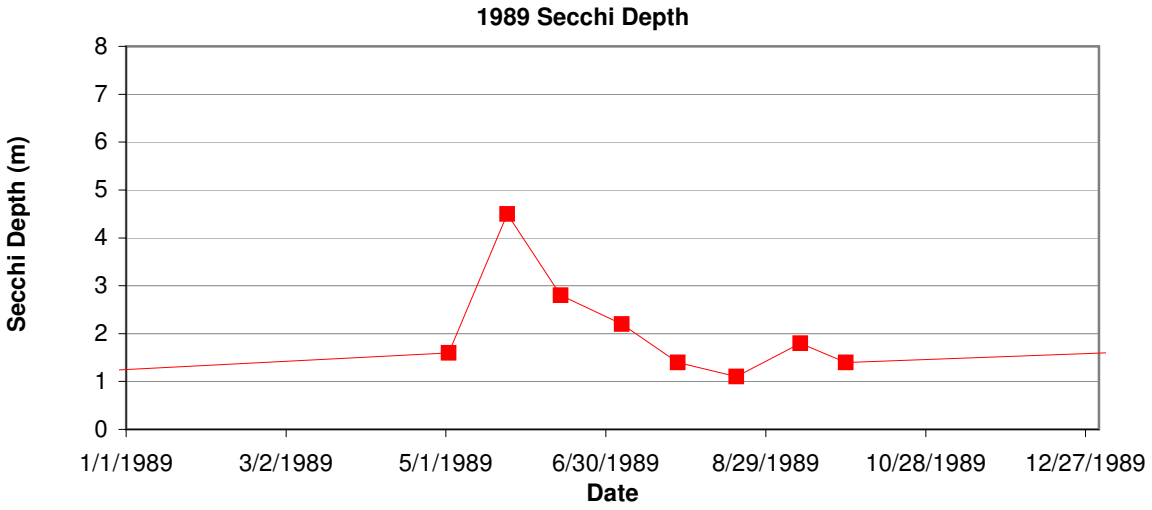

1987 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1987
3/2/1987
5/1/1987
6/30/1987
8/29/1987
10/28/1987
12/27/1987
Date

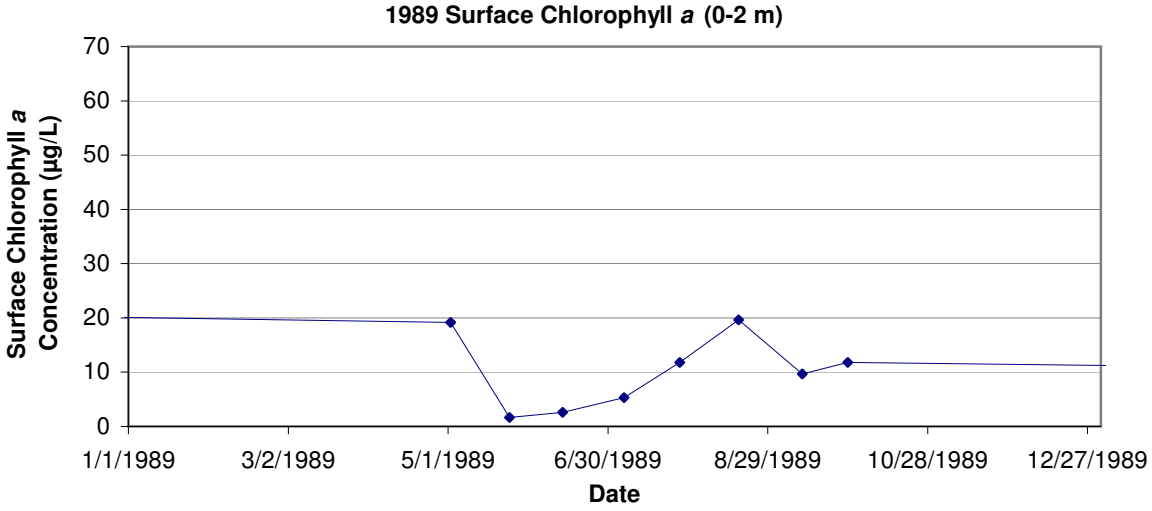

1987 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1987
3/2/1987
5/1/1987
6/30/1987
8/29/1987
10/28/1987
12/27/1987
Date

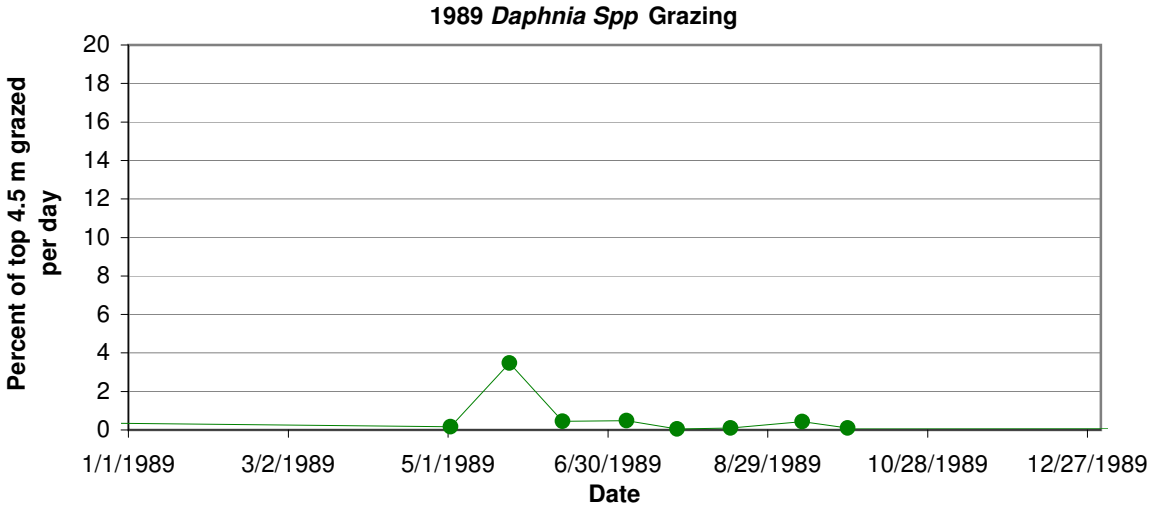

1988 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1988
3/1/1988
4/30/1988
6/29/1988
8/28/1988
10/27/1988
12/26/1988
Date

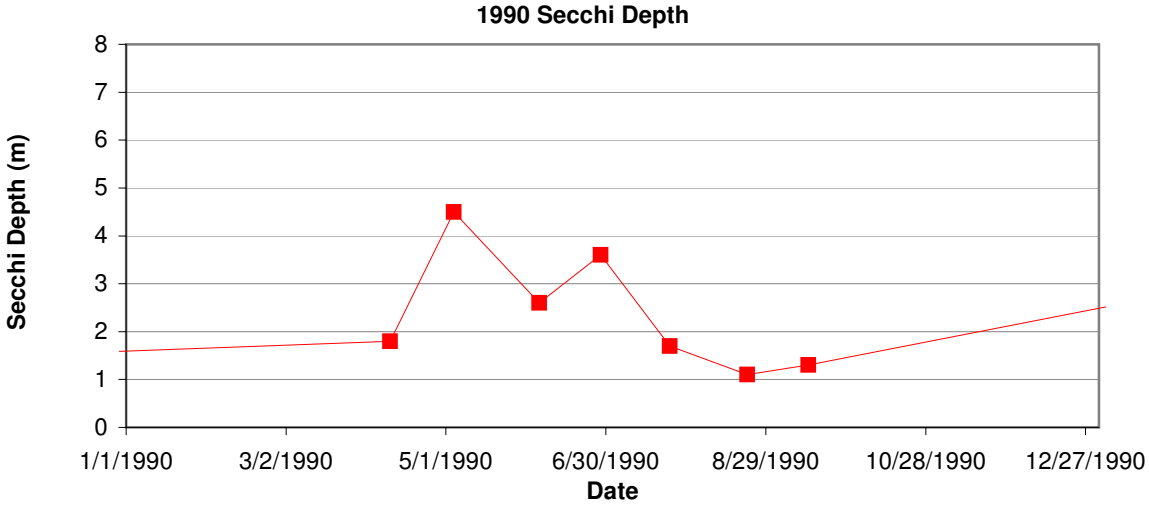

1988 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1988
3/1/1988
4/30/1988
6/29/1988
8/28/1988
10/27/1988
12/26/1988
Date

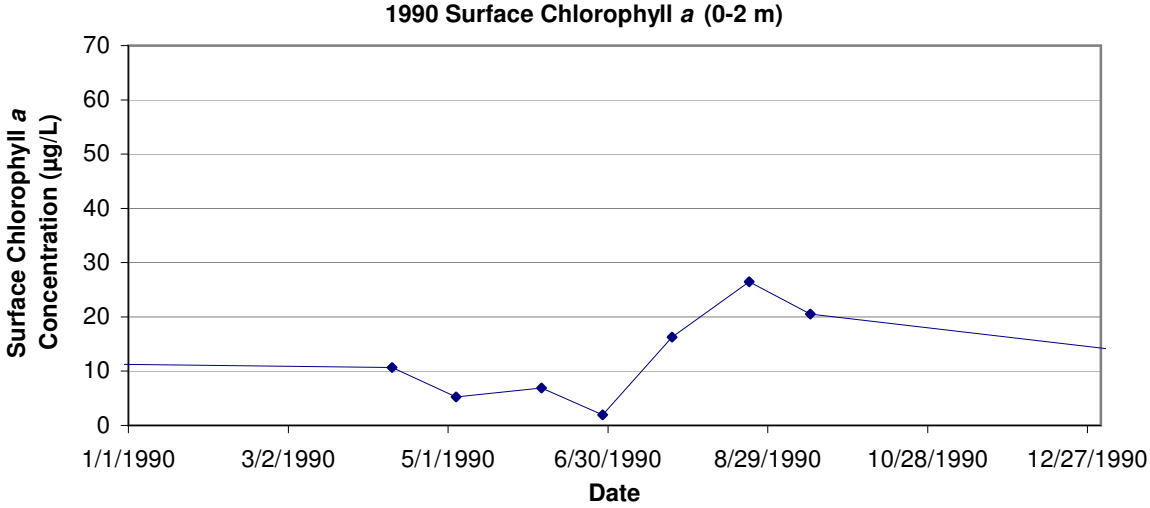

1988 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1988
3/1/1988
4/30/1988
6/29/1988
8/28/1988
10/27/1988
12/26/1988
Date

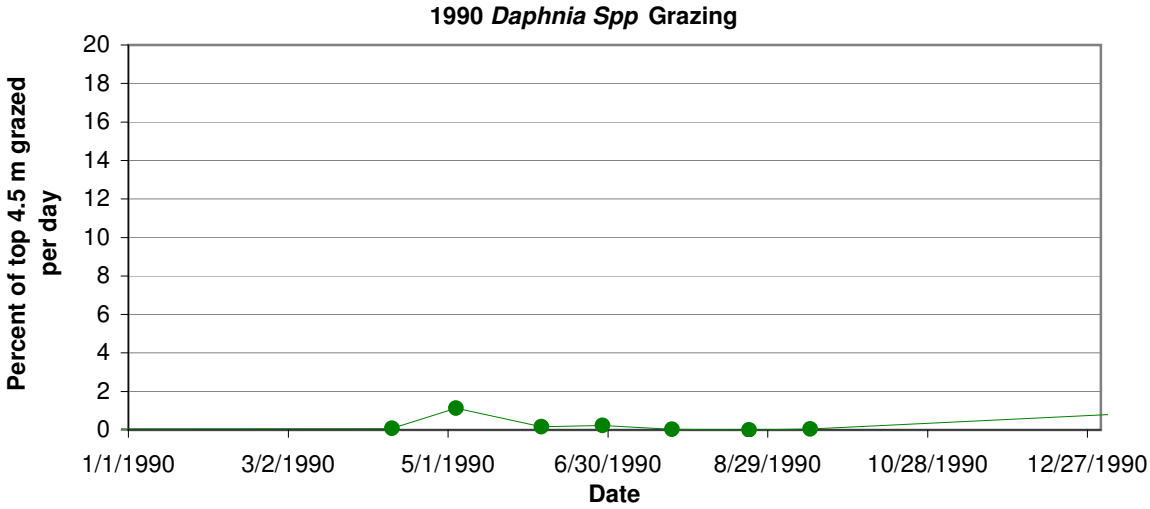

1989 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1989
3/2/1989
5/1/1989
6/30/1989
8/29/1989
10/28/1989
12/27/1989
Date

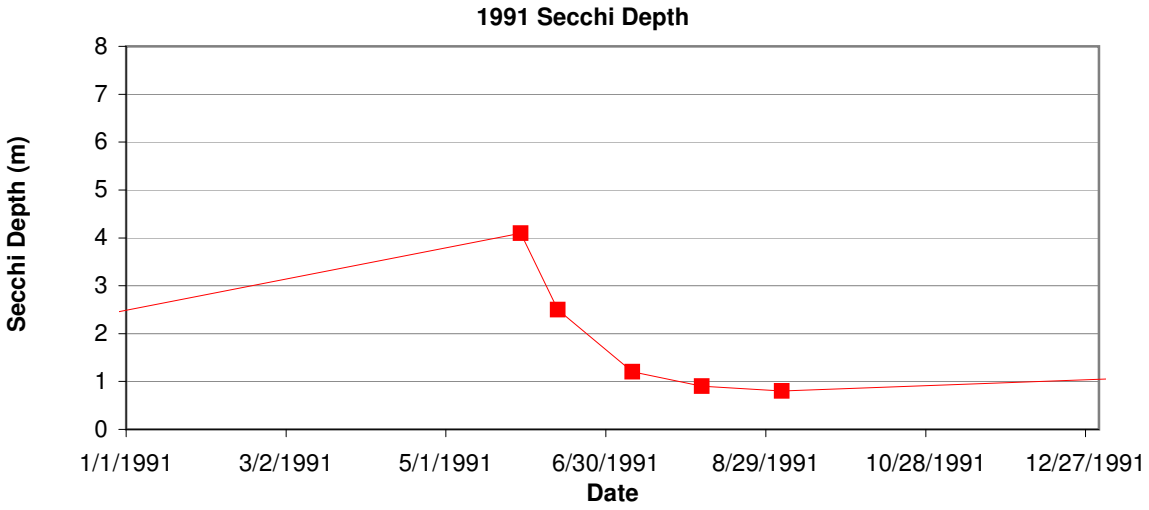

1989 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1989
3/2/1989
5/1/1989
6/30/1989
8/29/1989
10/28/1989
12/27/1989
Date

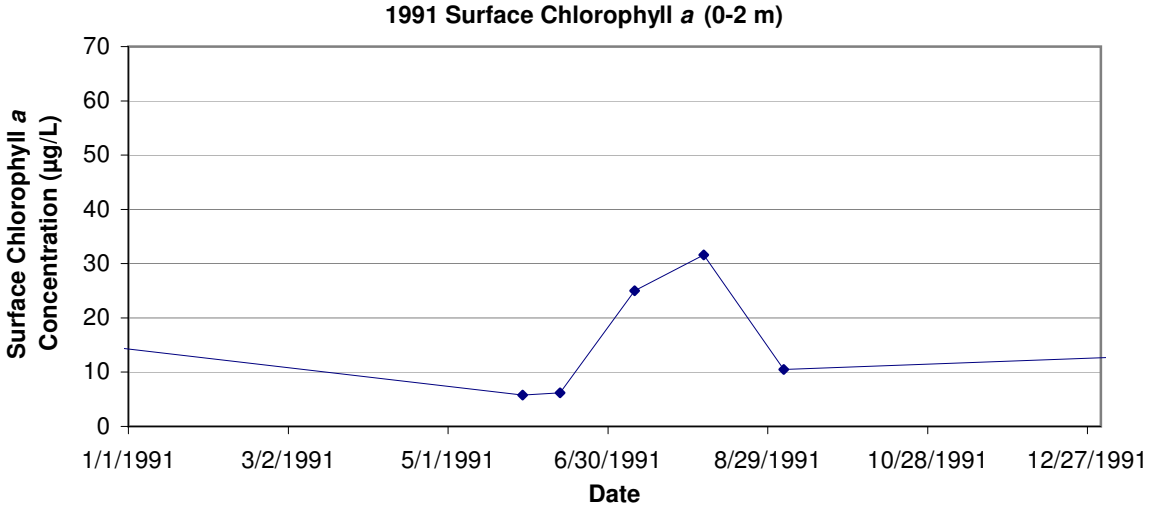

1989 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1989
3/2/1989
5/1/1989
6/30/1989
8/29/1989
10/28/1989
12/27/1989
Date

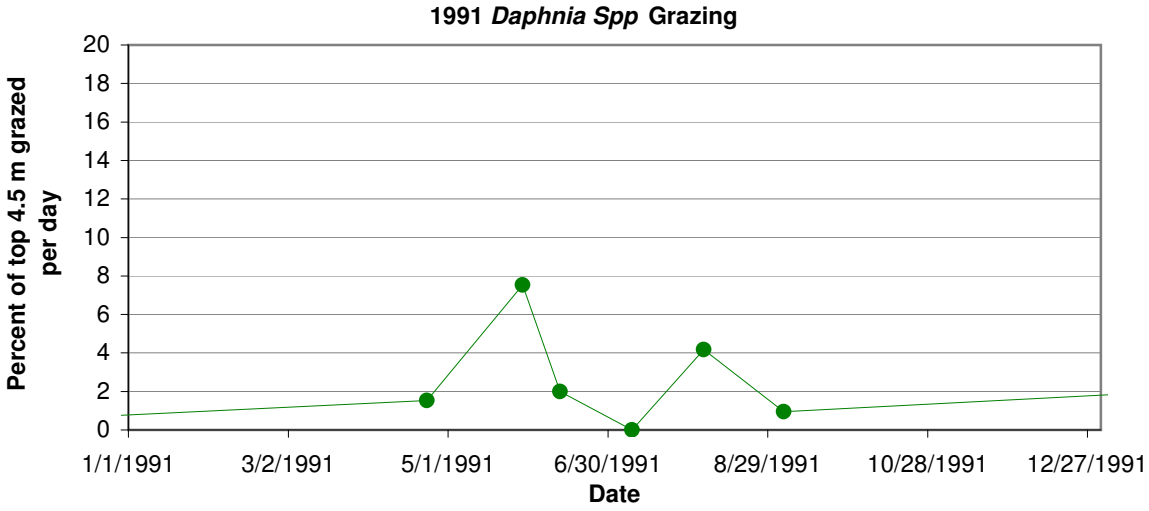

1990 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1990
3/2/1990
5/1/1990
6/30/1990
8/29/1990
10/28/1990
12/27/1990
Date

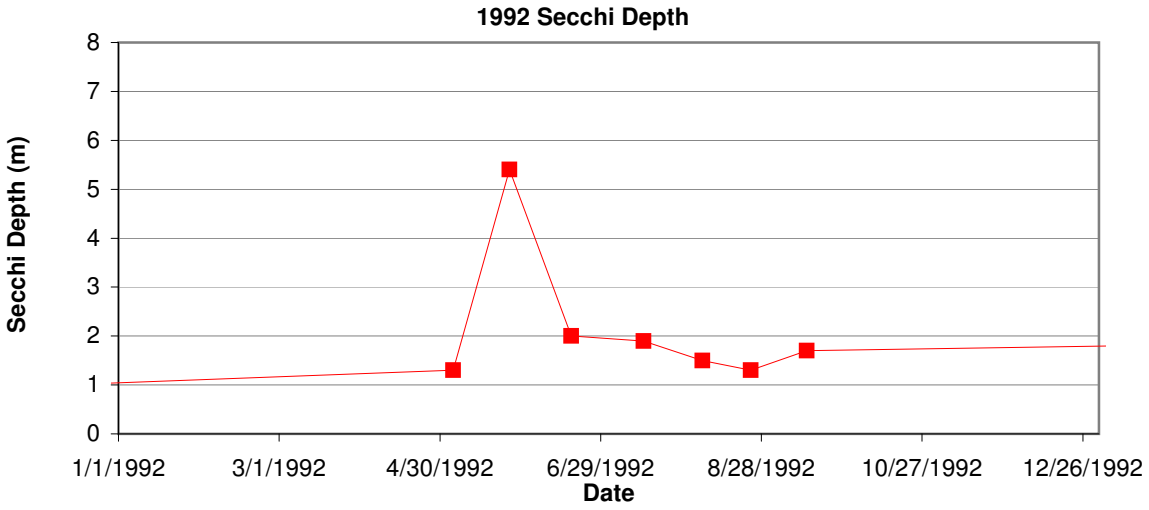

1990 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1990
3/2/1990
5/1/1990
6/30/1990
8/29/1990
10/28/1990
12/27/1990
Date

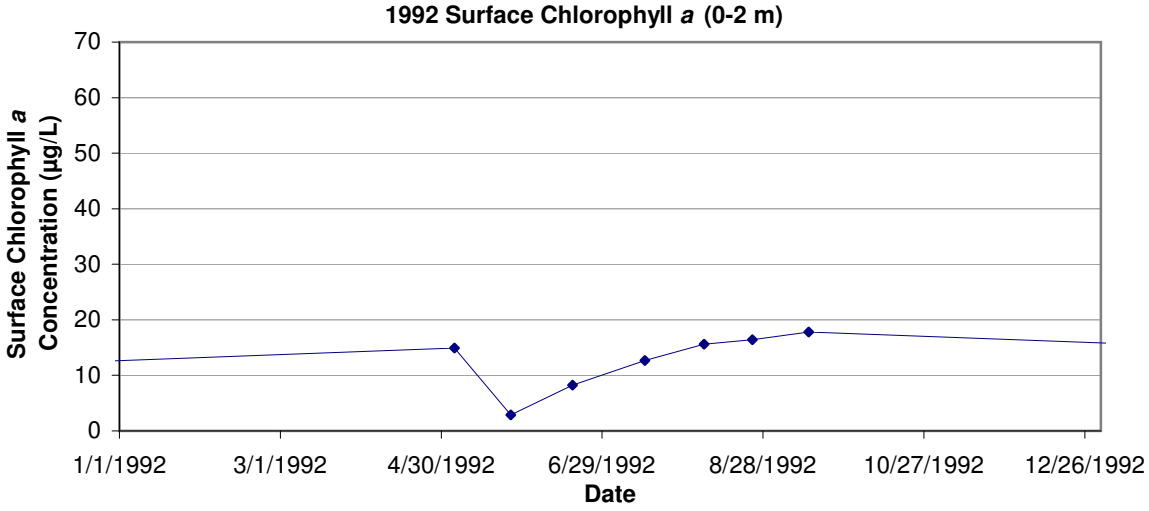

1990 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1990
3/2/1990
5/1/1990
6/30/1990
8/29/1990
10/28/1990
12/27/1990
Date

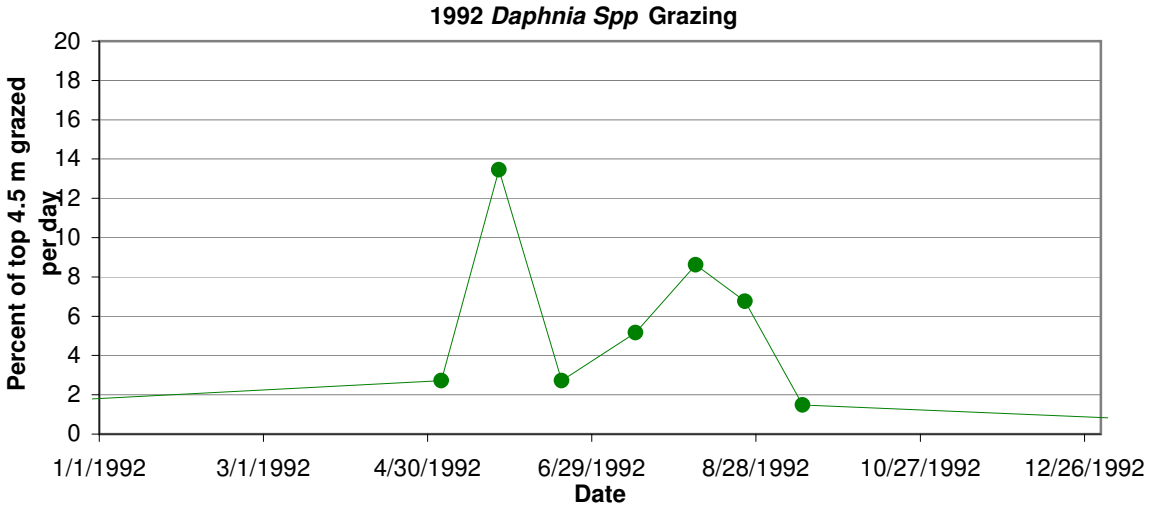

1991 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1991
3/2/1991
5/1/1991
6/30/1991
8/29/1991
10/28/1991
12/27/1991
Date

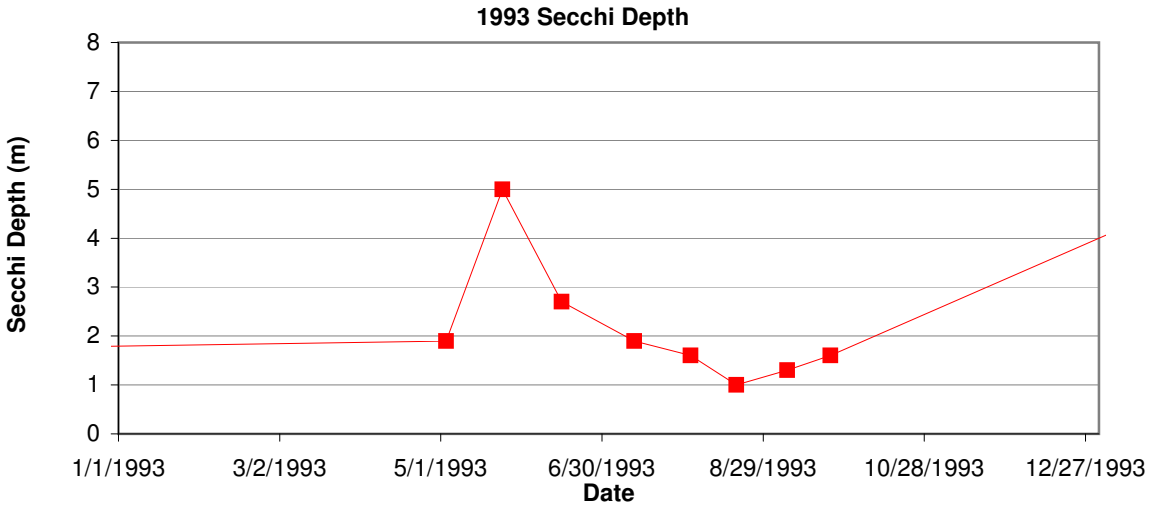

1991 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1991
3/2/1991
5/1/1991
6/30/1991
8/29/1991
10/28/1991
12/27/1991
Date

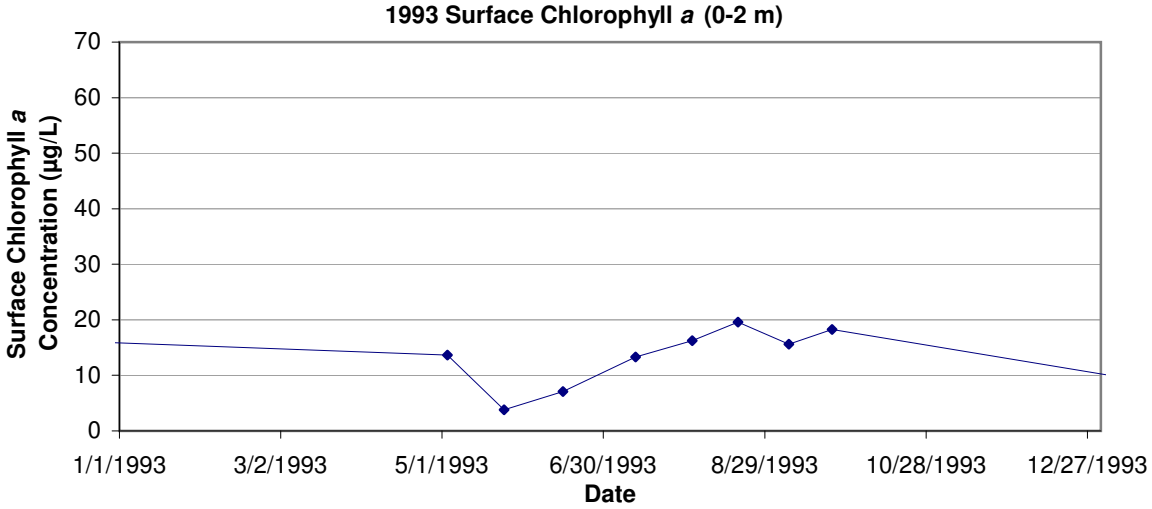

1991 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1991
3/2/1991
5/1/1991
6/30/1991
8/29/1991
10/28/1991
12/27/1991
Date

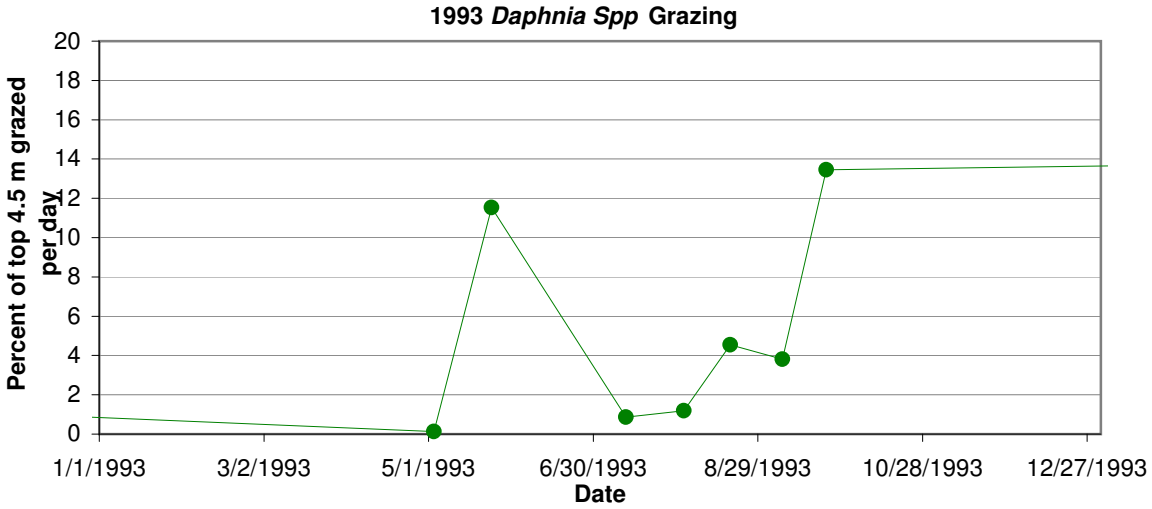

1992 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1992
3/1/1992
4/30/1992
6/29/1992
8/28/1992
10/27/1992
12/26/1992
Date

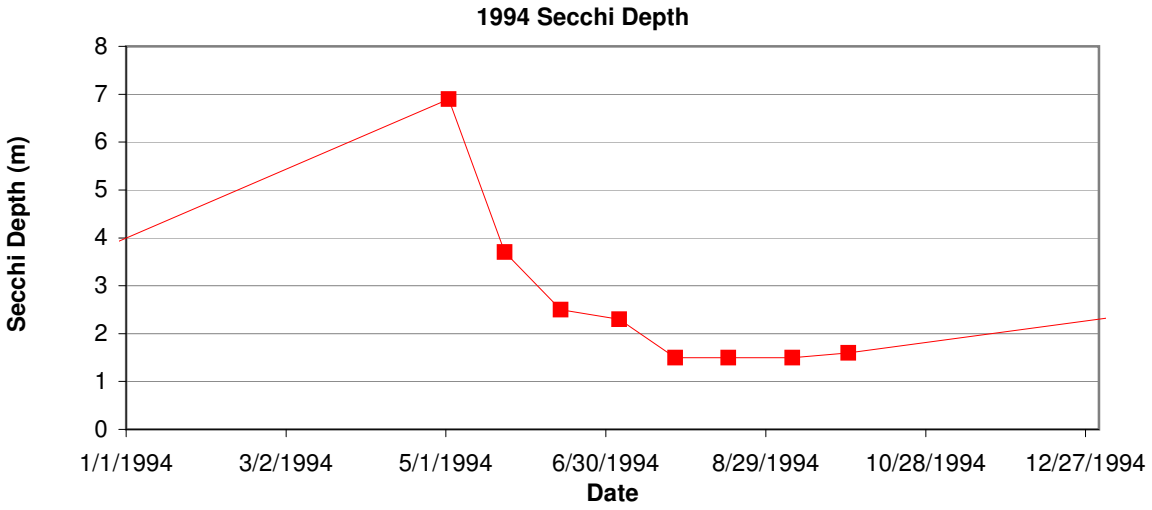

1992 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1992
3/1/1992
4/30/1992
6/29/1992
8/28/1992
10/27/1992
12/26/1992
Date

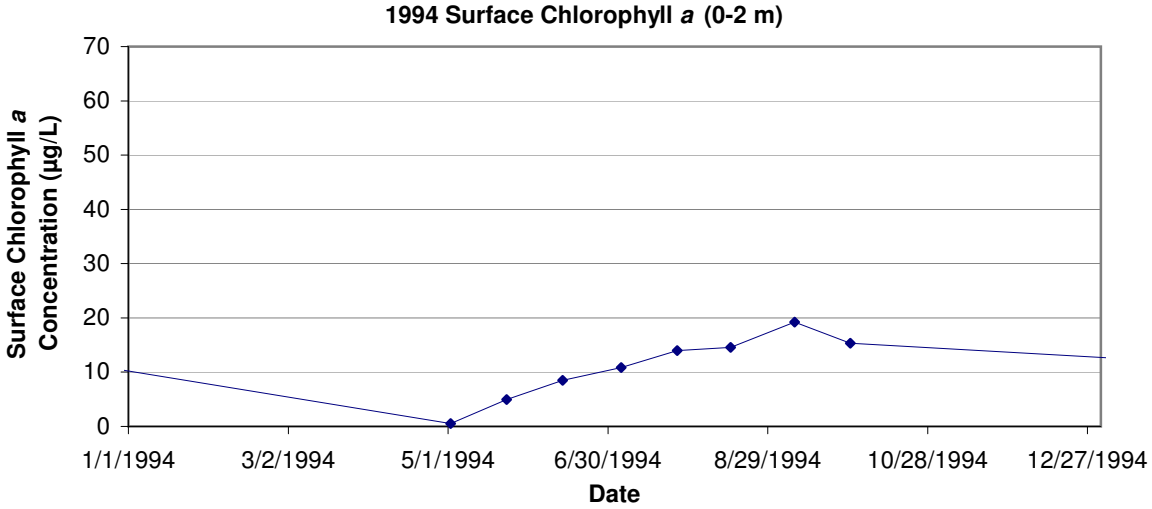

1992 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1992
3/1/1992
4/30/1992
6/29/1992
8/28/1992
10/27/1992
12/26/1992
Date

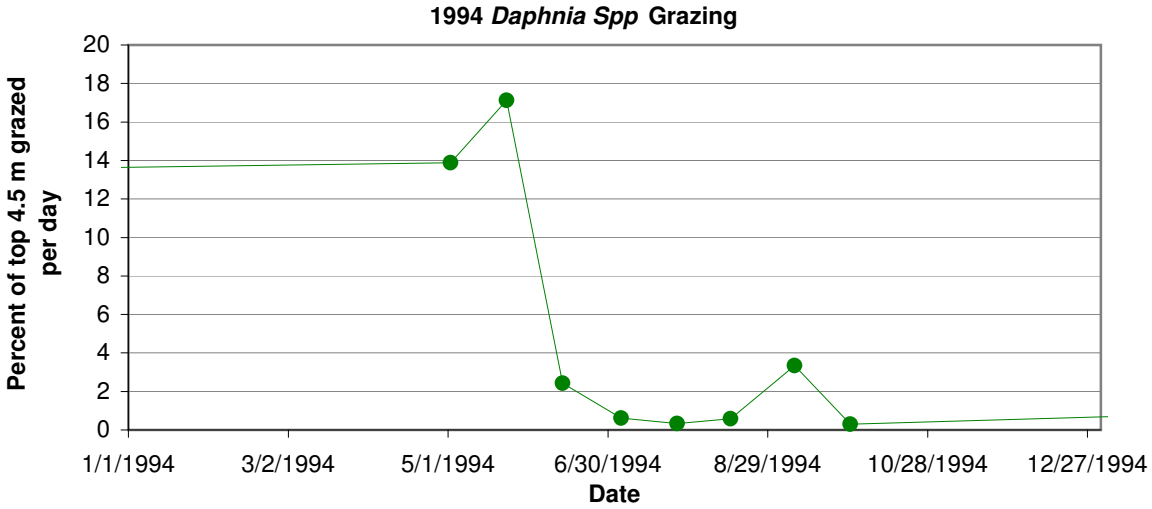

1993 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1993
3/2/1993
5/1/1993
6/30/1993
8/29/1993
10/28/1993
12/27/1993
Date

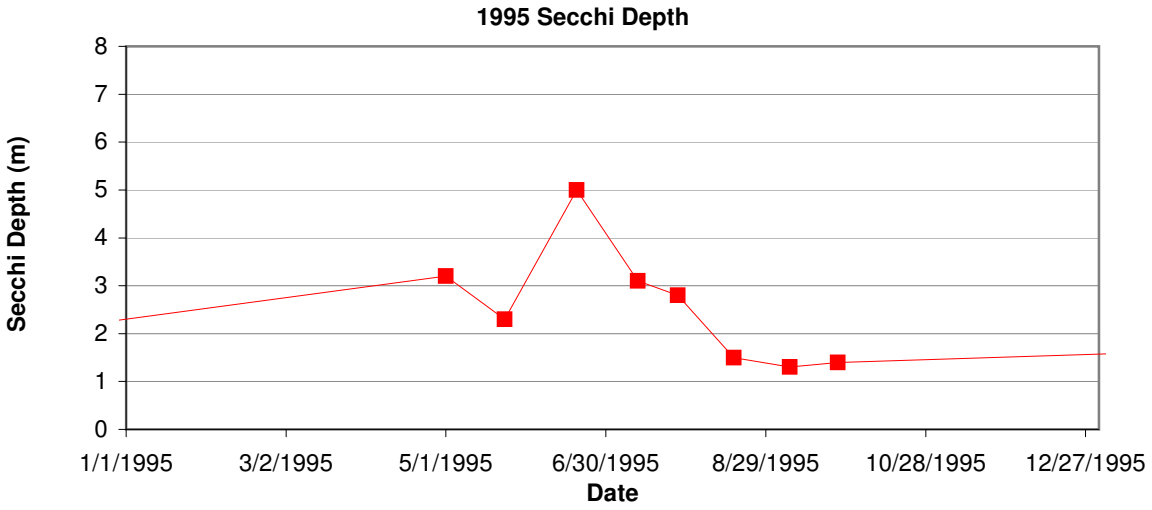

1993 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1993
3/2/1993
5/1/1993
6/30/1993
8/29/1993
10/28/1993
12/27/1993
Date

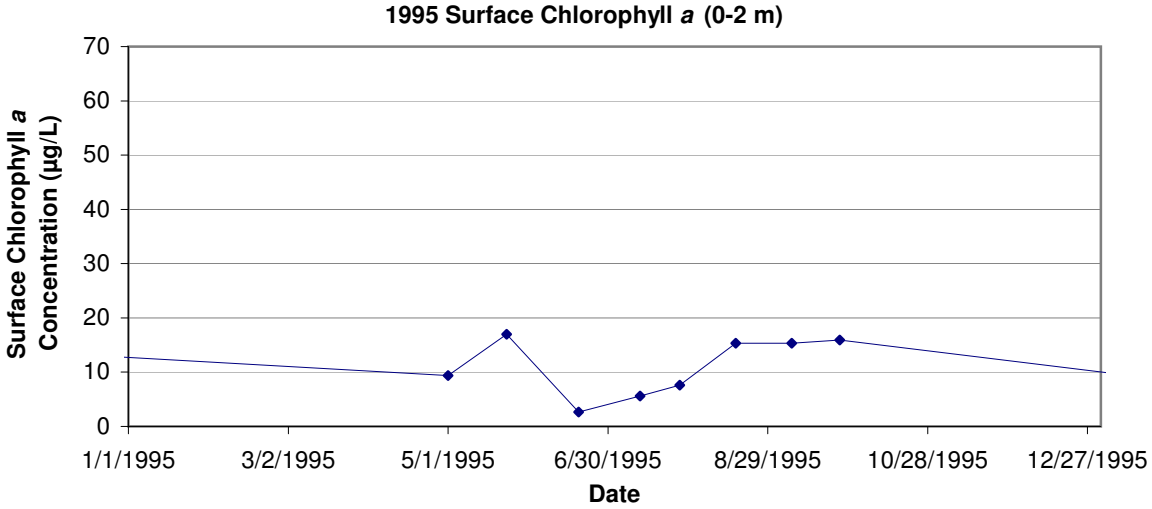

1993 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1993
3/2/1993
5/1/1993
6/30/1993
8/29/1993
10/28/1993
12/27/1993
Date

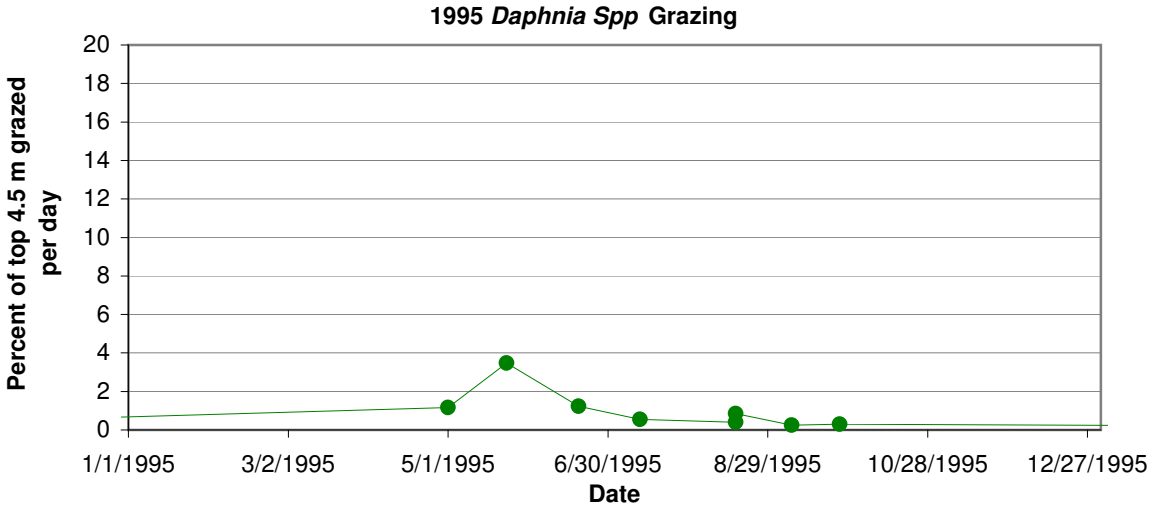

1994 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1994
3/2/1994
5/1/1994
6/30/1994
8/29/1994
10/28/1994
12/27/1994
Date

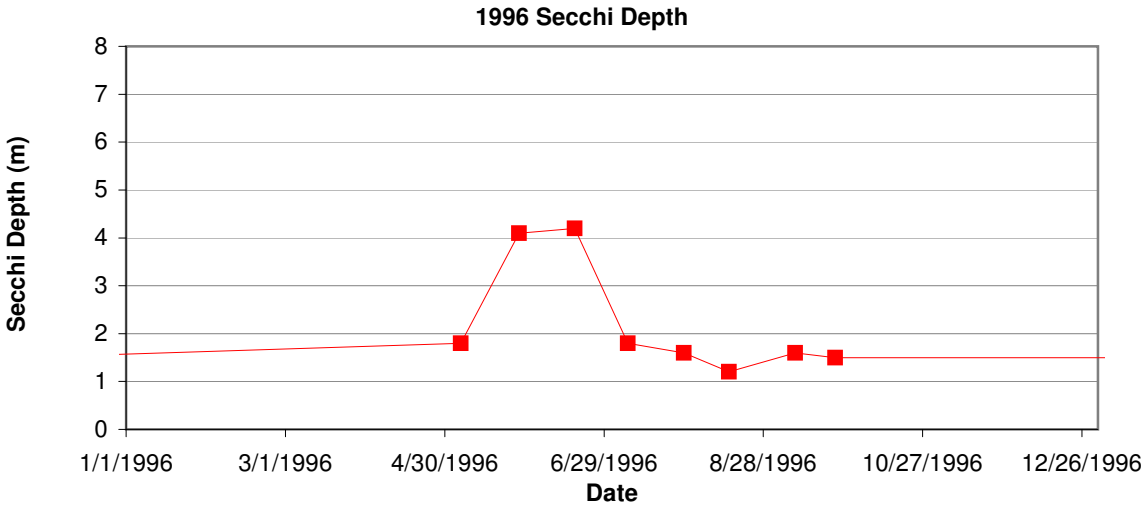

1994 Surface Chlorophyll a (0-2 m)
Surface Chlorophyll a Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1994
3/2/1994
5/1/1994
6/30/1994
8/29/1994
10/28/1994
12/27/1994
Date

