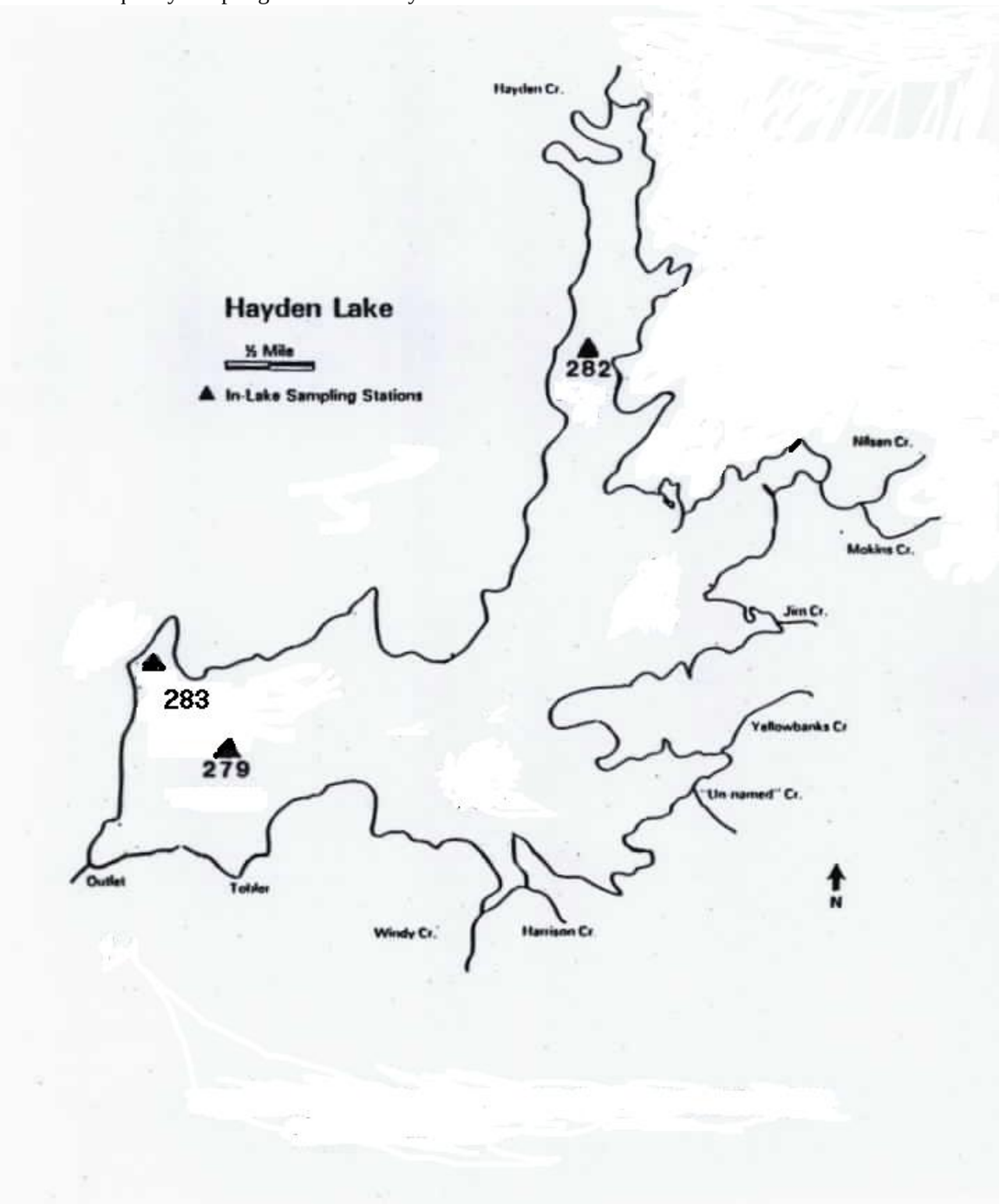
Draft Hayden Lake Water Quality Report – 2005

Summary: Based on Mid-Lake, Bervin Bay and Northern Arm sampling stations the water quality of Hayden Lake remains good. Lake clarity, total phosphorous, chlorophyll, and dissolved oxygen measurements provided values in the range of high water quality. However, total phosphorous has increased from values measured in 2004 and remains above the goal of the Hayden Lake Management Plan and federally required levels determined to fully protect water quality. The Forest Service and DEQ are working jointly to measure the amount of phosphorous entering the lake from its primary tributary, Hayden Creek. For the first time this year, continuous real-time data were collected along transects between the open lake and selected bays. As these measurements are made in subsequent years and compared, a more sensitive measure of the overall health of the lake should emerge.

