



Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org



Presentations to Standards Committee and GGLSA Members
July 13 and 14, 2007



Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

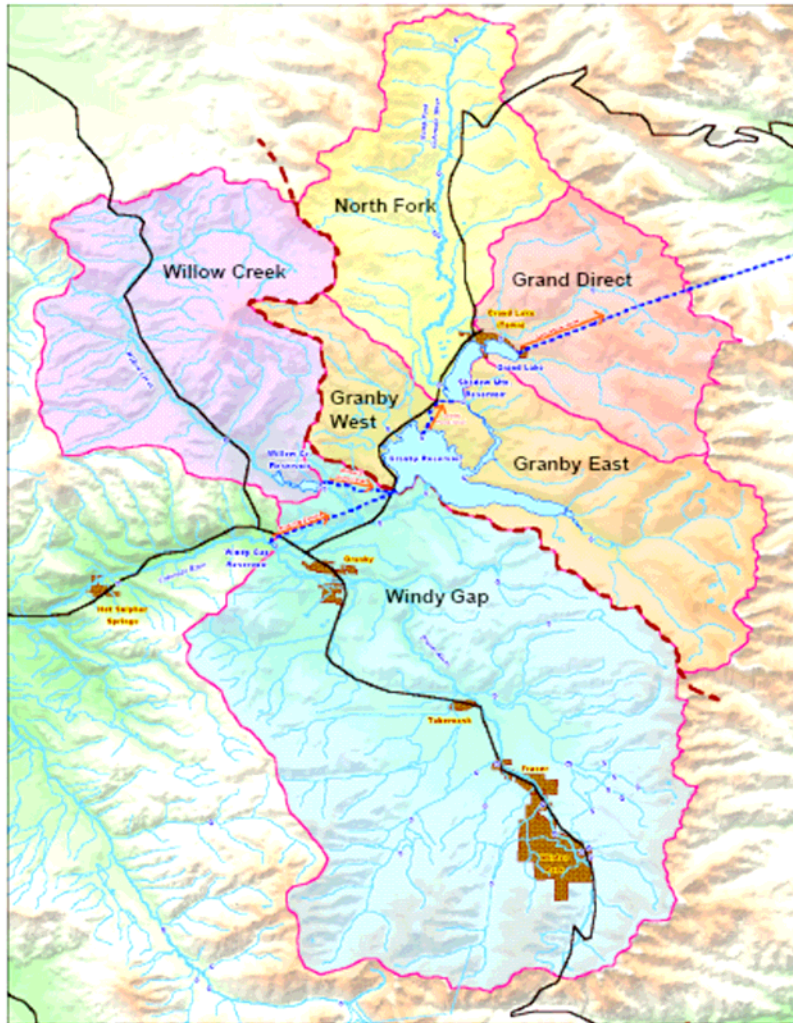


Figure 2.1: Three Lakes Basin Map

Presentations to Standards Committee and GGLSA Members
July 13 and 14, 2007



Greater Grand Lake Shoreline Association
 Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

Three Lakes Clean Lakes Watershed Assessment Draft Report

July 23, 2003

Submitted To:
 The Three Lakes Technical Advisory Committee

Submitted By:
 Hydrosphere Resource Consultants

Table 8.2 Summary of 10-year Simulations

METRIC	Units	Granby Reservoir			Shadow Mountain Reservoir			Grand Lake		
		2001-2002	Existing ¹	Future ²	2001-2002	Existing ¹	Future ²	2001-2002	Existing ¹	Future ²
Chlorophyll a (mean)	ug/l	2.8	3.6	3.6	4.3	4.8	4.8	6.7	6.7	6.7
Chlorophyll a (peak)	ug/l	8	10.7	10.5	9.1	11.9	11.5	10.7	12.2	12
Hypolimnetic DO (mean)	mg/l	5.9	6	6	----	----	----	5.9	5.8	5.8
Minimum deep-water DO	mg/l	2	2.4	2.4	----	----	----	4.6	4.5	4.5
TN (epi - mean)	ug/l	175	255	246	245	245	238	198	248	242
TN (hypo - mean)	ug/l	179	268	261	----	----	----	239	302	296
TP (epi - mean)	ug/l	9.9	14.8	19.8	13.8	13.8	17.4	7.2	11.3	13.8
TP (hypo - mean)	ug/l	10.8	16.3	20.7	----	----	----	9	14.3	17
Secchi Depth (mean)	m	3.6	3.2	3.2	1.9	1.9	1.9	2.9	3	2.9
Secchi Depth (min)	m	1.6	1.3	1.3	0.8	0.8	0.8	2	1.8	1.8
Secchi Depth (max)	m	4.9	4.5	4.5	3.3	3.3	3.3	5.2	4.8	4.9