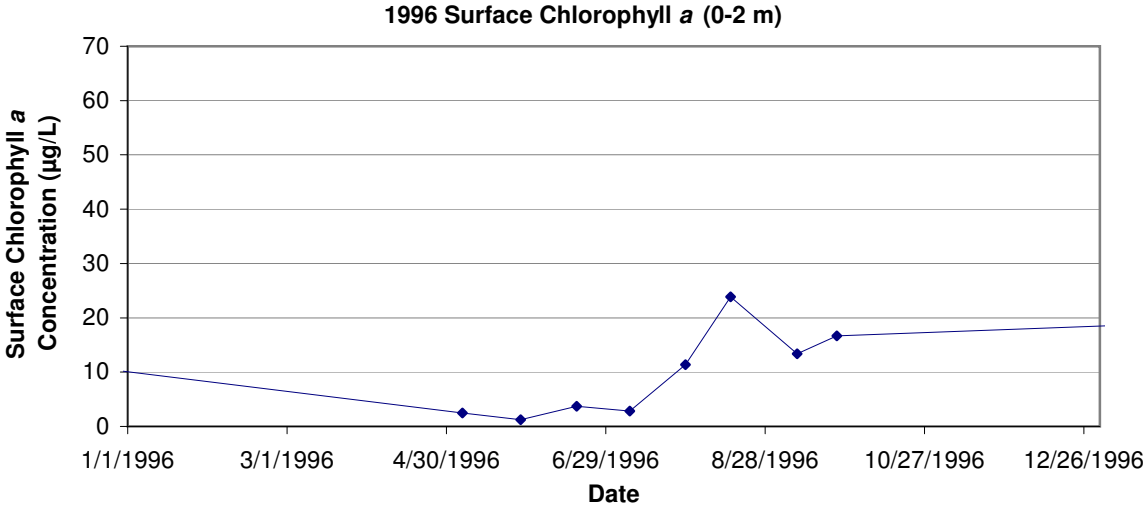

1994 Daphnia Spp Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1994
3/2/1994
5/1/1994
6/30/1994
8/29/1994
10/28/1994
12/27/1994
Date

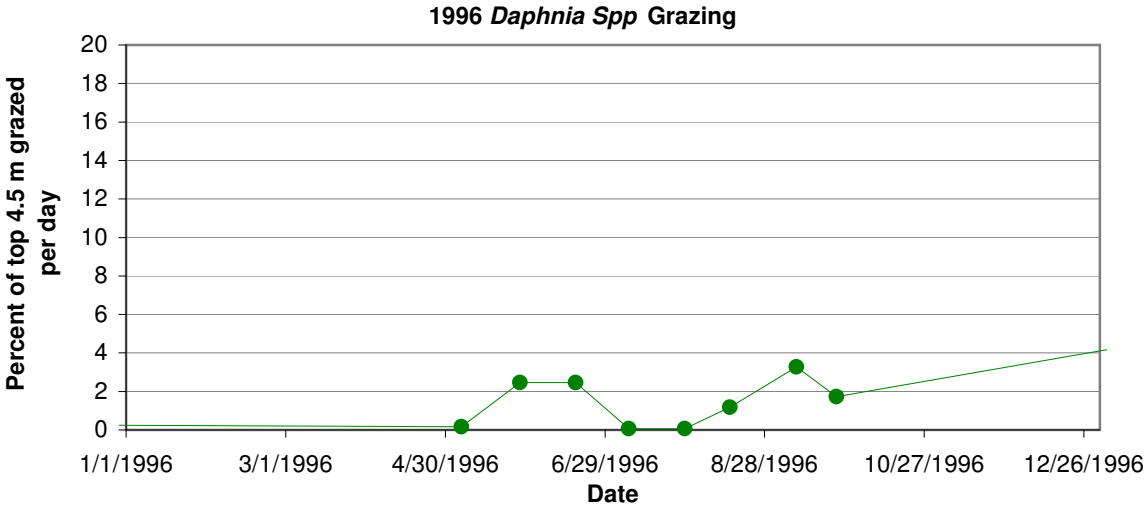

1995 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1995
3/2/1995
5/1/1995
6/30/1995
8/29/1995
10/28/1995
12/27/1995
Date

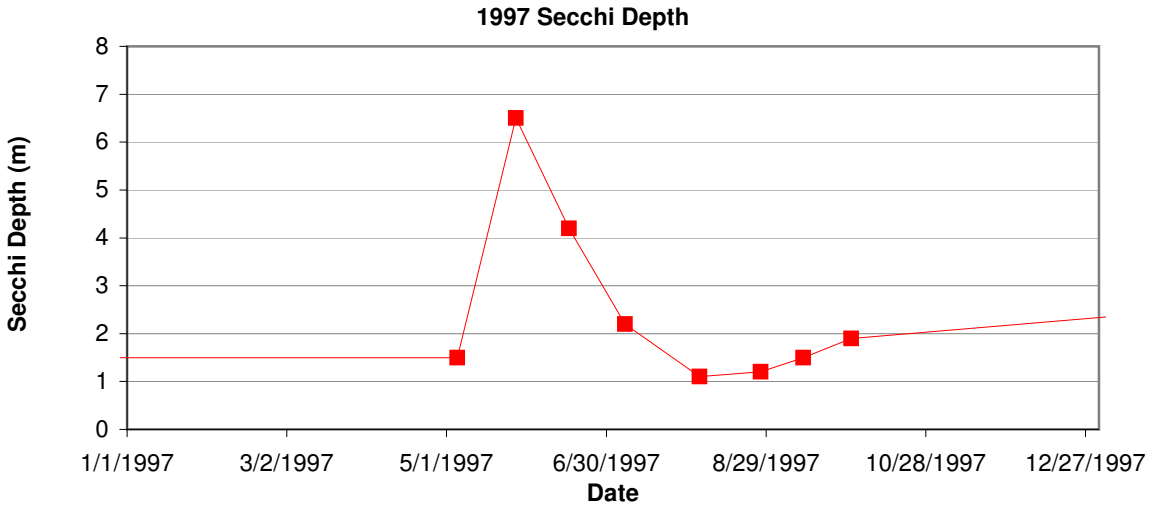

1995 Surface Chlorophyll a (0-2 m)
Surface Chlorophyll a Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1995
3/2/1995
5/1/1995
6/30/1995
8/29/1995
10/28/1995
12/27/1995
Date

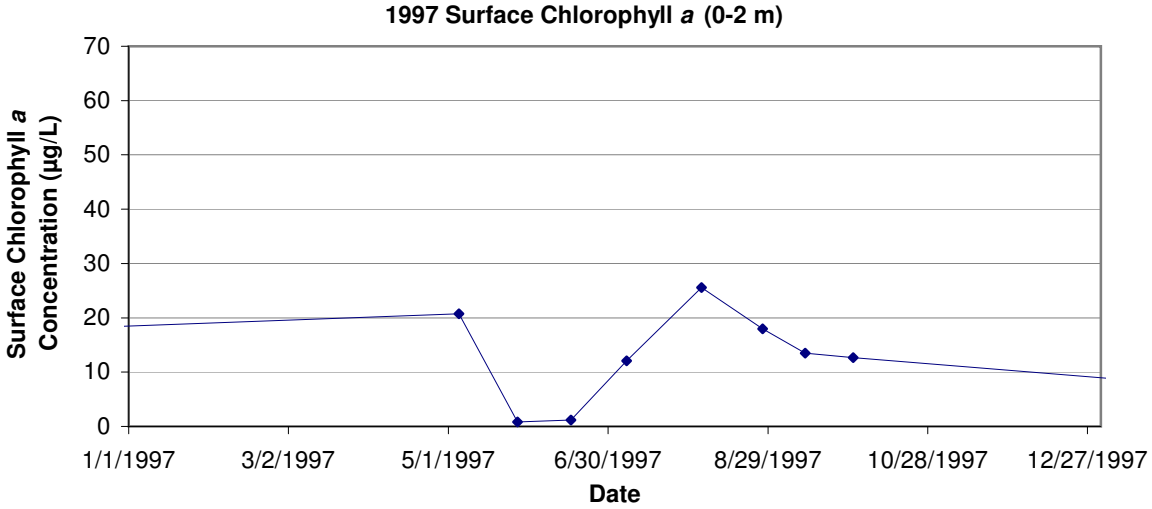

1995 Daphnia Spp Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1995
3/2/1995
5/1/1995
6/30/1995
8/29/1995
10/28/1995
12/27/1995
Date

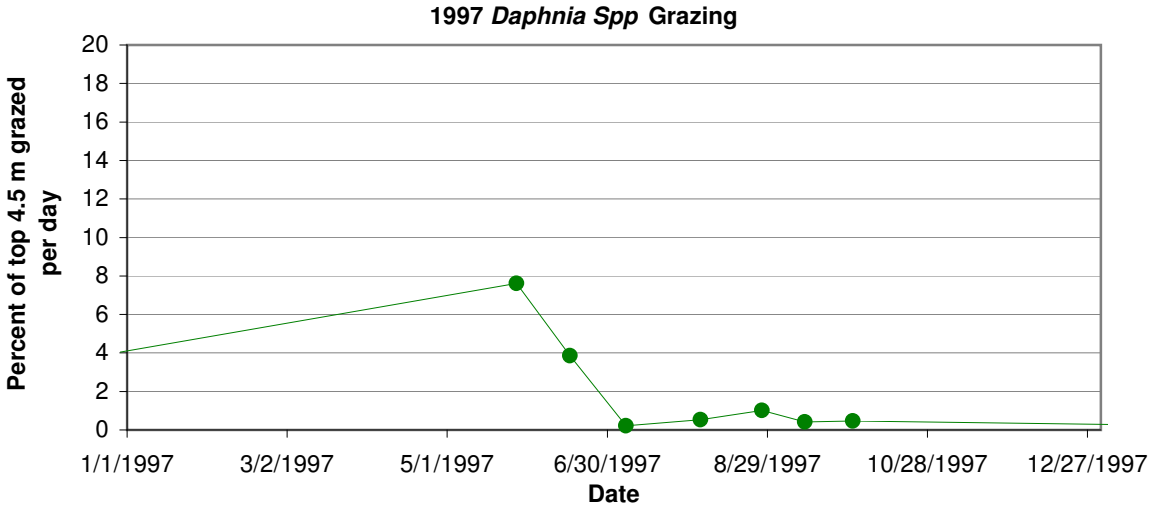

1996 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1996
3/1/1996
4/30/1996
6/29/1996
8/28/1996
10/27/1996
12/26/1996
Date

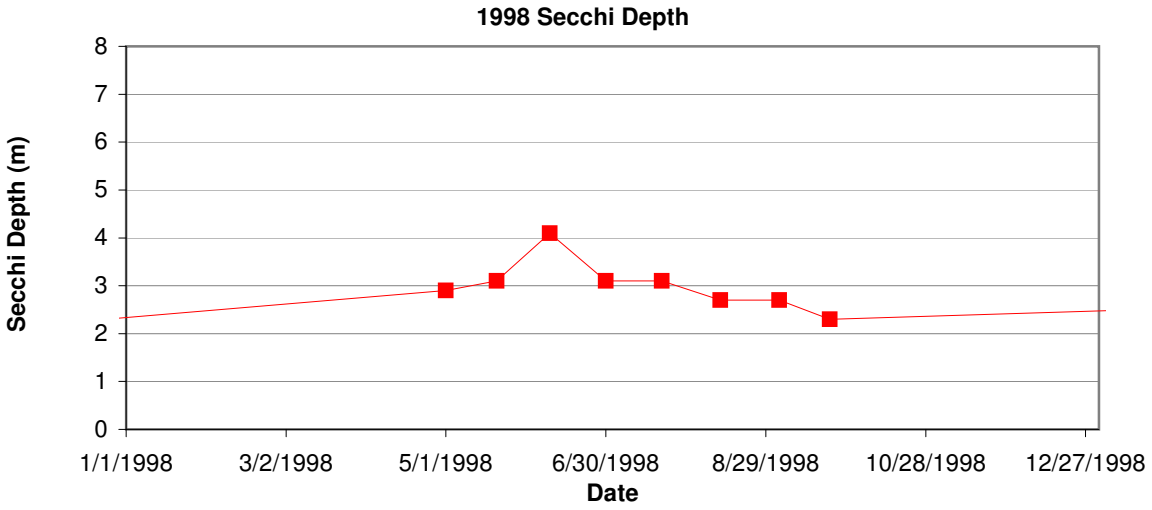

1996 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1996
3/1/1996
4/30/1996
6/29/1996
8/28/1996
10/27/1996
12/26/1996
Date

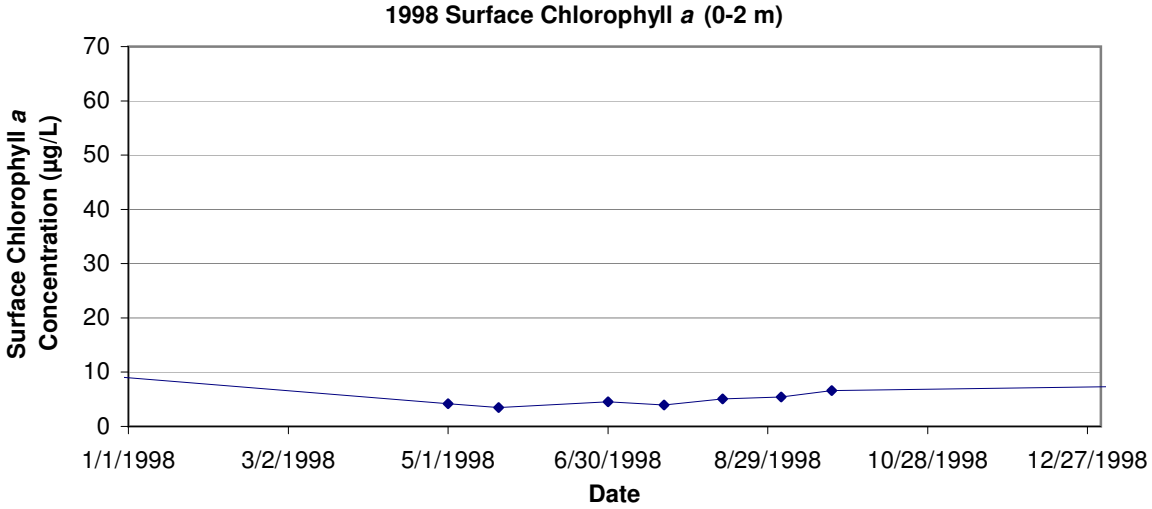

1996 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1996
3/1/1996
4/30/1996
6/29/1996
8/28/1996
10/27/1996
12/26/1996
Date

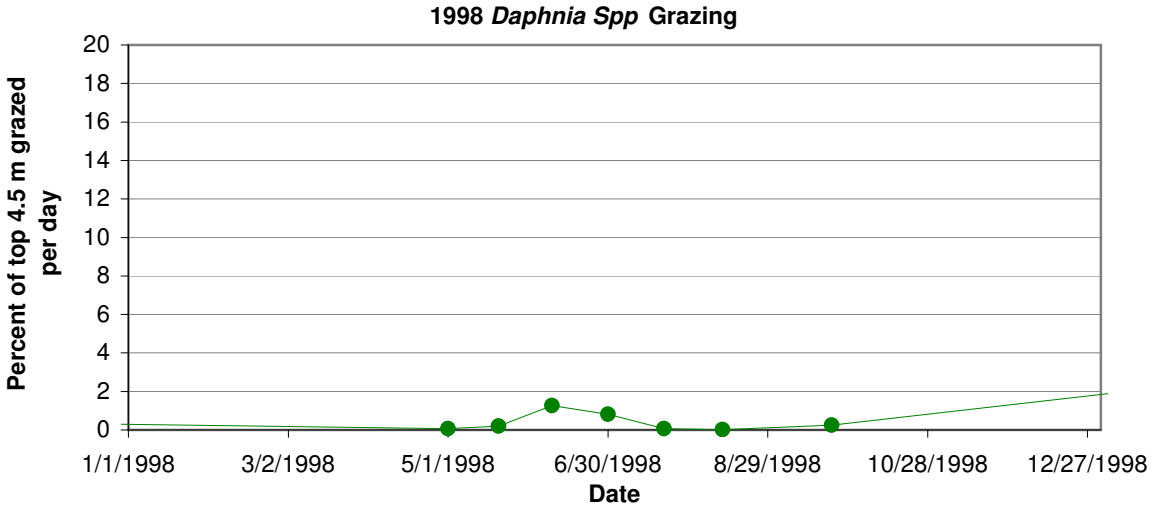

1997 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1997
3/2/1997
5/1/1997
6/30/1997
8/29/1997
10/28/1997
12/27/1997
Date

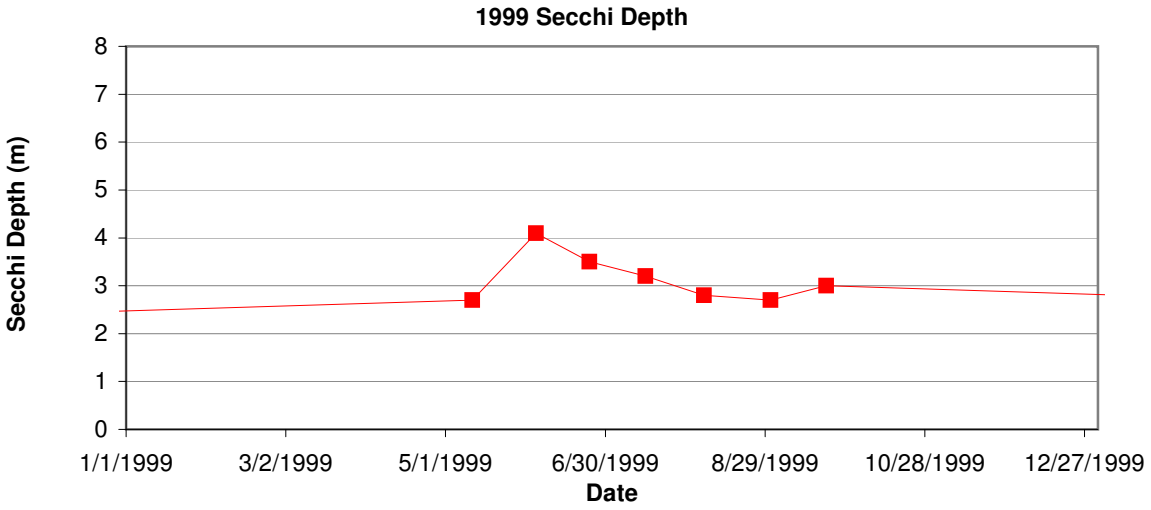

1997 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1997
3/2/1997
5/1/1997
6/30/1997
8/29/1997
10/28/1997
12/27/1997
Date

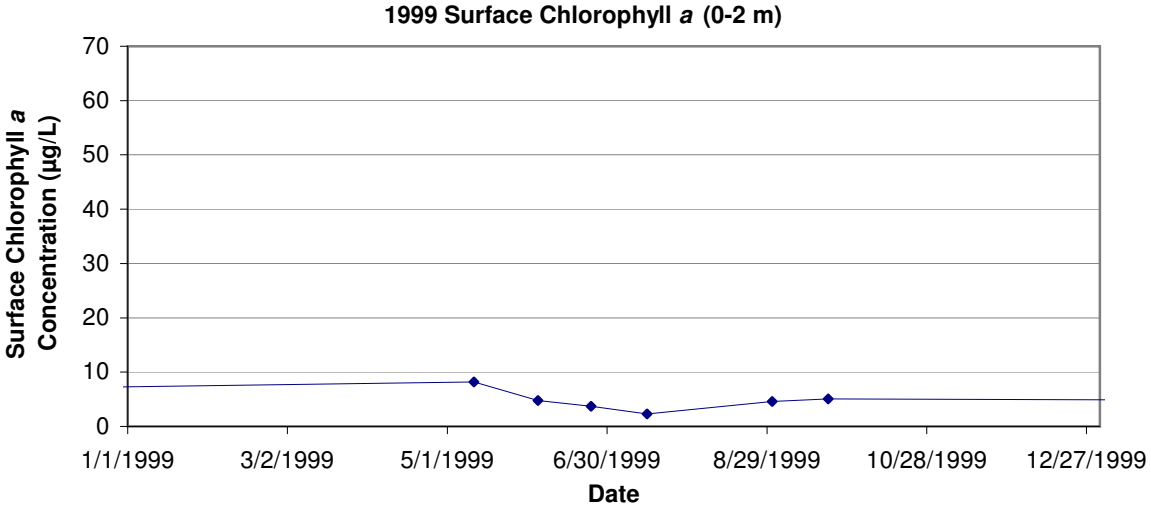

1997 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1997
3/2/1997
5/1/1997
6/30/1997
8/29/1997
10/28/1997
12/27/1997
Date

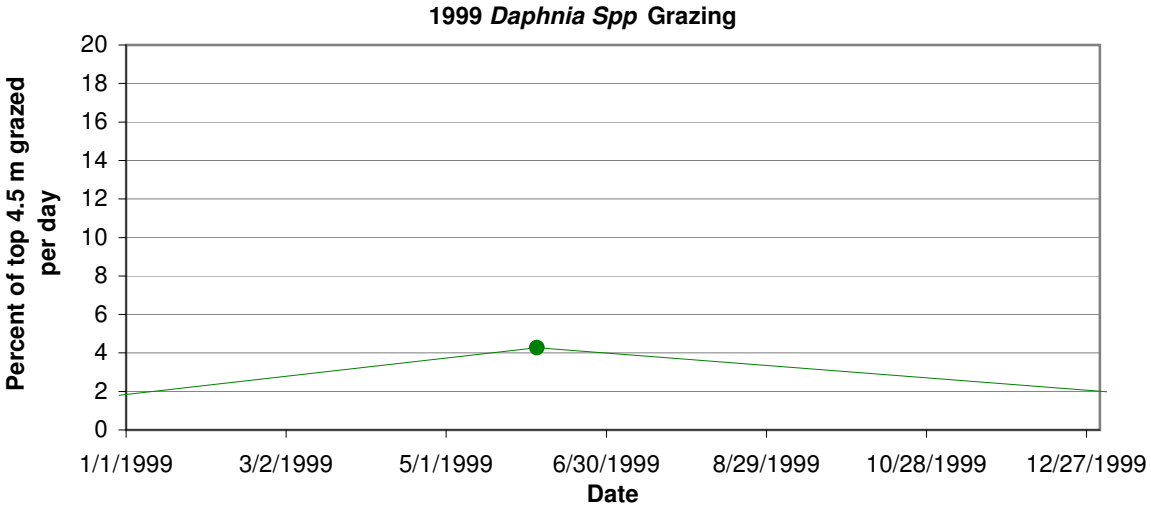

1998 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1998
3/2/1998
5/1/1998
6/30/1998
8/29/1998
10/28/1998
12/27/1998
Date

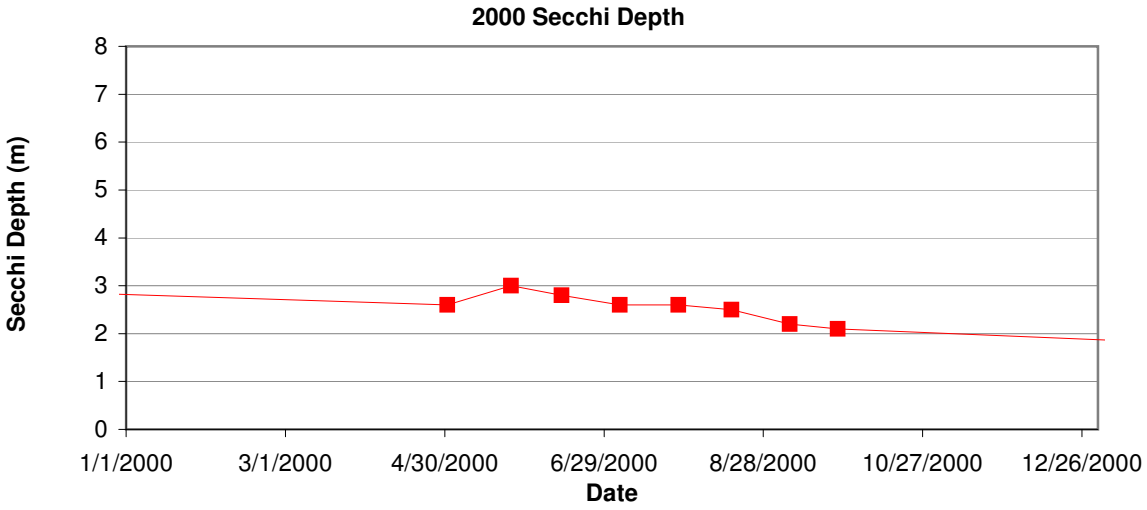

1998 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1998
3/2/1998
5/1/1998
6/30/1998
8/29/1998
10/28/1998
12/27/1998
Date

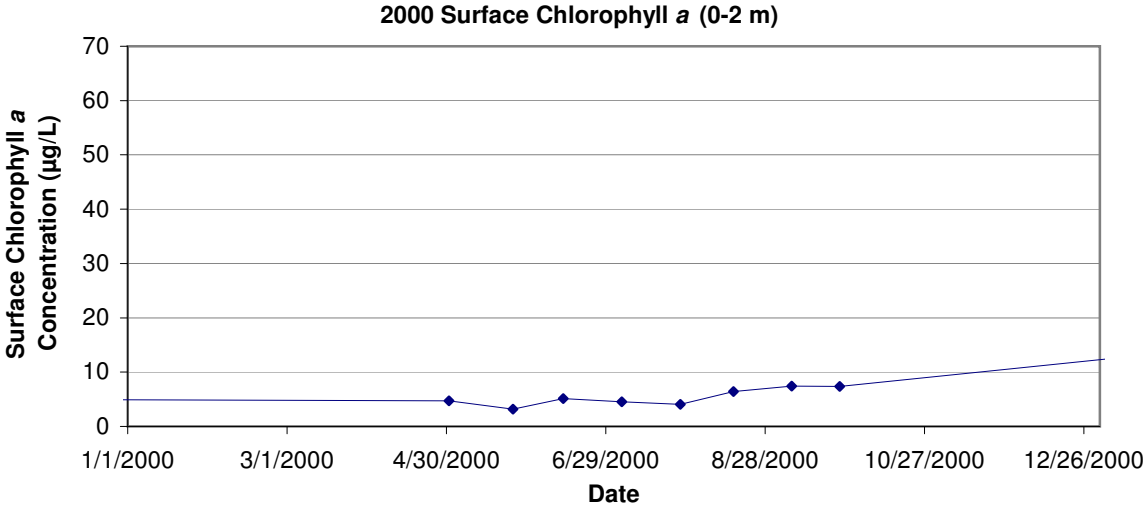

1998 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1998
3/2/1998
5/1/1998
6/30/1998
8/29/1998
10/28/1998
12/27/1998
Date

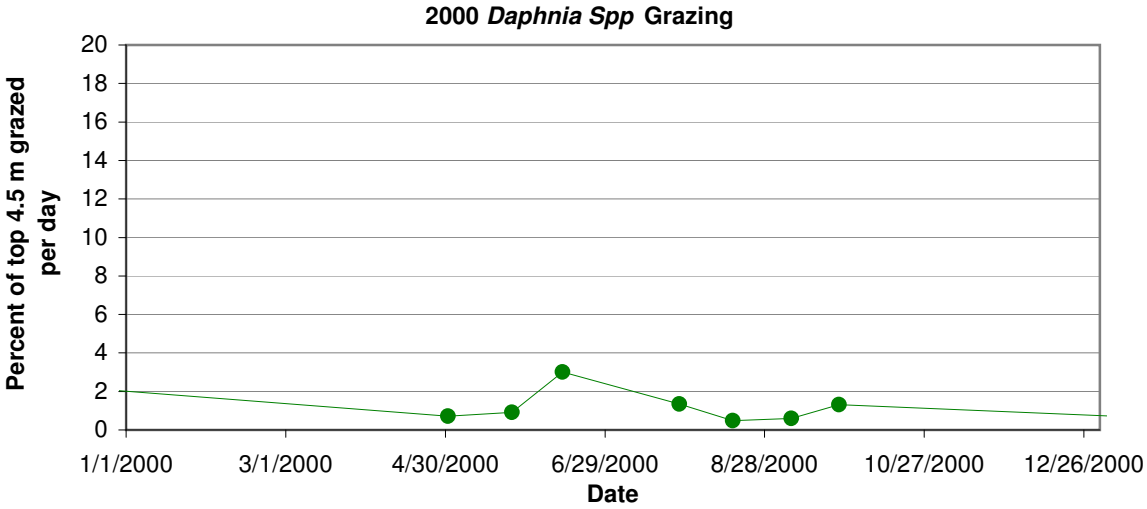

1999 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/1999
3/2/1999
5/1/1999
6/30/1999
8/29/1999
10/28/1999
12/27/1999
Date

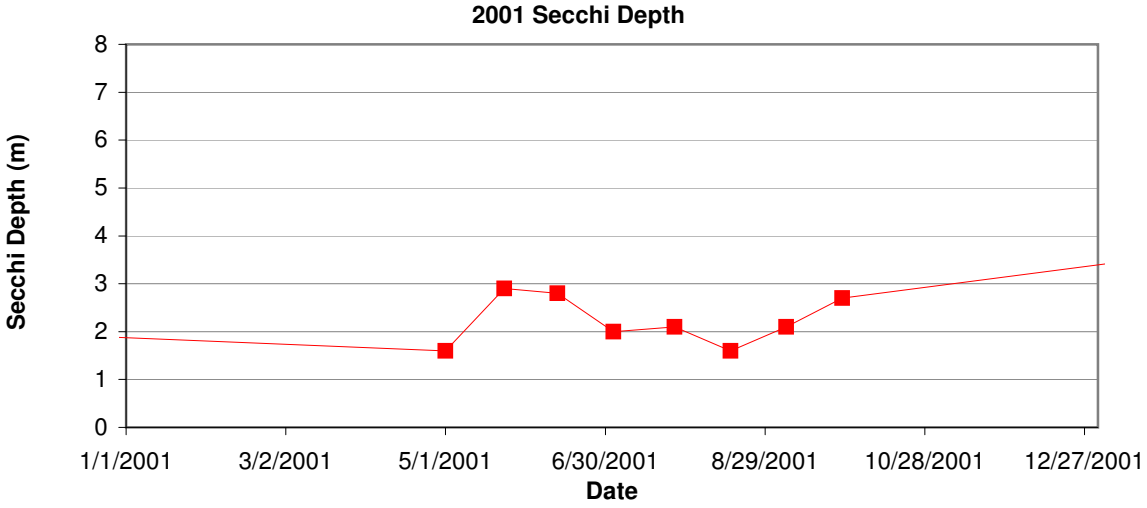

1999 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/1999
3/2/1999
5/1/1999
6/30/1999
8/29/1999
10/28/1999
12/27/1999
Date

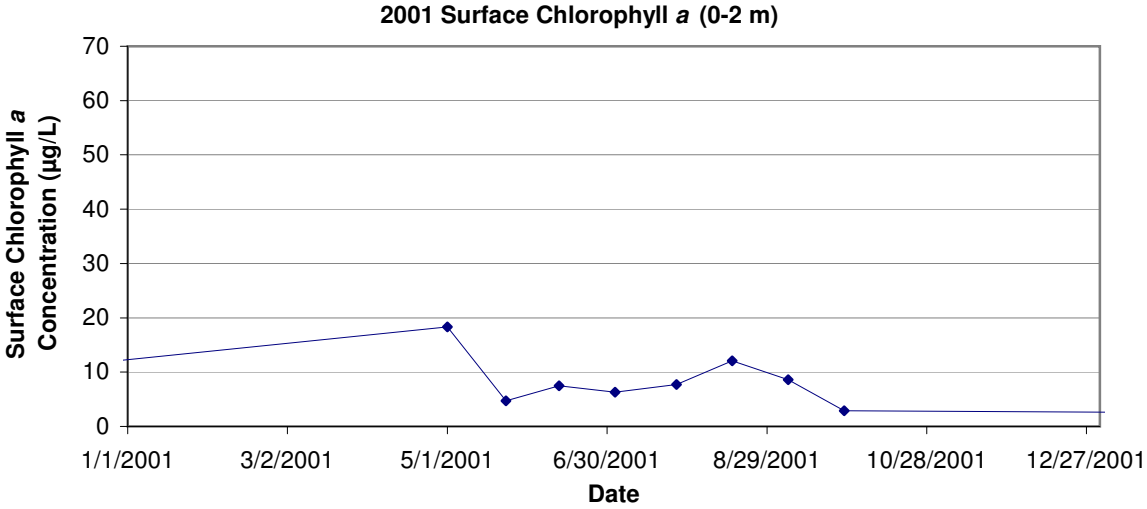

1999 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/1999
3/2/1999
5/1/1999
6/30/1999
8/29/1999
10/28/1999
12/27/1999
Date

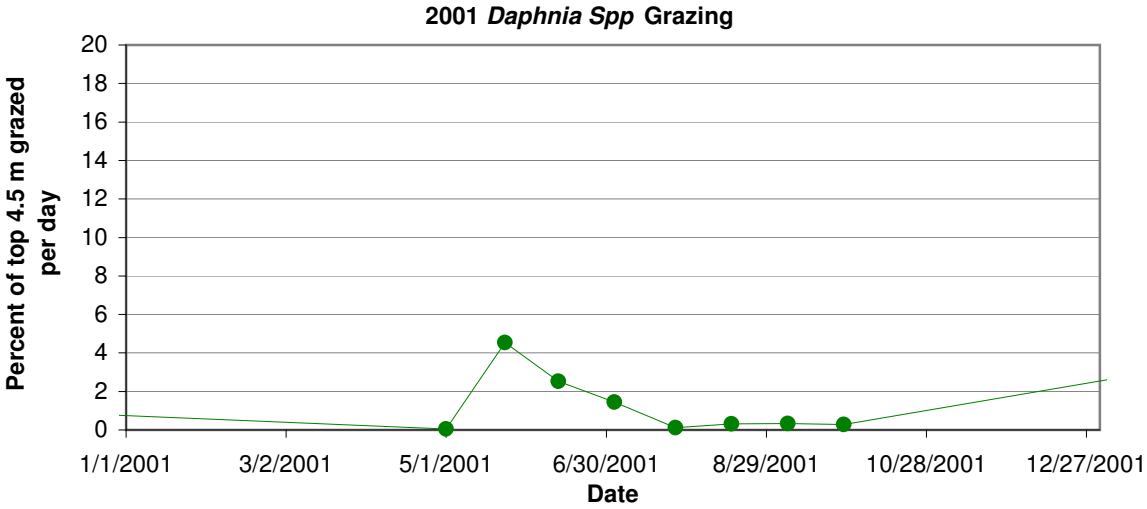

2000 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/2000
3/1/2000
4/30/2000
6/29/2000
8/28/2000
10/27/2000
12/26/2000
Date

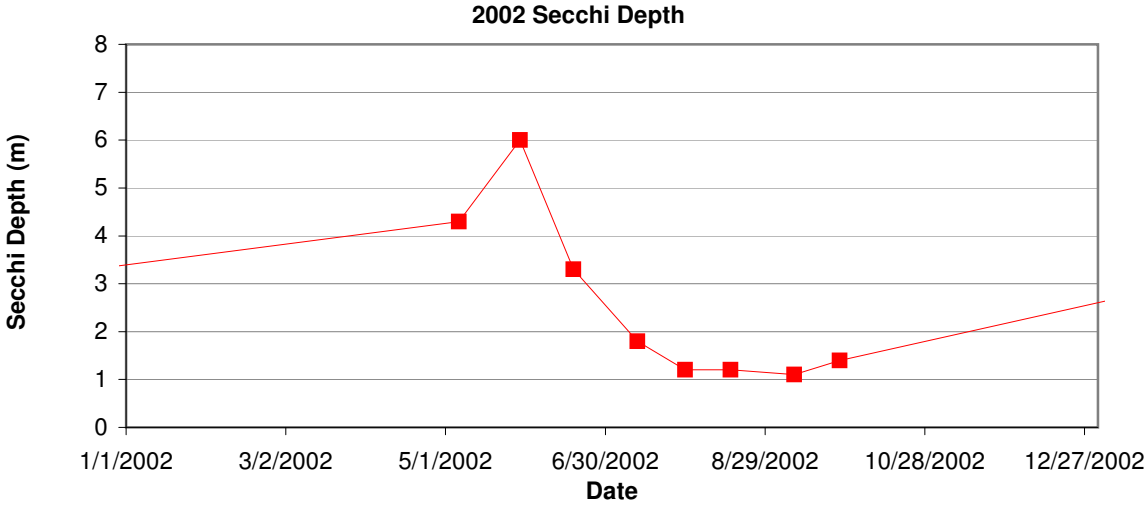

2000 Surface Chlorophyll a (0-2 m)
Surface Chlorophyll a Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/2000
3/1/2000
4/30/2000
6/29/2000
8/28/2000
10/27/2000
12/26/2000
Date

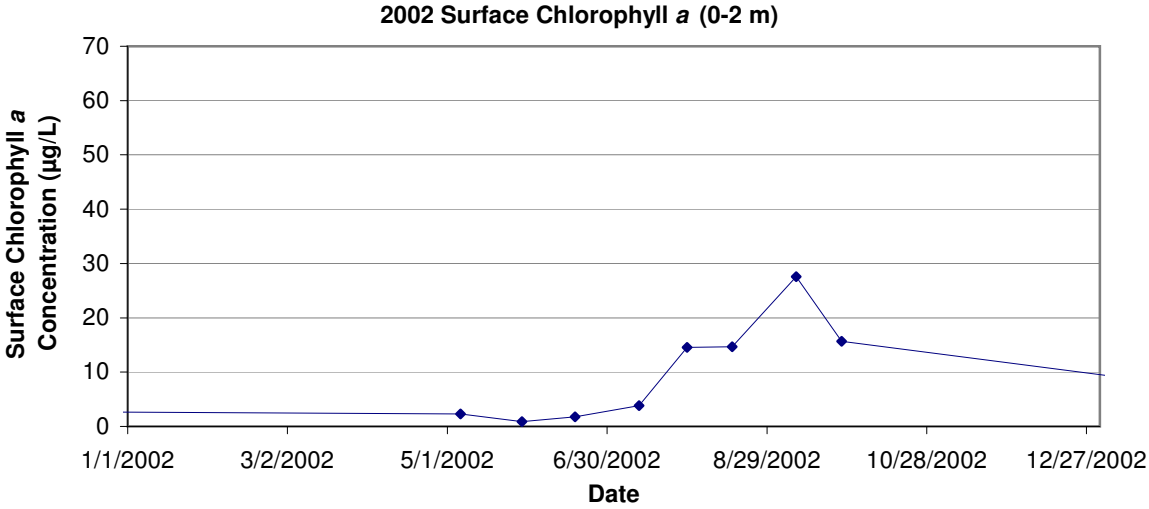

2000 Daphnia Spp Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/2000
3/1/2000
4/30/2000
6/29/2000
8/28/2000
10/27/2000
12/26/2000
Date

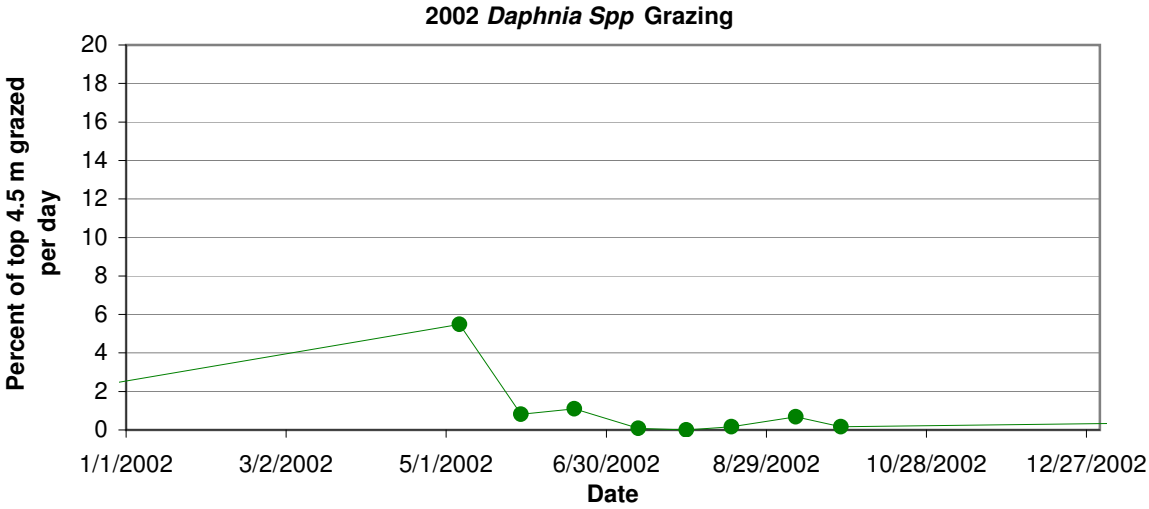

2001 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/2001
3/2/2001
5/1/2001
6/30/2001
8/29/2001
10/28/2001
12/27/2001
Date

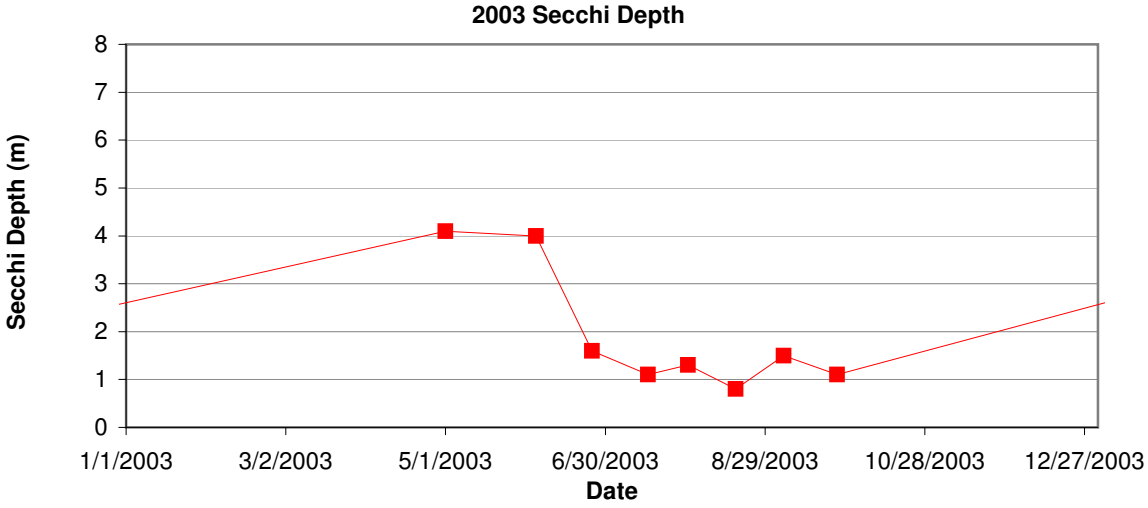

2001 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/2001
3/2/2001
5/1/2001
6/30/2001
8/29/2001
10/28/2001
12/27/2001
Date

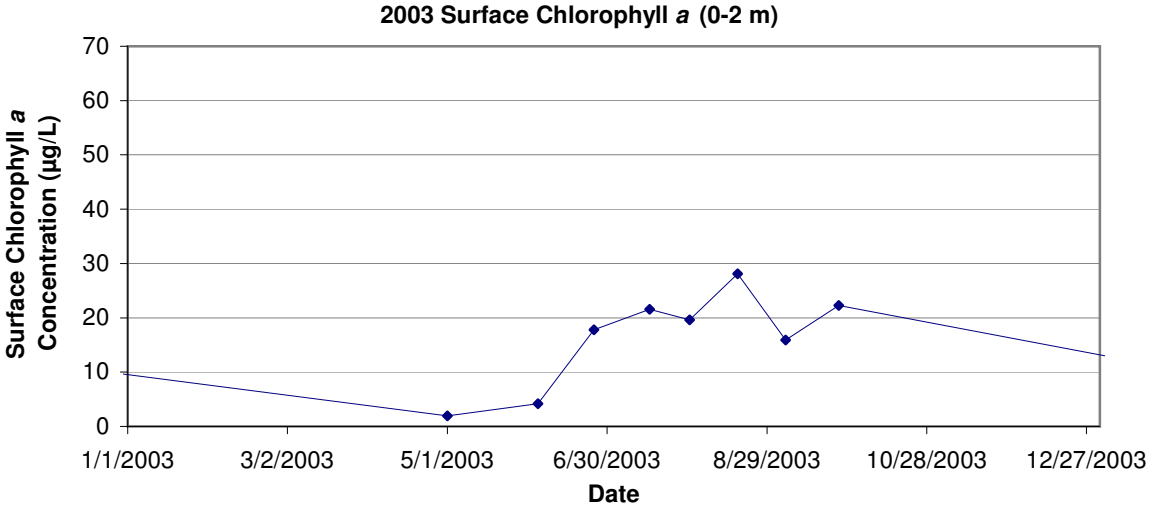

2001 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/2001
3/2/2001
5/1/2001
6/30/2001
8/29/2001
10/28/2001
12/27/2001
Date

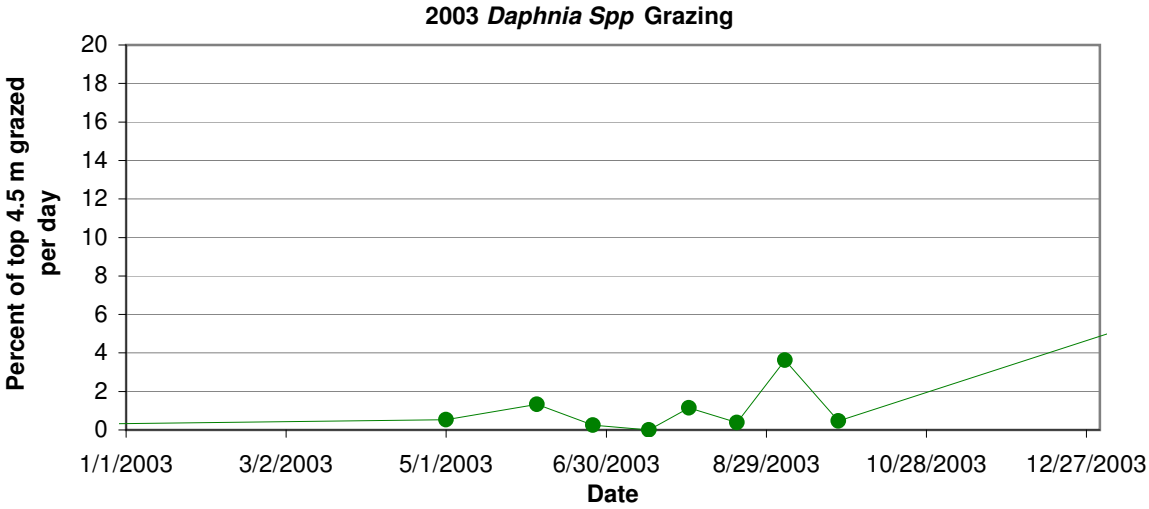

2002 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/2002
3/2/2002
5/1/2002
6/30/2002
8/29/2002
10/28/2002
12/27/2002
Date