Introduction: Assessment of Hayden Lake's water quality is based on three separate approaches. The water quality is assessed at three stations on the lake: Mid-Lake (279), Bervin Bay (283), and the Northern Arm's deep area (282) (Figure 1). Water quality is assessed at these stations based on four measurements. Clarity is the depth to which a fixed object can be seen in the water column. Total phosphorous is the key plant growth nutrient that can cause algae to multiply in the water column. Chlorophyll is a measure of the relative amount of algae growing in the water column. Dissolved oxygen is required by fish and other aquatic life to survive. An increase in phosphorous can cause increasing algae growth, resulting in reduction of the clarity of the water. Dissolved oxygen concentration declines as the algae decay. The second approach is the measurement of the load of total phosphorous entering the lake through its primary tributary, Hayden Creek. The final approach is to assess the key indicator of algae growth (chlorophyll) across transects from the open mid-lake waters into key bays where algal growth is known to occur naturally at higher levels. The change in the chlorophyll concentrations over the years and the nature of that change is the most sensitive measure of the lake's health.

Techniques: Water quality data were collected at the three stations five times during the period from late May to late October. Physical measurements (clarity, temperature dissolved oxygen) were completed on site, while samples from the upper water column (upper 45 feet) were collected and integrated for analysis of total phosphorous and chlorophyll. The Forest Service measured the discharge of water into the lake from Hayden Creek at a stream gage located near Forest Road 206 Bridge. The DEQ measured total phosphorous at a nearby gage. The total phosphorous load entering the lake from its largest tributary can be calculated in pounds per unit time from these data. The level of chlorophyll was measured in real time based on fluorescence of chlorophyll during early September, when the water column of the lake is most stable. Transect measurements were recorded between the mid-lake area and the upper end of the northern arm (Sportsman's Access) and from the mid-lake into Bervin Bay. All measurements were linked to global position for the most exact comparison to subsequent transects collected in the coming years. Water samples were collected at specific transect locations for chlorophyll analysis to calibrate results.

Figure 1: Approximate locations of Mid-Lake (279), Bervin Bay (283) and Northern Arm (282) water quality sampling stations on Hayden Lake.



Note: Adapted from Soltero et.al. 1986. Water Quality Assessment of Hayden Lake, Idaho. Eastern Washington University, Department of Biology, Cheney WA 99004. p.10.

2005 Results: The average, maximum and minimum values for clarity, total phosphorous, chlorophyll and dissolved oxygen for the three stations are provided in Table 1.