¹ Existing LandUse and Demands, WY75-WY84 Hydrology

² Existing LandUse, Future Demands, Denver's North End, WY75-WY84 Hydrology

Hydrosphere concludes that over the next ten years:

- Peak Chlorophyll a will increase by 20%
- Total Nitrogen will increase by 20%
- Total Phosphorus will increase by 100%

Presentations to Standards Committee and GGLSA Members
 July 13 and 14, 2007



Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

Potential Impact on Trophic State and Algal
Standing Crop of the Three Lakes System
due to Windy Gap Diversions

J. W. Yahnke
Natural Resource Specialist
Water and Power Resources Service
LM - Region
Denver, Colorado

February 1981

Supporting Report to C-BT/Windy Gap EIS

EPA (1977b) found both Grand Lake and Shadow Mountain Reservoir were phosphorus limited. In evaluating the trophic status of the two lakes, the EPA evaluated the areal phosphorus loading against the "permissible" and "dangerous" loadings, calculated in accordance with the Vollenweider model (Vollenweider and Dillon, 1974). However, in calculating the loading functions, the combined mean depths, based on their combined areas and volumes, and the mean hydraulic retention time of the combined lakes were used. The resulting "permissible" and "dangerous" loadings were 0.70 and 1.40 gP/m²/yr. The calculated loading was 1.38 gP/m²/yr. This indicates that, combined, the lakes are mesotrophic, but just barely below the eutrophic loading. Given the proximity of this calculated loading to the eutrophic boundary load and the history of nuisance algal blooms in the Three Lakes, there is an obvious potential for future problems if nutrient loadings are increased.



Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

1998
Three Lakes Water Quality Assessment

Robert Ray

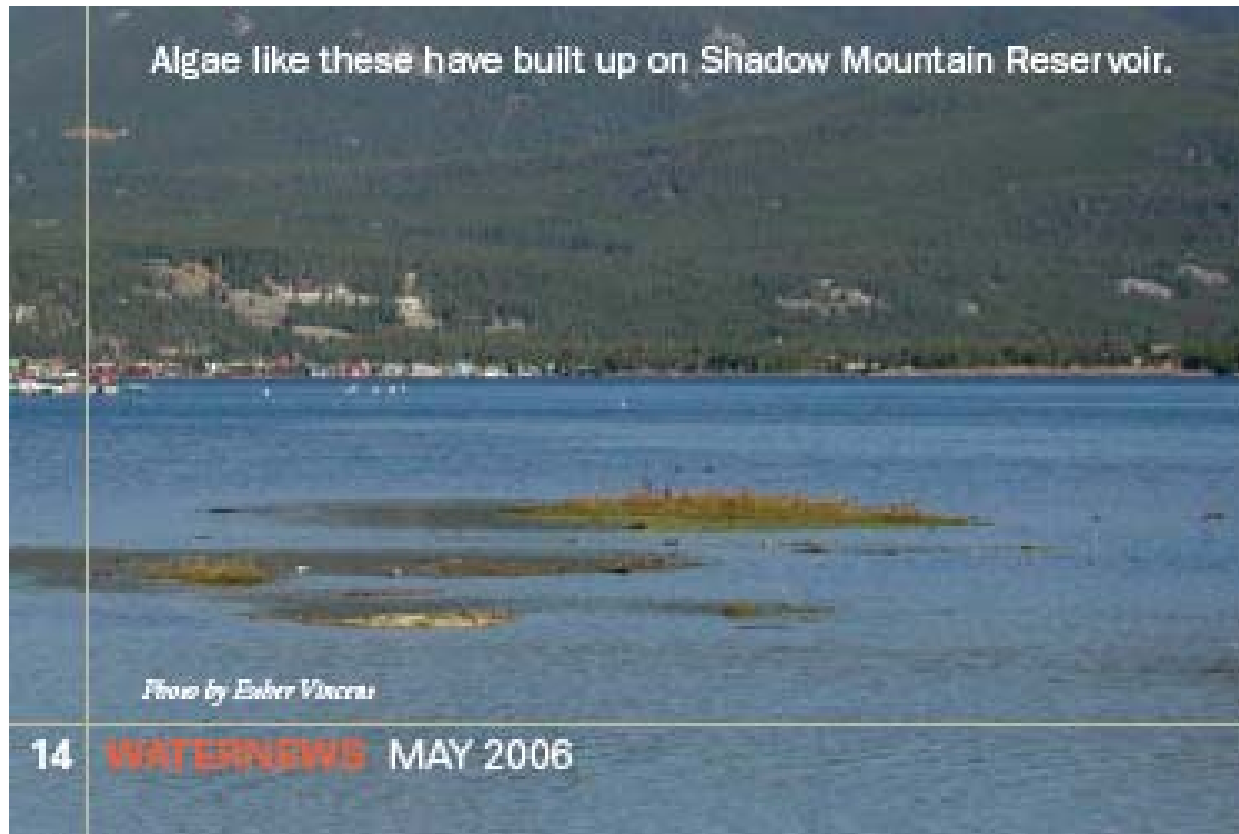
Northwest Colorado Council of Governments
Water Quality Program
September, 1998