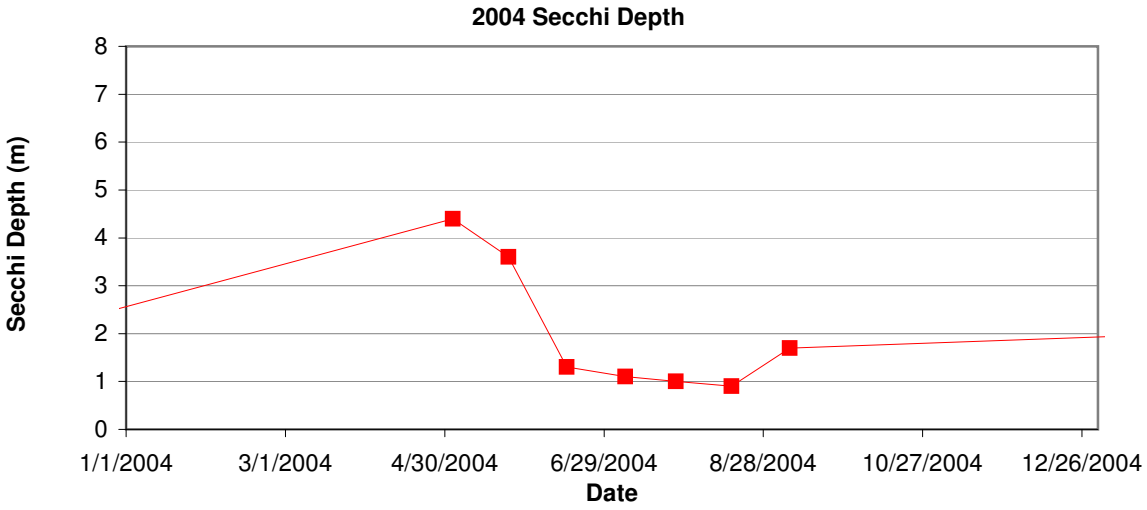

2002 Surface Chlorophyll a (0-2 m)
Surface Chlorophyll a Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/2002
3/2/2002
5/1/2002
6/30/2002
8/29/2002
10/28/2002
12/27/2002
Date

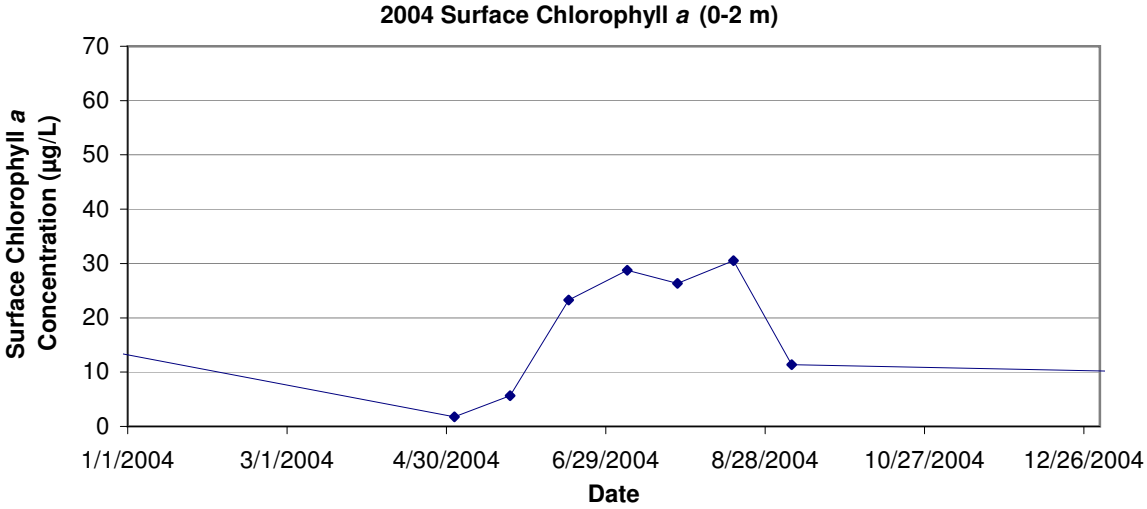

2002 Daphnia Spp Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/2002
3/2/2002
5/1/2002
6/30/2002
8/29/2002
10/28/2002
12/27/2002
Date

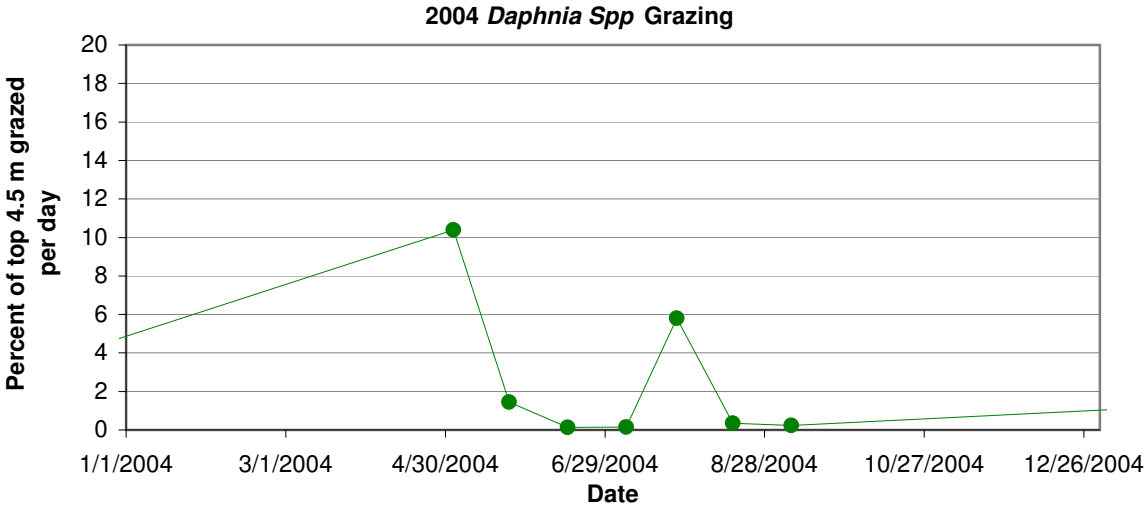

2003 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/2003
3/2/2003
5/1/2003
6/30/2003
8/29/2003
10/28/2003
12/27/2003
Date

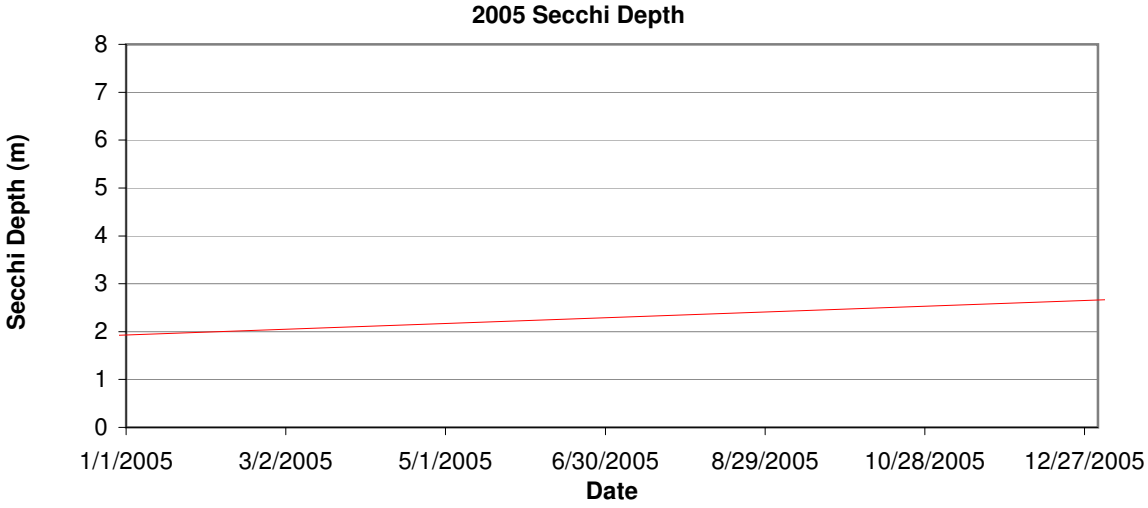

2003 Surface Chlorophyll a (0-2 m)
Surface Chlorophyll a Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/2003
3/2/2003
5/1/2003
6/30/2003
8/29/2003
10/28/2003
12/27/2003
Date

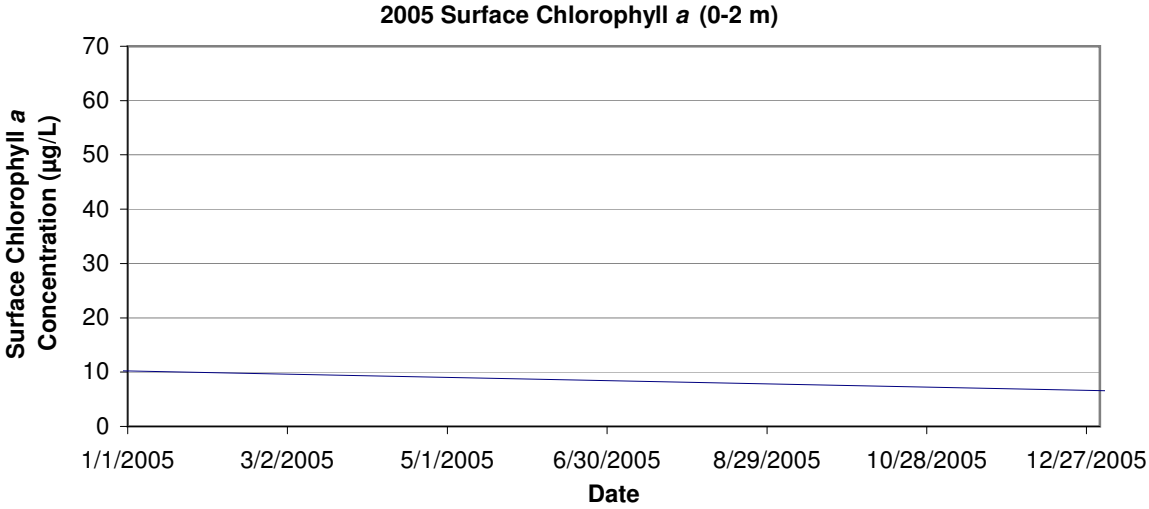

2003 Daphnia Spp Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/2003
3/2/2003
5/1/2003
6/30/2003
8/29/2003
10/28/2003
12/27/2003
Date

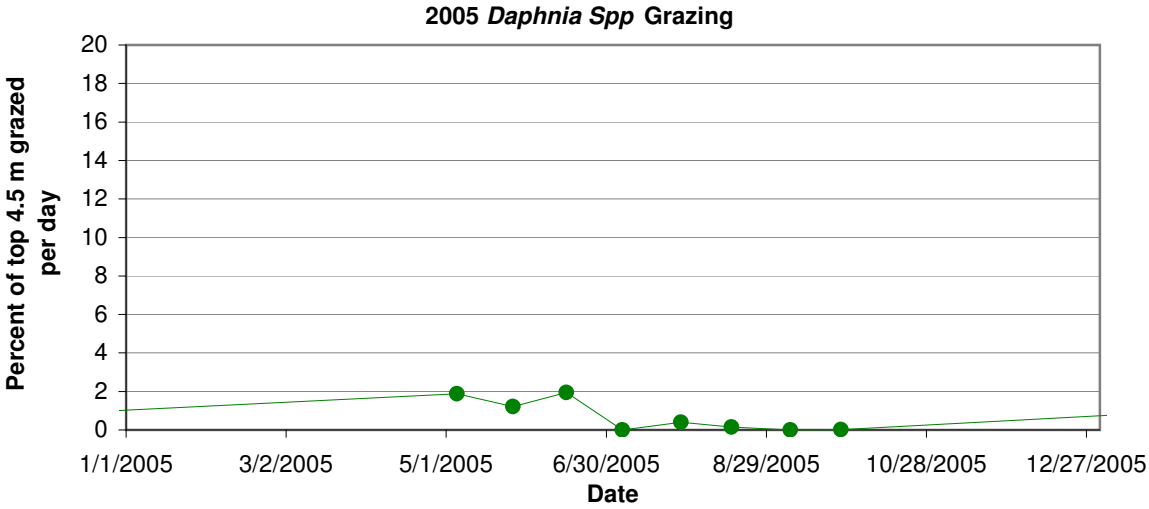

2004 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/2004
3/1/2004
4/30/2004
6/29/2004
8/28/2004
10/27/2004
12/26/2004
Date

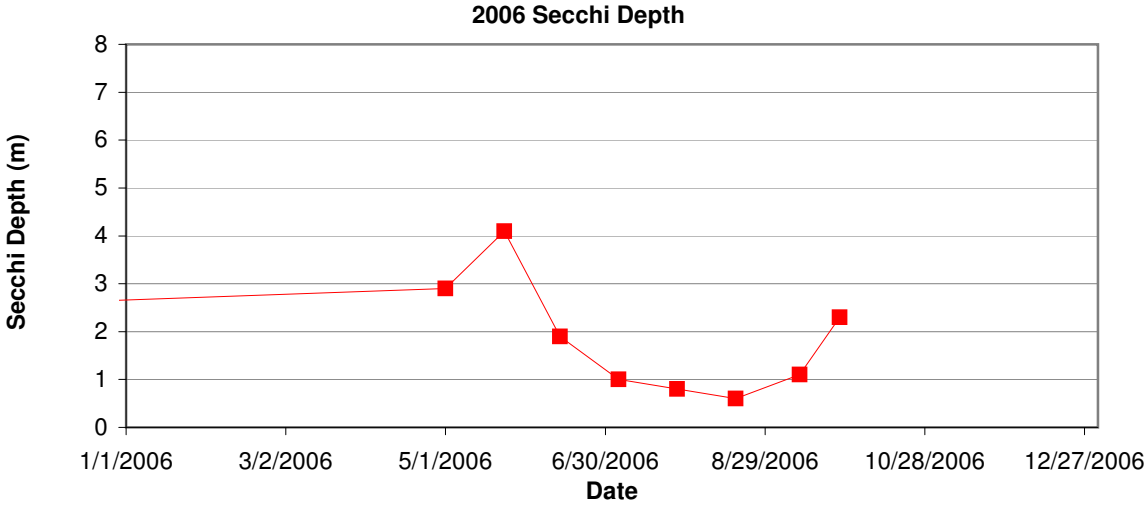

2004 Surface Chlorophyll *a* (0-2 m)
Surface Chlorophyll *a* Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/2004
3/1/2004
4/30/2004
6/29/2004
8/28/2004
10/27/2004
12/26/2004
Date

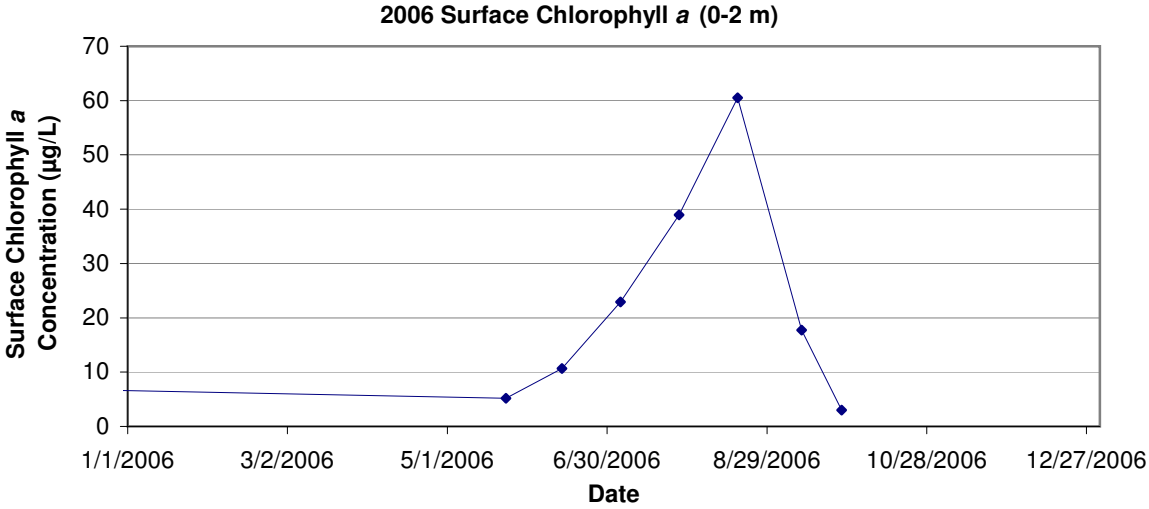

2004 *Daphnia Spp* Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/2004
3/1/2004
4/30/2004
6/29/2004
8/28/2004
10/27/2004
12/26/2004
Date

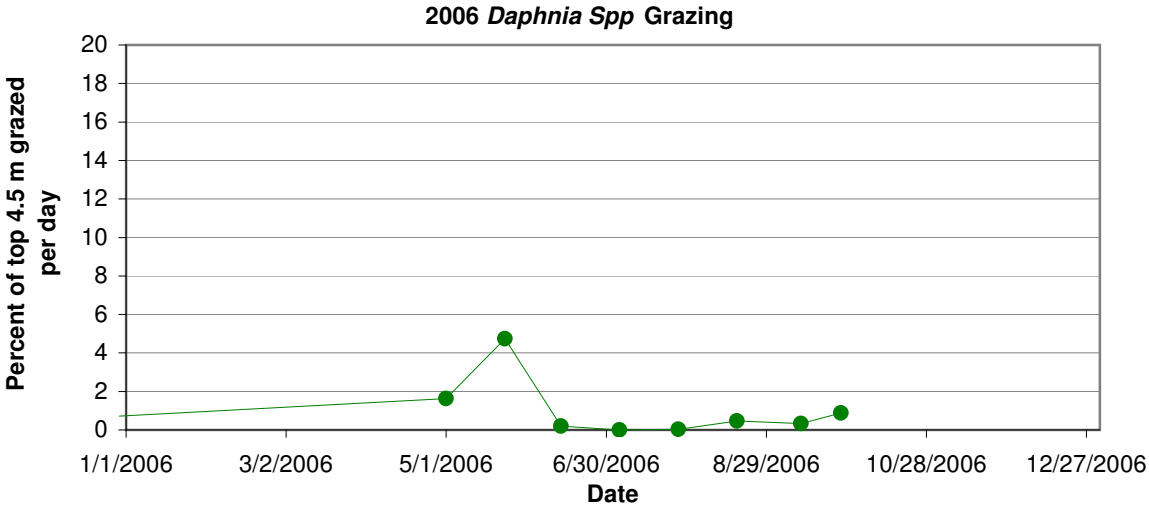

2005 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/2005
3/2/2005
5/1/2005
6/30/2005
8/29/2005
10/28/2005
12/27/2005
Date


2005 Surface Chlorophyll a (0-2 m)
Surface Chlorophyll a Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/2005
3/2/2005
5/1/2005
6/30/2005
8/29/2005
10/28/2005
12/27/2005
Date


2005 Daphnia Spp Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/2005
3/2/2005
5/1/2005
6/30/2005
8/29/2005
10/28/2005
12/27/2005
Date


2006 Secchi Depth
Secchi Depth (m)
8
7
6
5
4
3
2
1
0
1/1/2006
3/2/2006
5/1/2006
6/30/2006
8/29/2006
10/28/2006
12/27/2006
Date


2006 Surface Chlorophyll a (0-2 m)
Surface Chlorophyll a Concentration (µg/L)
70
60
50
40
30
20
10
0
1/1/2006
3/2/2006
5/1/2006
6/30/2006
8/29/2006
10/28/2006
12/27/2006
Date


2006 Daphnia Spp Grazing
Percent of top 4.5 m grazed per day
20
18
16
14
12
10
8
6
4
2
0
1/1/2006
3/2/2006
5/1/2006
6/30/2006
8/29/2006
10/28/2006
12/27/2006
Date

LAKENAME	DNRID	DATE	DATE	SITE	TOW	CYCLO-THOUS/M3	CALA-THOUS/M3	NAUP-THOUS/M3	ROTIF-THOUS/M3	DAPH-THOUS/M3	BOSM-THOUS/M3	CHYD-THOUS/M3	CERIOD-THOUS/M3	DIAPHAN-THOUS/M3	LEPTO-THOUS/M3	OTHER-THOUS/M3	TOTAL-THOUS/M3
OWASSO	62-0056	19840417	4/17/1984	5401	8	19.9	0.5	45.4	0.8	0.2	0.2	0.7	0.0	0.0	0.0	0.0	67.70
OWASSO	62-0056	19840606	6/6/1984	5401	6	17.1	122.8	71.4	220.0	41.4	38.6	24.3	4.3	0.0	0.0	0.0	539.90
OWASSO	62-0056	19840621	6/21/1984	5401	6	0.8	34.8	17.8	12.9	9.0	0.3	16.5	0.0	1.9	0.0	0.0	94.00
OWASSO	62-0056	19840705	7/5/1984	5401	5	2.3	28.3	27.6	105.3	10.5	1.0	98.1	3.0	105.0	0.0	0.0	381.10
OWASSO	62-0056	19840824	8/24/1984	5401	6	4.6	7.1	25.1	84.3	1.4	3.9	21.0	0.0	43.6	0.0	0.0	191.00
OWASSO	62-0056	19840829	8/29/1984	5401	4	2.9	3.7	37.0	157.1	6.6	4.9	14.0	0.0	76.5	0.0	0.0	302.70
OWASSO	62-0056	19850416	4/16/1985	5401	8	33.6	3.8	70.3	16.8	0.3	0.0	4.1	0.0	0.0	0.0	0.0	128.90
OWASSO	62-0056	19850516	5/16/1985	5401	7	54.8	90.1	105.8	184.1	113.6	415.3	82.3	0.0	0.0	0.0	0.0	1046.00
OWASSO	62-0056	19850611	6/11/1985	5401	5	3.8	55.4	103.1	72.4	12.6	1.6	20.8	0.0	3.8	0.0	0.0	273.50
OWASSO	62-0056	19850625	6/25/1985	5401	7	5.9	60.7	54.8	60.7	3.9	0.0	33.3	5.9	13.7	0.0	0.0	238.90
OWASSO	62-0056	19850730	7/30/1985	5401	7	1.5	7.3	61.7	58.8	6.6	15.4	29.4	0.0	31.6	0.0	0.0	212.30
OWASSO	62-0056	19850816	8/16/1985	5401	7	4.3	7.8	22.7	201.4	15.3	70.1	6.3	0.0	4.7	0.0	0.0	332.60
OWASSO	62-0056	19850912	9/12/1985	5401	6	1.8	3.2	18.3	22.4	4.6	43.4	10.1	0.0	1.4	0.0	0.0	105.20
OWASSO	62-0056	19860429	4/29/1986	5401	8	40.9	1.1	68.8	3.0	1.3	1.7	0.0	0.0	0.0	0.0	0.0	116.80
OWASSO	62-0056	19860522	5/22/1986	5401	5	35.7	16.5	37.8	33.5	42.8	37.3	9.9	0.0	0.0	0.0	0.0	213.50
OWASSO	62-0056	19860612	6/12/1986	5401	7	2.4	4.3	8.6	10.6	5.9	7.4	40.0	0.4	4.3	0.0	0.0	83.90
OWASSO	62-0056	19860701	7/1/1986	5401	6	17.8	24.0	52.4	27.4	2.1	60.0	53.5	41.5	13.4	0.0	0.0	292.10
OWASSO	62-0056	19860717	7/17/1986	5401	6	2.4	1.0	11.3	31.5	3.8	24.0	28.5	0.3	16.1	0.0	0.0	118.90
OWASSO	62-0056	19860812	8/12/1986	5401	7	4.1	2.4	6.2	37.6	2.1	5.6	11.8	0.0	5.0	0.0	0.0	74.80
OWASSO	62-0056	19860902	9/2/1986	5401	7	6.6	1.0	8.6	15.7	8.8	46.8	1.7	0.0	3.9	0.2	0.0	93.30
OWASSO	62-0056	19860924	9/24/1986	5401	9	3.0	1.8	14.6	7.6	20.4	12.2	1.8	0.0	1.8	0.0	0.0	63.20
OWASSO	62-0056	19870512	5/12/1987	5401	7	18.4	8.6	32.5	110.5	21.5	12.1	2.4	0.0	0.0	0.0	0.0	206.00
OWASSO	62-0056	19870604	6/4/1987	5401	7	8.6	14.1	42.3	30.2	8.6	11.0	16.5	0.0	0.0	0.0	0.0	131.30
OWASSO	62-0056	19870625	6/25/1987	5401	4	12.1	6.2	18.0	15.7	11.3	41.9	16.5	0.0	9.8	0.0	0.0	131.50
OWASSO	62-0056	19870716	7/16/1987	5401	6	5.5	7.0	4.1	120.3	1.2	40.3	2.1	0.0	15.3	0.0	0.0	195.80
OWASSO	62-0056	19870813	8/13/1987	5401	4	4.9	5.1	38.3	45.8	18.5	9.3	2.1	0.3	6.4	0.0	0.0	130.70
OWASSO	62-0056	19870828	8/28/1987	5401	8	3.0	0.6	9.6	4.2	22.8	4.0	0.6	0.1	4.2	0.0	0.0	49.10
OWASSO	62-0056	19870918	9/18/1987	5401	10	3.3	0.5	23.6	10.1	9.5	32.5	5.8	0.1	0.5	0.0	0.0	85.90
OWASSO	62-0056	19871008	10/8/1987	5401	10	6.6	1.9	3.8	5.6	4.4	8.1	2.9	0.0	1.0	0.0	0.0	34.30
OWASSO	62-0056	19880407	4/7/1987	5401	10	6.7	1.8	16.6	2.1	0.9	0.3	0.5	0.0	0.0	0.0	0.0	28.90
OWASSO	62-0056	19880503	5/3/1988	5401	10	16.8	1.2	16.6	22.2	2.3	1.0	1.9	0.0	0.0	0.0	0.0	62.00
OWASSO	62-0056	19880518	5/18/1988	5401	10	15.2	10.7	10.0	22.9	10.1	7.8	1.2	0.0	0.0	0.0	0.0	77.90
OWASSO	62-0056	19880608	6/8/1988	5401	7	0.9	5.5	4.7	5.3	0.9	0.1	0.9	0.0	0.3	0.1	0.0	18.70
OWASSO	62-0056	19880630	6/30/1988	5401	7	0.4	1.5	1.0	0.6	0.6	0.2	3.4	0.0	1.3	0.0	0.0	9.00
OWASSO	62-0056	19880719	7/19/1988	5401	6	1.4	0.8	1.3	3.3	0.4	1.0	1.7	0.0	0.5	0.0	0.0	10.40
OWASSO	62-0056	19880811	8/11/1988	5401	8	0.9	0.7	1.2	1.9	2.2	1.7	0.5	0.0	1.2	0.0	0.0	10.30
OWASSO	62-0056	19880902	9/2/1988	5401	9	0.6	0.1	4.1	7.2	2.0	5.2	2.8	0.1	1.4	0.1	0.0	23.60
OWASSO	62-0056	19890502	5/2/1989	5401	7	6.2	0.7	12.0	11.1	0.4	0.6	0.2	0.0	0.0	0.0	0.0	31.20
OWASSO	62-0056	19890524	5/24/1989	5401	8	12.6	2.3	3.9	32.6	6.9	9.3	0.1	0.0	0.0	0.0	0.0	67.70
OWASSO	62-0056	19890613	6/13/1989	5401	7	0.2	2.9	2.0	1.4	1.4	0.2	0.1	0.1	0.0	0.0	0.0	8.30
OWASSO	62-0056	19890707	7/7/1989	5401	6	0.7	4.0	2.6	5.5	1.0	0.1	1.0	0.0	1.4	0.0	0.0	16.30
OWASSO	62-0056	19890726	7/26/1989	5401	5	0.9	2.9	1.9	2.7	0.3	0.7	5.4	0.0	1.8	0.0	0.0	16.60
OWASSO	62-0056	19890815	8/15/1989	5401	8	0.6	0.6	1.7	2.1	0.3	0.2	0.2	0.0	0.6	0.0	0.0	6.30
OWASSO	62-0056	19890911	9/11/1989	5401	8	0.9	0.7	1.9	3.9	0.9	2.6	0.6	0.0	0.0	0.0	0.0	11.50
OWASSO	62-0056	19890928	9/28/1989	5401	10	0.7	1.0	0.7	3.1	0.3	2.6	0.1	0.0	0.2	0.0	0.0	8.70
OWASSO	62-0056	19900410	4/10/1990	5401	8	0.9	0.3	4.8	1.6	0.2	0.0	0.2	0.0	0.0	0.0	0.0	8.00
OWASSO	62-0056	19900504	5/4/1990	5401	8	1.7	0.3	6.0	5.7	2.7	0.7	0.2	0.0	0.0	0.0	0.0	17.30
OWASSO	62-0056	19900605	6/5/1990	5401	9	1.6	2.2	7.1	1.7	0.5	0.1	0.5	0.0	0.0	0.0	0.0	13.70
OWASSO	62-0056	19900628	6/28/1990	5401	6	1.6	2.6	10.7	1.1	0.5	0.4	0.9	0.0	0.1	0.0	0.0	17.90
OWASSO	62-0056	19900724	7/24/1990	5401	6	1.0	2.4	5.9	2.2	0.1	0.1	1.3	0.0	1.2	0.0	0.0	14.20
OWASSO	62-0056	19900822	8/22/1990	5401	8	1.3	0.4	2.3	1.6	0.0	0.2	0.6	0.0	0.1	0.0	0.0	6.50
OWASSO	62-0056	19900914	9/14/1990	5401	7	0.6	1.0	2.7	3.7	0.1	0.6	3.1	0.0	0.5	0.0	0.0	12.30
OWASSO	62-0056	19910423	4/23/1990	5401	9	57.9	1.5	62.8	32.3	5.2	0.6	3.4	0.0	0.0	0.0	0.0	163.70
OWASSO	62-0056	19910529	5/29/1990	5401	10.5	4.9	16.7	28.7	22.5	12.7	0.3	0.3	0.0	0.0	0.0	0.0	86.10
OWASSO	62-0056	19910612	6/12/1990	5401	8	8.1	25.3	36.9	18.9	3.0	7.3	0.9	0.0	1.3	0.0	0.0	101.70
OWASSO	62-0056	19910709	7/9/1990	5401	6	5.7	0.0	3.1	26.9	0.0	1.4	4.9	0.0	1.4	0.0	0.0	43.40
OWASSO	62-0056	19910805	8/5/1990	5401	6	14.4	19.2	26.1	53.5	15.1	61.0	64.4	0.0	3.4	0.0	0.0	257.10
OWASSO	62-0056	19910904	9/4/1990	5401	6	4.6	6.9	5.1	19.1	2.9	22.3	8.3	0.0	8.3	0.0	0.0	77.50
OWASSO	62-0056	19920505	5/5/1992	5401	9	76.8	3.4	66.4	87.8	7.6	0.0	1.5	0.0	0.0	0.0	0.0	243.50
OWASSO	62-0056	19920526	5/26/1992	5401	8	9.9	8.6	31.9	182.0	31.2	4.1	4.5	0.0	0.0	0.0	0.0	272.20
OWASSO	62-0056	19920618	6/18/1992	5401	8	3.9	9.9	5.7	2.1	4.3	1.2	10.6	0.0	0.0	0.0	0.0	37.70
OWASSO	62-0056	19920715	7/15/1992	5401	6	17.8	11.0	29.3	19.7	9.6	70.8	29.3	0.0	2.3	0.0	0.0	189.80
OWASSO	62-0056	19920806	8/6/1992	5401	6	22.4	10.1	41.6	111.1	18.3	21.0	15.1	0.0	4.6	0.0	0.0	244.20
OWASSO	62-0056	19920824	8/24/1992	5401	7	18.0	10.6	33.7	9.8	15.7	39.6	4.7	0.0	7.8	0.0	0.0	139.90
OWASSO	62-0056	19920914	9/14/1992	5401	9.5	4.8	1.9	12.4	7.9	2.7	13.1	0.9	0.1	2.0	0.0	0.0	45.80
OWASSO	62-0056	19930503	5/3/1993	5401	10	28.0	1.4	93.1	7.4	0.5	0.1	1.1	0.0	0.0	0.0	0.0	131.60
OWASSO	62-0056	19930524	5/24/1993	5401	7	20.8	11.0	91.7	41.5	32.1	3.5	6.7	0.0	0.0	0.0	0.0	207.30
OWASSO	62-0056	19930712	7/12/1993	5401	7	2.4	0.9	2.9	5.8	0.6	0.6	0.4	0.1	0.1	0.0	0.0	13.80
OWASSO	62-0056	19930802	8/2/1993	5401	6	28.8	4.1	57.6	16.9	2.7	28.8	7.3	0.0	3.2	0.0	0.0	149.40

OWASSO	62-0056	19930819	8/19/1993	5401	6	34.7	4.6	46.2	13.7	9.6	59.9	6.4	0.0	0.9	0.0	0.0	176.00
OWASSO	62-0056	19930907	9/7/1993	5401	8	39.8	3.1	20.9	14.4	13.4	8.9	4.5	0.0	5.5	0.0	0.0	110.50
OWASSO	62-0056	19930923	9/23/1993	5401	8.5	23.2	10.0	16.8	9.7	49.7	13.6	2.3	0.0	0.6	0.0	0.0	125.90
OWASSO	62-0056	19940502	5/2/1994	5401	8.5	36.3	10.1	50.4	52.0	32.3	1.2	1.6	0.0	0.0	0.0	0.0	183.90
OWASSO	62-0056	19940523	5/23/1994	5401	8	8.8	8.4	51.6	35.8	25.7	2.4	10.5	0.0	0.2	0.0	0.0	143.40
OWASSO	62-0056	19940613	6/13/1994	5401	7	6.5	10.3	25.2	6.7	6.0	4.4	8.2	0.0	0.0	0.0	0.0	67.30
OWASSO	62-0056	19940705	7/5/1994	5401	6	7.8	12.0	30.5	21.5	1.5	9.1	13.9	0.0	15.0	0.2	0.0	111.50
OWASSO	62-0056	19940726	7/26/1994	5401	8	12.6	6.4	10.1	7.4	1.0	5.7	2.1	0.0	8.3	0.0	0.0	53.60
OWASSO	62-0056	19940815	8/15/1994	5401	7	5.5	5.6	18.9	18.4	2.1	11.4	12.0	0.0	1.6	0.0	0.0	75.50
OWASSO	62-0056	19940908	9/8/1994	5401	7	4.9	10.3	23.3	6.4	12.2	17.9	6.6	0.0	2.7	0.0	0.0	84.30
OWASSO	62-0056	19940929	9/29/1994	5401	8	5.7	5.0	11.2	3.8	1.4	4.5	1.9	0.2	0.2	0.0	0.0	33.90
OWASSO	62-0056	19950501	5/1/1995	5401	9	13.1	3.2	18.5	32.1	3.1	0.8	2.1	0.1	0.0	0.0	0.0	73.00
OWASSO	62-0056	19950523	5/23/1995	5401	7	9.7	2.9	26.2	16.2	8.5	7.1	3.5	0.0	0.0	0.0	0.0	74.10
OWASSO	62-0056	19950619	6/19/1995	5401	8	7.8	3.9	24.0	12.1	2.6	1.2	2.1	0.1	0.0	0.0	0.0	53.80
OWASSO	62-0056	19950712	7/12/1995	5401	7	8.5	5.9	27.6	3.1	0.9	1.2	2.8	0.0	4.6	0.0	0.0	54.60
OWASSO	62-0056	19950817	8/17/1995	5401	6	7.4	1.9	9.9	19.0	1.0	5.1	6.7	0.0	2.4	0.0	0.0	53.40
OWASSO	62-0056	19950817	8/17/1995	5401	6	9.8	3.9	52.8	8.6	1.4	1.5	12.0	0.0	7.9	0.0	0.0	97.90
OWASSO	62-0056	19950907	9/7/1995	5401	7.5	5.6	1.4	12.9	47.9	0.8	7.7	10.3	0.0	1.5	0.0	0.0	88.10
OWASSO	62-0056	19950925	9/25/1995	5401	9.5	5.4	3.1	7.0	7.3	0.8	16.9	0.4	0.0	0.5	0.0	0.0	41.40
OWASSO	62-0056	19960506	5/6/1996	5401	9.5	11.5	1.8	22.6	9.8	0.5	1.1	0.8	0.0	0.0	0.0	0.0	48.10
OWASSO	62-0056	19960528	5/28/1996	5401	9	13.3	18.1	30.3	34.7	7.4	17.7	1.3	0.0	0.0	0.0	0.0	122.80
OWASSO	62-0056	19960618	6/18/1996	5401	8	1.9	5.4	6.1	4.4	4.1	0.4	0.6	0.0	0.4	0.0	0.0	23.30
OWASSO	62-0056	19960708	7/8/1996	5401	6	6.0	11.9	32.7	37.0	0.1	2.0	1.0	0.0	6.9	0.0	0.0	97.60
OWASSO	62-0056	19960729	7/29/1996	5401	6	8.7	10.5	23.3	8.9	0.2	16.5	2.1	0.0	5.8	0.0	0.0	76.00
OWASSO	62-0056	19960815	8/15/1996	5401	6	5.7	7.4	10.9	9.7	2.9	29.1	6.6	0.0	3.7	0.0	0.0	76.00
OWASSO	62-0056	19960909	9/9/1996	5401	6.5	10.3	2.2	14.6	10.3	7.6	1.6	0.3	0.0	1.8	0.0	0.0	48.70
OWASSO	62-0056	19960924	9/24/1996	5401	7	2.9	2.5	20.5	11.1	5.2	3.3	1.1	0.0	1.6	0.0	0.0	48.20
OWASSO	62-0056	19970527	5/27/1997	5401	7	10.0	5.1	15.9	52.9	16.3	1.8	1.6	0.0	0.0	0.0	0.0	103.60
OWASSO	62-0056	19970616	6/16/1997	5401	8	1.4	3.4	12.3	6.4	6.4	0.6	0.6	0.2	0.0	0.0	0.0	31.30
OWASSO	62-0056	19970707	7/7/1997	5401	9	0.5	6.1	5.6	4.6	0.2	1.9	0.1	0.1	1.8	0.0	0.0	20.90
OWASSO	62-0056	19970804	8/4/1997	5401	7	4.9	3.1	6.7	9.0	1.4	6.2	0.0	3.1	2.7	0.0	0.0	37.10
OWASSO	62-0056	19970827	8/27/1997	5401	8	1.9	0.7	7.9	3.2	2.6	4.7	0.3	0.0	1.0	0.0	0.0	22.30
OWASSO	62-0056	19970912	9/12/1997	5401	7	7.5	1.2	10.1	11.8	1.2	3.4	1.4	0.0	1.2	0.0	0.0	37.80
OWASSO	62-0056	19970930	9/30/1997	5401	7	8.2	2.7	5.0	5.0	2.0	9.7	0.2	0.0	0.2	0.0	0.0	33.00
OWASSO	62-0056	19980501	5/1/1998	5401	7	22.7	1.2	17.0	35.7	0.2	25.3	0.8	0.0	0.0	0.0	0.0	102.90
OWASSO	62-0056	19980520	5/20/1998	5401	8	12.3	3.3	16.6	15.9	1.0	6.2	0.7	0.0	0.0	0.0	0.0	56.00
OWASSO	62-0056	19980609	6/9/1998	5401	8.5	6.3	4.7	13.4	14.2	1.7	1.0	0.4	0.0	1.3	0.0	0.0	43.00
OWASSO	62-0056	19980630	6/30/1998	5401	6.4	6.4	6.3	12.9	10.9	2.0	4.4	0.6	0.4	2.6	0.0	0.0	46.50
OWASSO	62-0056	19980721	7/21/1998	5401	7	3.1	5.6	7.4	18.9	0.1	3.7	0.7	0.1	3.9	0.0	0.0	43.50
OWASSO	62-0056	19980812	8/12/1998	5401	8.5	3.1	4.5	11.3	11.0	0.2	3.9	1.5	0.0	0.3	0.0	0.0	35.80
OWASSO	62-0056	19980922	9/22/1998	5401	7.5	11.2	9.9	18.6	17.7	1.1	5.7	0.5	1.6	0.4	0.0	0.0	66.70
OWASSO	62-0056	19990604	6/4/1999	5401	7	29.4	14.7	40.6	58.3	18.1	21.1	10.8	0.0	4.4	0.0	0.0	197.40
OWASSO	62-0056	20000501	5/1/2000	5401	6	20.0	0.0	42.8	845.6	2.9	37.1	0.0	0.0	0.0	0.0	0.0	948.40
OWASSO	62-0056	20000525	5/25/2000	5401	7	13.0	4.2	23.5	87.7	2.7	23.8	7.3	0.0	0.5	0.0	0.0	162.70
OWASSO	62-0056	20000613	6/13/2000	5401	7	6.7	18.0	40.0	38.8	7.1	9.0	5.5	0.0	3.1	0.0	0.0	128.20
OWASSO	62-0056	20000727	7/27/2000	5401	7	7.8	18.8	22.7	2.4	3.5	20.8	7.4	0.4	2.4	0.0	0.0	86.20
OWASSO	62-0056	20000816	8/16/2000	5401	6	4.8	10.1	16.0	9.8	1.6	6.9	5.7	0.7	4.6	0.0	0.0	60.20
OWASSO	62-0056	20000907	9/7/2000	5401	7.5	5.1	6.9	10.6	14.6	1.6	7.9	2.7	0.2	4.4	0.0	0.0	54.00
OWASSO	62-0056	20000925	9/25/2000	5401	8.5	3.4	2.3	12.0	10.3	4.5	2.1	4.7	0.7	0.2	0.0	0.0	40.20
OWASSO	62-0056	20010501	5/1/2001	5401	9	17.4	0.0	23.8	15.2	0.1	0.5	0.2	0.1	0.1	0.0	0.0	57.40
OWASSO	62-0056	20010523	5/23/2001	5401	7	37.0	2.9	26.4	152.2	15.9	46.4	2.9	0.6	0.0	0.0	0.0	284.30
OWASSO	62-0056	20010612	6/12/2001	5401	8	4.9	1.7	15.9	3.3	4.8	0.3	0.9	0.0	0.2	0.0	0.0	32.00
OWASSO	62-0056	20010703	7/3/2001	5401	6	9.4	4.1	24.7	2.2	3.4	0.5	1.5	0.3	2.4	0.0	0.0	48.50
OWASSO	62-0056	20010726	7/26/2001	5401	5	0.4	2.9	9.5	15.0	0.4	15.6	6.8	0.4	4.1	0.0	0.0	55.10
OWASSO	62-0056	20010816	8/16/2001	5401	6	2.2	3.1	5.7	8.3	1.0	0.7	3.9	0.0	5.5	0.0	0.0	30.40
OWASSO	62-0056	20010906	9/6/2001	5401	7	6.6	4.8	13.8	15.0	0.9	14.3	0.9	0.0	2.5	0.0	0.0	58.80
OWASSO	62-0056	20010927	9/27/2001	5401	8	4.4	4.9	5.8	3.9	1.3	12.7	0.4	0.0	0.0	0.0	0.0	33.40
OWASSO	62-0056	20020506	5/6/2002	5401	6	13.5	6.9	52.1	21.9	14.9	1.8	0.5	0.0	0.0	0.0	0.0	111.60
OWASSO	62-0056	20020529	5/29/2002	5401	7.5	4.4	6.4	23.7	12.2	1.3	0.2	1.2	0.0	0.0	0.0	0.0	49.40
OWASSO	62-0056	20020618	6/18/2002	5401	6.8	2.9	9.8	26.8	1.6	2.9	0.0	1.4	0.0	0.0	0.0	0.0	45.40
OWASSO	62-0056	20020712	7/12/2002	5401	8	2.0	4.9	9.1	3.0	0.2	0.4	1.4	0.0	2.3	0.0	0.0	23.30
OWASSO	62-0056	20020730	7/30/2002	5401	6.5	0.3	2.7	6.1	2.2	0.0	3.2	0.5	0.0	6.3	0.0	0.0	21.30
OWASSO	62-0056	20020816	8/16/2002	5401	7	2.4	7.1	10.6	11.9	0.4	14.9	0.0	0.0	1.8	0.0	0.0	49.10
OWASSO	62-0056	20020909	9/9/2002	5401	6	2.2	4.8	7.5	3.2	1.1	7.0	0.2	0.0	1.0	0.0	0.0	27.00
OWASSO	62-0056	20020926	9/26/2002	5401	7	1.7	5.7	8.0	8.2	0.5	2.0	0.0	0.1	0.4	0.0	0.0	26.60
OWASSO	62-0056	20030501	5/1/2003	5401	8	9.4	2.6	30.9	11.4	1.2	0.8	3.6	0.0	0.0	0.0	0.0	59.90
OWASSO	62-0056	20030604	6/4/2003	5401	8	0.9	8.9	9.0	3.0	3.1	0.1	1.8	0.0	0.0	0.0	0.0	26.80
OWASSO	62-0056	20030625	6/25/2003	5401	6	2.5	4.8	6.1	2.4	0.5	0.6	0.6	0.0	0.6	0.0	0.0	18.10
OWASSO	62-0056	20030716	7/16/2003	5401	6	2.8	3.7	21.9	23.3	0.0	4.8	2.9	0.0	1.7	0.0	0.0	61.10
OWASSO	62-0056	20030731	7/31/2003	5401	6	2.3	3.4	26.3	15.3	2.1	37.9	0.0	0.0	3.4	0.0	0.0	90.70