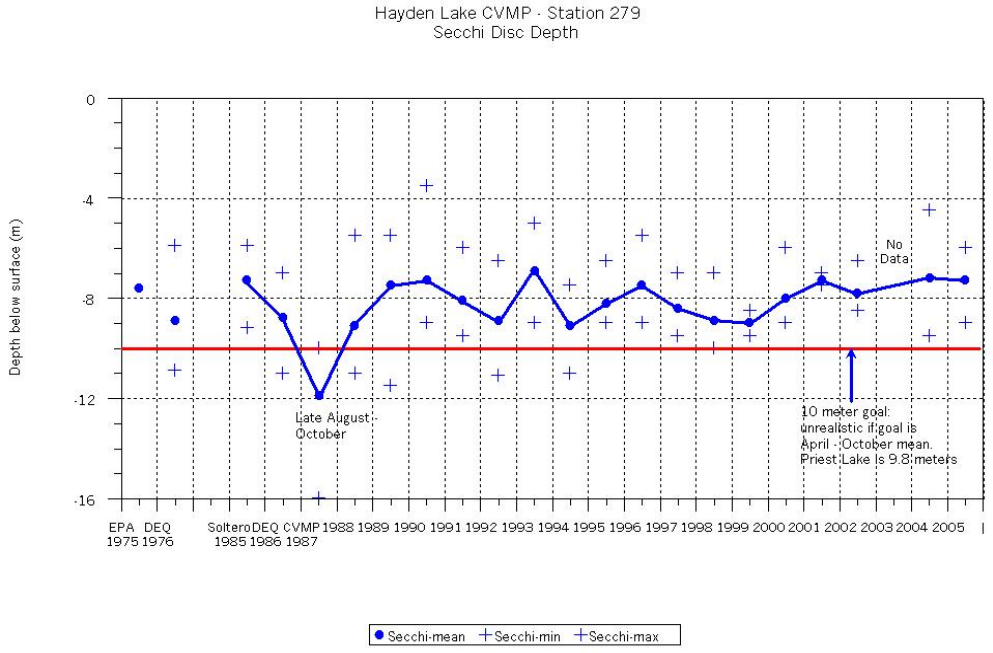
Table 1: Average, maximum and minimum clarity, total phosphorous, chlorophyll a and dissolved oxygen for the Mid-Lake, Bervin Bay and Northern Arm Stations of Hayden Lake.

Water Quality Parameter	Mid-Lake (279)			Bervin Bay (283)			Northern Arm (282)		
	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min
Clarity (feet)	23.9	29.5	19.7	25.6	29.5	20.7	22.6	29.8	16.4
Total Phosphorous (ug/L)	7.4	10.0	4.0	6.0	9.0	3.0	6.0	9.0	3.0
Chlorophyll a (ug/L)	1.9	2.2	1.5	1.4	1.7	1.1	1.4	1.7	1.1
Dissolved Oxygen (upper column) (mg/L)	10.6	11.3	10.2	10.1	11.2	9.5	10.1	11.2	9.5
Dissolved Oxygen (lower column) (mg/L)	10.3	11.2	9.4	11.6*	12.2	11.0	11.6*	12.2	11.0

Note: ug/L – micrograms per liter of water or parts per billion; mg/L – milligrams per liter of water or parts per million; * - near bottom, because station too shallow for stratified upper, warm water and lower cold water.

The averages for the three key measurements, clarity, total phosphorous and chlorophyll for the mid –lake station are plotted with averages from previous years in figures 2 – 4.

Figure 2: Average, maximum and minimum clarity measured as Secchi depth in meters from 1985 to 2005



Note: 1 meter equals 3.28 feet.

Figure 3: Average, maximum and minimum total phosphorous measured as micrograms per liter (parts per billion) from 1985 to 2005