Chlorophyll a (a measure of algae biomass) in Grand Lake appears to be approaching a level where algae blooms may become more common. Methods for limiting phosphorus inputs to Grand Lake would be appropriate.

Based on the EPA/NES criteria, Grand Lake should be considered a mesotrophic lake. The data is not consistent enough to determine trends, however, the chlorophyll a data should be of concern to those who value "blue water". Work on other lakes has indicated that the frequency of algae blooms (defined as levels of chlorophyll a above 30 ug/l begins to increase after reaching a season mean of 10 ug/l (Welch, 1989).



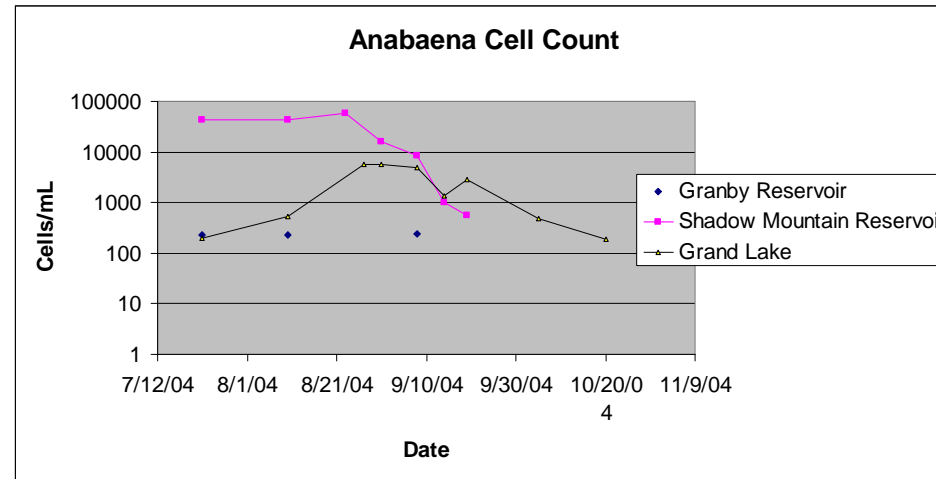
Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org



Presentations to Standards Committee and GGLSA Members
July 13 and 14, 2007



Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org



Summary Table of WHO Guidelines for Cyanobacteria Levels in Water

Risk of adverse health effects	Level	Recommended Action
LOW	20,000 cells/mL	At this level, the WHO states that providing information to bathers is considered sufficient.
MODERATE	100,000 cells/mL	The WHO states that interventions such as restricting bathing at beaches and public education campaigns may be appropriate when cyanobacterial counts are at this level.
HIGH	Presence of cyanobacterial scum at bathing areas	The WHO reports that animal poisonings and human illnesses related to cyanobacteria are usually accompanied by the presence of scum material at the water surface, and that ongoing observation of bathing beaches is necessary to assess the existence of high-risk exposures. INDIVIDUALS SHOULD RESPECT PUBLIC BEACH CLOSURES AS THEY INDICATE A SIGNIFICANT HEALTH RISK.