OWASSO	62-0056	20030818	8/18/2003	5401	5	2.6	2.8	6.2	5.9	1.1	0.1	0.5	0.0	3.8	0.0	0.0	23.00
OWASSO	62-0056	20030905	9/5/2003	5401	7	1.6	2.6	23.7	14.8	7.6	9.4	8.2	0.0	0.9	0.0	0.0	68.80
OWASSO	62-0056	20030925	9/25/2003	5401	7	2.5	3.9	10.4	9.2	1.6	4.4	0.1	0.0	0.2	0.0	0.0	32.30
OWASSO	62-0056	20040503	5/3/2004	5401	7	10.9	15.9	58.2	23.7	21.9	1.0	0.6	0.0	0.0	0.0	0.0	132.20
OWASSO	62-0056	20040524	5/24/2004	5401	7	1.2	8.6	12.9	3.0	2.4	1.6	1.4	0.0	0.1	0.0	0.0	31.20
OWASSO	62-0056	20040615	6/15/2004	5401	7	1.2	3.8	6.0	0.4	0.3	0.0	1.7	0.0	0.0	0.0	0.0	13.40
OWASSO	62-0056	20040707	7/7/2004	5401	6	1.8	6.7	15.5	23.0	0.6	3.7	7.3	0.0	0.5	0.0	0.0	59.10
OWASSO	62-0056	20040726	7/26/2004	5401	4	3.1	4.4	22.9	8.7	12.9	23.4	9.0	0.5	2.6	0.0	0.0	87.50
OWASSO	62-0056	20040816	8/16/2004	5401	6	1.2	2.1	16.0	5.5	1.0	0.7	0.3	0.0	0.8	0.0	0.0	27.60
OWASSO	62-0056	20040907	9/7/2004	5401	6	1.4	8.9	24.5	24.0	0.9	26.7	0.5	0.2	6.0	0.0	0.0	93.10
OWASSO	62-0056	20050505	5/5/2005	5401	7.5	5.3	2.9	13.1	21.0	6.0	1.7	0.8	0.0	0.1	0.0	0.0	50.90
OWASSO	62-0056	20050526	5/26/2005	5401	5.5	0.9	3.2	10.2	6.4	3.6	0.6	0.5	0.0	0.0	0.0	0.0	25.40
OWASSO	62-0056	20050615	6/15/2005	5401	7.5	2.3	2.9	23.6	9.5	3.2	1.8	4.4	0.0	0.1	0.0	0.0	47.80
OWASSO	62-0056	20050706	7/6/2005	5401	7	1.3	2.7	9.3	3.1	0.0	2.3	1.6	0.0	0.2	0.0	0.0	20.50
OWASSO	62-0056	20050728	7/28/2005	5401	6	3.4	4.9	5.0	1.2	0.8	0.3	0.9	0.0	4.6	0.0	0.0	21.10
OWASSO	62-0056	20050816	8/16/2005	5401	6.5	1.4	3.2	6.8	1.2	0.6	6.1	1.6	0.0	1.6	0.0	0.0	22.50
OWASSO	62-0056	20050907	9/7/2005	5401	7	4.4	6.4	11.2	6.4	0.1	7.6	1.1	0.0	5.1	0.0	0.0	42.30
OWASSO	62-0056	20050926	9/26/2005	5401	6	1.4	1.1	10.1	4.2	0.2	127.0	1.6	0.0	0.3	0.0	0.0	145.90
OWASSO	62-0056	20060501	5/1/2006	5401	7.5	10.5	8.8	28.5	32.7	4.8	6.1	1.2	0.0	0.1	0.0	0.0	92.70
OWASSO	62-0056	20060523	5/23/2006	5401	6.5	1.9	17.1	23.4	8.9	9.3	0.4	0.6	0.0	0.0	0.0	0.0	61.60
OWASSO	62-0056	20060613	6/13/2006	5401	6	0.8	6.6	7.9	1.7	0.7	0.5	2.7	0.0	0.0	0.0	0.0	20.90
OWASSO	62-0056	20060705	7/5/2006	5401	5.5	0.5	3.0	13.0	1.6	0.0	3.3	0.2	0.0	3.8	0.0	0.0	25.40
OWASSO	62-0056	20060727	7/27/2006	5401	5	1.2	5.2	10.1	4.9	0.1	0.2	0.7	0.0	3.0	0.0	0.0	25.40
OWASSO	62-0056	20060818	8/18/2006	5401	6	0.8	4.2	9.4	1.6	0.8	0.6	20.3	0.0	2.3	0.1	0.0	40.10
OWASSO	62-0056	20060911	9/11/2006	5401	7	0.8	2.7	8.2	4.5	0.8	49.6	1.0	0.0	2.5	0.0	0.0	70.10
OWASSO	62-0056	20060926	9/26/2006	5401	4	0.7	1.4	8.9	8.9	1.0	154.6	0.0	0.0	1.0	0.0	0.0	176.50
OWASSO	62-0056	20070329	3/29/2007	5401		0.6	0.9	6.6	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	9.32
OWASSO	62-0056	20070502	5/2/2007	5401		3.4	3.0	37.0	10.0	3.7	0.2	0.8	0.0	0.0	0.0	0.0	57.97
OWASSO	62-0056	20070530	5/30/2007	5401		1.3	6.5	12.9	1.6	5.1	0.0	0.4	0.0	0.0	0.0	0.0	27.83
OWASSO	62-0056	20070619	6/19/2007	5401		2.1	1.8	1.6	0.8	0.6	0.0	0.1	0.0	0.3	0.0	0.0	7.27
OWASSO	62-0056	20070705	7/5/2007	5401		3.0	3.7	10.4	4.9	0.0	0.0	0.1	0.0	0.9	0.0	0.0	23.02
OWASSO	62-0056	20070725	7/25/2007	5401		2.9	5.0	8.8	9.3	0.6	0.0	0.4	0.0	1.3	0.0	0.0	28.21
OWASSO	62-0056	20070814	8/14/2007	5401		1.5	1.7	11.7	3.2	0.6	0.1	0.4	0.0	2.5	0.0	0.0	21.60
OWASSO	62-0056	20070904	9/4/2007	5401		2.6	2.6	22.1	7.9	2.6	0.9	2.5	0.0	3.4	0.0	0.0	44.71
OWASSO	62-0056	20070925	9/25/2007	5401		0.6	3.3	8.7	8.4	0.5	14.7	6.7	0.0	0.3	0.0	0.0	43.28

					Number of Daphnia by Size Range							
LAKENAME	DNRID	DATE	DATE	SITE	0-.33 MM	.34-.66 MM	.67-.99 MM	1.0-1.33 MM	1.34-1.66 MM	1.67-1.99 MM	2.00-2.33 MM	2.34-2.66 MM
OWASSO	62-0056	19840417	4/17/1984	5401	0	1	0	0	0	0	0	0
OWASSO	62-0056	19840606	6/6/1984	5401	0	5	13	11	0	0	0	0
OWASSO	62-0056	19840621	6/21/1984	5401	0	10	10	11	2	0	0	0
OWASSO	62-0056	19840705	7/5/1984	5401	0	23	7	2	0	0	0	0
OWASSO	62-0056	19840824	8/24/1984	5401	0	0	3	2	1	0	0	0
OWASSO	62-0056	19840829	8/29/1984	5401	0	10	5	1	0	0	0	0
OWASSO	62-0056	19850416	4/16/1985	5401	0	1	0	0	0	0	0	0
OWASSO	62-0056	19850516	5/16/1985	5401	20	7	2	0	0	0	0	0
OWASSO	62-0056	19850611	6/11/1985	5401	11	12	0	0	0	0	0	0
OWASSO	62-0056	19850625	6/25/1985	5401	1	1	0	0	0	0	0	0
OWASSO	62-0056	19850730	7/30/1985	5401	5	1	2	1	0	0	0	0
OWASSO	62-0056	19850816	8/16/1985	5401	17	15	7	0	0	0	0	0
OWASSO	62-0056	19850912	9/12/1985	5401	2	4	4	0	0	0	0	0
OWASSO	62-0056	19860429	4/29/1986	5401	0	2	3	1	0	0	0	0
OWASSO	62-0056	19860522	5/22/1986	5401	0	22	38	18	0	0	0	0
OWASSO	62-0056	19860612	6/12/1986	5401	0	6	7	2	0	0	0	0
OWASSO	62-0056	19860701	7/1/1986	5401	0	1	5	0	0	0	0	0
OWASSO	62-0056	19860717	7/17/1986	5401	0	2	6	2	1	0	0	0
OWASSO	62-0056	19860812	8/12/1986	5401	0	3	3	1	0	0	0	0
OWASSO	62-0056	19860902	9/2/1986	5401	0	11	20	5	0	0	0	0
OWASSO	62-0056	19860924	9/24/1986	5401	0	24	35	8	0	0	0	0
OWASSO	62-0056	19870512	5/12/1987	5401	0	9	26	20	0	0	0	0
OWASSO	62-0056	19870604	6/4/1987	5401	0	5	4	11	2	0	0	0
OWASSO	62-0056	19870625	6/25/1987	5401	0	11	27	4	2	0	0	0
OWASSO	62-0056	19870716	7/16/1987	5401	0	1	3	3	0	0	0	0
OWASSO	62-0056	19870813	8/13/1987	5401	0	14	44	13	1	0	0	0
OWASSO	62-0056	19870828	8/28/1987	5401	0	17	108	26	1	0	0	0
OWASSO	62-0056	19870918	9/18/1987	5401	0	0	30	27	12	0	0	0
OWASSO	62-0056	19871008	10/8/1987	5401	0	8	10	14	0	0	0	0
OWASSO	62-0056	19880407	4/7/1987	5401	0	10	2	5	3	0	0	0
OWASSO	62-0056	19880503	5/3/1988	5401	0	10	16	7	1	0	0	0
OWASSO	62-0056	19880518	5/18/1988	5401	0	6	42	21	5	0	0	0
OWASSO	62-0056	19880608	6/8/1988	5401	0	2	11	6	0	0	0	0
OWASSO	62-0056	19880630	6/30/1988	5401	0	4	9	6	1	0	0	0
OWASSO	62-0056	19880719	7/19/1988	5401	0	5	4	2	0	0	0	0
OWASSO	62-0056	19880811	8/11/1988	5401	0	5	32	5	0	0	0	0
OWASSO	62-0056	19880902	9/2/1988	5401	0	4	17	0	0	0	0	0
OWASSO	62-0056	19890502	5/2/1989	5401	0	1	3	5	1	0	0	0
OWASSO	62-0056	19890524	5/24/1989	5401	0	12	26	16	6	0	0	0
OWASSO	62-0056	19890613	6/13/1989	5401	0	6	24	5	0	0	0	0
OWASSO	62-0056	19890707	7/7/1989	5401	0	8	4	6	3	0	0	0
OWASSO	62-0056	19890726	7/26/1989	5401	0	2	1	0	0	0	0	0
OWASSO	62-0056	19890815	8/15/1989	5401	0	3	4	2	0	0	0	0
OWASSO	62-0056	19890911	9/11/1989	5401	0	4	16	15	0	0	0	0
OWASSO	62-0056	19890928	9/28/1989	5401	0	4	6	6	0	0	0	0
OWASSO	62-0056	19900410	4/10/1990	5401	0	1	3	3	1	0	0	0
OWASSO	62-0056	19900504	5/4/1990	5401	0	1	40	23	11	0	0	0
OWASSO	62-0056	19900605	6/5/1990	5401	0	5	4	8	0	0	0	0
OWASSO	62-0056	19900628	6/28/1990	5401	0	1	8	3	1	0	0	0
OWASSO	62-0056	19900724	7/24/1990	5401	0	0	3	0	0	0	0	0
OWASSO	62-0056	19900822	8/22/1990	5401	0	1	1	0	0	0	0	0
OWASSO	62-0056	19900914	9/14/1990	5401	0	0	2	1	0	0	0	0
OWASSO	62-0056	19910423	4/23/1990	5401	0	3	9	5	0	0	0	0
OWASSO	62-0056	19910529	5/29/1990	5401	0	1	19	15	4	0	0	0
OWASSO	62-0056	19910612	6/12/1990	5401	0	0	2	4	1	0	0	0
OWASSO	62-0056	19910709	7/9/1990	5401	0	0	0	0	0	0	0	0
OWASSO	62-0056	19910805	8/5/1990	5401	0	9	10	3	0	0	0	0
OWASSO	62-0056	19910904	9/4/1990	5401	0	1	8	1	0	0	0	0
OWASSO	62-0056	19920505	5/5/1992	5401	0	2	14	7	2	0	0	0
OWASSO	62-0056	19920526	5/26/1992	5401	0	0	71	16	4	0	0	0
OWASSO	62-0056	19920618	6/18/1992	5401	0	5	8	7	5	0	0	0
OWASSO	62-0056	19920715	7/15/1992	5401	0	6	5	8	2	0	0	0
OWASSO	62-0056	19920806	8/6/1992	5401	0	6	20	10	4	0	0	0
OWASSO	62-0056	19920824	8/24/1992	5401	0	14	11	12	3	0	0	0
OWASSO	62-0056	19920914	9/14/1992	5401	0	2	6	11	0	0	0	0
OWASSO	62-0056	19930503	5/3/1993	5401	0	1	2	1	0	0	0	0
OWASSO	62-0056	19930524	5/24/1993	5401	0	1	51	25	5	0	0	0
OWASSO	62-0056	19930712	7/12/1993	5401	0	0	4	0	0	5	1	0
OWASSO	62-0056	19930802	8/2/1993	5401	0	0	4	2	0	0	0	0
OWASSO	62-0056	19930819	8/19/1993	5401	0	1	14	4	2	0	0	0
OWASSO	62-0056	19930907	9/7/1993	5401	0	5	33	1	0	0	0	0
OWASSO	62-0056	19930923	9/23/1993	5401	0	11	126	14	3	0	0	0

					Number of Daphnia by Size Range							
LAKENAME	DNRID	DATE	DATE	SITE	0-.33 MM	.34-.66 MM	.67-.99 MM	1.0-1.33 MM	1.34-1.66 MM	1.67-1.99 MM	2.00-2.33 MM	2.34-2.66 MM
OWASSO	62-0056	19940502	5/2/1994	5401	0	14	39	11	10	6	0	0
OWASSO	62-0056	19940523	5/23/1994	5401	0	1	55	36	27	1	0	0
OWASSO	62-0056	19940613	6/13/1994	5401	0	2	36	10	1	0	0	0
OWASSO	62-0056	19940705	7/5/1994	5401	0	2	3	3	0	0	0	0
OWASSO	62-0056	19940726	7/26/1994	5401	0	1	5	1	0	0	0	0
OWASSO	62-0056	19940815	8/15/1994	5401	0	4	12	1	0	0	0	0
OWASSO	62-0056	19940908	9/8/1994	5401	0	7	42	1	0	0	0	0
OWASSO	62-0056	19940929	9/29/1994	5401	0	2	10	0	0	0	0	0
OWASSO	62-0056	19950501	5/1/1995	5401	0	1	18	4	4	0	0	0
OWASSO	62-0056	19950523	5/23/1995	5401	0	1	16	8	3	1	0	0
OWASSO	62-0056	19950619	6/19/1995	5401	0	7	5	5	3	0	0	0
OWASSO	62-0056	19950712	7/12/1995	5401	0	0	3	2	1	0	0	0
OWASSO	62-0056	19950817	8/17/1995	5401	0	0	7	2	0	0	0	0
OWASSO	62-0056	19950817	8/17/1995	5401	0	1	2	4	1	0	0	0
OWASSO	62-0056	19950907	9/7/1995	5401	0	0	6	0	0	0	0	0
OWASSO	62-0056	19950925	9/25/1995	5401	0	1	2	4	0	0	0	0
OWASSO	62-0056	19960506	5/6/1996	5401	0	0	4	2	0	0	0	0
OWASSO	62-0056	19960528	5/28/1996	5401	0	0	29	8	2	0	0	0
OWASSO	62-0056	19960618	6/18/1996	5401	0	0	31	19	7	0	0	0
OWASSO	62-0056	19960708	7/8/1996	5401	0	0	0	1	0	0	0	0
OWASSO	62-0056	19960729	7/29/1996	5401	0	0	1	0	0	0	0	0
OWASSO	62-0056	19960815	8/15/1996	5401	0	1	6	3	0	0	0	0
OWASSO	62-0056	19960909	9/9/1996	5401	0	4	53	30	0	0	0	0
OWASSO	62-0056	19960924	9/24/1996	5401	0	4	37	23	0	0	0	0
OWASSO	62-0056	19970527	5/27/1997	5401	0	0	56	34	17	4	0	0
OWASSO	62-0056	19970616	6/16/1997	5401	0	3	45	35	17	0	0	0
OWASSO	62-0056	19970707	7/7/1997	5401	0	0	1	1	2	0	0	0
OWASSO	62-0056	19970804	8/4/1997	5401	0	3	11	5	0	0	0	0
OWASSO	62-0056	19970827	8/27/1997	5401	0	1	38	8	1	0	0	0
OWASSO	62-0056	19970912	9/12/1997	5401	0	2	14	0	1	0	0	0
OWASSO	62-0056	19970930	9/30/1997	5401	0	5	34	1	0	0	0	0
OWASSO	62-0056	19980501	5/1/1998	5401	0	0	1	0	0	0	0	0
OWASSO	62-0056	19980520	5/20/1998	5401	0	3	3	0	0	0	0	0
OWASSO	62-0056	19980609	6/9/1998	5401	0	0	9	2	5	0	0	0
OWASSO	62-0056	19980630	6/30/1998	5401	0	3	6	5	0	0	0	0
OWASSO	62-0056	19980721	7/21/1998	5401	0	0	0	1	0	0	0	0
OWASSO	62-0056	19980812	8/12/1998	5401	0	1	0	0	0	0	0	0
OWASSO	62-0056	19980922	9/22/1998	5401	0	2	4	0	0	0	0	0
OWASSO	62-0056	19990604	6/4/1999	5401	0	10	27	0	0	0	0	0
OWASSO	62-0056	20000501	5/1/2000	5401	0	0	1	0	0	0	0	0
OWASSO	62-0056	20000525	5/25/2000	5401	0	2	7	2	0	0	0	0
OWASSO	62-0056	20000613	6/13/2000	5401	0	0	15	2	1	0	0	0
OWASSO	62-0056	20000727	7/27/2000	5401	0	3	4	1	1	0	0	0
OWASSO	62-0056	20000816	8/16/2000	5401	0	2	4	1	0	0	0	0
OWASSO	62-0056	20000907	9/7/2000	5401	0	1	6	2	0	0	0	0
OWASSO	62-0056	20000925	9/25/2000	5401	0	2	33	7	1	0	0	0
OWASSO	62-0056	20010501	5/1/2001	5401	0	0	0	1	0	0	0	0
OWASSO	62-0056	20010523	5/23/2001	5401	0	0	23	4	0	0	0	0
OWASSO	62-0056	20010612	6/12/2001	5401	0	0	35	16	4	1	0	0
OWASSO	62-0056	20010703	7/3/2001	5401	0	0	14	6	0	0	0	0
OWASSO	62-0056	20010726	7/26/2001	5401	0	0	2	0	0	0	0	0
OWASSO	62-0056	20010816	8/16/2001	5401	0	0	9	0	0	0	0	0
OWASSO	62-0056	20010906	9/6/2001	5401	0	0	5	1	0	0	0	0
OWASSO	62-0056	20010927	9/27/2001	5401	0	2	8	0	0	0	0	0
OWASSO	62-0056	20020506	5/6/2002	5401	0	0	40	21	4	0	0	0
OWASSO	62-0056	20020529	5/29/2002	5401	0	0	4	10	0	0	0	0
OWASSO	62-0056	20020618	6/18/2002	5401	0	0	24	5	0	0	0	0
OWASSO	62-0056	20020712	7/12/2002	5401	0	0	3	1	0	0	0	0
OWASSO	62-0056	20020730	7/30/2002	5401	0	0	0	0	0	0	0	0
OWASSO	62-0056	20020816	8/16/2002	5401	0	0	3	1	0	0	0	0
OWASSO	62-0056	20020909	9/9/2002	5401	0	0	2	8	0	0	0	0
OWASSO	62-0056	20020926	9/26/2002	5401	0	0	5	3	0	0	0	0
OWASSO	62-0056	20030501	5/1/2003	5401	0	2	3	1	3	0	0	0
OWASSO	62-0056	20030604	6/4/2003	5401	0	2	16	5	1	0	0	0
OWASSO	62-0056	20030625	6/25/2003	5401	0	0	2	2	0	0	0	0
OWASSO	62-0056	20030716	7/16/2003	5401	0	0	0	0	0	0	0	0
OWASSO	62-0056	20030731	7/31/2003	5401	0	0	5	3	1	0	0	0
OWASSO	62-0056	20030818	8/18/2003	5401	0	0	10	1	0	0	0	0
OWASSO	62-0056	20030905	9/5/2003	5401	0	6	23	23	0	0	0	0
OWASSO	62-0056	20030925	9/25/2003	5401	0	6	15	6	1	0	0	0
OWASSO	62-0056	20040503	5/3/2004	5401	0	3	75	38	26	7	0	0
OWASSO	62-0056	20040524	5/24/2004	5401	0	0	2	16	5	1	0	0

					Number of Daphnia by Size Range							
LAKENAME	DNRID	DATE	DATE	SITE	0-.33 MM	.34-.66 MM	.67-.99 MM	1.0-1.33 MM	1.34-1.66 MM	1.67-1.99 MM	2.00-2.33 MM	2.34-2.66 MM
OWASSO	62-0056	20040615	6/15/2004	5401	0	1	1	2	0	0	0	0
OWASSO	62-0056	20040707	7/7/2004	5401	0	3	1	1	0	0	0	0
OWASSO	62-0056	20040726	7/26/2004	5401	0	0	32	18	0	0	0	0
OWASSO	62-0056	20040816	8/16/2004	5401	0	2	8	2	0	0	0	0
OWASSO	62-0056	20040907	9/7/2004	5401	0	1	4	0	0	0	0	0
OWASSO	62-0056	20050505	5/5/2005	5401	0	7	46	8	5	0	0	0
OWASSO	62-0056	20050526	5/26/2005	5401	0	0	20	8	1	0	0	0
OWASSO	62-0056	20050615	6/15/2005	5401	0	1	19	10	3	2	0	0
OWASSO	62-0056	20050706	7/6/2005	5401	0	0	0	0	0	0	0	0
OWASSO	62-0056	20050728	7/28/2005	5401	0	0	5	5	0	0	0	0
OWASSO	62-0056	20050816	8/16/2005	5401	0	2	7	0	0	0	0	0
OWASSO	62-0056	20050907	9/7/2005	5401	0	1	0	0	0	0	0	0
OWASSO	62-0056	20050926	9/26/2005	5401	0	2	0	0	0	0	0	0
OWASSO	62-0056	20060501	5/1/2006	5401	0	2	24	12	1	0	0	0
OWASSO	62-0056	20060523	5/23/2006	5401	0	0	7	32	5	0	0	0
OWASSO	62-0056	20060613	6/13/2006	5401	0	3	5	1	0	0	0	0
OWASSO	62-0056	20060705	7/5/2006	5401	0	0	0	0	0	0	0	0
OWASSO	62-0056	20060727	7/27/2006	5401	0	0	2	0	0	0	0	0
OWASSO	62-0056	20060818	8/18/2006	5401	0	1	3	6	1	0	0	0
OWASSO	62-0056	20060911	9/11/2006	5401	0	0	3	1	0	0	0	0
OWASSO	62-0056	20060926	9/26/2006	5401	0	0	0	0	3	0	0	0
OWASSO	62-0056	20070329	3/29/2007	5401	0	0	8	3	1	0	0	0
OWASSO	62-0056	20070502	5/2/2007	5401	0	5	18	18	4	2	0	1
OWASSO	62-0056	20070530	5/30/2007	5401	0	1	13	19	9	0	0	0
OWASSO	62-0056	20070619	6/19/2007	5401	0	1	7	6	3	0	0	0
OWASSO	62-0056	20070705	7/5/2007	5401	0	0	0	0	0	0	0	0
OWASSO	62-0056	20070725	7/25/2007	5401	0	2	4	3	0	0	0	0
OWASSO	62-0056	20070814	8/14/2007	5401	0	2	7	1	0	0	0	0
OWASSO	62-0056	20070904	9/4/2007	5401	0	1	22	14	0	0	0	0
OWASSO	62-0056	20070925	9/25/2007	5401	0	3	2	0	0	0	0	0

Phytoplankton - Lake Owasso - 1984 through 2006 - Units: No/mL

Date2	#N/A	BACILLARIOPHYCEAE (DIATOM)	CHLOROPHYTA (GREEN)	CHRYSOPHYTA (YELLOW-GREEN)	CRYPTOPHYTA (CRYPTOMONADS)	CYANOPHYTA (BLUE-GREEN)	EUGLENOPHYTA (EUGLENOIDS)	PYRRHOPHYTA (DINOFLAGELLATES)	Grand Total
3/15/1984	0		11	607	107	11			736
4/17/1984	0	420	920	1700	3000	140	20		6200
6/6/1984	0	50	510	160	120	1660			2500
6/21/1984	0	48	1405	32	32	878		16	2411
7/5/1984	0	801	1477			616	15		2909
7/30/1984	0	752	579	58	58	4911	29		6387
8/14/1984	0	534	455		107	5895		27	7018
8/29/1984	0	280	300	40		5320			5940
4/16/1985	0	5	75	5		604			689
5/16/1985	0	8	48			204		20	280
6/11/1985	0	23	114	250	63	94		20	564
6/25/1985	0	86	203	38		222		14	563
7/9/1985	0	57	134		19	814		32	1056
7/30/1985	0	26	236	102	6	358		6	734
8/16/1985	0	256	136	312	224	824	8	8	1768
9/12/1985	0		102		18	24258		6	24384
4/29/1986	0	51	141			563			755
5/22/1986	0	97	89	33	216	163			598
6/17/1986	0	67	164	38	29	461		58	817
7/1/1986	0	71	246			378		26	721
7/17/1986	0	11	190	27	38	882	5		1153
8/12/1986	0		198		25	3436		25	3684
9/24/1986	0	5	763	5	86	82		5	946
4/7/1987	0	100		220	1460	2800			4580
5/12/1987	0	762	41	371	536	62		10	1782
6/4/1987	0	40	144		20	140		64	408
6/25/1987	0	280	180	1180	40	1380			3060
7/16/1987	3875	91	34			1131			5131
8/13/1987	0		160		40	3960			4160
8/28/1987	0	10	110		140	1800			2060
9/18/1987	0		38	13		894		19	964
10/8/1987	0	380	150		190	1880	10	10	2620
5/3/1988	0	75	275	4075	1025				5450
5/18/1988	0	13	373		67	221		7	681
6/8/1988	0		340		20	2620			2980
6/30/1988	0	67	366		83	3250	17	33	3816
7/19/1988	0	120	252		160	2454			2986
8/11/1988	0		80		100	5440			5620
9/2/1988	0	40	20	40	540	7340			7980
5/2/1989	0	326	25		194	199		10	754
5/24/1989	0	3	24	20	6	165			218
6/13/1989	0		37	7	11	207		65	327
7/6/1989	0	15	310	5	30	490		5	855
7/26/1989	0	91	70		40	1191		30	1422
8/18/1989	0	82	51	71	143	2815		20	3182
9/11/1989	0	42	16	25	592	1491		25	2191
9/28/1989	0	17	51	17	119	2431		34	2669
4/10/1990	0		8	64	448	1744			2264
4/23/1990	0	150		3250	675	25			4100
5/29/1990	0	3	44	3	16	25		26	117
6/5/1990	0	22	1046		1205	1514			3787
6/12/1990	0	4	22		30	74	12	36	178

Phytoplankton - Lake Owasso - 1984 through 2006 - Units: No/mL

Date2	#N/A	BACILLARIOPHYCEAE (DIATOM)	CHLOROPHYTA (GREEN)	CHRYSOPHYTA (YELLOW-GREEN)	CRYPTOPHYTA (CRYPTOMONADS)	CYANOPHYTA (BLUE-GREEN)	EUGLENOPHYTA (EUGLENOIDS)	PYRRHOPHYTA (DINOFLAGELLATES)	Grand Total
6/28/1990	0	13	43	10	51	118		22	257
7/10/1990	0		16		48	1952		16	2032
7/24/1990	0	4	4		68	1360		24	1460
8/5/1990	0	112	96		224	3312			3744
8/22/1990	0		101		83	3678		17	3879
9/4/1990	0	24	169	48	73	4217			4531
9/14/1990	0		192	192	96	6560			7040
5/5/1992	0	1143	22		442	11			1618
5/26/1992	0	22	80	3	64	41		6	216
6/18/1992	0	42	27	64	21	479		11	644
8/6/1992	0	16	32	80	80	2768			2976
8/24/1992	0	64	80	32	113	2197			2486
9/14/1992	0	20	60	20	200	2440			2740
5/1/1995	0	24	12	1944	24	432			2436
5/23/1995	0	40	40	2120	80	12640			14920
6/19/1995	0	9	21	6	9	471		9	525
7/12/1995	0	3	113	7	10	353			486
7/27/1995	0	30	84	6	12	714			846
9/7/1995	0	24	16		90	1404			1534
9/25/1995	0	12	87			2695			2794
5/6/1996	0	169	16	4	231	22			442
5/28/1996	0	5	31	149	2	65		5	257
6/18/1996	0	6	39		18	78	2	41	184
7/8/1996	0	24	156		48	1584		12	1824
7/29/1996	0	60	36	12	12	2964		36	3120
8/15/1996	0					8112			8112
9/9/1996	0		10			2440		10	2460
9/24/1996	0		48	12	192	3312			3564
5/5/1997	0	49	32		702	1436			2219
5/27/1997	0	3	23		15	61	4		106
7/7/1997	0	24	64		16	1976		8	2088
8/4/1997	0	16	98		33	4667			4814
8/27/1997	0		82		102	5670		20	5874
9/12/1997	0	8	43			55			106
9/30/1997	0	12	78	24	408	1098		18	1638
5/1/1998	0	8	16	752	352	24			1152
5/20/1998	0	6	207		63	66	3		345
6/9/1998	0	14	34		30	118		8	204
6/30/1998	0	30	40	270	60	70		10	480
7/21/1998	0	7	84	35	7	791		7	931
8/12/1998	0		24	52	20	320		4	420
9/22/1998	0	10	29	29	82	229		5	384
5/11/1999	0		150	14	259	14			437
6/4/1999	0	5	221	279	5	53		10	573
5/1/2000	0	198	496		99			99	892
5/25/2000	0	582	2476		728			146	3932
6/13/2000	0	1	6	1	0	11		2	21
7/2/2000	0	1	6			11			18
7/27/2000	0	5	25	8		64		4	106
8/16/2000	8890		69989		25	279			79183
9/7/2000	0	33	92	17	17	395	8		562
9/25/2000	0		30	11	62	27		5	135

Phytoplankton - Lake Owasso - 1984 through 2006 - Units: No/mL

Date2	#N/A	BACILLARIOPHYCEAE (DIATOM)	CHLOROPHYTA (GREEN)	CHRYSOPHYTA (YELLOW-GREEN)	CRYPTOPHYTA (CRYPTOMONADS)	CYANOPHYTA (BLUE-GREEN)	EUGLENOPHYTA (EUGLENOIDS)	PYRRHOPHYTA (DINOFLAGELLATES)	Grand Total
5/1/2001	0	81	188		134	537			940
5/23/2001	0	249	299	299		149		50	1046
7/3/2001	0	2	4	1	0	4		0	11
7/26/2001	0	30	114		37	159			340
8/16/2001	0	53	232		95	768		11	1159
9/6/2001	0		32		115	205		6	358
9/27/2001	0	11	113	23	456	136		11	750
5/6/2002	0	306	124	3060		123			3613
5/29/2002	0	8	252	33	428	218		17	956
6/18/2002	0		101		29	138		58	326
7/12/2002	0	0	3		1	12		0	16
7/30/2002	0	17	29			111		2	159
8/16/2002	0	40	632		530	2795			3997
9/9/2002	0		93		280	1306		156	1835
5/1/2003	0	335	930	298		893		74	2530
6/25/2003	0	24	217		363	871		24	1499
7/16/2003	0		36		9	63		9	117
7/31/2003	0	14	82		299	299		14	708
8/18/2003	0					523			523
9/5/2003	0		303	76	227	1273		13	1892
9/25/2003	0		25		640	247		25	937
5/3/2004	0	322	38	101		14		5	480
5/24/2004	0	12	260	72	120	140	16	60	680
7/26/2004	0		96			4288		32	4416
9/7/2004	0		57	29	514	4772			5372
5/5/2005	0	26	49		175	10	8		268
5/26/2005	0	4	22	6	38	448	8	24	550
6/15/2005	0		3		7	679		10	699
7/6/2005	0	12	96			3996		12	4116
8/16/2005	0		500			16200		100	16800
9/7/2005	0				600	12600			13200
9/26/2005	0		60		360	10500			10920
5/1/2006		100	45	108	115	23			390
5/23/2006			5		80	960		45	1090
6/13/2006		30	101		53	989		18	1190
7/5/2006			167		67	6767		33	7033
7/27/2006						17200			17200
8/18/2006		600			900	52800		300	54600
9/11/2006		40	80		320	6920			7360
9/26/2006			27	11	571	21			629

Appendix I

Fishery and Stocking Data

NA-01570-01

LAKE MANAGEMENT PLAN

Region	Area	D.O.W Number	County	Lake Name	Acre/Lit-Ac
3	F313	62-0056	Ramsey	Owasso	384/292

Long Range Goal: To provide a fish population with pure strain muskellunge in excess of 48" and a walleye gillnet CPUE of 5 fish/net.

Operational Plan:

1) Re-survey in 2011; population assessment in 2016.
2) Stock WAE fingerlings. biannually at the rate of 3-lbs/littoral acre.
3) Stock MUE(LLB) finglerlings biannually at the rate of 1.3-fish/lit. acre.
4) Utilize lake as a potential source of adult BLG for stocking other lakes.
5) Review all applications for APM and DOW permits.
6) Encourage local WMO to develop programs to reduce nutrient loading.
7) Monitor winter oxygen levels/aerate as needed
8) Continue special regs limiting MUE harvest to those over 48".

Midrange Objective: Maintain a walleye gillnet CPUE at a minimum of 2 fish/net

Potential Plan:

1) Creel and rec. use survey	$10,000
2) Fishing pier	30,000
3) Permanent aeration system	35,000
4) Implement experimental regs. limiting harvest of LMB	1,000
5) Enlarge access parking	20,000

TOTAL $ 96,000

NARRATIVE: (Historical perspectives - various surveys; past management; social considerations; present limiting factors; survey needs; land acquisition; habitat development and protection; commercial fishery; stocking plans; other management tools; and evaluation plans)

(see reverse side)

FOR CENTRAL OFFICE USE ONLY

Entry Date:	Year Resurvey:
Stock Species -Size- Number per Acre	
Schedule:	Year Beginning
Population Manipulation _____YES _____NO Year	
Development _____YES _____NO Year	
Creel or Use Survey _____YES _____NO Year	
Other: Year	

Primary Species Management:	Secondary Species Management:
MUE, WAE	LMB, BLG

Area Supervisor's Signature:	Date
[signature]	3/12/07

Regional Manager's Signature:	Date

NA-01570-01

LAKE MANAGEMENT PLAN

Region	Area	D.O.W No.	County	D.O.W. Lake Name	Ac/ Lit-ac	Date
3	F313	62-0056	Ramsey	Owasso	384/292	3/12/07

NARRATIVE:

Various Surveys- Lake surveys were done in 1948, 1971 1981, 1991 and 2001; population assessments in 1956-1959, 1961, 1976, 1986, 1996 and 2006; creel and recreational use survey in 1974 and 1994; winter fish house annually from 1975 to 2002 and muskellunge population assessment after ice out in 1990, 1992 and 1994.

Past Management- Fish stocking has been the primary management of Lake Owasso. Northern pike were stocked from the late 1960's until 1982. Muskellunge stocking was initiated in 1983. Walleye fingerling stocking was started in 1983. Muskellunge eggs were taken from this lake for the first time in 1987. Muskellunge egg takes were discontinued in 1995.

Social Considerations- Lake Owasso is located in the city of Roseville. Most of the shoreline is developed as single-family homes. A small portion of the shoreline is a park operated by Ramsey County Parks and Recreation Department. Facilities in the park include a swimming beach and public boat access. Fishing use was estimated to be 17-angler-hours/acre in 1974 and 54-angler-hours/acre in 1994. It is believed that fishing use has increased somewhat in response to a better fish population. Surface use restrictions are in force on this lake limiting recreational boating and water skiing. Water quality is fair at best. Aquatic plant management is more extensive on this lake (area treated/acre) than any other in the area - more than 1\4 the lakes littoral area undergoes vegetation control each year.

Present Limiting Factors- Limited water quality and small size of the public access are considered to be the most limiting factors.

Land Acquisition- There may be a need for additional property for access expansion or for a fishing pier site.

Habitat Development and Protection- The local WMO should be encouraged to develop programs to reduce the amounts of nutrients entering the lake. Riparian owners should be encouraged to reduce the area of vegetation controlled and to control vegetation by harvesting instead of with chemical herbicides.

Commercial Fishery- None

Stocking Plans- Stock walleye fingerlings biannually at the rate of 3 lbs/littoral acre. Stock leech lake strain muskellunge fingerlings biannually at the rate of 1.3 fish/littoral acre (384 fish).

OTHER MANAGEMENT TOOLS- The regulation restricting harvest of muskellunge to individuals larger than 48" should be retained. Additional regulations to restrict the harvest of LMB may be beneficial.

EVALUATION PLANS- Management will be evaluated by scheduled surveys and assessments. Implementation of experimental regulations restricting the harvest of largemouth bass may require additional assessments be scheduled.

Minnesota Department of Natural Resources
Fisheries Management
STANDARD LAKE SURVEY REPORT

Lake Name: Owasso
DOW Number: 62-0056-00

Survey Type: Population Assessment
Survey ID Date: 06/26/2006

Lake Identification

Alternate Lake Name: N/A
Primary Lake Class ID: 24
DNR Sounding Map Number: C0498
Alternate Lake Class ID: 24

Lake Location

Primary County: Ramsey
Nearest Town: Shoreview

Legal Descriptions

Lake Center: Township - 29N Range - 23W Section - 2
PLS Section Lake Center: 4044

All Legal Descriptions:

Ramsey County: Township - 29N Range - 23W Sections - 1, 2
Township - 30N Range - 23W Sections - 35, 36

Area Office

Area Name: Metro East
Region Name: Central
ORG Code: F313
Region Number: 3

Lake Access

Station ID	Ownership	Public Use	Type	Location / Comments
AC - 1	County	Open to Public use	Concrete	County access. Access located on north shore. One ramp and very limited on site parking. Off site parking is available.

Lake Characteristics

Lake Area (planimetered acres): 384.10
GIS Lake Area (acres): 374.96
DOW Lake Area (acres): 393.00
Littoral Area (acres): 292.90
Area in MN (acres): 374.96
Maximum Depth (feet): 37.0
Mean Depth (feet): 11.2

GIS Shoreline Length (miles): 5.65
Maximum Fetch (miles): 1.90
Fetch Orientation (degrees): 45
USGS Quad Map Number: R17c
USGS Quad 24K GIS Index: 3533

Watershed Characteristics

Major Watershed

Name: Mississippi River
Watershed Number: 20
Watershed size (acres): 649,867

Minor Watershed

Name: Unknown Watershed Name
Watershed Number: 115
Watershed size (acres): 13,583

Surveys And Investigations

Surveys And Investigations (Continued)

Initial Survey: 09/14/1948.
Re-Survey: 06/25/2001, 06/26/1991, 06/24/1981, 08/16/1971.
Population Assessment: 06/26/2006, 06/25/1996, 06/23/1986, 06/23/1976, 06/13/1961, 08/24/1959, 06/16/1958, 06/17/1957, 07/09/1956, 08/03/1955.
Special Assessment: 04/24/2001, 05/06/1996, 04/25/1994, 04/28/1992, 04/25/1979.
Creel Survey: 01/01/1994, 01/01/1974.

Dissolved Oxygen And Temperature Profile Of Lake Water

Station ID	Sampling Date	Bottom Depth (Feet)	Sample Depth (Feet)	Water Temperature (°F)	Dissolved Oxygen (ppm)
WQ - 1	06/26/2006	36.0	0.0	76.3	8.3
			2.0	75.7	8.5
			4.0	75.2	8.4
			6.0	74.8	7.7
			8.0	74.7	7.3
			10.0	74.5	6.4
			12.0	74.1	6.6
			14.0	73.8	6.5
			16.0	71.4	1.5
			18.0	66.4	0.1
			20.0	63.5	0.1
			25.0	62.1	0.1
			30.0	54.1	0.1
			35.0	53.6	0.1
WQ - 2	06/26/2006	27.0	0.0	76.3	9.4
			2.0	75.7	9.2
			4.0	75.0	9.2
			6.0	74.7	8.9
			8.0	74.3	8.6
			10.0	73.8	7.5
			12.0	73.4	7.1
			14.0	72.3	6.0
			16.0	67.1	0.1
			18.0	62.8	0.1
			20.0	58.1	0.1
			25.0	54.5	0.1

Field Measurements Of Water Quality

Station ID	Sampling Date	Sample Depth (Feet)	Secchi Depth (Feet)	Field pH	Alkalinity (ppm)	Water Color	Color Cause
WQ - 1	06/26/2006	0.0	3.3	N\A	N/A	Green	Algae
				Color Description:		light green	
WQ - 2	06/26/2006	0.0	3.3	N\A	N/A	Green	Algae
				Color Description:		light green	

Net Catch Summary by Numbers for GN

Standard gill net sets

Number of Sets: 4
First Set Date: 06/26/2006
Last Lift Date: 06/30/2006
Target Species: N/A

Abbr	Species	Total Fish	Number Per Set	Quartiles for Lake Class 24* 25%	50%	75%
BLC	Black Crappie	86	21.50	2.50	6.91	16.50
BLG	Bluegill	39	9.75	N/A	N/A	N/A
CCF	Channel Catfish	1	0.25	N/A	N/A	N/A
GOS	Golden Shiner	3	0.75	0.25	0.50	1.54
MUE	Muskellunge	1	0.25	0.25	0.50	1.00
NOP	Northern Pike	25	6.25	1.50	3.75	7.29
PMK	Pumpkinseed	2	0.50	N/A	N/A	N/A
WAE	Walleye	10	2.50	1.17	2.82	6.33
WTS	White Sucker	1	0.25	0.40	1.00	2.17
YEB	Yellow Bullhead	2	0.50	0.50	2.00	7.51
YEP	Yellow Perch	31	7.75	2.00	10.50	27.94
	Total Fish/Set:		50.25	* Quartiles for Number Per Set		

Net Catch Summary by Weight for GN

Standard gill net sets

Abbr	Species	Total Weight (Pounds)	Pounds Per Set	Mean Weight	Quartiles for Lake Class 24* 25%	50%	75%
BLC	Black Crappie	8.89	2.22	0.10	0.15	0.20	0.26
BLG	Bluegill	3.78	0.95	0.10	N/A	N/A	N/A
CCF	Channel Catfish	11.36	2.84	11.36	N/A	N/A	N/A
GOS	Golden Shiner	0.29	0.07	0.10	0.10	0.10	0.13
MUE	Muskellunge	3.31	0.83	3.31	1.86	2.90	4.00
NOP	Northern Pike	114.11	28.53	4.56	2.02	2.68	3.50
PMK	Pumpkinseed	0.21	0.05	0.10	N/A	N/A	N/A
WAE	Walleye	21.73	5.43	2.17	1.20	1.81	2.69
WTS	White Sucker	0.88	0.22	0.88	1.55	2.00	2.38
YEB	Yellow Bullhead	1.98	0.50	0.99	0.46	0.61	0.82
YEP	Yellow Perch	3.22	0.80	0.10	0.10	0.13	0.18
	Total Pounds Fish/Set:		42.44		* Quartiles for Mean Weight		

Net Catch Summary by Numbers for TN

Standard 3/4-in mesh, double frame trap net sets

Number of Sets: 8
First Set Date: 06/26/2006
Last Lift Date: 06/30/2006
Target Species: N/A

Abbr	Species	Total Fish	Number Per Set	Quartiles for Lake Class 24* 25%	50%	75%
BLC	Black Crappie	231	28.88	1.83	6.50	21.16
BLG	Bluegill	1,803	225.38	7.54	23.13	62.50
CAP	Common Carp	3	0.38	0.38	0.74	2.00
GOS	Golden Shiner	1	0.13	0.17	0.30	0.83
GSF	Green Sunfish	1	0.13	0.20	0.50	1.29
HSF	Hybrid Sunfish	34	4.25	N/A	N/A	N/A
LMB	Largemouth Bass	2	0.25	0.20	0.33	0.67
NOP	Northern Pike	3	0.38	N/A	N/A	N/A
PMK	Pumpkinseed	14	1.75	0.74	2.00	4.24
WAE	Walleye	11	1.38	0.27	0.60	1.24
WTS	White Sucker	1	0.13	0.20	0.44	1.00
YEB	Yellow Bullhead	12	1.50	0.88	2.15	5.68
YEP	Yellow Perch	2	0.25	0.25	0.60	1.67
	Total Fish/Set:		264.75	* Quartiles for Number Per Set		

Net Catch Summary by Weight for TN

Standard 3/4-in mesh, double frame trap net sets

Abbr	Species	Total Weight (Pounds)	Pounds Per Set	Mean Weight	Quartiles for Lake Class 24* 25%	50%	75%
BLC	Black Crappie	23.55	2.94	0.10	0.18	0.24	0.33
BLG	Bluegill	265.25	33.16	0.15	0.13	0.18	0.25
CAP	Common Carp	11.41	1.43	3.80	2.58	4.07	6.02
GOS	Golden Shiner	0.13	0.02	0.13	0.07	0.10	0.13
GSF	Green Sunfish	0.06	0.01	0.06	0.07	0.10	0.17
HSF	Hybrid Sunfish	5.74	0.72	0.17	N/A	N/A	N/A
LMB	Largemouth Bass	0.43	0.05	0.22	0.15	0.31	0.91
NOP	Northern Pike	19.79	2.47	6.60	N/A	N/A	N/A
PMK	Pumpkinseed	1.61	0.20	0.12	0.10	0.13	0.18
WAE	Walleye	29.07	3.63	2.64	0.80	1.50	2.78
WTS	White Sucker	2.98	0.37	2.98	1.61	2.16	2.84
YEB	Yellow Bullhead	7.70	0.96	0.64	0.50	0.67	0.84
YEP	Yellow Perch	0.13	0.02	0.07	0.10	0.13	0.20
	Total Pounds Fish/Set:		45.98		* Quartiles for Mean Weight		

Length Frequency Distribution For GN (for fish < 36.00 inches)

Standard gill net sets

(Field work conducted between 06/26/2006 and 06/30/2006)