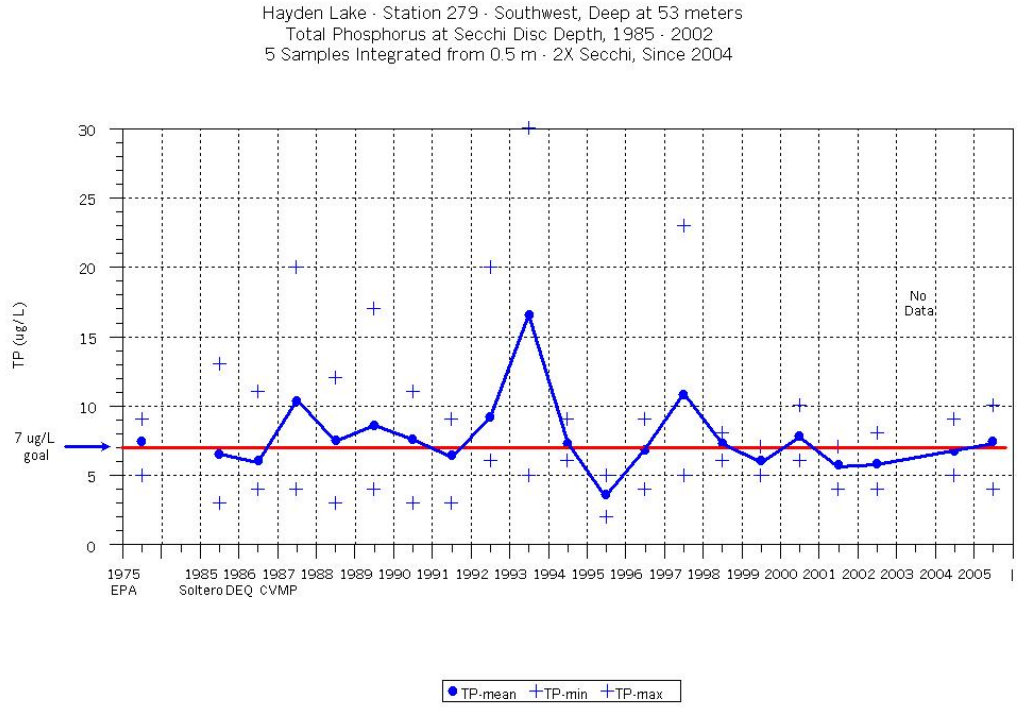
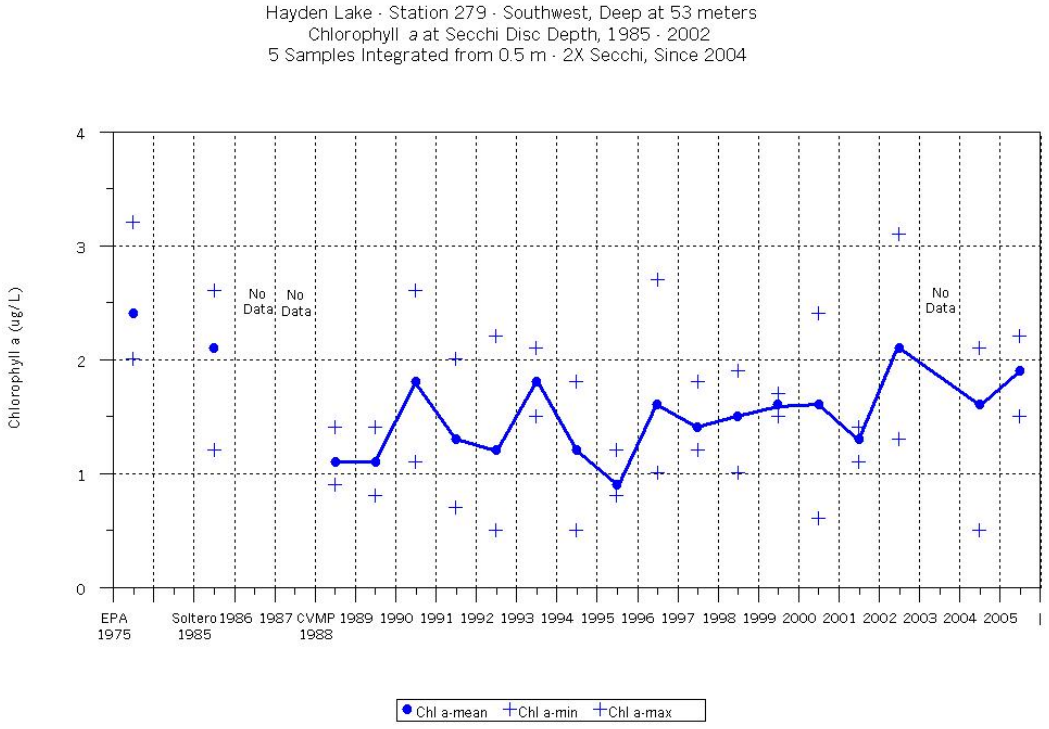