“Consumption of large amounts of these toxins by animals or humans can result in muscle cramps, twitching, paralysis and cardiac or respiratory failure. Symptoms can appear within a few hours of exposure, but may take up to 36 hours to manifest.”

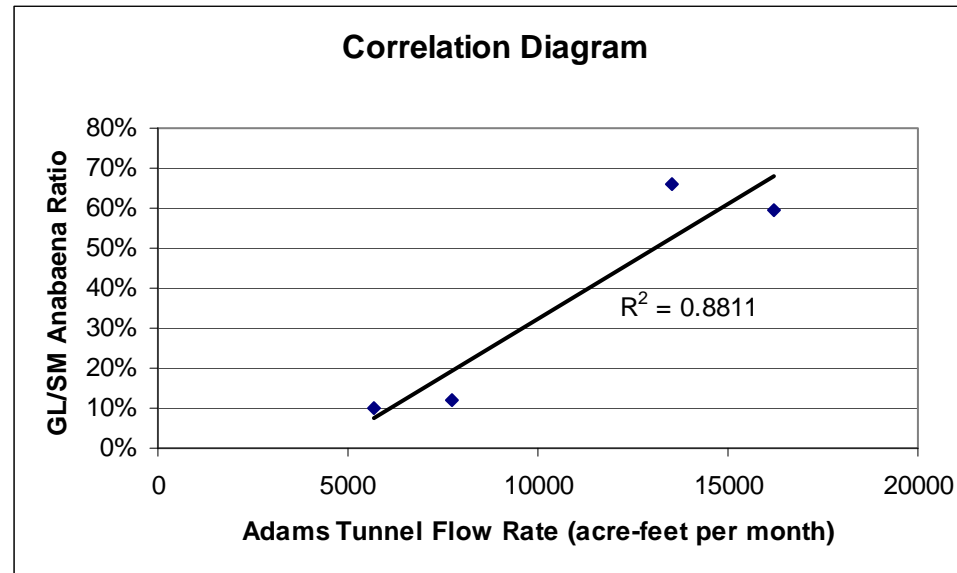
<http://www.glerl.noaa.gov/res/Centers/HumanHealth/hab/EventResponse/Toxins.html>



Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

<u>Anabaena count¹ (cells/ml)</u>	<u>Aug 2004</u>	<u>Sept 2004</u>	<u>Aug 2005</u>	<u>Sept 2005</u>
Shadow Mountain Res.	57000	8300	29376	32436
Grand Lake	5763	4921	3536	21471
Ratio (SM / GL)	10.1%	59.3%	12.0%	66.2%

<u>Monthly flow² (acre-feet)</u>	<u>Aug 2004</u>	<u>Sept 2004</u>	<u>Aug 2005</u>	<u>Sept 2005</u>
Adams Tunnel volume	5664	16193	7725	13515