	BLC	BLG	CCF	GOS	MUE	NOP	PMK	WAE	WTS	YEB	YEP
< 3.00	-	-	-	-	-	-	-	-	-	-	-
3.00 - 3.49	-	-	-	-	-	-	-	-	-	-	-
3.50 - 3.99	-	5	-	-	-	-	-	-	-	-	-
4.00 - 4.49	2	6	-	-	-	-	-	-	-	-	-
4.50 - 4.99	1	-	-	-	-	-	1	-	-	-	-
5.00 - 5.49	3	6	-	-	-	-	-	-	-	-	-
5.50 - 5.99	48	8	-	1	-	-	1	-	-	-	6
6.00 - 6.49	21	11	-	1	-	-	-	-	-	-	14
6.50 - 6.99	2	3	-	1	-	-	-	-	-	-	8
7.00 - 7.49	5	-	-	-	-	-	-	-	-	-	2
7.50 - 7.99	4	-	-	-	-	-	-	1	-	-	1
8.00 - 8.49	-	-	-	-	-	-	-	1	-	-	-
8.50 - 8.99	-	-	-	-	-	-	-	-	-	-	-
9.00 - 9.49	-	-	-	-	-	-	-	-	-	-	-
9.50 - 9.99	-	-	-	-	-	-	-	-	-	-	-
10.00 - 10.49	-	-	-	-	-	-	-	-	-	-	-
10.50 - 10.99	-	-	-	-	-	-	-	-	-	-	-
11.00 - 11.49	-	-	-	-	-	-	-	-	-	1	-
11.50 - 11.99	-	-	-	-	-	-	-	-	-	-	-
12.00 - 12.99	-	-	-	-	-	-	-	-	1	-	-
13.00 - 13.99	-	-	-	-	-	-	-	-	-	1	-
14.00 - 14.99	-	-	-	-	-	-	-	-	-	-	-
15.00 - 15.99	-	-	-	-	-	-	-	-	-	-	-
16.00 - 16.99	-	-	-	-	-	-	-	-	-	-	-
17.00 - 17.99	-	-	-	-	-	-	-	-	-	-	-
18.00 - 18.99	-	-	-	-	-	-	-	2	-	-	-
19.00 - 19.99	-	-	-	-	-	-	-	2	-	-	-
20.00 - 20.99	-	-	-	-	-	-	-	3	-	-	-
21.00 - 21.99	-	-	-	-	-	-	-	1	-	-	-
22.00 - 22.99	-	-	-	-	-	3	-	-	-	-	-
23.00 - 23.99	-	-	-	-	-	3	-	-	-	-	-
24.00 - 24.99	-	-	-	-	-	4	-	-	-	-	-
25.00 - 25.99	-	-	-	-	1	4	-	-	-	-	-
26.00 - 26.99	-	-	-	-	-	1	-	-	-	-	-
27.00 - 27.99	-	-	1	-	-	3	-	-	-	-	-
28.00 - 28.99	-	-	-	-	-	-	-	-	-	-	-
29.00 - 29.99	-	-	-	-	-	2	-	-	-	-	-
30.00 - 30.99	-	-	-	-	-	1	-	-	-	-	-
31.00 - 31.99	-	-	-	-	-	3	-	-	-	-	-
32.00 - 32.99	-	-	-	-	-	-	-	-	-	-	-
33.00 - 33.99	-	-	-	-	-	-	-	-	-	-	-
34.00 - 34.99	-	-	-	-	-	-	-	-	-	-	-
35.00 - 35.99	-	-	-	-	-	-	-	-	-	-	-
= > 36.00	-	-	-	-	-	1	-	-	-	-	-

	BLC	BLG	CCF	GOS	MUE	NOP	PMK	WAE	WTS	YEB	YEP
Total	86	39	1	3	1	25	2	10	1	2	31
Min. Length	4.06	3.74	27.13	5.91	25.35	22.24	4.84	7.87	12.24	11.34	5.71
Max. Length	7.60	6.77	27.13	6.61	25.35	36.22	5.71	21.54	12.24	13.31	7.76
Mean Length	5.99	5.39	27.13	6.27	25.35	26.74	5.28	17.52	12.24	12.32	6.38
# Measured	86	39	1	3	1	25	2	10	1	2	31
No Lengths for	0	0	0	0	0	0	0	0	0	0	0

Length Frequency Distribution For GN (for fish ≥ 36.00 inches)

Standard gill net sets

(Field work conducted between 06/26/2006 and 06/30/2006)

	BLC	BLG	CCF	GOS	MUE	NOP	PMK	WAE	WTS	YEB	YEP
< 36.00	86	39	1	3	1	24	2	10	1	2	31
36.00 - 36.99	-	-	-	-	-	1	-	-	-	-	-
37.00 - 37.99	-	-	-	-	-	-	-	-	-	-	-
38.00 - 38.99	-	-	-	-	-	-	-	-	-	-	-
39.00 - 39.99	-	-	-	-	-	-	-	-	-	-	-
40.00 - 40.99	-	-	-	-	-	-	-	-	-	-	-
41.00 - 41.99	-	-	-	-	-	-	-	-	-	-	-
42.00 - 42.99	-	-	-	-	-	-	-	-	-	-	-
43.00 - 43.99	-	-	-	-	-	-	-	-	-	-	-
44.00 - 44.99	-	-	-	-	-	-	-	-	-	-	-
45.00 - 45.99	-	-	-	-	-	-	-	-	-	-	-
46.00 - 46.99	-	-	-	-	-	-	-	-	-	-	-
47.00 - 47.99	-	-	-	-	-	-	-	-	-	-	-
48.00 - 48.99	-	-	-	-	-	-	-	-	-	-	-
49.00 - 49.99	-	-	-	-	-	-	-	-	-	-	-
50.00 - 50.99	-	-	-	-	-	-	-	-	-	-	-
51.00 - 51.99	-	-	-	-	-	-	-	-	-	-	-
52.00 - 52.99	-	-	-	-	-	-	-	-	-	-	-
53.00 - 53.99	-	-	-	-	-	-	-	-	-	-	-
54.00 - 54.99	-	-	-	-	-	-	-	-	-	-	-
55.00 - 55.99	-	-	-	-	-	-	-	-	-	-	-
56.00 - 56.99	-	-	-	-	-	-	-	-	-	-	-
57.00 - 57.99	-	-	-	-	-	-	-	-	-	-	-
58.00 - 58.99	-	-	-	-	-	-	-	-	-	-	-
59.00 - 59.99	-	-	-	-	-	-	-	-	-	-	-
60.00 - 60.99	-	-	-	-	-	-	-	-	-	-	-
61.00 - 61.99	-	-	-	-	-	-	-	-	-	-	-
62.00 - 62.99	-	-	-	-	-	-	-	-	-	-	-
63.00 - 63.99	-	-	-	-	-	-	-	-	-	-	-
64.00 - 64.99	-	-	-	-	-	-	-	-	-	-	-
65.00 - 65.99	-	-	-	-	-	-	-	-	-	-	-
66.00 - 66.99	-	-	-	-	-	-	-	-	-	-	-
67.00 - 67.99	-	-	-	-	-	-	-	-	-	-	-
68.00 - 68.99	-	-	-	-	-	-	-	-	-	-	-
69.00 - 69.99	-	-	-	-	-	-	-	-	-	-	-
70.00 - 70.99	-	-	-	-	-	-	-	-	-	-	-
71.00 - 71.99	-	-	-	-	-	-	-	-	-	-	-
72.00 - 72.99	-	-	-	-	-	-	-	-	-	-	-
73.00 - 73.99	-	-	-	-	-	-	-	-	-	-	-
74.00 - 74.99	-	-	-	-	-	-	-	-	-	-	-
75.00 - 75.99	-	-	-	-	-	-	-	-	-	-	-
76.00 - 76.99	-	-	-	-	-	-	-	-	-	-	-
77.00 - 77.99	-	-	-	-	-	-	-	-	-	-	-
= > 78.00	-	-	-	-	-	-	-	-	-	-	-

	BLC	BLG	CCF	GOS	MUE	NOP	PMK	WAE	WTS	YEB	YEP
Total	86	39	1	3	1	25	2	10	1	2	31
Min. Length	4.06	3.74	27.13	5.91	25.35	22.24	4.84	7.87	12.24	11.34	5.71
Max. Length	7.60	6.77	27.13	6.61	25.35	36.22	5.71	21.54	12.24	13.31	7.76
Mean Length	5.99	5.39	27.13	6.27	25.35	26.74	5.28	17.52	12.24	12.32	6.38
# Measured	86	39	1	3	1	25	2	10	1	2	31
No Lengths for	0	0	0	0	0	0	0	0	0	0	0

Length Frequency Distribution For TN

Standard 3/4-in mesh, double frame trap net sets

(Field work conducted between 06/26/2006 and 06/30/2006)

	BLC	BLG	CAP	GOS	GSF	HSF	LMB	NOP	PMK	WAE	WTS	YEB	YEP
< 3.00	-	-	-	-	-	-	-	-	-	-	-	-	-
3.00 - 3.49	-	20	-	-	-	-	-	-	-	-	-	-	-
3.50 - 3.99	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00 - 4.49	2	8	-	-	-	-	-	-	4	-	-	-	-
4.50 - 4.99	16	8	-	-	1	2	-	-	1	-	-	-	-
5.00 - 5.49	20	147	-	-	-	4	-	-	2	-	-	-	-
5.50 - 5.99	138	495	-	-	-	12	-	-	5	-	-	-	2
6.00 - 6.49	27	615	-	-	-	6	1	-	1	-	-	-	-
6.50 - 6.99	13	484	-	-	-	8	-	-	1	-	-	-	-
7.00 - 7.49	7	27	-	1	-	2	-	-	-	-	-	-	-
7.50 - 7.99	3	-	-	-	-	-	-	-	-	1	-	-	-
8.00 - 8.49	1	-	-	-	-	-	-	-	-	-	-	-	-
8.50 - 8.99	3	-	-	-	-	-	1	-	-	1	-	1	-
9.00 - 9.49	1	-	-	-	-	-	-	-	-	-	-	2	-
9.50 - 9.99	-	-	-	-	-	-	-	-	-	1	-	1	-
10.00 - 10.49	-	-	-	-	-	-	-	-	-	-	-	5	-
10.50 - 10.99	-	-	-	-	-	-	-	-	-	1	-	-	-
11.00 - 11.49	-	-	-	-	-	-	-	-	-	-	-	1	-
11.50 - 11.99	-	-	-	-	-	-	-	-	-	1	-	1	-
12.00 - 12.99	-	-	-	-	-	-	-	-	-	1	-	-	-
13.00 - 13.99	-	-	-	-	-	-	-	-	-	-	-	-	-
14.00 - 14.99	-	-	-	-	-	-	-	-	-	-	-	1	-
15.00 - 15.99	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00 - 16.99	-	-	-	-	-	-	-	-	-	-	-	-	-
17.00 - 17.99	-	-	-	-	-	-	-	-	-	-	-	-	-
18.00 - 18.99	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00 - 19.99	-	-	-	-	-	-	-	-	-	-	1	-	-
20.00 - 20.99	-	-	3	-	-	-	-	-	-	-	-	-	-
21.00 - 21.99	-	-	-	-	-	-	-	-	-	1	-	-	-
22.00 - 22.99	-	-	-	-	-	-	-	-	-	1	-	-	-
23.00 - 23.99	-	-	-	-	-	-	-	-	-	-	-	-	-
24.00 - 24.99	-	-	-	-	-	-	-	-	-	-	-	-	-
25.00 - 25.99	-	-	-	-	-	-	-	-	-	2	-	-	-
26.00 - 26.99	-	-	-	-	-	-	-	-	-	1	-	-	-
27.00 - 27.99	-	-	-	-	-	-	-	1	-	-	-	-	-
28.00 - 28.99	-	-	-	-	-	-	-	-	-	-	-	-	-
29.00 - 29.99	-	-	-	-	-	-	-	1	-	-	-	-	-
30.00 - 30.99	-	-	-	-	-	-	-	-	-	-	-	-	-
31.00 - 31.99	-	-	-	-	-	-	-	-	-	-	-	-	-
32.00 - 32.99	-	-	-	-	-	-	-	1	-	-	-	-	-
33.00 - 33.99	-	-	-	-	-	-	-	-	-	-	-	-	-
34.00 - 34.99	-	-	-	-	-	-	-	-	-	-	-	-	-
35.00 - 35.99	-	-	-	-	-	-	-	-	-	-	-	-	-
= > 36.00	-	-	-	-	-	-	-	-	-	-	-	-	-

	BLC	BLG	CAP	GOS	GSF	HSF	LMB	NOP	PMK	WAE	WTS	YEB	YEP
Total	231	1804	3	1	1	34	2	3	14	11	1	12	2
Min. Length	4.21	3.15	20.35	7.20	4.53	4.65	6.30	27.95	4.33	7.87	19.37	8.74	5.51
Max. Length	9.06	7.20	20.55	7.20	4.53	7.36	8.86	32.44	6.50	26.46	19.37	14.84	5.98
Mean Length	6.03	6.19	20.46	7.20	4.53	6.06	7.58	29.82	5.30	16.68	19.37	10.46	5.75
# Measured	91	222	3	1	1	34	2	3	14	11	1	12	2
No Lengths for	140	1581	0	0	0	0	0	0	0	0	0	0	0

Length At Capture With Last Incremental Length

(Body-Scale constant, all lengths, and all length increments in inches)

Species: Black Crappie
Body-Scale Constant: 0.79
Total Sample Size: 44

Length at Capture in 2006 for Each Age Class, with Incremental Lengths for 2006

Year Class	Age	Sample Size	Length At Capture				Length Increments	
			Average Length	Maximum Length	Minimum Length	Standard Error	Increment	Standard Error
2005	1	5	4.41	4.72	4.06	0.123	0.67	0.086
2004	2	15	5.76	6.42	5.24	0.092	0.39	0.023
2003	3	7	6.48	6.97	5.87	0.140	0.28	0.046
2002	4	8	7.34	8.66	6.38	0.247	0.30	0.058
2001	5	9	7.92	9.06	7.17	0.203	0.20	0.016

Species: Bluegill
Body-Scale Constant: 0.79
Total Sample Size: 35

Length at Capture in 2006 for Each Age Class, with Incremental Lengths for 2006

Year Class	Age	Sample Size	Length At Capture				Length Increments	
			Average Length	Maximum Length	Minimum Length	Standard Error	Increment	Standard Error
2004	2	3	4.21	4.45	4.06	0.120	0.69	0.076
2003	3	10	5.19	5.83	4.37	0.132	0.41	0.044
2002	4	5	5.59	5.83	5.43	0.096	0.25	0.026
2001	5	8	6.42	6.89	5.94	0.127	0.23	0.029
2000	6	9	6.67	7.20	5.98	0.136	0.21	0.034

Species: Largemouth Bass
Body-Scale Constant: 0.79
Total Sample Size: 2

Length at Capture in 2006 for Each Age Class, with Incremental Lengths for 2006

Year Class	Age	Sample Size	Length At Capture				Length Increments	
			Average Length	Maximum Length	Minimum Length	Standard Error	Increment	Standard Error
2005	1	1	6.30	6.30	6.30	N/A	0.97	N/A
2004	2	1	8.86	8.86	8.86	N/A	0.85	N/A

Length At Capture With Last Incremental Length (Continued)

Species: Northern Pike
Body-Scale Constant: 2.09
Total Sample Size: 28

Length at Capture in 2006 for Each Age Class, with Incremental Lengths for 2006

Year Class	Age	Sample Size	Length At Capture				Length Increments	
			Average Length	Maximum Length	Minimum Length	Standard Error	Increment	Standard Error
2003	3	1	23.82	23.82	23.82	N/A	2.45	N/A
2002	4	8	24.44	26.30	22.83	0.445	1.07	0.071
2001	5	7	25.47	27.60	22.24	0.777	0.79	0.077
2000	6	5	27.53	29.13	25.59	0.758	0.73	0.060
1999	7	3	30.58	31.54	29.17	0.717	0.57	0.084
1998	8	3	31.57	32.44	30.39	0.612	0.37	0.077
1997	9	0	-	-	-	-	-	-
1996	10	0	-	-	-	-	-	-
1995	11	1	36.22	36.22	36.22	N/A	0.18	N/A

Species: Walleye
Body-Scale Constant: 1.10
Total Sample Size: 20

Length at Capture in 2006 for Each Age Class, with Incremental Lengths for 2006

Year Class	Age	Sample Size	Length At Capture				Length Increments	
			Average Length	Maximum Length	Minimum Length	Standard Error	Increment	Standard Error
2004	2	8	9.82	12.99	7.87	0.662	1.00	0.234
2003	3	0	-	-	-	-	-	-
2002	4	0	-	-	-	-	-	-
2001	5	3	19.50	20.79	18.31	0.717	0.59	0.009
2000	6	4	20.11	21.54	18.19	0.702	0.62	0.091
1999	7	0	-	-	-	-	-	-
1998	8	1	21.97	21.97	21.97	N/A	0.32	N/A
1997	9	2	24.23	26.46	22.01	2.224	0.39	0.011
1996	10	1	25.28	25.28	25.28	N/A	0.48	N/A
1995	11	1	25.59	25.59	25.59	N/A	0.35	N/A

Back-Calculated Lengths for Each Age Class and Average Annual Increments of Back-Calculated Lengths

Species: Black Crappie
Gear Type: Combined Gear Types (GN and TN)

Class	Age	N	1	2	3	4	5
2005	1	5	3.74	-	-	-	-
			3.74	-	-	-	-
2004	2	15	3.27	5.37	-	-	-
			3.27	2.10	-	-	-
2003	3	7	3.24	4.80	6.20	-	-
			3.24	1.57	1.40	-	-
2002	4	8	2.99	4.77	6.17	7.04	-
			2.99	1.78	1.40	0.88	-
2001	5	9	3.31	4.72	5.99	6.96	7.72
			3.31	1.41	1.28	0.96	0.76
Mean Length			3.28	4.99	6.11	7.00	7.72
Mean Increment			3.28	1.78	1.35	0.92	0.76
Total N			44	39	24	17	9

Species: Bluegill
Gear Type: Combined Gear Types (GN and TN)

Class	Age	N	1	2	3	4	5	6
2004	2	3	1.99	3.53	-	-	-	-
			1.99	1.54	-	-	-	-
2003	3	10	2.16	3.59	4.77	-	-	-
			2.16	1.43	1.18	-	-	-
2002	4	5	1.98	3.23	4.39	5.34	-	-
			1.98	1.25	1.16	0.96	-	-
2001	5	8	1.92	3.28	4.46	5.41	6.19	-
			1.92	1.36	1.18	0.95	0.78	-
2000	6	9	1.97	3.10	4.05	4.92	5.74	6.46
			1.97	1.13	0.95	0.87	0.82	0.72
Mean Length			2.02	3.34	4.43	5.19	5.95	6.46
Mean Increment			2.02	1.32	1.11	0.92	0.80	0.72
Total N			35	35	32	22	17	9

Species: Largemouth Bass
Gear Type: Combined Gear Types (TN)

Class	Age	N	1	2
2005	1	1	5.33	-
			5.33	-
2004	2	1	3.36	8.01
			3.36	4.65
Mean Length			4.35	8.01
Mean Increment			4.35	4.65
Total N			2	1

Back-Calculated Lengths for Each Age Class and Average Annual Increments of Back-Calculated Lengths (Continued)

Species: Northern Pike
Gear Type: Combined Gear Types (GN and TN)

Class	Age	N	1	2	3	4	5	6	7	8	9	10	11
2003	3	1	7.95	14.15	21.37	-	-	-	-	-	-	-	-
			7.95	6.20	7.22	-	-	-	-	-	-	-	-
2002	4	8	8.59	14.35	19.98	23.37	-	-	-	-	-	-	-
			8.59	5.76	5.63	3.40	-	-	-	-	-	-	-
2001	5	7	7.96	13.03	18.53	22.33	24.68	-	-	-	-	-	-
			7.96	5.07	5.50	3.80	2.36	-	-	-	-	-	-
2000	6	5	7.37	11.70	17.01	21.66	24.51	26.80	-	-	-	-	-
			7.37	4.33	5.31	4.64	2.86	2.29	-	-	-	-	-
1999	7	3	8.61	13.68	20.48	24.34	26.71	28.53	30.01	-	-	-	-
			8.61	5.07	6.80	3.85	2.38	1.82	1.48	-	-	-	-
1998	8	3	8.53	13.96	19.40	24.14	26.78	28.53	30.00	31.20	-	-	-
			8.53	5.44	5.44	4.74	2.64	1.75	1.47	1.20	-	-	-
1995	11	1	8.42	13.52	23.49	28.65	30.77	32.11	33.23	34.40	35.16	35.69	36.04
			8.42	5.10	9.97	5.16	2.12	1.34	1.12	1.17	0.76	0.53	0.35
Mean Length			8.18	13.39	19.25	23.17	25.61	28.11	30.47	32.00	35.16	35.69	36.04
Mean Increment			8.18	5.21	5.86	4.00	2.52	1.96	1.42	1.19	0.76	0.53	0.35
Total N			28	28	28	27	19	12	7	4	1	1	1

Species: Walleye
Gear Type: Combined Gear Types (GN and TN)

Class	Age	N	1	2	3	4	5	6	7	8	9	10	11
2004	2	8	5.48	8.82	-	-	-	-	-	-	-	-	-
			5.48	3.34	-	-	-	-	-	-	-	-	-
2001	5	3	6.52	10.16	13.47	16.27	18.91	-	-	-	-	-	-
			6.52	3.63	3.32	2.80	2.64	-	-	-	-	-	-
2000	6	4	5.03	9.43	12.12	15.70	17.89	19.49	-	-	-	-	-
			5.03	4.39	2.69	3.58	2.19	1.60	-	-	-	-	-
1998	8	1	4.04	6.60	9.95	12.48	14.95	18.07	20.50	21.65	-	-	-
			4.04	2.56	3.35	2.53	2.47	3.12	2.43	1.15	-	-	-
1997	9	2	5.58	8.20	11.80	15.30	18.22	20.29	21.61	22.85	23.85	-	-
			5.58	2.62	3.60	3.51	2.92	2.07	1.33	1.24	1.00	-	-
1996	10	1	4.54	6.94	9.03	12.34	14.43	17.44	20.40	22.75	23.93	24.80	-
			4.54	2.40	2.09	3.31	2.09	3.01	2.96	2.35	1.18	0.87	-
1995	11	1	4.46	6.99	11.95	15.00	16.44	18.18	19.62	21.32	23.19	24.46	25.24
			4.46	2.53	4.96	3.05	1.44	1.74	1.44	1.70	1.87	1.27	0.78
Mean Length			5.39	8.78	11.95	15.17	17.55	19.13	20.75	22.28	23.70	24.63	25.24
Mean Increment			5.39	3.40	3.19	3.22	2.38	2.04	1.90	1.54	1.26	1.07	0.78
Total N			20	20	12	12	12	9	5	5	4	2	1

Age Class Frequency Distribution

Species and Gear (1)	Number of Fish (2)			Number of Fish in Year Class ('yy) and Age Class														
	Aged	Keyed	Unaged	'06 0	'05 1	'04 2	'03 3	'02 4	'01 5	'00 6	'99 7	'98 8	'97 9	'96 10	'95 11	'94 12	'93 13	'92 14	<'92 15+
Black Crappie																			
GN	39	47	0	33	3	31	10	4	5	0	0	0	0	0	0	0	0	0	0
TN	17	76	138	0	18	20	27	23	5	0	0	0	0	0	0	0	0	0	0
Totals:	56	123	138	33	21	51	37	27	10	0	0	0	0	0	0	0	0	0	0
Bluegill																			
GN	23	16	0	7	0	3	7	5	8	9	0	0	0	0	0	0	0	0	0
TN	14	1155	634	0	0	8	576	73	323	189	0	0	0	0	0	0	0	0	0
Totals:	37	1171	634	7	0	11	583	78	331	198	0	0	0	0	0	0	0	0	0
Largemouth Bass																			
TN	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Muskellunge																			
GN	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Northern Pike																			
GN	25	0	0	0	0	0	1	8	7	3	3	2	0	0	1	0	0	0	0
TN	3	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0
Totals:	28	0	0	0	0	0	1	8	7	5	3	3	0	0	1	0	0	0	0
Walleye																			
GN	9	1	0	0	0	2	0	0	4	4	0	0	0	0	0	0	0	0	0
TN	11	0	0	0	0	6	0	0	0	0	0	1	2	1	1	0	0	0	0
Totals:	20	1	0	0	0	8	0	0	4	4	0	1	2	1	1	0	0	0	0

(1) **Key to sampling gear abbreviations:**
GN = Standard gill net sets
TN = Standard 3/4-in mesh, double frame trap net sets

(2) **Notes:**
Number of Fish Aged: Fish that were aged from bony parts.
Number of Fish Keyed: Fish assigned an age with an age-length key or by expansion of mesh or station age distributions.
Number of Fish Unaged: Fish that were not aged and were not assigned an age.

Survey Crew Notes

Area Signed by user 'Gejohnso' on 06/27/2007

Region Signed by user 'damccorm' on 06/28/2007

Discussion

Lake Owasso is an eutrophic lake that is categorized in lake class 24. Surface acreage is 384 acres with 292 acres being littoral (76.0%) and the lake has a maximum depth of 37.0 feet. Muskellunge (MUE) and Walleye (WAE) are the primary management species in Lake Owasso. Special regulations were established in 1989 with a 48.0 inch minimum harvest length for Muskellunge to protect potential broodstock fish. Muskellunge fingerlings are scheduled to be stocked biennially on odd numbered years at a rate of 1.0 fish/surface acre (384 fish). All Muskellunge stocked in Lake Owasso have been the Leech Lake Strain. This lake has been a popular local Muskellunge fishery from the early 1990's to present. Walleye are stocked biennially on even numbered years at a rate of 3.0 pounds/littoral-acre (879.0 pounds). In Fall 2006, a total of 13,102 WAE fingerlings and 230 yearlings weighing a combined total of 879.0 pounds were stocked. The WAE stocking quota in 2004 was comprised of fingerlings purchased under contract by the State of Minnesota from private aquaculture facilities.

In 2006, Walleye were sampled between the first quartile and median level for gill net abundance in class 24 lakes. The CPUE of 2.50 WAE/set reflects no significant change from the gill net catch rate observed since 1986 (2.2 to 2.6 fish/gill-net). The average size of gill net sampled WAE was 17.5" TL and 2.17 pounds. The RSD20 for gill net sampled WAE was determined to be 50.0 percent. Walleye growth rates were good, with the average length of an Age-IV fish being 15.5" TL. Walleye from the 2004 stocked year class (Age II) made up 40.0 percent of the aged sample.

Northern Pike (NOP) were sampled between the median and third quartile levels for abundance in gill nets. Gill net sampled NOP were above the third quartile for mean weight. The gill net CPUE for NOP of 6.25 fish/set was up from that observed in 2001 (5.2/set). Historically, the gill net CPUE for NOP has ranged from 1.33-10.25 fish/set since 1961, and the 2006 sample lies solidly within that range. The average size of NOP sampled in 2006 was 26.7" TL and 4.56 pounds. The RSD28 for gill net captured NOP was 29.2 percent. The largest NOP captured measured 36.22" TL. Growth rates for NOP were found to be good with Age VI fish averaging 28.1" TL.

Only one Muskellunge measuring 25.3" TL was captured during this summer assessment.

Yellow Perch (YEP) were sampled between first quartile and median levels for abundance in gill nets (7.75 fish/set). This catch rate is less than half of the level recorded in 2001 (16.4 YEP/set) and reflects a steady drop in gill net CPUE since 1996. The average size of YEP sampled was 6.38" TL and 0.10 pounds

Bluegill were sampled above the third quartile for abundance in trap nets. The trap net CPUE of 225.38 fish/set is less than half of the 2001 sample (588.4 BLG/set), but represents the 3rd highest catch rate observed for this species in this lake. The average size of BLG sampled was 6.19" TL and 0.15 pounds (approximately 6.67 fish/pound). The Bluegill PSD and RSD7 was 66.7 and 2.3 percent, respectively. Bluegill growth was found to be below average.

Black Crappie (BLC) were sampled above the 3rd quartile level for abundance in both gear types. The 2006 sample reflected the highest catch rate observed for BLC in both gear types in this lake since 1986. The average BLC captured for combined gears was 6.02" TL and 0.10 pounds. The PSD for the combined gear sample was less than 4.0 percent. Black Crappie growth rates were also found to be below average.

Few Largemouth Bass (LMB) were captured during this assessment.

Status Of The Fishery

Lake Owasso is primarily managed for Walleye (WAE) and Muskellunge (MUE). Walleye stocking is conducted biennially on even numbered years at a rate of 3.0 pounds/littoral-acre (879.0 lbs). Muskellunge stocking currently consists of stocking fall fingerlings at a rate of 1.0 fish/surface-acre (384 fish) biennially on odd numbered years. All Muskellunge stocked in Lake Owasso have been the Leech Lake Strain. Walleye were sampled below the median levels for abundance in gill nets. The gill net catch rate for WAE has shown little change since 1986. The average size of gill net sampled WAE in 2006 was 17.5 inches and 2.17 pounds. Fifty percent of all WAE captured measured 20.0 inches or longer. Only one 25.3 inch MUE was captured during this assessment. Northern Pike (NOP) were sampled above median levels for abundance and mean weight and reflected an increase in catch rate from the 2001 assessment. The average size NOP captured was approximately 26.7 inches and 4.5 pounds. Over 29 percent of sampled NOP measured 28.0 inches or larger. Yellow Perch (YEP) catch rates continue to exhibit a steady decline in abundance since 1996. The average size of YEP sampled was 6.4 inches and 0.10 pounds. No YEP sampled measured over 8.0 inches in length. Bluegill (BLG) abundance still remains very high with the average size of fish sampled being 6.2 inches and 0.15 pounds. Only 2 percent of sampled BLG measured 7.0 inches or longer. Black Crappie (BLC) abundance exhibited a significant increase since the 2001 fisheries survey. The average size of BLC sampled measured 6.0 inches and 0.11 pounds. Less than 4 percent of all BLC captured measured 8.0 inches or longer.

Approval Dates And Notices

Date Approved By Metro East Area Fisheries Supervisor: 06/27/2007

Date Approved By Central Region Fisheries Manager: 06/28/2007

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SUBREPORTS WITH NO DATA

(This page is not part of the Standard Lake Survey Report and should be discarded)

Lake Name: Owasso | **Survey Type: Population Assessment**

DOW Number: 62-0056-00 | **Survey ID Date: 06/26/2006**

Survey Status: Region Signed

The following 15 report components are not included in this report:

1. Current Water Level
2. Benchmark And Gauge Descriptions / Locations
3. Water Level History
4. Lake Inlets
5. Additional Inlet Information
6. Lake Outlets
7. Additional Outlet Information
8. Water Control Structure (Dam)
9. Surrounding Watershed Characteristics And Shoreline Characteristics
10. Resorts And Campgrounds
11. Fish Spawning Conditions
12. Erosion And Pollution
13. Fish Diseases And Parasites
14. Aquatic Vegetation And Shoalwater Substrates
15. Laboratory Analysis Of Water Chemistry

Note: The data source for Length and Age Class Frequency Distribution tables is updated twice daily - once at noon and once overnight. Any changes to the data made before noon on 08/06/2007 may not be reflected in the Distribution tables until after 12:30PM on 08/06/2007.

Lake: OWASSO

DOW No.: (62-0056)

Fish Age Class Distributions (2006):

SPECIES	SAMPLE SIZE	SUB-SAMPLE	Number of Fish in Age Group											
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+
BLC	316	44	5	15	7	8	9							
BLG	1,842	35	3	10	5	8	9							
LMB*	2	2	1	1										
MUE*	1	1					1							
NOP*	28	28			1	8	7	5	3	3			1	
WAE*	21	20		8			3	4		1	2	1	1	

* indicates species that growth data includes ice-out assessment and summer survey samples.

Mean Lengths-at-Age in Inches (2006):

SPECIES	Age Groups (Sample Size)											
	I (N)	II (N)	III (N)	IV (N)	V (N)	VI (N)	VII (N)	VIII (N)	IX (N)	X (N)	XI (N)	XII+ (N)
BLC	3.59 (44)	5.15 (39)	6.21 (24)	7.05 (17)	7.74 (9)							
BLG	2.02 (35)	3.34 (35)	4.43 (32)	5.19 (22)	5.95 (17)	6.46 (9)						
LMB*	4.34 (2)	8.01 (1)										
MUE*	10.25 (1)	15.94 (1)	20.21 (1)	22.45 (1)	24.48 (1)							
NOP*	8.18 (28)	13.40 (28)	19.25 (28)	23.17 (27)	25.61 (19)	28.11 (12)	30.46 (7)	32.00 (4)	35.16 (1)	35.69 (1)	36.04 (1)	
WAE*	6.10 (20)	9.22 (20)	12.44 (12)	15.50 (12)	17.75 (12)	19.29 (9)	20.91 (5)	22.37 (5)	23.75 (4)	24.66 (2)	25.26 (1)	

****

NAME OF FILE = OW06BLC.ANU
BLC All GN,TN Owasso 2006:mm;
BODY-SCALE CONSTANT = 35.00 N = 44

****

Length at Capture in 2006

Year Class	Age	N	Average	Maximum	Minimum	Standard Error
2005	1	5	112.00	120.00	103.00	3.130
2004	2	15	146.33	163.00	133.00	2.335
2003	3	7	164.57	177.00	149.00	3.565
2002	4	8	186.50	220.00	162.00	6.271
2001	5	9	201.11	230.00	182.00	5.149

****

Average Back-calculated Lengths for Each Age Class

****

Year Class	Age	N	Back-calculation Age 1	2	3	4	5
2005	1	5	97.75				
2004	2	15	90.68	137.60			
2003	3	7	90.73	126.46	158.09		
2002	4	8	85.88	127.05	159.34	179.57	
2001	5	9	93.63	126.47	156.25	178.76	196.51
All Classes			91.22	130.87	157.82	179.14	196.51
N		44	44	39	24	17	9

****

Standard Error of Average Back-calculated Length For Each Age Class

****

Year Class	Age	N	Back-calculation Age 1	2	3	4	5
2005	1	5	3.996				
2004	2	15	2.240	2.147			
2003	3	7	5.369	7.617	3.918		
2002	4	8	3.558	3.426	5.681	6.538	
2001	5	9	2.779	3.192	3.331	3.938	5.236
All Classes		44	1.516	1.996	2.442	3.594	5.236

NAME OF FILE = OW06BLG.ANU
BLG All GN,TN Owasso 2006:mm;
BODY-SCALE CONSTANT = 20.00 N = 35

Length at Capture in 2006

Year Class	Age	N	Average	Maximum	Minimum	Standard Error
2004	2	3	107.00	113.00	103.00	3.055
2003	3	10	131.80	148.00	111.00	3.359
2002	4	5	142.00	148.00	138.00	2.449
2001	5	8	163.13	175.00	151.00	3.221
2000	6	9	169.33	183.00	152.00	3.444

Average Back-calculated Lengths for Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5	6
2005	1	0	0.00					
2004	2	3	50.54	89.60				
2003	3	10	54.95	91.25	121.27			
2002	4	5	50.20	82.08	111.42	135.76		
2001	5	8	48.78	83.22	113.16	137.38	157.22	
2000	6	9	50.10	78.82	102.92	124.93	145.82	164.05
All Classes			51.23	84.76	112.54	131.92	151.19	164.05
N		35	35	35	32	22	17	9

Standard Error of Average Back-calculated Length For Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5	6
2005	1	0	0.000					
2004	2	3	1.996	4.203				
2003	3	10	0.952	1.496	2.594			
2002	4	5	3.471	3.493	3.065	2.021		
2001	5	8	2.159	2.187	2.694	3.209	3.032	
2000	6	9	1.827	2.070	1.362	2.267	3.585	3.290
All Classes		35	0.940	1.294	1.721	1.963	2.705	3.290

****

NAME OF FILE = OW06LMB.ANU

LMB All GN,TN Owasso 2006:mm;

BODY-SCALE CONSTANT = 20.00 N = 2

****

Length at Capture in 2006

Year Class	Age	N	Average	Maximum	Minimum	Standard Error
2005	1	1	160.00	160.00	160.00	0.000
2004	2	1	225.00	225.00	225.00	0.000

****

Average Back-calculated Lengths for Each Age Class

****

Year Class	Age	N	Back-calculation Age 1	2
2005	1	1	135.47	
2004	2	1	85.25	203.52
All Classes			110.36	203.52
N		2	2	1

****

Standard Error of Average Back-calculated Length For Each Age Class

****

Year Class	Age	N	Back-calculation Age 1	2
2005	1	1	0.000	
2004	2	1	0.000	0.000
All Classes		2	25.107	0.000

NAME OF FILE = OW06MUE.ANU
MUE All GN,TN Owasso 2006:mm;
BODY-SCALE CONSTANT = 70.00 N = 1

Length at Capture in 2006

Year Class	Age	N	Average	Maximum	Minimum	Standard Error
2001	5	1	644.00	644.00	644.00	0.000

Average Back-calculated Lengths for Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5
2005	1	0	0.00				
2004	2	0	0.00	0.00			
2003	3	0	0.00	0.00	0.00		
2002	4	0	0.00	0.00	0.00	0.00	
2001	5	1	260.40	404.90	513.37	570.35	621.72
All Classes			260.40	404.90	513.37	570.35	621.72
N		1	1	1	1	1	1

Standard Error of Average Back-calculated Length For Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5
2005	1	0	0.000				
2004	2	0	0.000	0.000			
2003	3	0	0.000	0.000	0.000		
2002	4	0	0.000	0.000	0.000	0.000	
2001	5	1	0.000	0.000	0.000	0.000	0.000
All Classes		1	0.000	0.000	0.000	0.000	0.000

NAME OF FILE = OW06NOP.ANU
NOP All GN,TN Owasso 2006:mm;
BODY-SCALE CONSTANT = 53.00 N = 28

Length at Capture in 2006

Year Class	Age	N	Average	Maximum	Minimum	Standard Error
2003	3	1	605.00	605.00	605.00	0.000
2002	4	8	620.88	668.00	580.00	11.297
2001	5	7	647.00	701.00	565.00	19.744
2000	6	5	699.20	740.00	650.00	19.242
1999	7	3	776.67	801.00	741.00	18.224
1998	8	3	802.00	824.00	772.00	15.535
1997	9	0	0.00	0.00	0.00	0.000
1996	10	0	0.00	0.00	0.00	0.000
1995	11	1	920.00	920.00	920.00	0.000

Average Back-calculated Lengths for Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5	6	7	8	9	10	11
2005	1	0	0.00										
2004	2	0	0.00	0.00									
2003	3	1	202.05	359.29	542.76								
2002	4	8	218.15	364.38	507.36	593.64							
2001	5	7	202.08	330.94	470.68	567.16	626.97						
2000	6	5	187.14	297.18	432.07	550.01	622.60	680.69					
1999	7	3	218.75	347.48	520.27	618.10	678.50	724.71	762.10				
1998	8	3	216.59	354.69	492.75	613.06	680.30	724.67	762.06	792.52			
1997	9	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
1996	10	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
1995	11	1	213.89	343.50	596.74	727.84	781.46	815.72	844.02	873.82	893.19	906.59	915.53
All Classes			207.76	340.24	489.02	588.54	650.51	713.94	773.78	812.84	893.19	906.59	915.53
N		28	28	28	28	28	27	19	12	7	4	1	1	1

Standard Error of Average Back-calculated Length For Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5	6	7	8	9	10	11
2005	1	0	0.000										
2004	2	0	0.000	0.000									
2003	3	1	0.000	0.000	0.000								
2002	4	8	5.020	10.300	12.991	10.160							
2001	5	7	10.372	19.039	24.797	19.301	19.072						
2000	6	5	8.237	13.085	14.566	15.358	19.105	19.077					
1999	7	3	4.232	1.571	33.364	10.834	5.038	10.757	16.472				
1998	8	3	5.504	18.767	1.501	12.512	6.646	7.978	12.397	14.300			
1997	9	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
1996	10	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
1995	11	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
All Classes		28	3.893	7.490	10.600	9.432	12.440	13.744	14.062	22.701	0.000	0.000	0.000

NAME OF FILE = OW06WAE.ANU
WAE All GN,TN Owasso 2006:mm;
BODY-SCALE CONSTANT = 55.00 N = 20

Length at Capture in 2006

Year Class	Age	N	Average	Maximum	Minimum	Standard Error
2004	2	8	249.38	330.00	200.00	16.825
2003	3	0	0.00	0.00	0.00	0.000
2002	4	0	0.00	0.00	0.00	0.000
2001	5	3	495.33	528.00	465.00	18.224
2000	6	4	510.75	547.00	462.00	17.839
1999	7	0	0.00	0.00	0.00	0.000
1998	8	1	558.00	558.00	558.00	0.000
1997	9	2	615.50	672.00	559.00	56.500
1996	10	1	642.00	642.00	642.00	0.000
1995	11	1	650.00	650.00	650.00	0.000

Average Back-calculated Lengths for Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5	6	7	8	9	10	11
2005	1	0	0.00										
2004	2	8	152.63	226.97									
2003	3	0	0.00	0.00	0.00								
2002	4	0	0.00	0.00	0.00	0.00							
2001	5	3	184.64	271.60	351.03	418.13	481.24						
2000	6	4	149.25	254.47	319.02	405.04	457.58	495.82					
1999	7	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
1998	8	1	125.79	187.63	268.32	329.20	388.83	464.04	522.61	550.21			
1997	9	2	163.39	226.93	314.13	399.28	469.94	520.00	552.03	582.05	606.17		
1996	10	1	138.55	196.71	247.51	327.93	378.64	451.61	523.57	580.71	609.24	630.41	
1995	11	1	136.51	197.95	318.61	392.75	427.66	470.03	504.93	546.20	591.79	622.46	641.53
All Classes			154.98	234.23	315.99	393.58	450.75	489.88	531.03	568.24	603.34	626.43	641.53
N		20	20	20	12	12	12	9	5	5	4	2	1

Standard Error of Average Back-calculated Length For Each Age Class

Year Class	Age	N	Back-calculation Age 1	2	3	4	5	6	7	8	9	10	11
2005	1	0	0.000										
2004	2	8	10.784	13.405									
2003	3	0	0.000	0.000	0.000								
2002	4	0	0.000	0.000	0.000	0.000							
2001	5	3	3.739	8.910	8.742	17.054	18.139						
2000	6	4	6.130	3.337	2.278	13.990	12.808	15.863					
1999	7	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
1998	8	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
1997	9	2	23.624	21.591	47.087	86.034	75.693	68.909	65.304	61.531	56.724		
1996	10	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
1995	11	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
All Classes		20	5.754	7.756	10.889	15.013	14.741	15.365	22.604	21.119	23.486	3.972	0.000

LAKE OWASSO (62-0056) STOCKING HISTORY

1976-1982

1976	1977	1978	1979	1980	1981	1982
5,000 NOP FGL		8,640 NOP FGL 1,141 NOP YRL	36 LMB ADL 1,216 NOP YRL	1,211 NOP YRL	1,250 NOP YRL	527 MUE(L)FGL

1983-1990

1983	1984	1985	1986	1987	1988	1989	1990
2,940 WAE FGL	250,000 WAE FRY 4,860 WAE FGL 525 MUE(L)FGL	1,800 WAE FGL	4,980 WAE FGL	4,450 WAE FGL 525 MUE(L)FGL		4,545 WAE FGL	250 WAE FGL 129 MUE(L)FGL

1991-1998

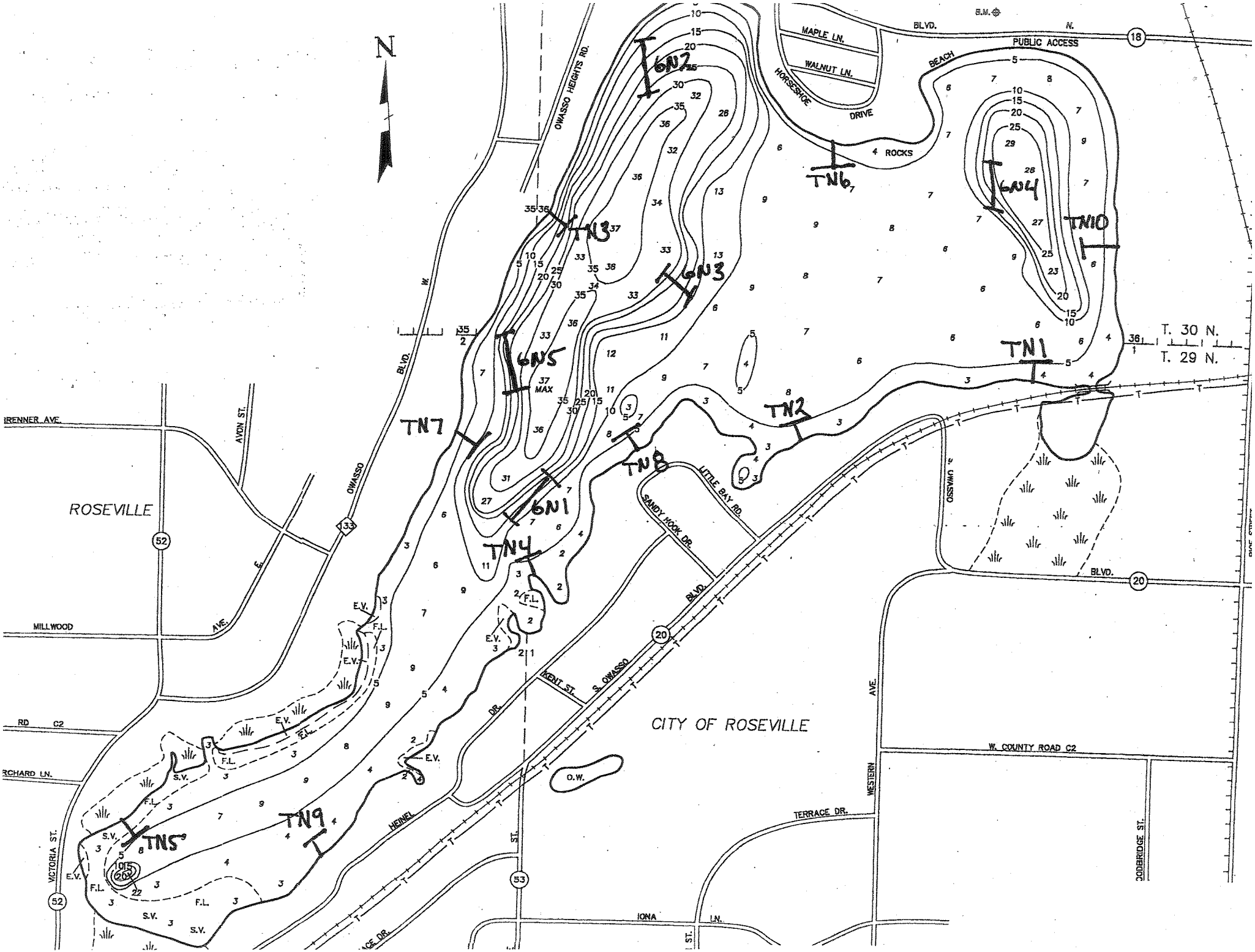
1991	1992	1993	1994	1995	1996	1997	1998
8,736 WAE FGL 5 WAE YRL	5,572 WAE FGL 107 MUE(L)FGL	11,504 WAE FGL 4 WAE YRL 187 WAE ADL 108 MUE(L)FGL	112 MUE(L)FGL	218 MUE(L)FGL 1,640 WAE FGL 78 WAE YRL		1,864 WAE FGL 340 WAE YRL 124 MUE(L)FGL	4,924 WAE FGL (263 lbs)

1999-2006

1999	2000	2001	2002	2003	2004	2005	2006
246 MUE(L)FGL	20,102 WAE FGL (743 lbs)	5 MUE(L)ADL 614 MUE(L)FGL 1 NOP ADL	251 MUE(L)FGL 1,136 WAE FGL 2,125 WAE YRL (922.0 lbs)		*20,350 WAE FGL* *(879.0 lbs)*	*280 MUE(L)FGL*	160 MUE(L)ADL *384 MUE(L)FGL* 13,102 WAE FGL 230 WAE YRL

ABBREVIATION KEY (SPECIES): BLG=Bluegill; BLC=Black Crappie; LMB=Largemouth Bass; NOP=Northern Pike; MUE=Muskellunge; TME=Hybrid Muskie; WAE=Walleye; YEP=Yellow Perch; CCF=Channel Catfish; BLB=Black Bullhead; YEB=Yellow Bullhead; WHC=White Crappie; CRP=Crappie spp. RBT=Rainbow Trout; BNT=Brown Trout; BKT=Brook Trout; LAT=Lake Trout; TLC=Tullibee (Cisco); PMK=Pumpkinseed Sunfish; SUN=Sunfish spp. SMB=Smallmouth Bass. '(SIZE): FRY=Fry; FGL=Fingerling; TPL=Transplant Fingerling; YRL=Yearling; ADL=Adult (age 2+) @=Mixed Origin

* private stocking under DNR permit ** fish <12 months old but from previous year class(YRL) *** spawning area operated but no estimate of number stocked


N
MAPLE LN.
WALNUT LN.
HORSESHOE DRIVE
BLVD.
PUBLIC ACCESS
BEACH
4 ROCKS
OWASSO HEIGHTS RD.
6N2
6N3
6N4
6N5
6N1
TN1
TN2
TN3
TN4
TN5
TN6
TN7
TN8
TN9
TN10
37 MAX
T. 30 N.
T. 29 N.
ROSEVILLE
CITY OF ROSEVILLE
IRENNER AVE.
AVON ST.
OWASSO BLVD.
MILLWOOD AVE.
LITTLE BAY RD.
SANDY HOOK DR.
S. OWASSO BLVD.
W. COUNTY ROAD C2
TERRACE DR.
IONA LN.
HEINEL DR.
WESTERN AVE.
VICTORIA ST.
E.V.
F.L.
S.V.
O.W.
52
53
20
18
33

Name: OWASSO

Nearest Town: SHOREVIEW
Primary County: Ramsey

Survey Date: 06/25/2001
Inventory Number: 62-0056-00

Public Access Information

Ownership	Type	Description
County	Concrete	Public access in a Ramsey County Park on the N shore.

Lake Characteristics

Lake Area (acres): 384.10
Littoral Area (acres): 292.90
Maximum Depth (ft): 37.00
Water Clarity (ft): 7.00

Dominant Bottom Substrate: sand, silt, clay
Abundance of Aquatic Plants: abundant
Maximum Depth of Plant Growth (ft): 10.50

Fish Sampled up to the 2001 Survey Year

Species	Gear Used	Number of fish per net Caught	Normal Range	Average Fish Weight (lbs)	Normal Range (lbs)
Black Bullhead	Trap net	0.3	0.7 - 25.7	0.43	0.3 - 0.6
Black Crappie	Gill net	9.0	2.5 - 16.5	0.08	0.1 - 0.3
	Trap net	4.2	1.8 - 21.2	0.09	0.2 - 0.3
Bluegill	Gill net	10.6	N/A - N/A	0.07	N/A - N/A
	Trap net	588.4	7.5 - 62.5	0.06	0.1 - 0.3
Brown Bullhead	Trap net	0.6	0.2 - 1.4	0.48	0.5 - 1.0
Common Carp	Trap net	1.4	0.4 - 2.0	5.66	2.6 - 6.0
Golden Shiner	Gill net	0.2	0.3 - 1.5	0.08	0.1 - 0.1
	Trap net	1.8	0.2 - 0.8	0.12	0.1 - 0.1
Green Sunfish	Trap net	0.2	0.2 - 1.3	0.09	0.1 - 0.2
Hybrid Sunfish	Gill net	0.2	N/A - N/A	0.08	N/A - N/A
	Trap net	3.9	N/A - N/A	0.09	N/A - N/A
Largemouth Bass	Trap net	0.3	0.2 - 0.7	0.22	0.2 - 0.9
Muskellunge	Gill net	0.2	0.2 - 1.0	14.59	1.9 - 4.0
Northern Pike	Gill net	5.2	1.5 - 7.3	4.15	2.0 - 3.5
	Trap net	0.1	N/A - N/A	2.47	N/A - N/A
Pumpkinseed Sunfish	Gill net	1.6	N/A - N/A	0.07	N/A - N/A
	Trap net	9.8	0.7 - 4.2	0.07	0.1 - 0.2
Walleye	Gill net	2.2	1.2 - 6.3	3.68	1.2 - 2.7
	Trap net	0.6	0.3 - 1.2	4.84	0.8 - 2.8
White Sucker	Gill net	0.4	0.4 - 2.2	1.16	1.5 - 2.4
	Trap net	0.1	0.2 - 1.0	2.93	1.6 - 2.8

Yellow Bullhead	Gill net	2.6	0.5 - 7.5	0.57	0.5 - 0.8
	Trap net	4.3	0.9 - 5.7	0.48	0.5 - 0.8
Yellow Perch	Gill net	16.4	2.0 - 27.9	0.10	0.1 - 0.2
	Trap net	1.3	0.3 - 1.7	0.10	0.1 - 0.2

Normal Ranges represent typical catches for lakes with similar physical and chemical characteristics.

Length of Selected Species Sampled for All Gear for the 2001 Survey Year

	Number of fish caught in each category (inches)								
Species	***0-5***	***6-8***	***9-11***	***12-14***	***15-19***	***20-24***	***25-29***	***>29***	***Total***
Black Bullhead	0	2	1	0	0	0	0	0	3
Black Crappie	73	10	0	0	0	0	0	0	83
Bluegill	322	13	0	0	0	0	0	0	335
Brown Bullhead	0	1	3	1	0	0	0	0	5
Green Sunfish	2	0	0	0	0	0	0	0	2
Hybrid Sunfish	33	3	0	0	0	0	0	0	36
Largemouth Bass	1	1	1	0	0	0	0	0	3
Muskellunge	0	0	0	0	0	0	0	1	1
Northern Pike	0	0	0	0	0	15	9	3	27
Pumpkinseed Sunfish	96	0	0	0	0	0	0	0	96
Walleye	0	0	0	0	3	11	2	0	16
Yellow Bullhead	1	31	11	9	0	0	0	0	52
Yellow Perch	30	63	1	0	0	0	0	0	94

Fish Stocked by Species for the Last Five Years

Year	Species	Age	Number
2000	*Walleye*	Fingerling	20,102
2001	*Muskellunge*	Adult	5
	Muskellunge	Fingerling	614
	Northern Pike	Adult	1
2002	*Muskellunge*	Fingerling	251
	Walleye	Fingerling	1,098
	Walleye	Yearling	10
	Walleye	Fingerling	38
	Walleye	Yearling	2,115
2004	*Walleye*	Fingerling	20,350
2005	*Muskellunge*	Fingerling	259
	Muskellunge	Fingerling	21

Fish Consumption Advisory

Meal Advice for Pregnant Women, Women who may become pregnant and Children under age 15

Species	less than 15"	15" to 20"	20" to 25"	25" to 30"	greater than 30"
Black Bullhead	◔				
Black Crappie	○				
Bluegill Sunfish	◔				
Carp				◔	
Northern Pike		◔	◔	◑	◑
Walleye	◔	◔	◑		
White Sucker	○				
Yellow Bullhead	◔				
Yellow Perch	◔				

Meal Advice for the General Population

Species	less than 15"	15" to 20"	20" to 25"	25" to 30"	greater than 30"
Black Bullhead	○				
Black Crappie	○				
Bluegill Sunfish	○				
Carp				○	
Northern Pike		○	◔	◔	◔
Walleye	○	○	◔		
White Sucker	○				
Yellow Bullhead	○				
Yellow Perch	○				

Symbol Key	unlimited	1 meal per week	1 meal per month	1 meal every 2 months	do not eat
Mercury	○	◔	◑		●
PCBs	□	◩	◪	◪	■

Status of the Fishery (as of 06/25/2001)

Bluegill were the most abundant species sampled in the 2001 fisheries survey. Catch rates for bluegill

exceded historic levels, but the average size of sampled fish was only 4.6 inches and 0.06 pounds (16.7 fish/lb.). Only 5.9% of all bluegill captured measured 6.0 inches or longer, and no fish measured 7.0 inches or larger. Pumpkinseed sunfish were also captured at record levels of abundance, but averaged small in size. Black crappie were sampled within normal levels of abundance, but averaged 5.6 inches in length. Growth rates for these three species were found to be slow. Yellow perch were sampled above median levels for gill net abundance and the long term average for this lake. Sampled yellow perch averaged only 6.1 inches and exhibited average rates of growth.

Muskellunge and walleye are the primary management species in Lake Owasso. Experimental regulations were established in 1989 with a 48.0 inch minimum harvest size for Muskellunge to protect potential broodstock fish. Muskellunge are stocked biennially on odd numbered years at a rate of one fish/surface acre. Only one 40 inch muskellunge was sampled in this survey. Walleye are stocked biennially on even numbered years at a rate of 3.0 pounds/littoral acre. Walleye were captured within the normal interquartile range for abundance in gill nets. The catch rate reflected no significant change in sampling abundance from those observed in assessments since 1986. The average walleye sampled was 21.3 inches and 3.7 pounds. Northern pike were sampled above median levels for abundance. The average individual sampled was 25.4 inches and 4.1 pounds. Over 11% of all northern pike sampled were 30.0 inches or longer. Growth rates for all major predator species was found to be good.

For Additional Information

Area Fisheries Supervisor:

1200 WARNER ROAD
ST. PAUL, MN 55106
(651) 772-7950

Lake maps can be obtained from:

Minnesota Bookstore
660 Olive Street
St. Paul, MN 55155
(651) 297-3000 or (800) 657-3757
To order, use C0498 for the map-id.

General DNR Information:

DNR Information Center
500 Lafayette Road
St. Paul, MN 55155-4040
(651) 296-6157 or (888) MINNDNR
TDD: (651) 296-5484 or (800) 657-3929
E-Mail: info@dnr.state.mn.us

Turn in Poachers (TIP):

Toll-free: (800) 652-9093

Ramsey Cty (DNR) Fish Stocking

RAMSEY CO. 1976-1981

LAKE NAME	DOW NO.	1976	1977	1978	1979	1980	1981
LOEB	62-0048				343 CRP ADL 140 BLG ADL 72 BLB ADL	624 CRP ADL	377 CRP ADL 100 BLG ADL
LONG	62-0067	10,589 BLG ADL 550 NOP YRL	4,730 NOP FGL	550 NOP YRL	550 NOP YRL 118,000 WAE FRY	550 NOP YRL 120,000 WAE FRY	110,000 WAE FRY 668 NOP YRL
McCARRON'S	62-0054		1,050 NOP YRL		39,000 WAE FRY		50,000 WAE FRY
MISSISSIPPI R. (POOL 2)	M-1						
OWASSO	62-0056	5,000 NOP FGL		8,640 NOP FGL 1,141 NOP YRL	36 LMB ADL 1,216 NOP YRL	1,211 NOP YRL	1,250 NOP YRL
PIGS EYE	62-0004						
PHALEN	62-0013		30 NOP ADL	3,142 NOP FGL 1,156 WAE FGL	3,779 WAE FGL	1,521 WAE FGL	1,775 WAE FGL
PLEASANT	62-0046			300 MUE(S)FGL 300 MUE(w)FGL	8,269 WAE FGL	2,680 WAE FGL	2,875 WAE FGL
ROUND (KFP)	62-0012	691 BLG ADL					
SILVER (NB)	62-0083			2,590 NOP FGL	660 BLG ADL 10 LMB ADL 320 NOP YRL		315 NOP YRL
SILVER (NSP)	62-0001						
SILVERVIEW (KFP)	62-0170						
SNAIL	62-0073	6,902 NOP FGL		7,125 NOP FGL	540 BLG ADL 20 LMB ADL 79,000 WAE FRY		
SPOON	62-0010-1						
SUCKER	62-0028						
TURTLE	62-0061						
VADNAIS	62-0038				5,880 WAE FGL	3,428 WAE FGL	3,296 WAE FGL
WABASSO	62-0082	1,125 NOP FGL		1,845 NOP FGL	315 NOP FGL	43 NOP YRL	1,216 NOP FGL
WAKEFIELD	62-0011						

RAMSEY CO. 1982-1989

LAKE NAME	DOW NO.	1982	1983	1984	1985	1986	1987	1988	1989
LOEB	62-0048	400 CRP ADL 1,719 BLG ADL	427 CRP ADL 5 BLG ADL	548 CRP ADL 76 NOP ADL	605 CRP ADL 10 NOP ADL	658 BLG ADL 25 NOP ADL	465 CRP ADL 173 BLG ADL	284 CRP ADL 500 BLG ADL	138 CRP ADL 592 BLG ADL
LONG	62-0067	107,000 WAE FRY	110,000 WAE FRY	120,000 WAE FRY 275 TME FGL	110,000 WAE FRY	500,000 WAE FRY	185,000 WAE FRY	110,000 WAE FRY 330 TME FGL	1,110,000 WAE FRY
McCARRON'S	62-0054	42,000 WAE FRY	39,000 WAE FRY 65 TME FGL	39,000 WAE FRY	48,000 WAE FRY	2,900 WAE FGL 40 TME FGL	522 WAE YRL		312 WAE FGL 55 TME FGL
MISSISSIPPI R (POOL 2)	M-1								
OWASSO	62-0056	527 MUE(L)FGL	2,940 WAE FGL	250,000 WAE FRY 4,860 WAE FGL 525 MUE(L)FGL	1,800 WAE FGL	4,980 WAE FGL	4,450 WAE FGL 525 MUE(L)FGL		4,545 WAE FGL
PIGS EYE	62-0004								
PHALEN	62-0013	2,664 WAE FGL	1,753 WAE FGL 158 TME FGL	5,712 WAE FGL	5,399 WAE FGL 100 WAE YRL	5,750 WAE FGL 162 TME FGL	5,400 WAE FGL 230 WAE YRL 87 WAE ADL	2,795 WAE FGL	2,778 WAE FGL
PLEASANT	62-0046	2,880 WAE FGL	2,759 WAE FGL 515 TME FGL 298 MUE(w)FGL	2,750 WAE FGL 275 TME FGL 300 MUE(w)FGL	1,482 WAE FGL	894 BLG ADL	25 NOP ADL	22 NOP ADL 301 MUE(L)FGL 209 MUE(L)YRL	21 NOP ADL 300 MUE(L)FGL
ROUND (KFP)	62-0012								
SILVER (NB)	62-0083			504 NOP YRL	90 LMB ADL	195 NOP YRL			198 BLG ADL 35,000 WAE FRY
SILVER (NSP)	62-0001		6,480 WAE FGL	6,325 WAE FGL	6,384 WAE FGL 4,134 LMB FGL	6,800 WAE FGL 50 TME FGL	3,200 WAE FGL	1,400 WAE FGL	3,060 WAE FGL
SILVERVIEW (KFP)	62-0170		517 CRP ADL 36 BLG ADL	400 CRP ADL	377 CRP ADL	350 BLG ADL	50 CRP ADL 343 BLG ADL	250 BLG ADL	
SNAIL	62-0073		3,180 WAE FGL						
SPOON	62-0010-1								
SUCKER	62-0028								
TURTLE	62-0061								
VADNAIS	62-0038	3,472 WAE FGL	4,875 WAE FGL	5,429 WAE FGL	5,008 WAE FGL	5,130 WAE F GL	3,120 WAE YRL 197 WAE ADL	1,129 WAE FGL	1,409 WAE FGL
WABASSO	62-0082	1,120 NOP FGL	1,125 NOP FGL						
WAKEFIELD	62-0011								

ABBREVIATION KEY (SPECIES): BLG=Bluegill; BLC=Black Crappie; LMB=Largemouth Bass; NOP=Northern Pike; MUE=Muskellunge; TME=Hybrid Muskie; WAE=Walleye; YEP=Yellow Perch; CCF=Channel Catfish; BLB=Black Bullhead; YEB=Yellow Bullhead; WHC=White Crappie; CRP=Crappie spp. RBT=Rainbow Trout; BNT=Brown Trout; BKT=Brook Trout; LAT=Lake Trout; TLC=Tullibee (Cisco); PMK=Pumpkinseed Sunfish; SUN=Sunfish spp. SMB=Smallmouth Bass. '(SIZE): FRY=Fry; FGL=Fingerling; TPL=Transplant Fingerling; YRL=Yearling; ADL=Adult (age 2+)

* private stocking under DNR permit ** fish <12 months old but from previous year class(YRL) *** spawning area operated but no estimate of number stocked

RAMSEY CO. 1990-1997

LAKE NAME	DOW NO.	1990	1991	1992	1993	1994	1995	1996	1997
LOEB	62-0048	377 CRP ADL 200 BLG ADL	470 CRP ADL 300 BLG ADL	456 CRP ADL	787 CRP ADL 557 BLG ADL	161 CRP ADL 302 BLC ADL	478 CRP ADL 549 SUN ADL	632 BLG ADL 430 BLC ADL	412 BLC ADL 1,901 BLG ADL 873 CCF(O)YRL 9,000 WAE FRY
LONG	62-0067	110,000 WAE FRY 164 TME FGL 1 TME YRL	110,000 WAE FRY	112,850 WAE FRY	330,000 WAE FRY 197 TME FGL	330,000 WAE FRY	110,000 WAE FRY	110,000 WAE FRY 2,319 NOP FGL 440 NOP ADL	1,110,000 WAE FRY 446 NOP ADL
McCARRON'S	62-0054	650 WAE FGL	423 WAE FGL 46 WAE YRL						75,000 WAE FRY
MISSISSIPPI R. (POOL 2)	M-1						81,552 MUE FRY		5,192 MUE(L)TPL
OWASSO	62-0056	250 WAE FGL 129 MUE(L)FGL	8,736 WAE FGL 5 WAE YRL	5,572 WAE FGL 107 MUE(L)FGL	11,504 WAE FGL 4 WAE YRL 187 WAE ADL 108 MUE(L)FGL	112 MUE(L)FGL	218 MUE(L)FGL 1,640 WAE FGL 78 WAE YRL		1,864 WAE FGL 340 WAE YRL 124 MUE(L)FGL
PIGS EYE	62-0004								
PHALEN	62-0013	10,920 WAE FGL 118 TME FGL	10,703 WAE FGL 24 WAE YRL	10,344 WAE FGL 198 TME FGL		11,787 WAE FGL	305 TME FGL	3,180 WAE FGL	
PLEASANT	62-0046	280 MUE(L)FGL	281 MUE(L)FGL	277 MUE(L)FGL					2,986 BLC ADL 6,463 BLG ADL
ROUND (KFP)	62-0012								
SILVER (NB)	62-0083				126,000 WAE FRY			2,173 BLG ADL 7,727 NOP FGL	80,000 WAE FRY
SILVER (NSP)	62-0001	6,800 WAE FGL 107 TME FGL	7,350 WAE FGL	5,196 WAE FGL 90 TME FGL		6,555 WAE FGL	90 TME FGL	2,740 WAE FGL 14,550 CCF FGL	2,231 CCF(O)YRL 1,612 YEP ADL
SILVERVIEW (KFP)	62-0170	200 CRP ADL 250 BLG ADL	240 CRP ADL 220 BLG ADL	180 CRP ADL 150 SUN ADL 50 YEB ADL	168 CRP ADL 215 BLG ADL	200 BLC ADL			
SNAIL	62-0073								134 LMB ADL 47 LMB FGL
SPOON	62-0010-1								
SUCKER	62-0028							445 SMB FGL	
TURTLE	62-0061								
VADNAIS	62-0038	6,680 WAE FGL							
WABASSO	62-0082			13,950 LMB FRY 562 BLG ADL	14,300 LMB FRY	3,120 LMB FRY	28 NOP ADL	108 NOP ADL	
WAKEFIELD	62-0011								

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RAMSEY CO. 1998-2005

LAKE NAME	DOW NO.	1998	1999	2000	2001	2002	2003	2004	2005
LOEB	62-0048	482 BLC ADL 526 BLG ADL 7,562 CCF FGL	539 BLC ADL 775 BLG ADL 9,198 CCF FGL** 10 PMK ADL 1 LMB ADL 50 NOP ADL	100 BLC ADL 1,522 BLG ADL 752 CCF FGL**	275 BLC ADL 1,701 BLG ADL 720 CCF YRL 30 SMB ADL 9,000 WAE FRY	150 BLC ADL 720 BLG ADL 837 CCF YRL 10,000 WAE FRY	335 BLC ADL 852 BLG ADL 782 SMB FGL 60 CCF YRL 10,000 WAE FRY 234 WAE ADL	10,000 WAE FRY 444 BLG ADL 149 WAE FGL 3 WAE YRL	10,000 WAE FRY 19 WAE FGL 9 BLC ADL 242 BLG ADL 627 BLG YRL
LONG	62-0067	110,000 WAE FRY 560 NOP ADL	1,110,000 WAE FRY 14 NOP ADL	110,000 WAE FRY 550 NOP ADL	99,000 WAE FRY	299 NOP ADL 310,000 WAE FRY	1,210,000 WAE FRY 550 NOP ADL	110,000 WAE FRY	110,000 WAE FRY
McCARRON'S	62-0054	75,000 WAE FRY	75,000 WAE FRY	175,000 WAE FRY	1,054 WAE FGL (68 lbs)	78,000 WAE FRY	81,000 WAE FRY	75,000 WAE FRY	124 NOP YRL
MISSISSIPPI R. (POOL 2)	M-1	21,128 MUE(L)FRY	76,220 MUE(L)FRY 28,417 MUE(L)TPL						
OWASSO	62-0056	4,924 WAE FGL (263 lbs)	246 MUE(L)FGL	20,102 WAE FGL (743 lbs)	5 MUE(L)ADL 614 MUE(L)FGL 1 NOP ADL	251 MUE(L)FGL 1,136 WAE FGL 2,125 WAE YRL (922.0 lbs)		*20,350 WAE FGL* *(879.0 lbs)*	*280 MUE(L)FGL*
PIGS EYE	62-0004		10,733 MUE(L)FGL						
PHALEN	62-0013	281 TME FGL 1,940 WAE FGL (227 lbs)		*3,028 WAE FGL* *(150 lbs)* 18,512 CCF YRL	307 TME FGL	*2,336 WAE FGL* *(160.0 lbs)* 2,356 CCF YRL	300 TME FGL	*7,248 WAE FGL* *(316.0 lbs)* 20,100 TME FRY	*276 TME FGL*
PLEASANT	62-0046	1,120 BLG ADL							602 MUE(L)FGL
ROUND (KFP)	62-0012								
SILVER (NB)	62-0083			200,000 WAE FRY	113,400 WAE FRY	3,772 CCF YRL 258 NOP ADL 134 YEP ADL	1,126,000 WAE FRY		126,000 WAE FRY
SILVER (NSP)	62-0001	15,065 CCF FGL 107 TME FGL 1,573 WAE FGL (188 lbs) 2,261 YEP ADL	2,300 CCF FGL** 1,231 YEP ADL	62 BLC ADL 52 BLG ADL 165 YEP ADL 2,130 CCF FGL** 90 WAE YRL 5,760 WAE FGL (261.5 lbs)	1,674 CCF YRL 33 SMB ADL 107 TME FGL	2,100 CCF YRL 194 YEP ADL 1,026 WAE FGL 826 WAE YRL (285.0 lbs)	1,082 CCF YRL	107 TME FGL 11,730 WAE FGL (255.0 lbs) 41 WAE YRL (33.0 lbs)	
SILVERVIEW (KFP)	62-0170								
SNAIL	62-0073				117,000 WAE FRY	265,000 WAE FRY 5,169 WAE FGL (264.0 lbs)		260,000 WAE FRY 11,368 WAE FGL 27 WAE YRL	
SPOON	62-0010-1				600 CCF YRL				
SUCKER	62-0028								
TURTLE	62-0061					490,000 WAE FRY 9,800 WAE FGL (500.0 lbs)		1,000,000 WAE FRY 11,778 WAE FGL 38 WAE YRL 12 WAE ADL	
VADNAIS	62-0038							20 WAE ADL	
WABASSO	62-0082					28 NOP ADL			
WAKEFIELD	62-0011					471 BLC ADL 2,191 BLG ADL 16 BLB ADL 6 NOP ADL 210 YEP ADL	680 BLC ADL 1,175 BLG ADL	60 BLC ADL 1,411 BLG ADL 50 NOP ADL	567 BLC ADL 380 BLG ADL 100 NOP ADL

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Appendix J

Macrophyte Survey Data

Lake Owasso Macrophyte Survey

May 22-30, 2007
Ramsey County Public Works Lake Management

Methods:

Stratified random transect sampling conducted on parts of 4 days: May 22, 25, 29, and 30. A maximum of three samples were taken along each of 39 transects (total length less than 500 F) out of 55 potential transects located approximately 500 F apart along the entire shoreline of the lake including one mid-bay transect; there were 106 total sampling points. Sampling was stratified by transects (59% transects, n=23) located entirely within large littoral (<15 F deep) areas of lakebed not connected to deep water (>15 F) and transects (41%, n=16) located within littoral areas of lakebed connected to deep water (>15 F). Visual, hook and rake assessment of composition and abundance; O=observed, Numeric (1-5 = increasing scale of relative abundance).

Summary of species observed:

Potomogeton crispus	curly-leaf pondweed
Potomogeton amplifolius	large-leaved pondweed
Potomogeton pectinatus	fine-leaved (Sago) pondweed
Potomogeton natans	floating-leaved pondweed
Myriophyllum exalbescens	native northern water milfoil
Myriophyllum spicatum	Eurasion water milfoil
Ceratophyllum demersum	coontail
Nuphar Variegata	yellow water-lily
Nymphaea odorata	white water-lily
Chara vulgaris	muskgrass
Zanichellia palustris	horned pondweed
Najas flexilis	bushy pondweed
Unidentified filamentous algae	

Transect Notes

Transect 2: Samples 1 & 2 – Northern milfoil sample with 10 leaflet pairs, coarse appearance; Sample 3 – Eurasian milfoil sample 12 leaflet pairs, feathery appearance, Curly-leaf pondweed within 0.5 F of water surface.

Transect 3: Sample 1 – Curly-leaf pondweed growing to water surface.

Transect 10: Sample 1 – Curly-leaf pondweed growing to water surface. Eurasian milfoil sample with 13 leaflet pairs; Sample 2 – Northern milfoil sample with 8 leaflet pairs.

Transect 12: May 30, 2007 sampling Curly-leaf pondweed with fruiting bodies above water surface.

Transect 18: Dense plant assemblage including Yellow water-lily and Curly-leaf pondweed visible between sampling point and shoreline was not sampled.

Transect 19: Dense plant assemblage including Yellow water-lily and Curly-leaf pondweed visible between sampling point and shoreline was not sampled.

Transects 28 to 30: Dense Curly-leaf pondweed bed at sampling locations furthest from shore; 0.5 to 1.5 F from water surface to top of plant; bed localized and not extending to mid-bay Transect 39.

Transect 31 to 32: Large Yellow water-lily bed not sampled; transect not selected in randomization process.

Lake Owasso Macrophyte Survey Transects May 2007

Lake Owasso May 22-30, 2007	Transect Sampling Key (Abundance (1-5), O=Observed)																				
	1			2			3			4			5			6			7		
Approx. Sample Distance from Shore (F)	50	200	500	50	200	300	80	300		50	250		50	150		50	150		30	100	
Water Depth (cm)	165	210	240	160	230	280	280	460		240	340		250	360		220	450		80	330	
Curly-leaf pondweed	1	3	O	2	1	1	1			2			3			2			1		
Large-leaved pondweed																					
Fine-leaved pondweed																					
Floating-leaved pondweed																					
Northern water milfoil	1			1	1																
Eurasian water milfoil						1	1														
Coontail																					
Yellow water-lily																					
White water-lily																					
Muskgrass	2	1	3																1		
Horned pondweed																					
Bushy pondweed																					
Filamentous algae	2	O		1	1	1	1			1			2			2			1		

Lake Owasso May 22-30, 2007	Transect Sampling Key (Abundance (1-5), O=Observed)																				
	8			9			10			11			12			13			14		
Approx. Sample Distance from Shore (F)	50	150	350	50	150		50	200	350	50	225	500	50	250	450	100	250	400	50	100	250
Water Depth (cm)	70	160	260	210	280		190	270	450	140	180	225	180	210	220	160	165	180	65	180	260
Curly-leaf pondweed		1		4			4			4	3	1	5	4	1	3	5		4	2	4
Large-leaved pondweed										3	1										
Fine-leaved pondweed																				1	
Floating-leaved pondweed																			O		
Northern water milfoil								1					1			2					
Eurasian water milfoil		1					1			O	1			1	O				2	1	
Coontail														1						1	
Yellow water-lily																5			5		
White water-lily													O								
Muskgrass	1	1			1							1									
Horned pondweed																					
Bushy pondweed																					
Filamentous algae		1		2	1		2	1		3	3	1	3	1	3	3		5	4	2	

Lake Owasso May 22-30, 2007	Transect Sampling Key (Abundance (1-5), O=Observed)																				
	15			16			17			18			19			20			21		
Approx. Sample Distance from Shore (F)	100	150	300	100	250	400	30	75	200	500	1000		500			100	250	500	50	250	500
Water Depth (cm)	90	110	150	90	110	155	90	140	370	130			135			135	135	165	135	140	155
Curly-leaf pondweed	2	2	2	3	4	5	1			5	5		3			3	3	2	2	1	1
Large-leaved pondweed										1											
Fine-leaved pondweed																		O	1		1
Floating-leaved pondweed																					
Northern water milfoil	2	5	1	3	5	2	1									2			1		
Eurasian water milfoil		5		3	5	2				3			3			2	1	O			
Coontail	2			2	3		1	1	1	4			5								
Yellow water-lily	5			5			5														
White water-lily	5			5																	
Muskgrass																					
Horned pondweed																					
Bushy pondweed																		O			
Filamentous algae	2							2								4	4		2	1	2

Lake Owasso May 22-30, 2007	Transect Sampling Key (Abundance (1-5), O=Observed)																				
	22			23			24			25			26			27			28		
Approx. Sample Distance from Shore (F)	50	250	400	100	200	400	50	250	500	50	250	500	50	250	500	50	250	500	50	250	500
Water Depth (cm)	130	150	190	100	140	220	130	180	250	140	220	480	125	250	290	150	150	240	100	220	230
Curly-leaf pondweed	1	1	O	O	2		1	1		1			2	1		1	O	4	1		5
Large-leaved pondweed					1														2		
Fine-leaved pondweed	2																		1		
Floating-leaved pondweed				O																	
Northern water milfoil	1			O															1		
Eurasian water milfoil										2											
Coontail			1		O																
Yellow water-lily	O			5																	
White water-lily																					
Muskgrass										1							O				
Horned pondweed																					
Bushy pondweed																					
Filamentous algae	2	4	1	4	3	1	5	3		2			5	1		4	4		1		

Lake Owasso May 22-30, 2007	Transect Sampling Key (Abundance (1-5), O=Observed)																				
	29			30			31			32			33			34			35		
Approx. Sample Distance from Shore (F)	40	300	500	50	250	500	50	250	500	50	250	500	50	200		50	300		50	250	500
Water Depth (cm)	165	200	200	110	180	205	110	175	180	110	170	160	75	320		160	450		160	250	360
Curly-leaf pondweed	1	1	5	1	5	2	2	4	2	3	2	3	O	1					1	1	
Large-leaved pondweed							4						O						1		
Fine-leaved pondweed				1	1														1		
Floating-leaved pondweed																					
Northern water milfoil																			1		
Eurasian water milfoil	1			2									1						1		
Coontail							1														
Yellow water-lily																					
White water-lily																					
Muskgrass		1		1				2	5		5		3			2					
Horned pondweed	1																				
Bushy pondweed																					
Filamentous algae	1				1					2			3			2			1	1	

Lake Owasso May 22-30, 2007	Transect Sampling Key (Abundance (1-5), O=Observed)																					
	36			37			38			39												
Approx. Sample Distance from Shore (F)	50	250	400	50	250	500	50	250	500	1250 south	1500	1750 north										
Water Depth (cm)	125	210	240	120	230	295	140	240	360	210	225	225										
Curly-leaf pondweed			1	2							1											
Large-leaved pondweed				1		O																
Fine-leaved pondweed																						
Floating-leaved pondweed																						
Northern water milfoil																						
Eurasian water milfoil																						
Coontail	1			2																		
Yellow water-lily																						
White water-lily																						
Muskgrass			O							1	1	1										
Horned pondweed																						
Bushy pondweed	1	O						1														
Filamentous algae	1	O		1	O	O	O															

Lake Owasso

Aquatic Plant Survey and Shoreland Assessment – September 2005

Bill Bartodziej and Simba Blood– Ramsey-Washington Metro Watershed District
Contact Information: Bill@rwmwd.org or 651.704.2089

I. Aquatic Plant Survey

Introduction

Aquatic plants are an important biological component of Lake Owasso, providing fish and wildlife habitat, holding bottom sediments and lakeshore soils in place, and indirectly affecting water clarity. For this particular survey, we focused on the submersed and floating-leaf plant communities because they are the most dynamic in Lake Owasso, and relatively sensitive to changes in water quality. Additionally, active management of the lake will influence these plant communities. This type of survey data will aid in the lake planning process.

Methods

The point intercept method incorporating Global Positioning System (GPS) technology (Madsen 1999) was used to assess the submersed aquatic plant community on Lake OWasso. Sampling was conducted during the week of September 5th, 2005. The point intercept method is currently being used by various resource management agencies, including the United States Geological Survey (Long Term Resource Monitoring Program) and the Minnesota Department of Natural Resources.

The crux of this method is that spot observations, presence/absence and abundance ranking data, are made at preselected locations covering the entire lake littoral zone. The littoral zone is defined as the near shore area where sunlight penetrates all the way to the bottom sediments, allowing aquatic plants to grow. For the Owasso survey, evenly spaced (100-m) spot locations were superimposed on a geo-referenced aerial photograph in the software program ArcPad. The GPS unit was then linked with ArcPad in the field and boat position was plotted on a hand-held computer. After reaching a point, all observational data (i.e., depth, substrate firmness, plant height, plant species, and abundance rank) was directly entered into the ArcPad data logger. The GPS unit used in this survey provided at least 1-m accuracy.

A double-tined rake attached to a rope was used to collect plant specimens. At each point, the rake was thrown over the boat in a 1-m imaginary square. The same sampling station off the deck of the boat was used throughout the survey. After a collection was made, each species was identified and given an abundance ranking based on a percent cover of rake tines (Yin et al. 2000) – see Table 1. Plant species that were in the 1-m sampling square but did not appear on the rake (e.g., floating leaf species) were also counted.

Table 1: Aquatic plant abundance ranking based on cover found on sampling rake.

Percent Cover of Tines	Abundance Ranking
81-100	5
61-80	4
41-60	3
21-40	2
1-20	1

Presence/absence data can be statistically compared using the assumptions of a binomial distribution – Chi-square tests and related comparisons, rather than parametric tests based on normal distributions (Madsen 1999). Having plant data of this type will enable us to statistically compare species distribution by season or by year. This will be useful in determining the effects of watershed and lake management activities on the submersed and floating-leaf plant communities, as well as potentially assessing plant management activities. In using the point intercept method, Newman (1998) found that taking 40 to 100 samples in a lake littoral zone was adequate in producing solid estimates for common species – less than 20% error associated with the mean. Taking more than 100 samples typically did not provide better estimates. For the Lake Owasso survey, we sampled 102 points in the littoral zone.

Results and Discussion

Sixteen floating-leaf and submersed plant species were identified in the survey (Table 2). This is the highest number of aquatic plant taxa recorded compared to other lakes surveyed this year by the Watershed District (Table 3).

Table 2: Plant taxa list generated from the point intercept aquatic plant survey – September 2005.

Common Name	Scientific Name	Origin
Coontail	*Ceratophyllum demersum*	Native
Muskgrass	*Chara*	Native
Canada elodea	*Elodea canadensis*	Native
Aquatic moss	*Fontinalis* sp.	Native
Spiny-spored quillwort	*Isoetes echinospora*	Native
Common duckweed	*Lemna minor*	Native
Eurasian water milfoil	*Myriophyllum spicatum*	Non-native
Water naiad	*Najas* spp.	Native
Nitella	*Nitella* sp.	Native
Yellow water lily	*Nuphar variegatum*	Native
White water lily	*Nymphaea odorata*	Native
Large leaf pondweed	*Potamageton amplifolius*	Native
Leafy pondweed	*Potamageton foliosus*	Native

Sago pondweed	*Potamogeton pectinatus*	Native
Whitestem Pondweed	*Potamageton praelongus*	Native
Flat-stem pondweed	*Potamageton zosteriformis*	Native

Submersed plants were present at depths of up to 8 feet. Light availability prevented rooted plants from establishing in deeper areas. The maximum depth at which aquatic plants were present and the number of sampling sites with plants present were the lowest recorded for east Metro area lakes (Table 3). This finding is of concern. A substantial drop in aquatic plant cover and littoral zone depth over time could result in a decrease in water quality and have detrimental effects on the fishery. District staff will be consulting with Terry Noonan, a limnologist with Ramsey County, to go over plant surveys that he conducted in the 1980s and 1990s. By comparing data we will attempt to determine if a trend is evident.

Table 3: Total number of plant taxa and littoral zone maximum depth for selected east Metro area lakes.

Lake	Total Taxa	Maximum littoral zone depth	Percentage of sites in littoral zone with aquatic plants
Owasso	16	8'	56.9%
Gervais	7	10' *	84.5%
Kohlman	12	9' *	94.4%
Phalen	11	14'	98.4%
Beaver	10	12'	95.4%
Tanners	13	17'	100.0%

* Depths not recorded at Kohlman and Gervais.
Littoral zone depth extrapolated from sample points & contour maps

The native coontail was the most abundant submersed vascular plant species (Figure 1). It was present at approximately 25% of the sites sampled in the littoral zone. This is a fairly aggressive submersed plant in the Metro area, doing well in relatively turbid pond and lake systems. It lacks true roots and obtains a majority of its nutrients through the water column. It seemed to favor depths in the 2 to 5 foot range.

The noxious weed species, Eurasian water milfoil, was the most abundant rooted macrophyte. It was present in 12 of the sampling sites. It was most commonly found in the southeastern finger of the lake. Its average abundance was a 1, indicating that this weed's cover was not excessive at the locations sampled and was not at the level that would potentially impede recreation.

Nitella, a macro-algae, was relatively common – present in 11 of the sites sampled. It was found most often in the south-central part of the lake, especially

in the 6 to 8 foot depth range. This is in the deeper part of Lake Owasso's littoral zone.

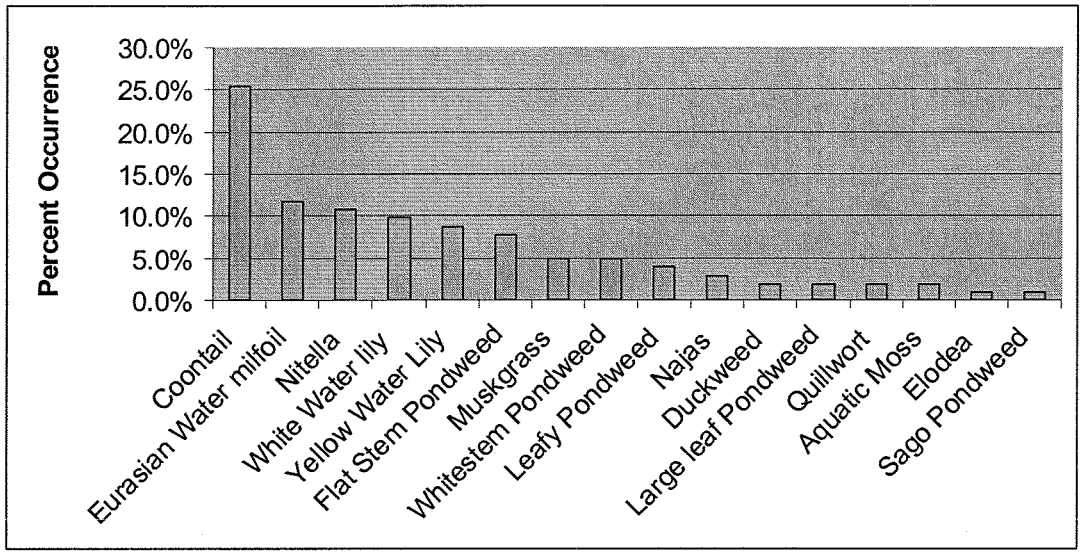


Figure 1: Percent occurrence for each species detected in the littoral zone- Lake Owasso.

The two most abundant floating leaved plants were white and yellow water lily. They were present in approximately 7% of the sites sampled. Their distribution was limited to the narrow southeastern finger of the lake. This is of no surprise since lilies favor calm water areas with organic lake bottom substrates.

From a resource management perspective, the most pressing issue resulting from this survey has to do with the relatively low cover of submersed vegetation compared to other lakes in the area. Sometimes, lakes receiving urban-residential storm water inputs will reach a threshold where decreased water clarity substantially limits aquatic plant growth. When aquatic plant cover is severely limited, there is a risk of sustained poor water quality. Thus, a balanced aquatic plant community is essential for a healthy lake. Further investigation is needed to better understand the dynamics of Owasso's aquatic plant community.

II. Shoreland Assessment

Introduction

Over the last ten years, greater attention has been given to shoreland management and ecological restoration. The MN DNR has begun a lakeshore restoration grants program to encourage the preservation and establishment of natural buffers. A natural shoreline with a diversity of native plants is less prone to erosion and provides quality fish and wildlife habitat. Recently, there seems to be a general increase in the appreciation of natural shoreland and for wetland wildflowers and other native species that compose these areas.

Watershed District staff surveyed the Lake Owasso shore with the intention of classifying segments based on a suite of characteristics that help determine condition and ecological restoration potential. This information will be helpful in future shoreland management planning and education.

Methods

An assessment of shoreline condition and restoration potential was conducted on September 9, 2005. A visual survey was conducted by boat – two staff slowly navigated the entire shore perimeter of the lake.

Shore segments were analyzed on a property by property basis. A GPS unit was used to determine location on a lake map including the Ramsey County GIS shoreland parcel data. For each property, a record was made of shore material (i.e., grass, rip-rap, woody vegetation, retaining wall, sand), slope (i.e., shallow, moderate, steep) and restoration potential (i.e., good, moderate, poor) for each property. The ranking for restoration potential was a subjective overall assessment based on slope, shore material, and evidence of shoreland use. For instance, a property with a shallow slope, no rip-rap, turf to the water's edge, and minimal signs of shore recreation would receive a "good" restoration potential ranking. A "poor" ranking was given to properties with steep slopes, large quantities of rip-rap, and signs of heavy recreational use (e.g., water slides, and shore stations). An assignment of 'poor' was also given to sites with a large wooded buffer or extensive cattail fringe. This ranking refers to restoration potential and not current shoreland condition. A "moderate" ranking was given to properties with a mix of characteristics, e.g., moderate slope, turf grass, and dock with boats along the shore. (See Appendix A for example photos of restoration potential – good, moderate, and poor)

Results and Discussion

Lake Owasso has approximately 5 miles of shoreland. Close to 2 miles was categorized as having good restoration potential. A bit less than a mile was assigned a moderate ranking. And approximately 2 miles was considered to have poor restoration potential.

Table 4 summarizes the results of the shoreland survey. Approximately 3 miles of shore was dominated by turf grass and rock rip-rap. This is fairly common in an urban lake setting. Close to one mile of shore had tall grass-forb type buffer. Much of this type of shore could be improved with minimal resource input. Approximately 1,180 feet of shore had retaining walls, which would require considerable effort to employ ecological restoration.

Table 4: A breakdown by linear feet of shoreland categories, restoration potential, and ownership for Lake Owasso.

Restoration Potential	Linear Feet
Good	10,218
Moderate	4,786
Poor	10,509
Total	25,512
Shore Material	
Riprap	8,967
Turf	8,001
Tall grass-forb	5,206
Woody - Tree/shrub	1,523
Retaining wall	1,183
Sand	632
Total	25,512
Slope	
Shallow	14,173
Moderate	7,797
Steep	3,543
Total	25,512
Ownership	
Private	23,172
Public	1,583
Joint Ownership - Cooperative	757
Total	25,512

Figure 2 identifies individual parcels and their restoration potential. Generally, most shore segments have a number of adjoining properties that have moderate to good restoration potential. On the northwest and west sides of the lake, there are two large stretches with properties having poor restoration potential. This is due to steep slopes and rip-rap on the northwest and a large cattail fringe on the west side.