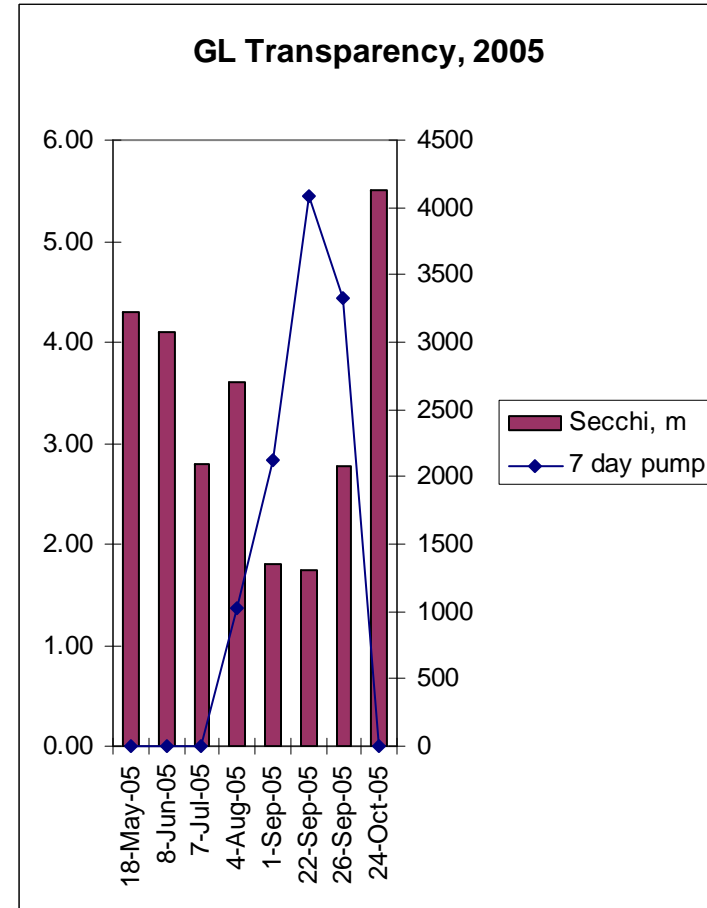
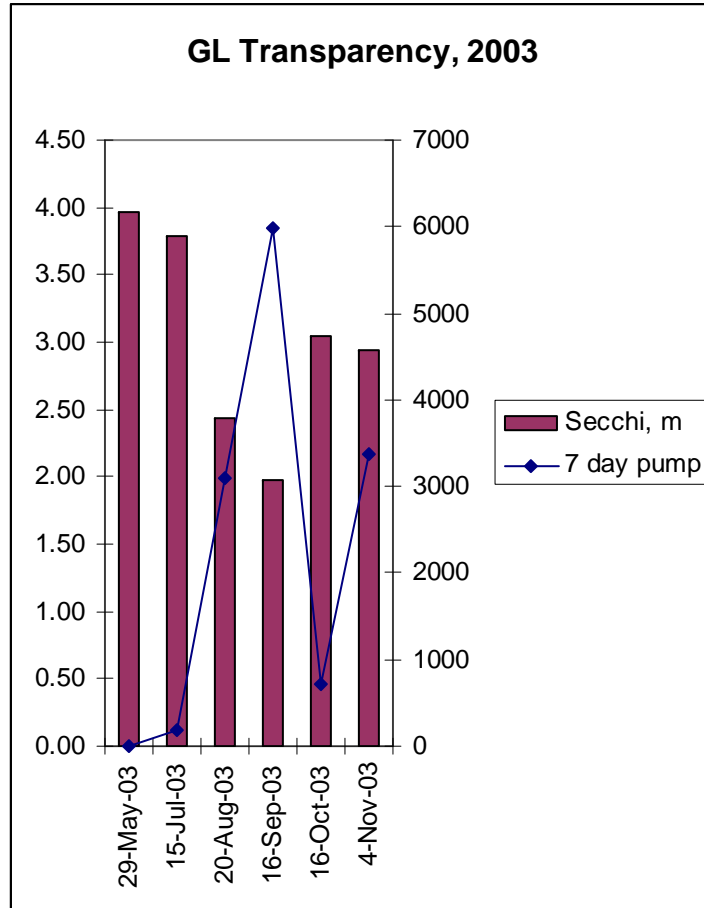


- 1) Data from GCWIN
- 2) State of Colorado Decision Support System (www.cdss.co.us)



Greater Grand Lake Shoreline Association
 Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