From a resource management perspective, it would be reasonable to first address strings of properties that have good restoration potential. There are at least six of these strings on the lake. Having shoreland owners pool resources and conduct joint restorations would be most efficient. The Ramsey County park on the north end of the lake would also be another reasonable choice to conduct initial restoration efforts. This would be a prime location for a demonstration.

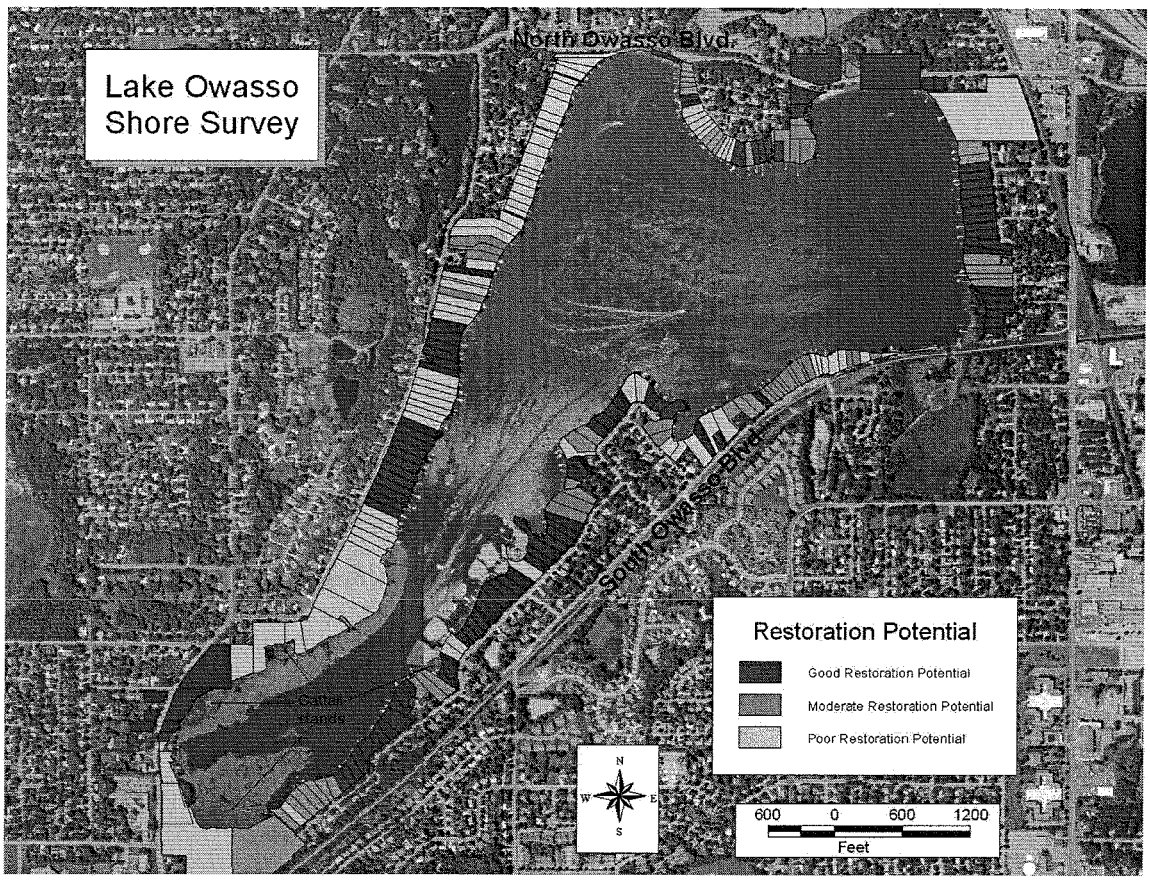
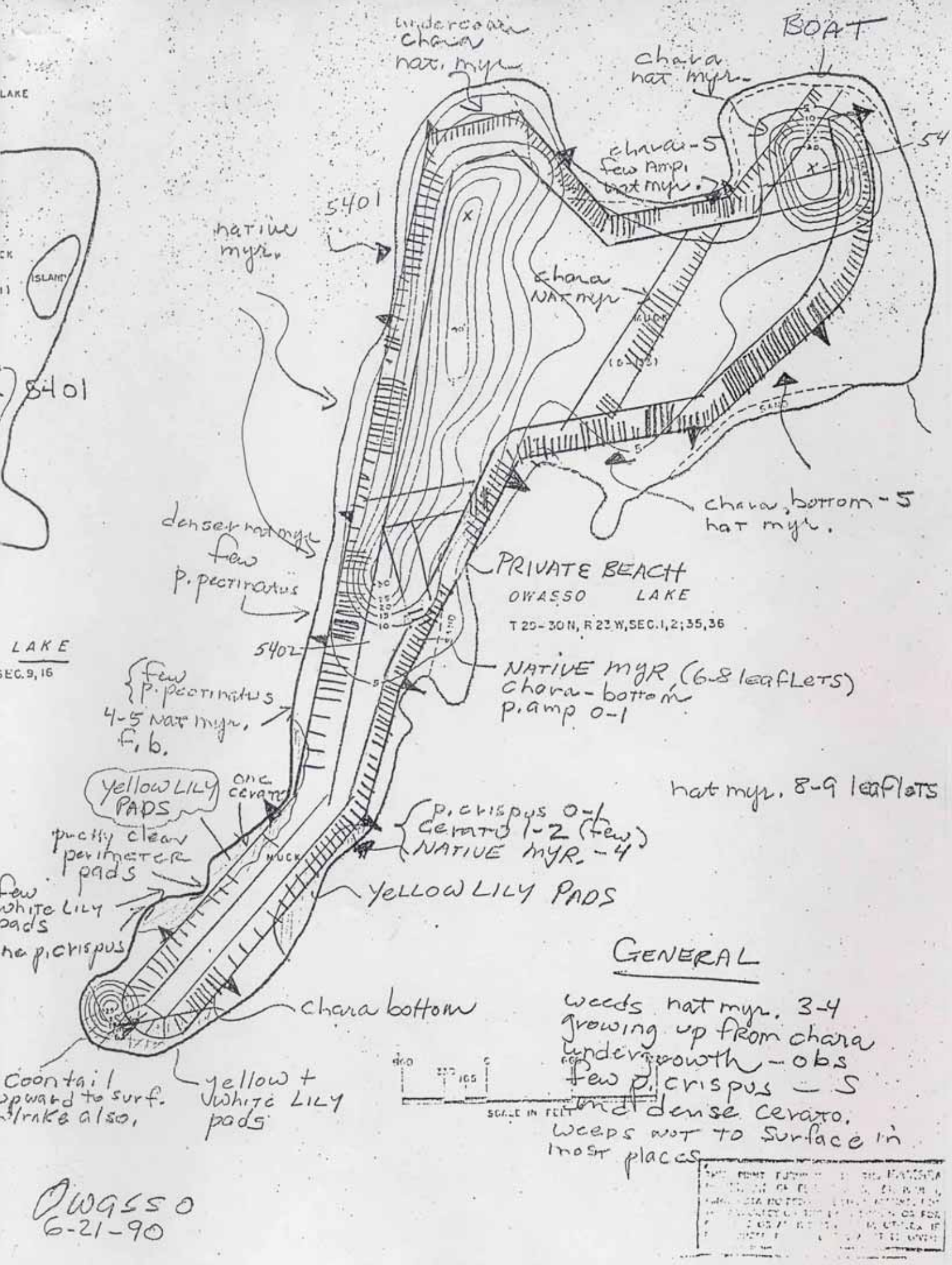
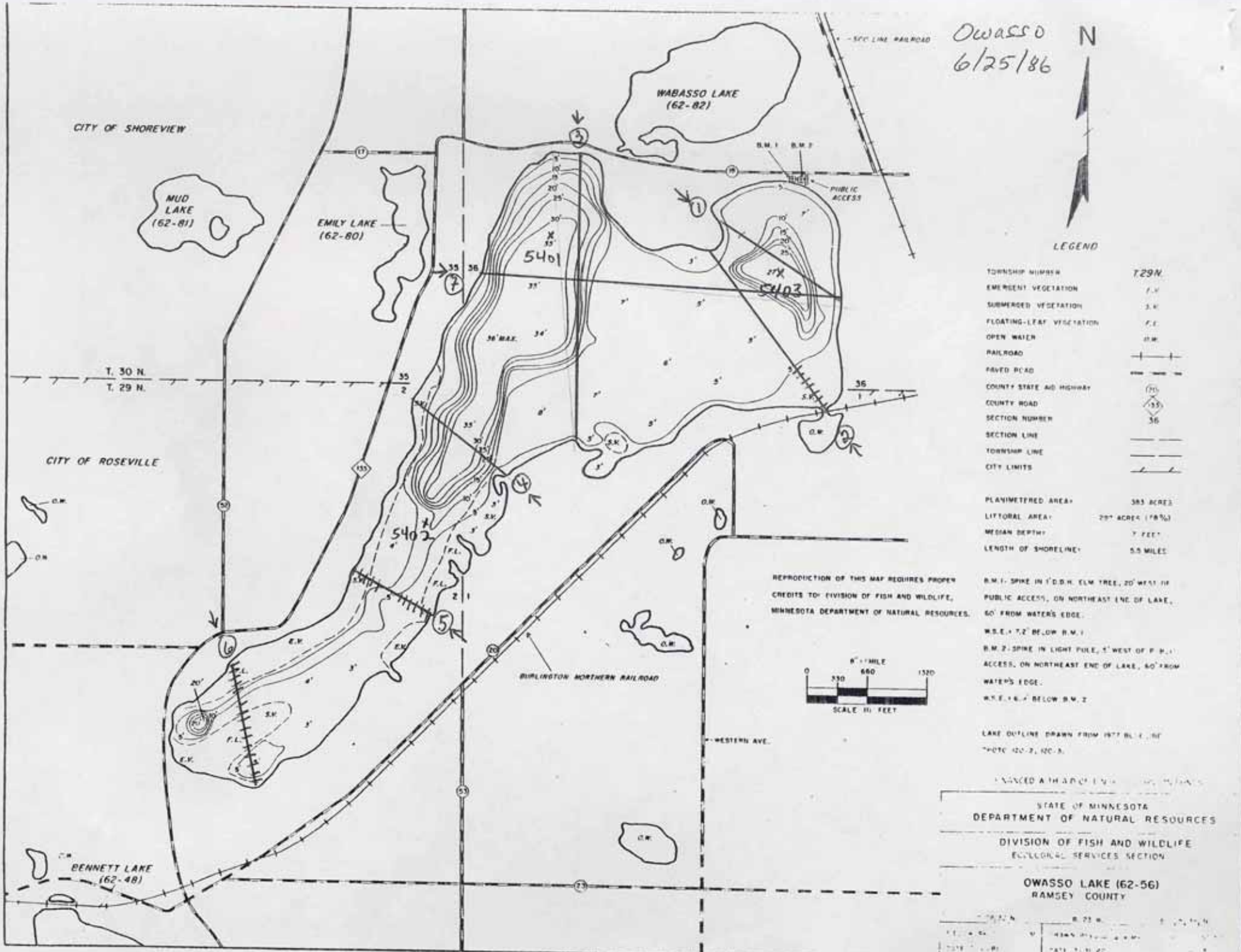


Figure 2: Map of Ramsey County shoreland parcels and their restoration potential ranking.

The results of this survey clearly indicate that a substantial portion of the Lake Owasso shoreland has good to moderate restoration potential. From a resource management perspective, the most challenging aspect to implementing restoration is that a majority of Owasso's shoreland is privately owned. Thus, education and possibly incentives (e.g., cost-share programs) must be used in order for the overall condition of Owasso's shoreland to improve. The benefits of individual shoreland owners employing ecological restoration will likely be cumulative over time.


undercover chara nat. myr.
BOAT
chara nat myr.
chara-5 few Amp. nat myr.
54
5401
native myr.
chara NAT myr
chara, bottom-5 nat myr.
denser nat myr few P. pectinatus
PRIVATE BEACH
OWASSO LAKE
T 20-30 N, R 23 W, SEC. 1, 2; 35, 36
5402
NATIVE MYR (6-8 leaflets) chara-bottom P. amp 0-1
few P. pectinatus 4-5 Nat myr, f, b.
nat myr. 8-9 leaflets
yellow LILY PADS
one cerato
P. crispus 0-1 CERATO 1-2 (few) NATIVE MYR. -4
yellow LILY PADS
pretty clean perimeter pads
few white LILY pads
P. crispus
chara bottom
coontail upward to surf. Drake also,
yellow + white LILY pads
SCALE IN FEET
GENERAL
weeds nat myr. 3-4 growing up from chara undergrowth - obs
few P. crispus - S
and dense cerato.
weeds not to surface in most places
OWASSO
6-21-90

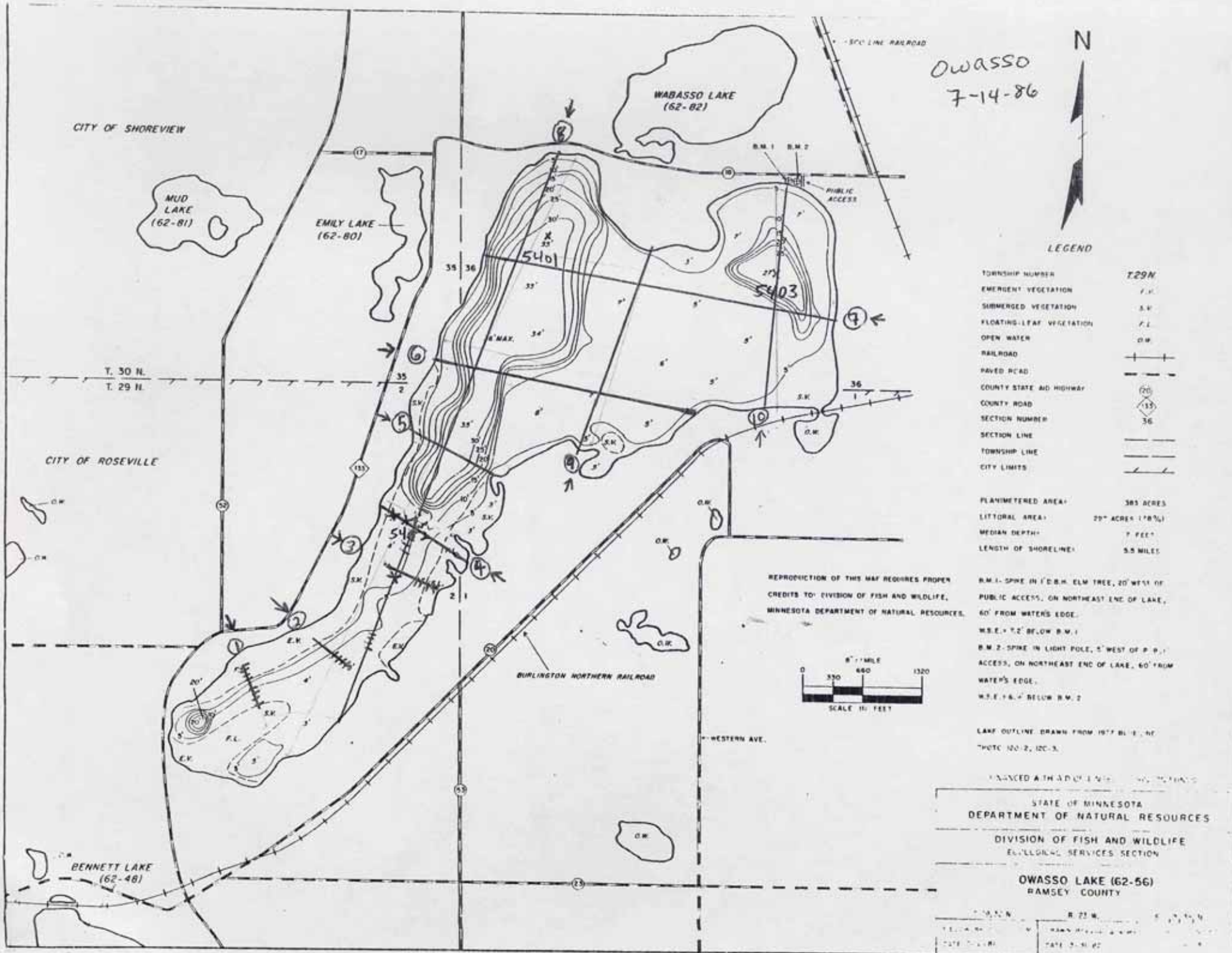

Owasso
6/25/86
N
WABASSO LAKE
(62-82)
CITY OF SHOREVIEW
MUD
LAKE
(62-81)
EMILY LAKE
(62-80)
CITY OF ROSEVILLE
T. 30 N.
T. 29 N.
BENNETT LAKE
(62-48)
BURLINGTON NORTHERN RAILROAD
WESTERN AVE.
PUBLIC ACCESS
B.M. 1
B.M. 2
5401
5402
5403
LEGEND
TOWNSHIP NUMBER
T29N.
EMERGENT VEGETATION
E.V.
SUBMERGED VEGETATION
S.V.
FLOATING-LEAF VEGETATION
F.L.
OPEN WATER
O.W.
RAILROAD
PAVED ROAD
COUNTY STATE AID HIGHWAY
COUNTY ROAD
SECTION NUMBER
SECTION LINE
TOWNSHIP LINE
CITY LIMITS
PLANIMETERED AREA
383 ACRES
LITTORAL AREA
297 ACRES (78%)
MEDIAN DEPTH
7 FEET
LENGTH OF SHORELINE
5.5 MILES
REPRODUCTION OF THIS MAP REQUIRES PROPER CREDITS TO: DIVISION OF FISH AND WILDLIFE, MINNESOTA DEPARTMENT OF NATURAL RESOURCES.
B.M. 1 - SPIKE IN 1' D.B.H. ELM TREE, 20' WEST OF PUBLIC ACCESS, ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E. = 7.2' BELOW B.M. 1
B.M. 2 - SPIKE IN LIGHT POLE, 5' WEST OF P.A., ACCESS, ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E. = 6.4' BELOW B.M. 2
LAKE OUTLINE DRAWN FROM 1977 BLACK AND WHITE PHOTOS 120-3, 120-4.
1" = 1 MILE
0
330
660
1320
SCALE IN FEET
STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
ECOLOGICAL SERVICES SECTION
OWASSO LAKE (62-56)
RAMSEY COUNTY

(1) Owasso 6/25/86

P. crispus
P. pectinatus → P. sp T.
Myriophes
some dead fish (Bluegill 5)
Ceratophyllum

(2) Chara mats on bottom
Ceratophyllum
P. crispus
pectinatus
Sparse
Sagarus
Typha
Carex

(3) Mixphar
Ceratophyllum
P. crispus
Myriophyllum
Typha latifolia


Owasso
7-14-86
N
WABASSO LAKE
(62-82)
CITY OF SHOREVIEW
MUD
LAKE
(62-81)
EMILY LAKE
(62-80)
CITY OF ROSEVILLE
T. 30 N.
T. 29 N.
BENNETT LAKE
(62-48)
BURLINGTON NORTHERN RAILROAD
WESTERN AVE.
PUBLIC ACCESS
B.M. 1
B.M. 2
5401
5403
LEGEND
TOWNSHIP NUMBER T29N
EMERGENT VEGETATION E.V.
SUBMERGED VEGETATION S.V.
FLOATING-LEAF VEGETATION F.L.
OPEN WATER O.W.
RAILROAD
PAVED ROAD
COUNTY STATE AID HIGHWAY
COUNTY ROAD
SECTION NUMBER
SECTION LINE
TOWNSHIP LINE
CITY LIMITS
PLANIMETERED AREA: 383 ACRES
LITTORAL AREA: 294 ACRES (78%)
MEDIAN DEPTH: 7 FEET
LENGTH OF SHORELINE: 5.5 MILES
REPRODUCTION OF THIS MAP REQUIRES PROPER CREDITS TO: DIVISION OF FISH AND WILDLIFE, MINNESOTA DEPARTMENT OF NATURAL RESOURCES.
B.M. 1- SPIKE IN 1' D.B.H. ELM TREE, 20' WEST OF PUBLIC ACCESS, ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E. = 7.2' BELOW B.M. 1
B.M. 2- SPIKE IN LIGHT POLE, 5' WEST OF P.A., ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E. = 6.4' BELOW B.M. 2
LAKE OUTLINE DRAWN FROM 1977 BLACK & WHITE PHOTO 120-2, 120-3.
0 330 660 1320
SCALE IN FEET
STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
ECOLOGICAL SERVICES SECTION
OWASSO LAKE (62-56)
RAMSEY COUNTY
R. 23 W.

7/14/86 Oconee

Cloudy, cool, rain threatening

1 Myriophyllum 5 ft
Nymphea 200 FFS
Nuphar ooze

2 Ceratophyllum 3 ft
400 FFS
Nymphea
Nuphar bottom dead plant matter

3 Ceratophyllum 5 ft
ooze 50 FFS

3A Ceratophyllum no weeds
Nuphar 3 ft 50 FFS
Nymphea ooze

4 sand no weeds 5 ft 20 FFS

4A " " " 5 ft 50 FFS

4D ooze & dead plant matter 4 ft 200 FFS
no live plants observed

5 sandy ooze V+N
Ceratophyllum 3 ft 100 FFS

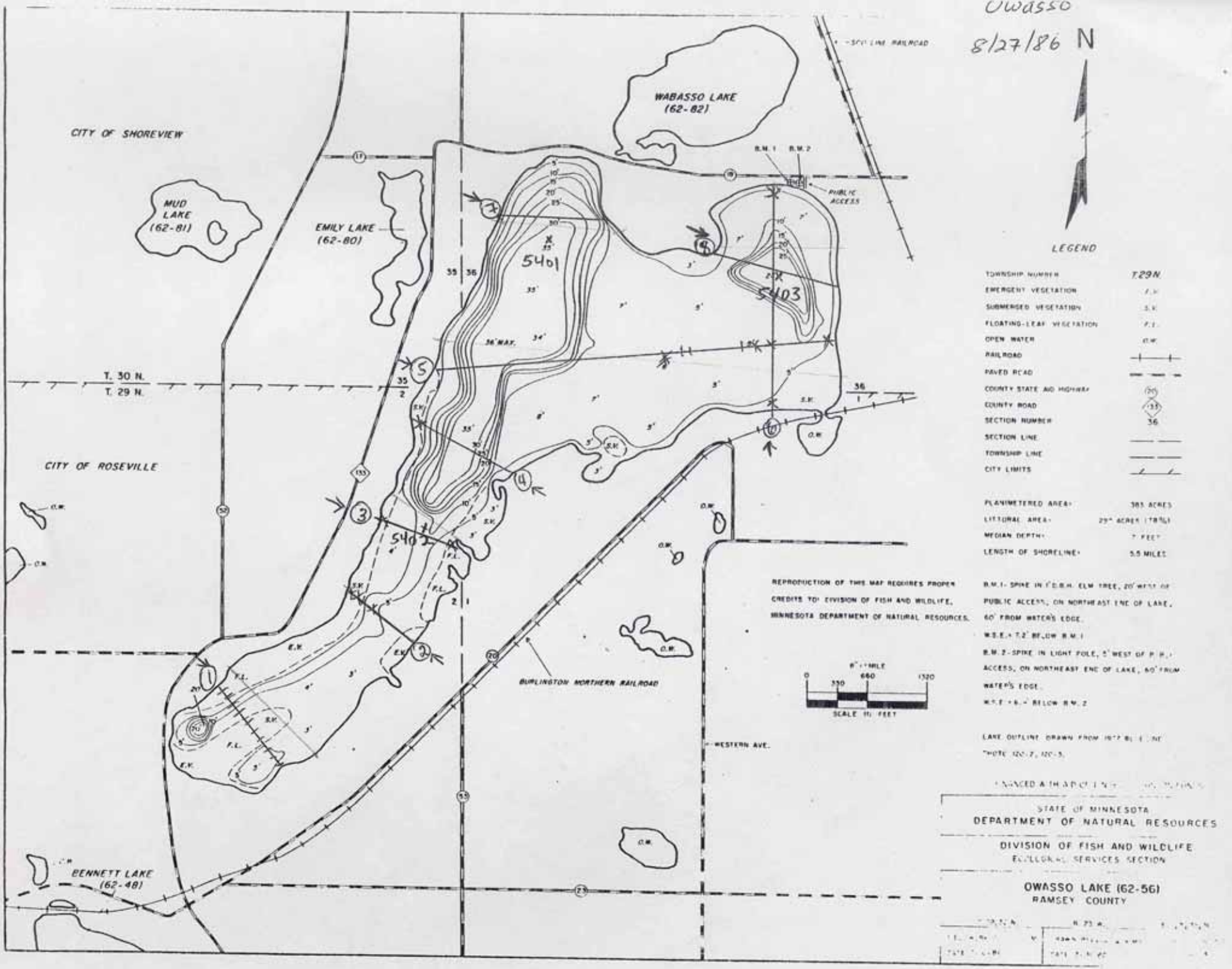
OL 7/14/96

KJ2

GA Sandy — no plants
7 ft 620 FFS

GB No plants ooze
10 ft 30 FFS

GC 5 ft 400 FFS
No plants ooze


Owasso
8/27/86
N
WABASSO LAKE (62-82)
CITY OF SHOREVIEW
MUD LAKE (62-81)
EMILY LAKE (62-80)
CITY OF ROSEVILLE
T. 30 N.
T. 29 N.
BENNETT LAKE (62-48)
BURLINGTON NORTHERN RAILROAD
WESTERN AVE.
PUBLIC ACCESS
B.M. 1
B.M. 2
5401
5402
5403
LEGEND
TOWNSHIP NUMBER T.29N.
EMERGENT VEGETATION E.V.
SUBMERSED VEGETATION S.V.
FLOATING-LEAF VEGETATION F.L.
OPEN WATER O.W.
RAILROAD
PAVED ROAD
COUNTY STATE AID HIGHWAY
COUNTY ROAD
SECTION NUMBER 36
SECTION LINE
TOWNSHIP LINE
CITY LIMITS
PLANIMETERED AREA= 383 ACRES
LITTORAL AREA= 29* ACRES (78%)
MEDIAN DEPTH= 7 FEET
LENGTH OF SHORELINE= 5.5 MILES
REPRODUCTION OF THIS MAP REQUIRES PROPER CREDITS TO: DIVISION OF FISH AND WILDLIFE, MINNESOTA DEPARTMENT OF NATURAL RESOURCES.
B.M.1- SPIKE IN F.D.H. ELM TREE, 20' WEST OF PUBLIC ACCESS, ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E.= 7.2' BELOW B.M.1
B.M.2- SPIKE IN LIGHT POLE, 5' WEST OF P.A., ACCESS, ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E.= 6.4' BELOW B.M.2
LAKE OUTLINE DRAWN FROM 1977 BLUE LINE PHOTO 120-7, 120-8.
0 330 660 1320
SCALE IN FEET
STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
OWASSO LAKE (62-56)
RAMSEY COUNTY

Owasso 8/27/86 60°F Cloudy Breezy

1 Cerotophyllum / Chara — Muddy — 3 ft — 200 FFS

2 Chara attached algae — mucky — 3 ft — 20 FFS

3 Chara / Valisneria — sand — 3 ft — 10 FFS

4 P crispus — muck — 3 ft — 200 FFS

5 Nothing — Sand — 5 ft — 20 FFS

5A Myriophyllum / heterophyllum — mud — 3 ft — 50 FFS

6 P. zosteriformis / Valisneria — 3 ft — sandy — 20 FFS

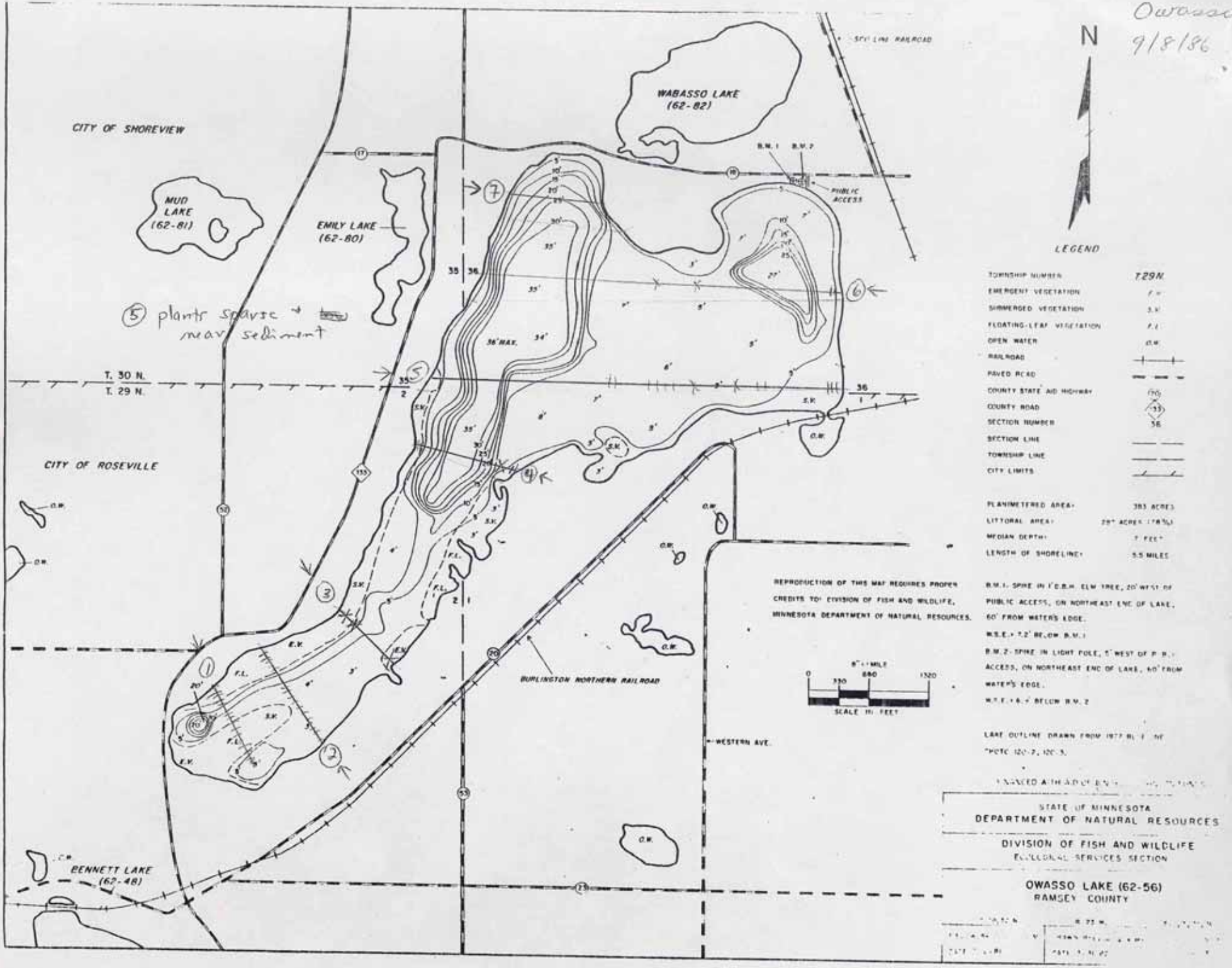
Owasso 8/27/86

(5) plants sparse, loc. very near substrate

flats

(2) pl very near substrate; contour map off here

Owasso
9/8/86


N
SOO LINE RAILROAD
WABASSO LAKE (62-82)
CITY OF SHOREVIEW
MUD LAKE (62-81)
EMILY LAKE (62-80)
B.M. 1
B.M. 2
PUBLIC ACCESS
5 plants sparse + mod sediment
T. 30 N.
T. 29 N.
CITY OF ROSEVILLE
BENNETT LAKE (62-48)
BURLINGTON NORTHERN RAILROAD
WESTERN AVE.
REPRODUCTION OF THIS MAP REQUIRES PROPER CREDITS TO: DIVISION OF FISH AND WILDLIFE, MINNESOTA DEPARTMENT OF NATURAL RESOURCES.
SCALE IN FEET
LEGEND
TOWNSHIP NUMBER 129N
EMERGENT VEGETATION
SUBMERGED VEGETATION
FLOATING-LEAF VEGETATION
OPEN WATER
RAILROAD
PAVED ROAD
COUNTY STATE AID HIGHWAY
COUNTY ROAD
SECTION NUMBER
SECTION LINE
TOWNSHIP LINE
CITY LIMITS
PLANIMETERED AREA= 383 ACRES
LITTORAL AREA= 298 ACRES (78%)
MEDIAN DEPTH= 7 FEET
LENGTH OF SHORELINE= 5.5 MILES
B.M.1- SPIKE IN 1' D.B.H. ELM TREE, 20' WEST OF PUBLIC ACCESS, ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E.= 7.2' BELOW B.M.1
B.M.2- SPIKE IN LIGHT POLE, 5' WEST OF P.A., ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E.= 6.4' BELOW B.M.2
LAKE OUTLINE DRAWN FROM 1977 BL
PHOTO 120-7, 120-8.
STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
ECOLOGICAL SERVICES SECTION
OWASSO LAKE (62-56)
RAMSEY COUNTY

Orasso 9/18/86 Sunny Cool breezy

1 Ceratophyllum 200FFS 4 ft
Nymphea Muck

2 Ceratophyllum 200FFS 5 ft
Chara Dogs

3 100FFS 5 ft gravel
Myriophyllum

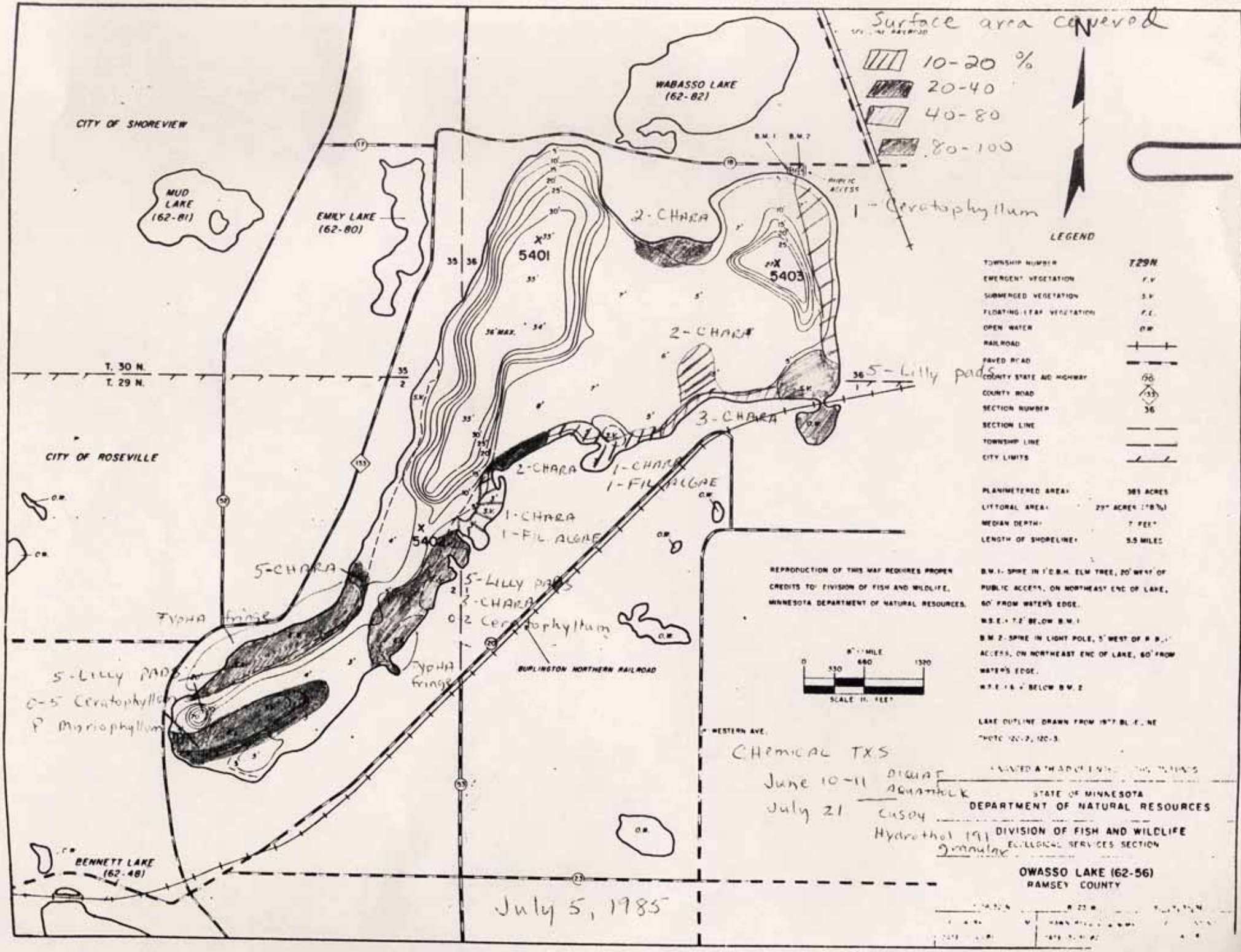
4 50 FFS 4 ft sand
P. nodosus
Chara

5 50FFS 3 ft muck
P. crispus
Myriophyllum

6 50FFS 5 ft
sand no plants

6A 100FFS 4 ft gravel
P nodosus

Plants mostly unhealthy


Surface area covered
10-20 %
20-40
40-80
80-100
N
WABASSO LAKE (62-82)
CITY OF SHOREVIEW
MUD LAKE (62-81)
EMRY LAKE (62-80)
CITY OF ROSEVILLE
BENNETT LAKE (62-48)
T. 30 N.
T. 29 N.
B.M.1
B.M.2
PUBLIC ACCESS
5401
5403
5402
2-CHARA
1-Ceratophyllum
2-CHARA
5-Lilly pads
3-CHARA
2-CHARA
1-CHARA
1-FIL ALGAE
1-CHARA
1-FIL ALGAE
5-CHARA
5-LILLY PADS
2-CHARA
2 Ceratophyllum
Typha fringe
Typha fringe
5-LILLY PADS
0-5' Ceratophyllum
P Myriophyllum
BURLINGTON NORTHERN RAILROAD
WESTERN AVE.
CHEMICAL TXS
June 10-11
July 21
Cusoy
Hydrothol 191
Granular
July 5, 1985
LEGEND
TOWNSHIP NUMBER T.29N
EMERGENT VEGETATION E.V.
SUBMERGED VEGETATION S.V.
FLOATING-LEAF VEGETATION F.L.
OPEN WATER O.W.
RAILROAD
PAVED ROAD
COUNTY STATE AID HIGHWAY 88
COUNTY ROAD 33
SECTION NUMBER 36
SECTION LINE
TOWNSHIP LINE
CITY LIMITS
PLANIMETERED AREA: 381 ACRES
LITTORAL AREA: 29* ACRES (78%)
MEDIAN DEPTH: 7 FEET*
LENGTH OF SHORELINE: 5.5 MILES
REPRODUCTION OF THIS MAP REQUIRES PROPER CREDITS TO DIVISION OF FISH AND WILDLIFE, MINNESOTA DEPARTMENT OF NATURAL RESOURCES.
B.M.1 - SPIKE IN 1' D.B.H. ELM TREE, 20' WEST OF PUBLIC ACCESS, ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E. = 7.2' BELOW B.M.1
B.M.2 - SPIKE IN LIGHT POLE, 5' WEST OF P.A., ON NORTHEAST END OF LAKE, 60' FROM WATER'S EDGE.
W.S.E. = 6.4' BELOW B.M.2
LAKE OUTLINE DRAWN FROM 1977 BLUE LINE PHOTO 120-2, 120-3.
1/4 MILE
0 330 660 1320
SCALE IN FEET
STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
ECOLOGICAL SERVICES SECTION
OWASSO LAKE (62-56)
RAMSEY COUNTY

Appendix K

RWMWD Shoreland Assessment—2005

Lake Owasso

Aquatic Plant Survey and Shoreland Assessment – September 2005

Bill Bartodziej and Simba Blood– Ramsey-Washington Metro Watershed District
Contact Information: Bill@rwmwd.org or 651.704.2089

I. Aquatic Plant Survey

Introduction

Aquatic plants are an important biological component of Lake Owasso, providing fish and wildlife habitat, holding bottom sediments and lakeshore soils in place, and indirectly affecting water clarity. For this particular survey, we focused on the submersed and floating-leaf plant communities because they are the most dynamic in Lake Owasso, and relatively sensitive to changes in water quality. Additionally, active management of the lake will influence these plant communities. This type of survey data will aid in the lake planning process.

Methods

The point intercept method incorporating Global Positioning System (GPS) technology (Madsen 1999) was used to assess the submersed aquatic plant community on Lake OWasso. Sampling was conducted during the week of September 5th, 2005. The point intercept method is currently being used by various resource management agencies, including the United States Geological Survey (Long Term Resource Monitoring Program) and the Minnesota Department of Natural Resources.

The crux of this method is that spot observations, presence/absence and abundance ranking data, are made at preselected locations covering the entire lake littoral zone. The littoral zone is defined as the near shore area where sunlight penetrates all the way to the bottom sediments, allowing aquatic plants to grow. For the Owasso survey, evenly spaced (100-m) spot locations were superimposed on a geo-referenced aerial photograph in the software program ArcPad. The GPS unit was then linked with ArcPad in the field and boat position was plotted on a hand-held computer. After reaching a point, all observational data (i.e., depth, substrate firmness, plant height, plant species, and abundance rank) was directly entered into the ArcPad data logger. The GPS unit used in this survey provided at least 1-m accuracy.

A double-tined rake attached to a rope was used to collect plant specimens. At each point, the rake was thrown over the boat in a 1-m imaginary square. The same sampling station off the deck of the boat was used throughout the survey. After a collection was made, each species was identified and given an abundance ranking based on a percent cover of rake tines (Yin et al. 2000) – see Table 1. Plant species that were in the 1-m sampling square but did not appear on the rake (e.g., floating leaf species) were also counted.

Table 1: Aquatic plant abundance ranking based on cover found on sampling rake.

Percent Cover of Tines	Abundance Ranking
81-100	5
61-80	4
41-60	3
21-40	2
1-20	1

Presence/absence data can be statistically compared using the assumptions of a binomial distribution – Chi-square tests and related comparisons, rather than parametric tests based on normal distributions (Madsen 1999). Having plant data of this type will enable us to statistically compare species distribution by season or by year. This will be useful in determining the effects of watershed and lake management activities on the submersed and floating-leaf plant communities, as well as potentially assessing plant management activities. In using the point intercept method, Newman (1998) found that taking 40 to 100 samples in a lake littoral zone was adequate in producing solid estimates for common species – less than 20% error associated with the mean. Taking more than 100 samples typically did not provide better estimates. For the Lake Owasso survey, we sampled 102 points in the littoral zone.

Results and Discussion

Sixteen floating-leaf and submersed plant species were identified in the survey (Table 2). This is the highest number of aquatic plant taxa recorded compared to other lakes surveyed this year by the Watershed District (Table 3).

Table 2: Plant taxa list generated from the point intercept aquatic plant survey – September 2005.

Common Name	Scientific Name	Origin
Coontail	*Ceratophyllum demersum*	Native
Muskgrass	*Chara*	Native
Canada elodea	*Elodea canadensis*	Native
Aquatic moss	*Fontinalis* sp.	Native
Spiny-spored quillwort	*Isoetes echinospora*	Native
Common duckweed	*Lemna minor*	Native
Eurasian water milfoil	*Myriophyllum spicatum*	Non-native
Water naiad	*Najas* spp.	Native
Nitella	*Nitella* sp.	Native
Yellow water lily	*Nuphar variegatum*	Native
White water lily	*Nymphaea odorata*	Native
Large leaf pondweed	*Potamageton amplifolius*	Native
Leafy pondweed	*Potamageton foliosus*	Native

Sago pondweed	*Potamogeton pectinatus*	Native
Whitestem Pondweed	*Potamageton praelongus*	Native
Flat-stem pondweed	*Potamageton zosteriformis*	Native

Submersed plants were present at depths of up to 8 feet. Light availability prevented rooted plants from establishing in deeper areas. The maximum depth at which aquatic plants were present and the number of sampling sites with plants present were the lowest recorded for east Metro area lakes (Table 3). This finding is of concern. A substantial drop in aquatic plant cover and littoral zone depth over time could result in a decrease in water quality and have detrimental effects on the fishery. District staff will be consulting with Terry Noonan, a limnologist with Ramsey County, to go over plant surveys that he conducted in the 1980s and 1990s. By comparing data we will attempt to determine if a trend is evident.

Table 3: Total number of plant taxa and littoral zone maximum depth for selected east Metro area lakes.

Lake	Total Taxa	Maximum littoral zone depth	Percentage of sites in littoral zone with aquatic plants
Owasso	16	8'	56.9%
Gervais	7	10' *	84.5%
Kohlman	12	9' *	94.4%
Phalen	11	14'	98.4%
Beaver	10	12'	95.4%
Tanners	13	17'	100.0%

* Depths not recorded at Kohlman and Gervais.
Littoral zone depth extrapolated from sample points & contour maps

The native coontail was the most abundant submersed vascular plant species (Figure 1). It was present at approximately 25% of the sites sampled in the littoral zone. This is a fairly aggressive submersed plant in the Metro area, doing well in relatively turbid pond and lake systems. It lacks true roots and obtains a majority of its nutrients through the water column. It seemed to favor depths in the 2 to 5 foot range.

The noxious weed species, Eurasian water milfoil, was the most abundant rooted macrophyte. It was present in 12 of the sampling sites. It was most commonly found in the southeastern finger of the lake. Its average abundance was a 1, indicating that this weed's cover was not excessive at the locations sampled and was not at the level that would potentially impede recreation.

Nitella, a macro-algae, was relatively common – present in 11 of the sites sampled. It was found most often in the south-central part of the lake, especially

in the 6 to 8 foot depth range. This is in the deeper part of Lake Owasso's littoral zone.

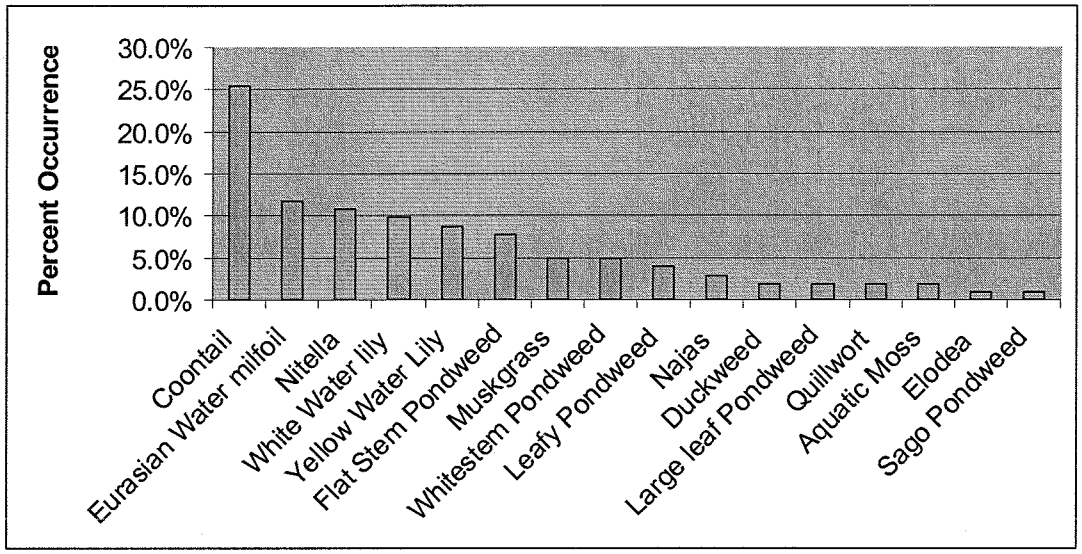


Figure 1: Percent occurrence for each species detected in the littoral zone- Lake Owasso.

The two most abundant floating leaved plants were white and yellow water lily. They were present in approximately 7% of the sites sampled. Their distribution was limited to the narrow southeastern finger of the lake. This is of no surprise since lilies favor calm water areas with organic lake bottom substrates.

From a resource management perspective, the most pressing issue resulting from this survey has to do with the relatively low cover of submersed vegetation compared to other lakes in the area. Sometimes, lakes receiving urban-residential storm water inputs will reach a threshold where decreased water clarity substantially limits aquatic plant growth. When aquatic plant cover is severely limited, there is a risk of sustained poor water quality. Thus, a balanced aquatic plant community is essential for a healthy lake. Further investigation is needed to better understand the dynamics of Owasso's aquatic plant community.

II. Shoreland Assessment

Introduction

Over the last ten years, greater attention has been given to shoreland management and ecological restoration. The MN DNR has begun a lakeshore restoration grants program to encourage the preservation and establishment of natural buffers. A natural shoreline with a diversity of native plants is less prone to erosion and provides quality fish and wildlife habitat. Recently, there seems to be a general increase in the appreciation of natural shoreland and for wetland wildflowers and other native species that compose these areas.

Watershed District staff surveyed the Lake Owasso shore with the intention of classifying segments based on a suite of characteristics that help determine condition and ecological restoration potential. This information will be helpful in future shoreland management planning and education.

Methods

An assessment of shoreline condition and restoration potential was conducted on September 9, 2005. A visual survey was conducted by boat – two staff slowly navigated the entire shore perimeter of the lake.

Shore segments were analyzed on a property by property basis. A GPS unit was used to determine location on a lake map including the Ramsey County GIS shoreland parcel data. For each property, a record was made of shore material (i.e., grass, rip-rap, woody vegetation, retaining wall, sand), slope (i.e., shallow, moderate, steep) and restoration potential (i.e., good, moderate, poor) for each property. The ranking for restoration potential was a subjective overall assessment based on slope, shore material, and evidence of shoreland use. For instance, a property with a shallow slope, no rip-rap, turf to the water's edge, and minimal signs of shore recreation would receive a "good" restoration potential ranking. A "poor" ranking was given to properties with steep slopes, large quantities of rip-rap, and signs of heavy recreational use (e.g., water slides, and shore stations). An assignment of 'poor' was also given to sites with a large wooded buffer or extensive cattail fringe. This ranking refers to restoration potential and not current shoreland condition. A "moderate" ranking was given to properties with a mix of characteristics, e.g., moderate slope, turf grass, and dock with boats along the shore. (See Appendix A for example photos of restoration potential – good, moderate, and poor)

Results and Discussion

Lake Owasso has approximately 5 miles of shoreland. Close to 2 miles was categorized as having good restoration potential. A bit less than a mile was assigned a moderate ranking. And approximately 2 miles was considered to have poor restoration potential.

Table 4 summarizes the results of the shoreland survey. Approximately 3 miles of shore was dominated by turf grass and rock rip-rap. This is fairly common in an urban lake setting. Close to one mile of shore had tall grass-forb type buffer. Much of this type of shore could be improved with minimal resource input. Approximately 1,180 feet of shore had retaining walls, which would require considerable effort to employ ecological restoration.

Table 4: A breakdown by linear feet of shoreland categories, restoration potential, and ownership for Lake Owasso.

Restoration Potential	Linear Feet
Good	10,218
Moderate	4,786
Poor	10,509
Total	25,512
Shore Material	
Riprap	8,967
Turf	8,001
Tall grass-forb	5,206
Woody - Tree/shrub	1,523
Retaining wall	1,183
Sand	632
Total	25,512
Slope	
Shallow	14,173
Moderate	7,797
Steep	3,543
Total	25,512
Ownership	
Private	23,172
Public	1,583
Joint Ownership - Cooperative	757
Total	25,512

Figure 2 identifies individual parcels and their restoration potential. Generally, most shore segments have a number of adjoining properties that have moderate to good restoration potential. On the northwest and west sides of the lake, there are two large stretches with properties having poor restoration potential. This is due to steep slopes and rip-rap on the northwest and a large cattail fringe on the west side.

From a resource management perspective, it would be reasonable to first address strings of properties that have good restoration potential. There are at least six of these strings on the lake. Having shoreland owners pool resources and conduct joint restorations would be most efficient. The Ramsey County park on the north end of the lake would also be another reasonable choice to conduct initial restoration efforts. This would be a prime location for a demonstration.

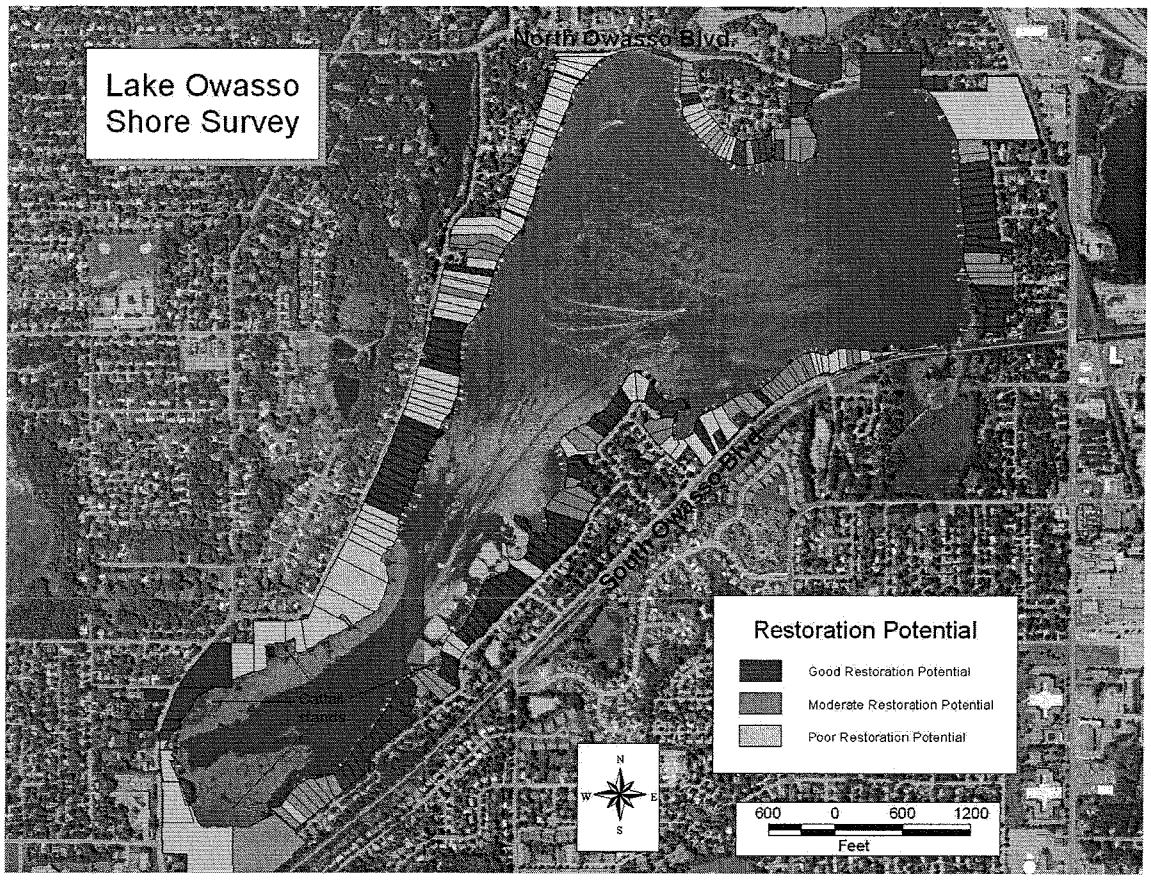
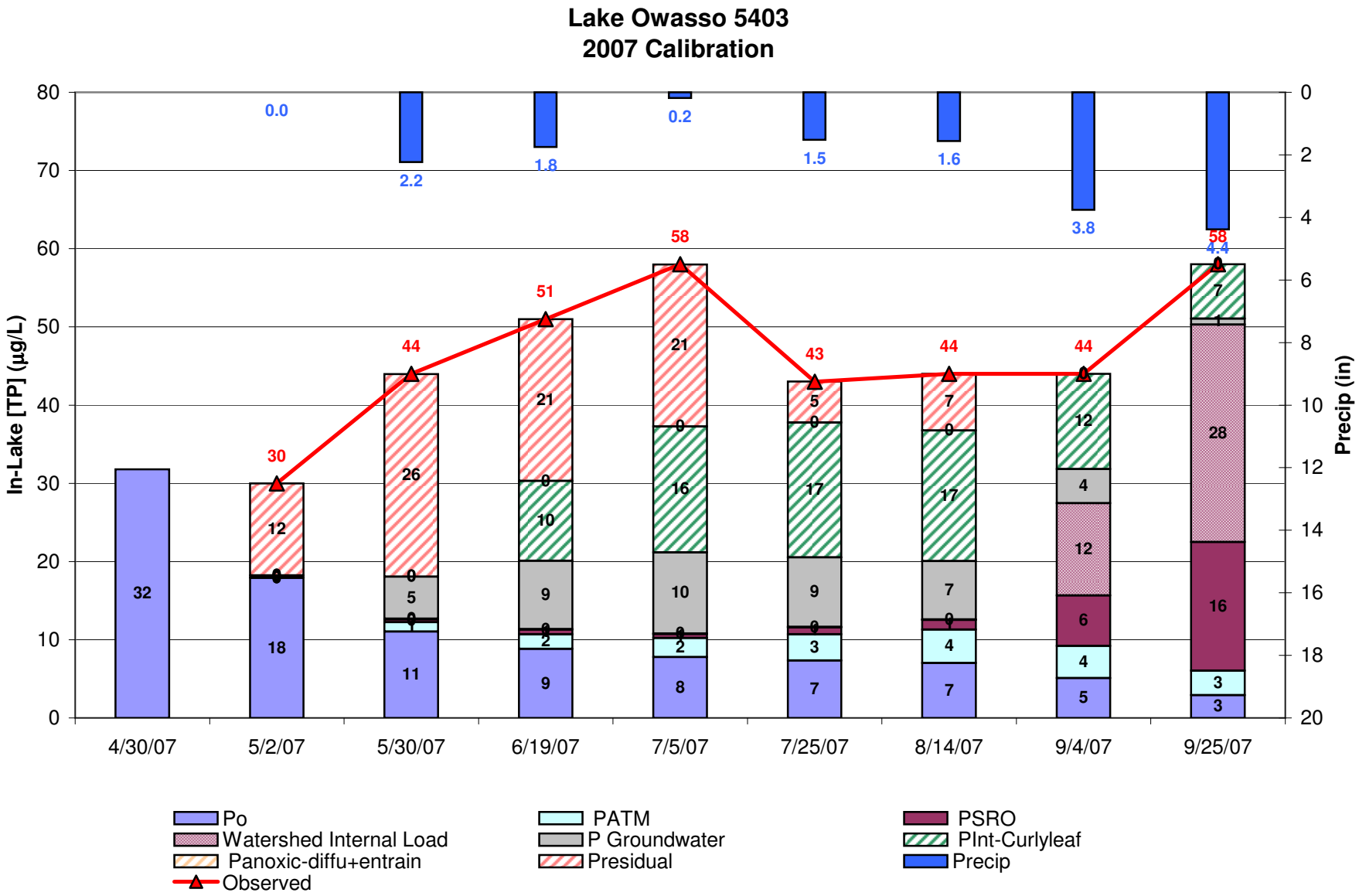


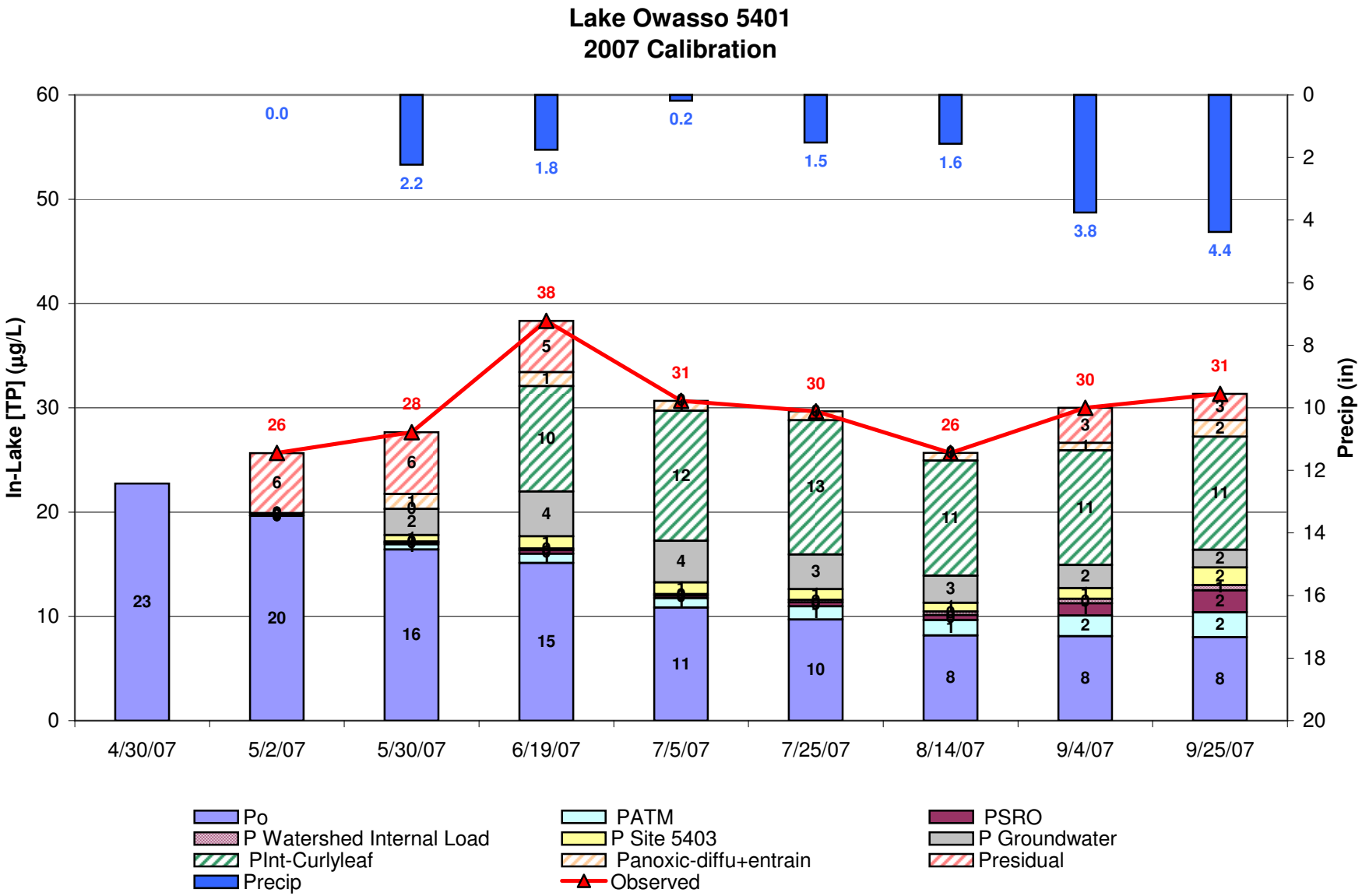
Figure 2: Map of Ramsey County shoreland parcels and their restoration potential ranking.

The results of this survey clearly indicate that a substantial portion of the Lake Owasso shoreland has good to moderate restoration potential. From a resource management perspective, the most challenging aspect to implementing restoration is that a majority of Owasso's shoreland is privately owned. Thus, education and possibly incentives (e.g., cost-share programs) must be used in order for the overall condition of Owasso's shoreland to improve. The benefits of individual shoreland owners employing ecological restoration will likely be cumulative over time.

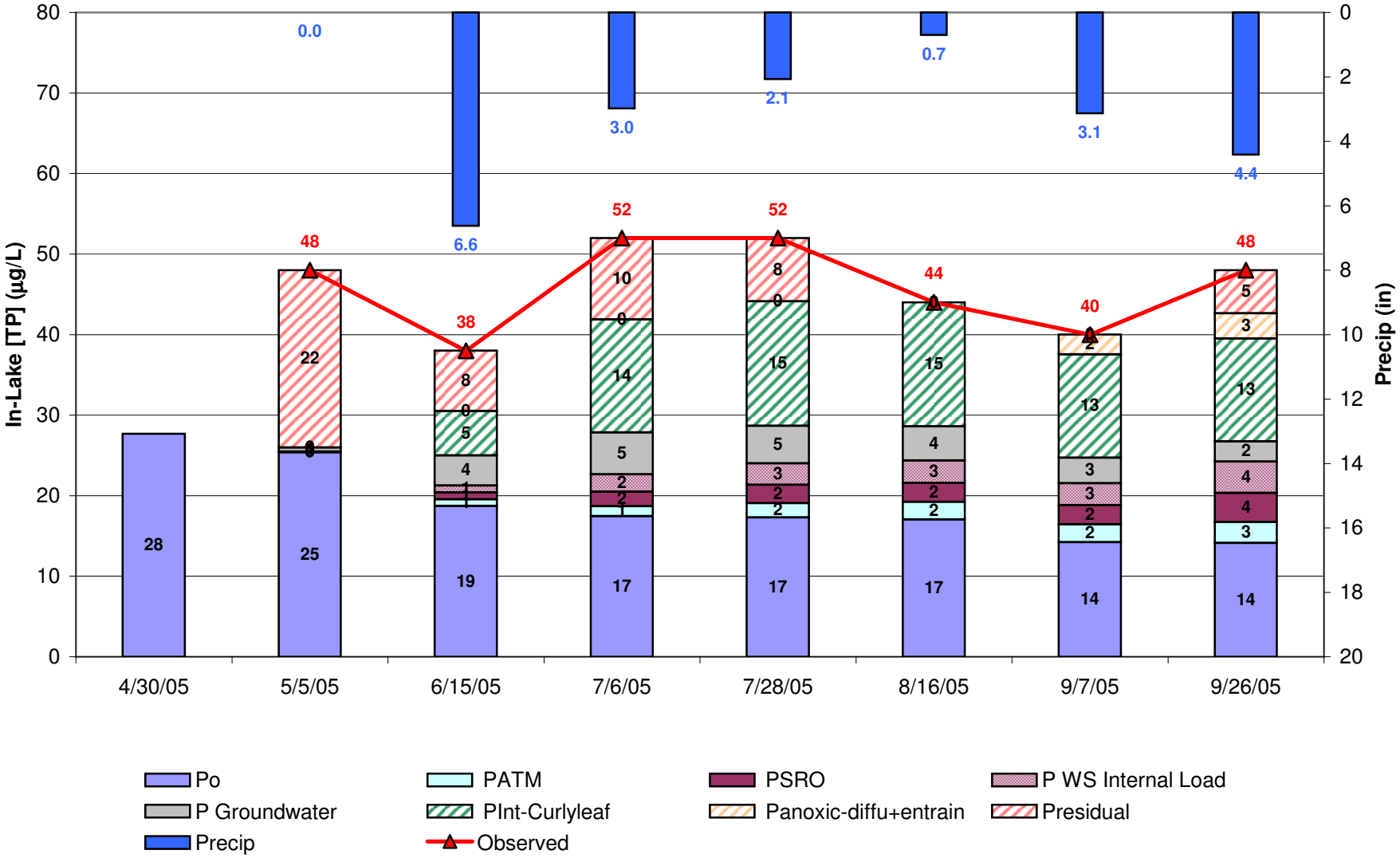
Appendix L

In-Lake Modeling Results

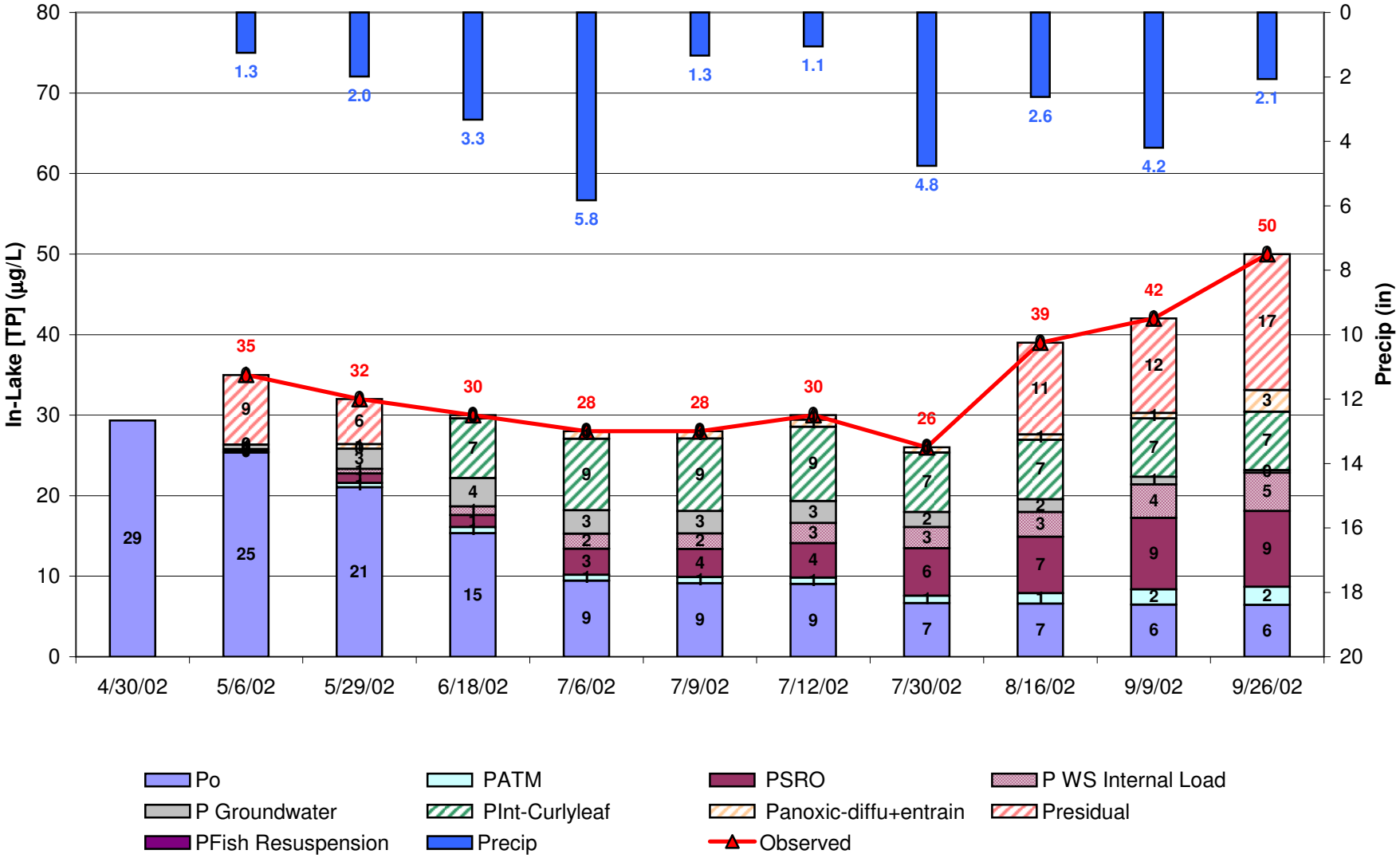

Lake Owasso 5403
2007 Calibration
In-Lake [TP] (µg/L)
Precip (in)
4/30/07
5/2/07
5/30/07
6/19/07
7/5/07
7/25/07
8/14/07
9/4/07
9/25/07
Po
Watershed Internal Load
Panoxic-diffu+entrain
PATM
P Groundwater
Presidual
PSRO
PInt-Curlyleaf
Precip
Observed


Lake Owasso 5401
2007 Calibration
In-Lake [TP] (µg/L)
Precip (in)
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18
20
4/30/07
5/2/07
5/30/07
6/19/07
7/5/07
7/25/07
8/14/07
9/4/07
9/25/07
0.0
2.2
1.8
0.2
1.5
1.6
3.8
4.4
26
28
38
31
30
26
30
31
23
20
6
16
6
2
15
5
1
10
4
11
12
4
10
13
3
8
11
3
8
11
2
2
8
11
2
2
2
2
Po
P Watershed Internal Load
PInt-Curlyleaf
Precip
PATM
P Site 5403
Panoxic-diffu+entrain
Observed
PSRO
P Groundwater
Presidual

Lake Owasso 2005 (Avg) Calibration



Lake Owasso 2002 (Wet) Calibration



Appendix M

2007 Sediment Core Data

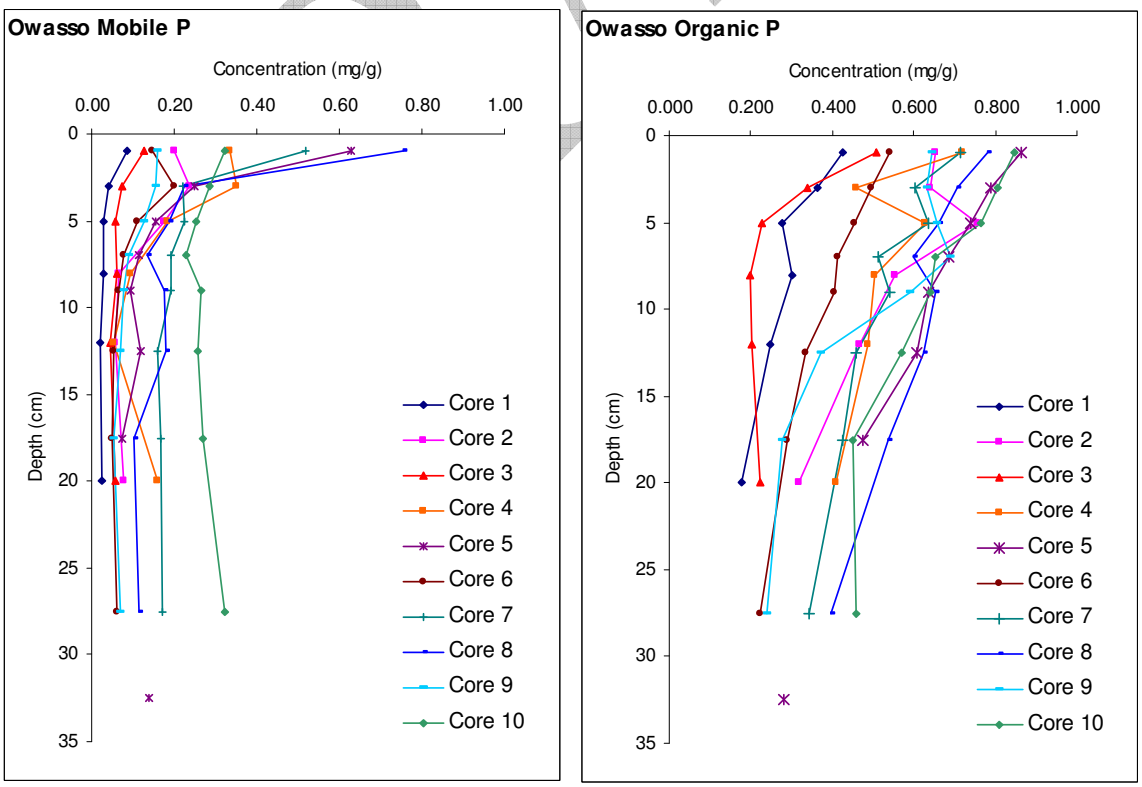
Sediment Investigation of Lake Owasso

Sediment Cores were collected in May of 2007 to determine sediment phosphorus concentrations that can lead to internal phosphorus loading in Lake Owasso. Phosphorus fractions were determined according to a modified version of Psenner et al. (1988) and internal loading estimates were calculated according to the method developed by Pilgrim et al. (2007). After laboratory analysis, sediment phosphorus concentrations were modeled to determine lake wide internal phosphorus loading rates using Geostatistical Analysis within the ArcMap GIS program. Simple core averages were used as well and the data are presented below.

Results

Ten sediment cores were collected from Lake Owasso and analyzed for mobile phosphorus (contributes directly to internal phosphorus loading) and organic bound phosphorus (Figure 1). Both mobile and organic bound phosphorus were elevated in the surficial sediment and concentrations (dry weight) decreased as sediment depth increased. Mobile phosphorus ranged from 0.08 mg/g to 0.75 mg/g and organic bound phosphorus ranged from 0.43 mg/g to 0.86 mg/g at the surface of the sediment cores. Based on the mobile phosphorus content of the sediment, internal phosphorus loading ranged from 0 mg/m^2/d in shallower areas (Core 1) and 2.9 mg/m^2/d in deeper areas of the lake (Core 8).

Figure 1. Sediment phosphorus concentrations (dry weight) in Lake Owasso.



Organic bound phosphorus was consistently higher than mobile phosphorus in all cores. This may indicate that available mobile phosphorus that is exported from the sediment during internal loading is used quickly by algae and/or plants. This is especially likely in shallower areas of the lake where water movement can move phosphorus released from the sediment to the surface water or algae are present near the sediment surface where sufficient light is available for growth. Over time, excess organic phosphorus in the upper part of the sediment will degrade and contribute to the mobile phosphorus pool which can lead to internal phosphorus loading.

Appendix N

BMP Cost Estimates

Cost Estimate – Endothall Treatments in Lake Owasso to Control Curlyleaf Pondweed

Item	Unit	Estimated Quantity	Unit Price*	Extension Per Year*	Extension 4 Years*
Mobilization (10%)	L.S.	1	$2,405	$2,405	$9,620
Endothall Application	Ac.	293	$325	$95,225	$380,900
Subtotal				$97,630	$390,520
Contingencies (10%)				$9,763	$39,052
Engineering & Administration (30%) (One Time Cost)				$29,289	$29,289
Total				$136,682	$458,861

*2008 dollars

Cost Estimate – Obtain MDNR Treatment Permit and Letter of Variance and Letters of Permission to Treat Within 150 Feet of Riparian Property Boundaries

Item	Unit	Estimated Quantity	Unit Price*	Extension Per Year*	Extension 4 Years*
Obtain Letter of Variance	L.S.	1	$500	$500	$2,000
Obtain Permit For Endothall Application	L.S	1	$1,000	$1,000	$4,000
Obtain Permission Letters From Riparian Owners	L.S	1	$500	$500	$500
Total				$2,000	$6,500

*2008 dollars

Cost Estimate - Monitoring, Analysis, and Reporting Cost Estimate – Aquatic Plant, Biomass, Turion, and Herbicide Residue

Item	Unit	Estimated Quantity	Unit Price*	Extension Per Year*	Extension 4 Years*
Aquatic Plant Monitoring	L.S.	1	$22,500	$22,500	$90,000
Biomass Monitoring	L.S	1	$4,000	$4,000	$16,000
Turion Monitoring	L.S	1	$1,300	$1,300	$5,200
Herbicide Residue Monitoring	L.S.	1	$5,000	$5,000	$20,000
Subtotal				$32,800	$131,200
Contingencies (10%)				$3,280	$13,120
Engineering and Administration (30%)				$9,840	$39,360
Total				$45,920	$183,680

*2008 dollars

Water Quality Monitoring in Central Park - East & West Wetlands and the Charlie Pond System

Item	Unit	Estimated Quantity	Unit Price[1]	Total Cost per Item[1]	Unit Price[2]	Total Cost per Item[2]	Comments
Field Time	Hours	80	$50.00	$4,000	$50.00	$4,000	Sampling every 2 weeks, May through Sept, 10 sampling events total, Assumes 8 hrs per sampling event (for all three locations)
Lab Analysis							
TP	Sample	30	$5.04	$151	$22.88	$686	1 grab sample per pond (3) per sampling event
TDP	Sample	30	$8.66	$260	$28.08	$842	1 grab sample per pond (3) per sampling event
Chla	Sample	30	$12.02	$361	$46.80	$1,404	1 grab sample per pond (3) per sampling event
TSS	Sample	30	$9.92	$298	$13.52	$406	1 grab sample per pond (3) per sampling event
Analysis of Lab Results and Brief Technical Memo Discussing Results	Hours	10	$100.00	$1,000	$100.00	$1,000	
Subtotal				**$6,069**		**$8,338**	
Contingencies (15%)				**$910**		**$1,251**	
Total Cost				**$6,980**		**$9,589**	

1 - Field Cost based on Barr Intern Rate; Based on 2009 Ramsey County Laboratory Costs
2 - Field Cost based on Barr Intern Rate; Laboratory Cost on 2008 Braun Intertec Laboratory Costs + 4%

Water Quality Monitoring in Shallow Area of Lake Owasso

Item	Unit	Estimated Quantity	Unit Price[1]	Total Cost per Item	Unit Price[2]	Total Cost per Item[2]	Comments
Field Time	Hours	7.5	$35.00	$263	$35.00	$263	Sampling every month, May through Sept, Assumes 1.5 hrs per sampling event (b/c Ramsey County will already be out on Lake Owasso for routine sampling at 5401)
Lab Analysis							
TP	Sample	20	$5.04	$101	$22.88	$458	Assumes 4 samples for profile for each sampling date
TDP	Sample	20	$8.66	$173	$28.08	$562	Assumes 4 samples for profile for each sampling date
Chla	Sample	5	$12.02	$60	$46.80	$234	Assumes 1 surface sample for each sampling date
Analysis of Lab Results and Brief Technical Memo Discussing Results	Hours	10	$100.00	$1,000	$100.00	$1,000	
Subtotal				**$1,597**		**$2,516**	
Contingencies (15%)				**$160**		**$252**	
Total Cost				**$1,756**		**$2,767**	

1 - Assumes minimal field time as Ramsey County will be collecting data at Site 5401 as part of its regular lake monitoring program; Based on 2009 Ramsey County Laboratory Costs
2 - Assumes minimal field time as Ramsey County will be collecting data at Site 5401 as part of its regular lake monitoring program; Based on 2008 Braun Intertec Laboratory Costs + 4%

Sediment Core Analysis - Cost Estimate

10 cores
Analyze for Mobile P, Organic P, Iron
Model/estimate internal P loading potential at each location

$7,900

Collection	Lab Cost	Data Analysis	Total
$2,800	$4,000	$1,100	$7,900

Cost Estimate – Alum Treatment

Item	Unit	Estimated Quantity	Unit Price*	Extension Per Year*
Mobilization (15%)	L.S.	1	$7,500	$7,500
Alum Application (One Time Cost)	Gal	116053	$1.30	$150,869
Subtotal				$158,369
Contingencies (10%)				$15,837
Engineering & Administration (15%) (One Time Cost)				$23,755
Total				$197,961

Estimated Cost Estimate for Infiltration of 0.5" Runoff from ALL Impervious Surfaces in the South and East Drainage Districts

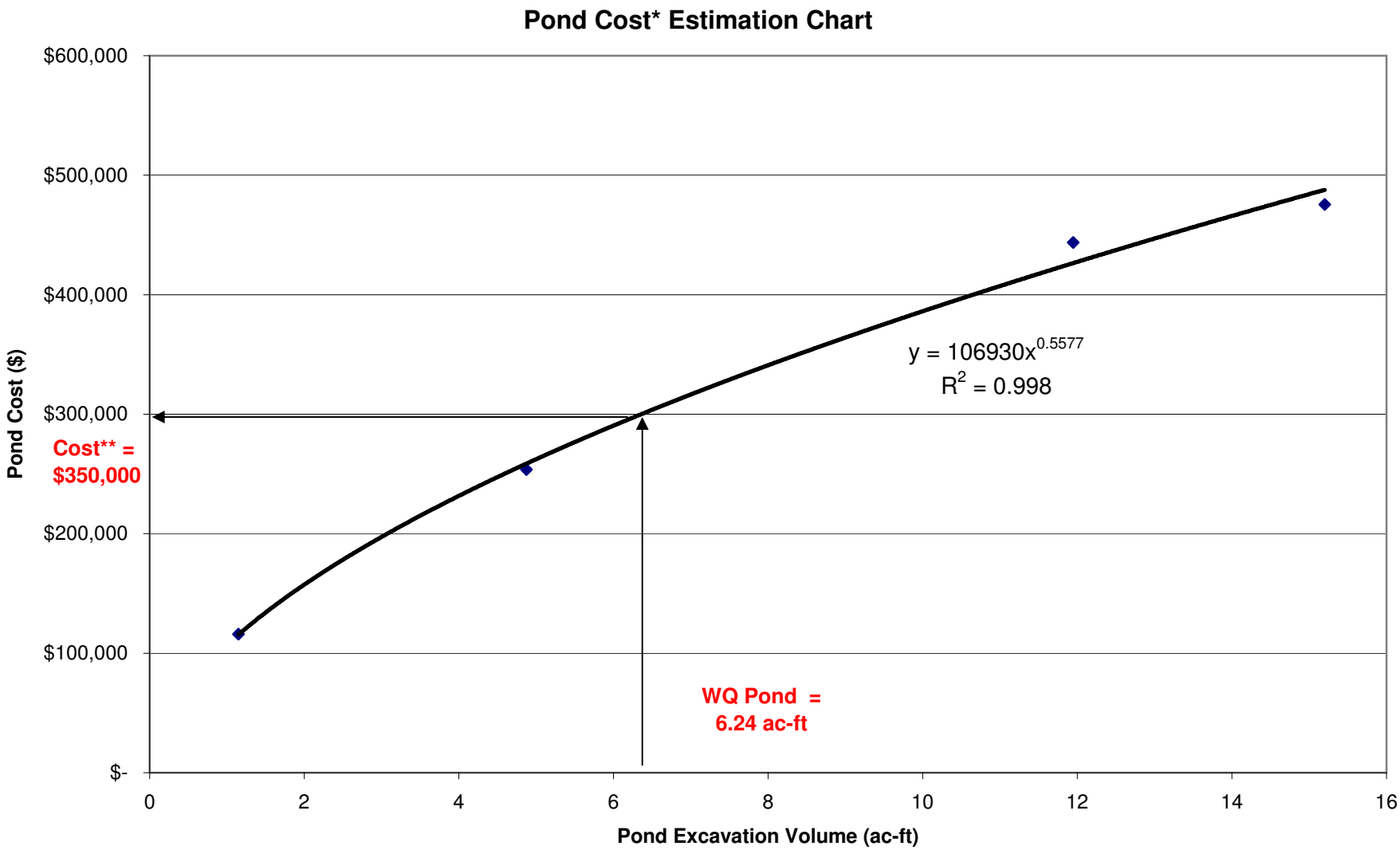
Subwatershed	Impervious Area (Ac)	0.5" Runoff Volume from Imperv Area (acre-ft)	Area of Infiltration BMP assuming 18" depth (acres)	Area of Infiltration BMP assuming 18" depth (square feet)	Unit Cost ($/sq ft)	Cost ($)
East Drainage District						
LO_E_1a	0.62	0.03	0.02	751	13	$9,767
LO_E_1b	2.80	0.12	0.08	3387	13	$44,034
LO_E_1c	0.31	0.01	0.01	376	13	$4,883
LO_E_1d	0.99	0.04	0.03	1197	13	$15,556
LO_E_1e	0.63	0.03	0.02	757	13	$9,842
LO_E_1f	22.64	0.94	0.63	27390	13	$356,076
LO_E_1g	0.36	0.01	0.01	432	13	$5,613
LO_E_1h	3.43	0.14	0.10	4149	13	$53,934
LO_E_1i	2.35	0.10	0.07	2838	13	$36,896
LO_E_1j	0.29	0.01	0.01	350	13	$4,552
LO_E_1k	2.06	0.09	0.06	2494	13	$32,427
South Drainage District						
LO_S_1	30.38	1.27	0.84	36764	13	$477,936
LO_S_10	1.28	0.05	0.04	1545	13	$20,089
LO_S_11	2.39	0.10	0.07	2887	13	$37,530
LO_S_12	5.08	0.21	0.14	6151	13	$79,959
LO_S_13	10.47	0.44	0.29	12669	13	$164,703
LO_S_2a	42.36	1.77	1.18	51257	13	$666,336
LO_S_2b	9.05	0.38	0.25	10954	13	$142,402
LO_S_2c	4.21	0.18	0.12	5099	13	$66,284
LO_S_3a	4.38	0.18	0.12	5295	13	$68,838
LO_S_3b	1.19	0.05	0.03	1437	13	$18,682
LO_S_4	10.58	0.44	0.29	12800	13	$166,401
LO_S_5	15.65	0.65	0.43	18935	13	$246,156
LO_S_6a	16.95	0.71	0.47	20507	13	$266,591
LO_S_6b	16.05	0.67	0.45	19425	13	$252,526
LO_S_7	9.03	0.38	0.25	10930	13	$142,095
LO_S_8	85.75	3.57	2.38	103753	13	$1,348,789
LO_S_9	2.19	0.09	0.06	2654	13	$34,503
					TOTAL COST	**$4,773,400**

Estimated Cost Estimate for Infiltration of 0.5" Runoff from Select Impervious Surfaces in the South and East Drainage Districts

Infiltration Area ID	Location Description	Subwatershed	Estimated BMP Watershed Area (Ac)	Fraction of Flow Diverted to Infiltration BMP	Watershed Impervious Fraction	Imperv Area Contributing to Infiltration BMPs (acres)	0.5" Runoff Volume from Impervious Surfaces (acre-ft)	Area of Infiltration BMP assuming 18" Depth (acres)	Area of Infiltration BMP assuming 18" Depth (sq ft)	Unit Cost ($/sq ft)	Cost ($)
A	Materion Park - On Southside of Pond	LO_S_2b	11.8	0.75	0.31	2.78	0.116	0.08	3361	13	$43,698
B	Open space in the Southwest Corner of Woodhill Drive and Western Ave N	LO_S_5	55.18	0.25	0.12	1.60	0.067	0.04	1936	13	$25,171
C	Northwest Corner of Rosedale Estates	LO_E_1f	34.6	0.75	0.23	6.03	0.251	0.17	7291	13	$94,783
D	Mapleview Park	LO_E_1d	7.1	0.75	0.10	0.54	0.022	0.01	648	13	$8,418
E	Private Parcel Along Southeast Corner of Ladyslipper Park	LO_E_1h	9.15	0.5	0.20	0.90	0.037	0.02	1088	13	$14,148
F	Private Parcel Along Northeast Corner of Ladyslipper Park	LO_E_1i	14.65	0.75	0.16	1.76	0.073	0.05	2127	13	$27,653
G	Central Park - North of Soccer Field	LO_S_2a	39.8	0.25	0.15	1.45	0.060	0.04	1751	13	$22,757
H	Central Park Elementary School Ballfields	LO_S_2a	34.04	0.25	0.23	1.96	0.082	0.05	2368	13	$30,788
I	Roseville High School - Playing Fields	LO_S_8	58.44	0.25	0.23	3.36	0.140	0.09	4066	13	$52,858
J	Central Park - Ballfields West of Bennett Lake	LO_S_6a/LO_S_7	67.1	0.25	0.15	2.52	0.105	0.07	3045	13	$39,581
K	Central Park - Ballfields South of Central Park - West Wetland	LO_S_1	31.4	0.5	0.12	1.87	0.078	0.05	2261	13	$29,388
										TOTAL COST	**$389,244**

Cost Estimate - Extended Detention in Bay South of Railroad Tracks in Lady Slipper Park
PRELIMINARY ENGINEERS ESTIMATE
Lake Owasso
Steel Sheet Pile Weir 3/19/2009

ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL COST
MOBILIZATION	L.S.	1		12000.00
CLEAR AND GRUB	L.S.	1	1200.00	1200.00
EROSION CONTRON ENTRANCE	EACH	1	2500.00	2500.00
SITE ACCESS	L.S.	1	3500.00	3500.00
GRADING	S.Y.	166	2.25	373.50
PZC-13 STEEL SHEET PILE	S.F.	420	30.00	12600.00
CONCRETE PILE CAP	L.S.	1	2500.00	4500.00
TOP SOIL BORROW	C.Y.	20	27.00	540.00
Mn/DOT CAT 3 EROSION CONTROL MAT	S.Y.	225	3.50	787.50
SEED NATIVE GRASSES	AC	0.05	5700.00	285.00
SILT FENCE	L.F.	65	3.50	227.50
FLOATATION SILTATION CURTAIN	L.F.	45	9.50	427.50
MISC. EROSION CONTROL	L.S.	1	1000.00	1000.00
			SUBTOTAL =	39941.00
ENGINEERING & DESIGN	L.S.	1	5000.00	5000.00
GEOTECHNICAL, SOIL BORING	L.S.	1	3500.00	3500.00
RAIL ROAD AND OTHER PERMITS	L.S.	1	2500.00	2500.00
CONSTRUCTION OBSERVATION	L.S.	1	4200.00	4200.00
			SUBTOTAL =	15200.00
			TOTAL =	$ 55,141.00



*Pond Cost are based on Actual 2005 Project Bid Tabs plus an additional 30% for Engineering, Design, Construction Observation & Admin and 15% Contingencies. This chart does EXCLUDE wetland restoration/mitigation costs

**Cost Adjusted to 2009 $ based on inflation of 4% per year