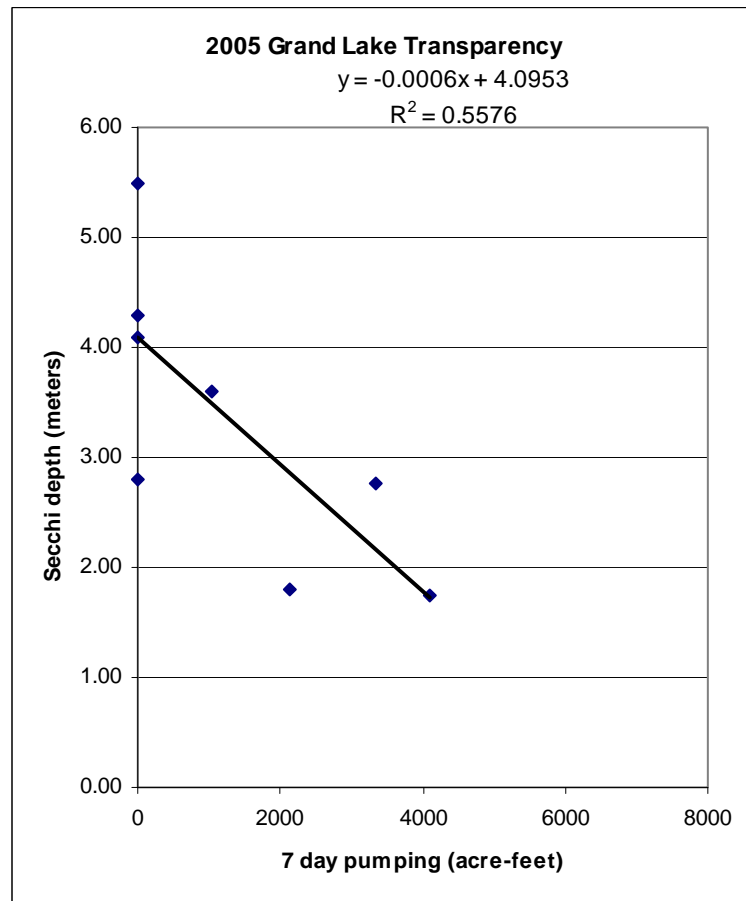
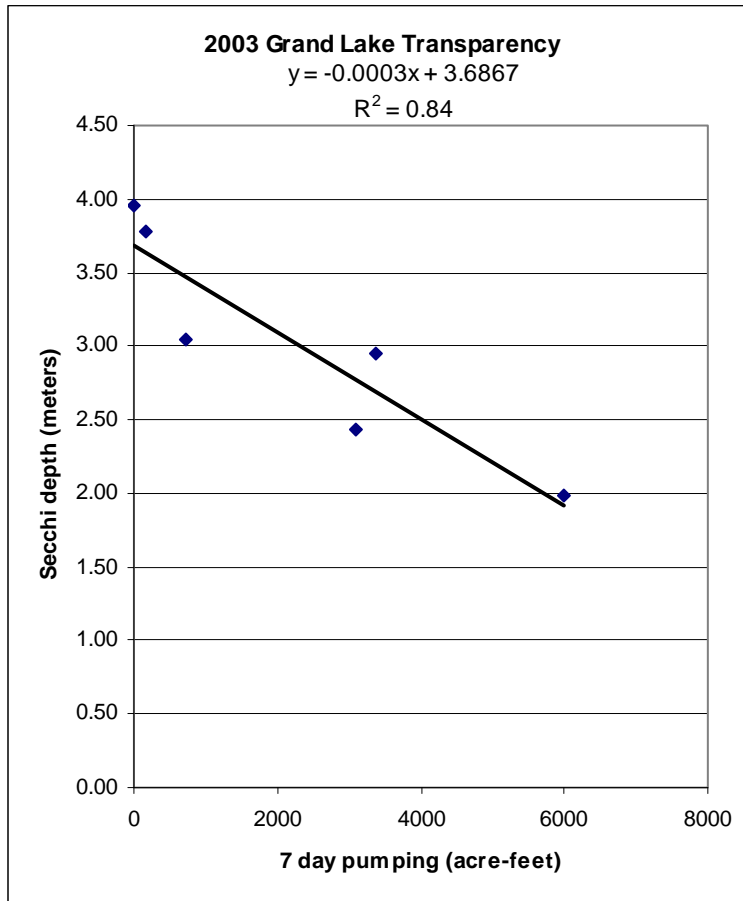
Data provided by the Colorado Department of Public Health and Environment
 (2003 Secchi data from USGS; 2005 data from USBR; Pumping data from USBR)





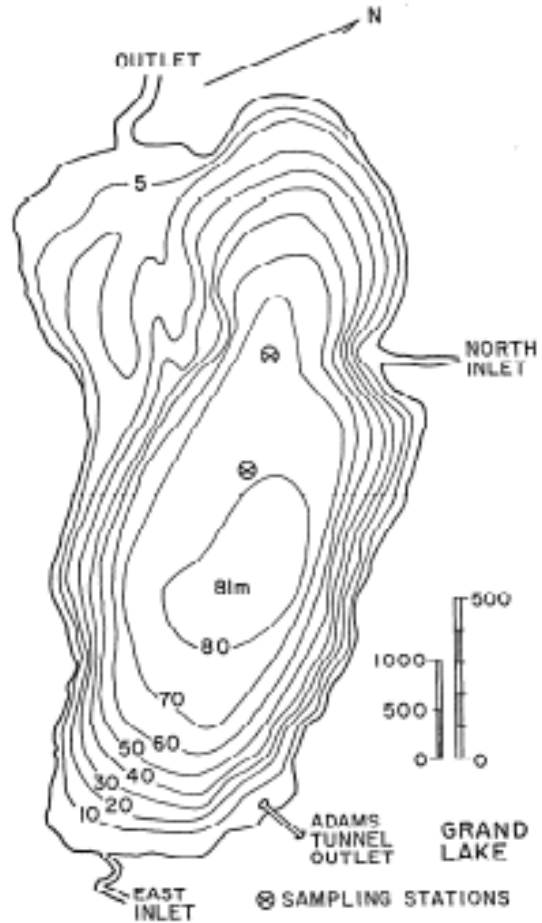
Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

Data provided by the Colorado Department of Public Health and Environment

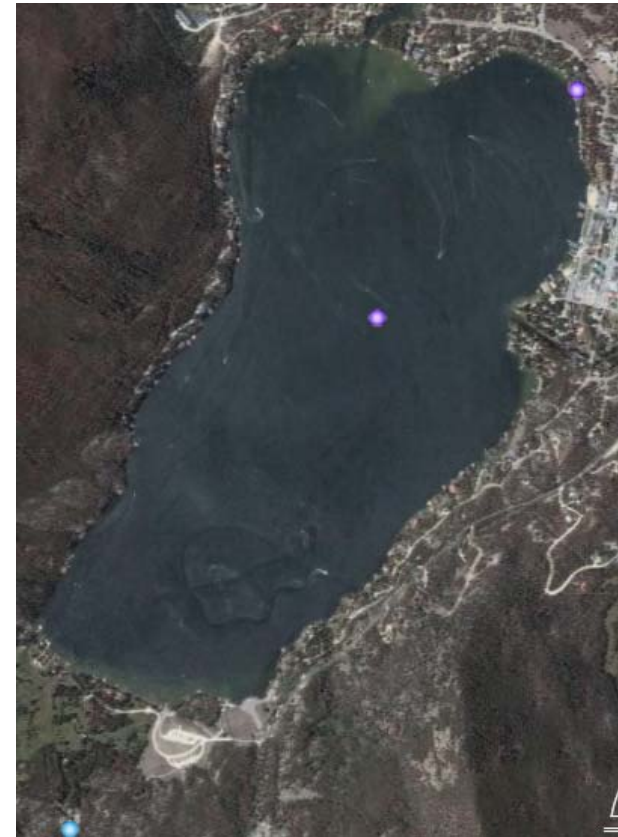




Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org



Note silting on both sides of the "Outlet"



Comparative Limnology of Colorado-Big Thompson Project
Rivers and Lake, Wesley C. Nelson, CO DOW, 1971

Google Earth, Grand Lake circa 2006



Greater Grand Lake Shoreline Association
Box 1096, Grand Lake, Colorado 80447
www.gglsa.org

Colorado-Big Thompson Project Authorization

U.S. Senate Document 80 (1937):

“To **preserve** the fishing and recreational facilities and the scenic attractions of Grand Lake, the Colorado River, and the Rocky Mountain National Park”.

United States Department of the Interior

Bureau of Reclamation Report on Plans and Cost Estimate

Colorado-Big Thompson Project, September 1937, Mills Bunger, p. 92:

“The approach to the western gateway of Rocky Mountain National Park will be along the shores of Shadow Mountain Lake and a view of **clear water...**”



Contrast this to 9.2 Meter transparency measured by Prof. Robt. Pennak in 1941

9.2 Meters should be our goal, if we believe in preserving clear water...

Presentations to Standards Committee and GGLSA Members
July 13 and 14, 2007