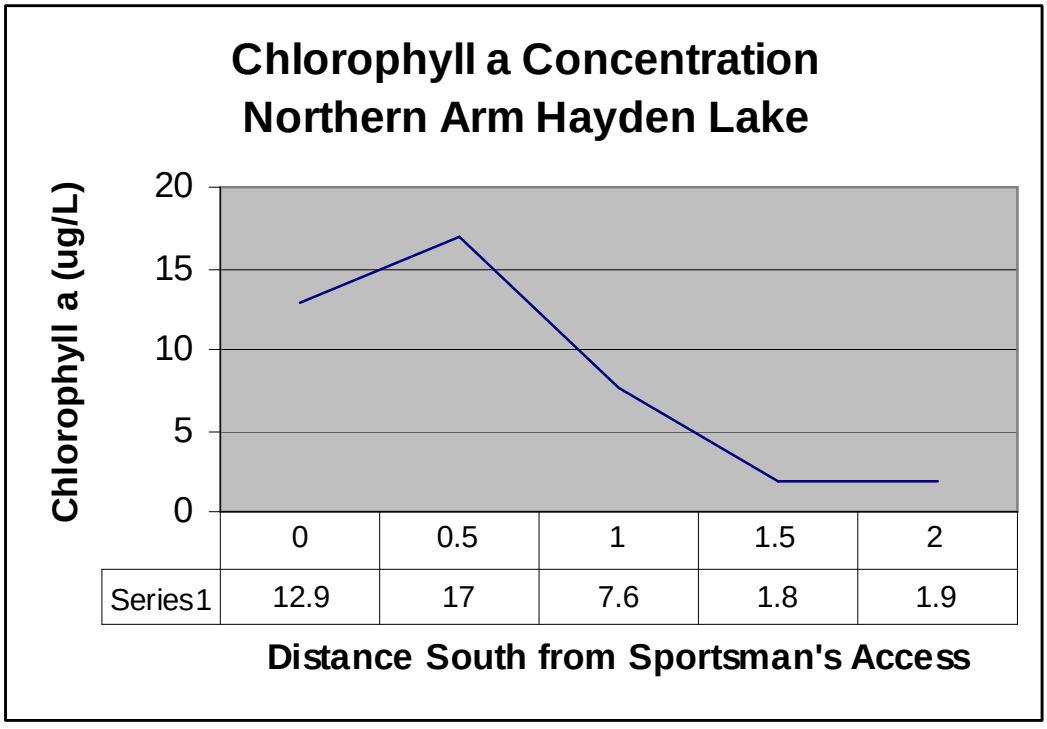
Figure 4: Average, maximum and minimum chlorophyll a measured as micrograms per liter (parts per billion) from 1985 to 2005



Data on discharge and phosphorous content of Hayden Creek were collected by the Forest Service and DEQ from spring 2005 to date. These data have not been compiled nor have phosphorous loads to the lake been calculated.

During late August and early September, the water column of the lake is stratified between warm water on the surface and cold water at depth. During this period precipitation is at a minimum and for this reason, discharge into the lake is at a low point. Weather is typically warm, calm and stable. The result of these conditions is a stable water column in the lake and typically the highest level of algae abundance. Since the lakes conditions are at maximum stability, the most repeatable results from year to year should be possible. During this period (September 2nd), transects were made from the mid-lake area off Mokins Bay into the northern arm of the lake towards Sportsman's Access and from the mid-lake area off Bervin Bay into Bervin Bay. Along these transects, the fluorescence of chlorophyll was measured in real time and the data was linked to the global position at which it was collected. It is expected that chlorophyll concentration, as measured as its fluorescence property will increase as a more nutrient rich area of the lake is entered. An example is provided by chlorophyll data collected in 2004 across the northern arm of Hayden Lake (Figure 5). These data were collected from individual sites, while the data collected in 2005 was collected continuously across the chlorophyll "gradient." Similar transect data collected over the years should indicate any changing condition in the lake for better or for worse as it develops. These data will allow for a timely response to deteriorating water quality conditions.

Figure 5: Chlorophyll a content of the water column at individual locations on a transect between the mid-lake area off Mokins Bay and Sportsman's Access.



Discussion: Based on the Hayden Lake monitoring station data collected during 2005, the lakes clarity remains high with peak values of 9 meters or 29.5 feet. Chlorophyll levels at the mid-lake, Bervin Bay and Northern Arm stations are typical of a lake with low available phosphorous concentrations and low algae growth. Total phosphorous concentrations have moved above the goal for the lake set by the lake management plan and federally required levels determined to fully protect water quality. The ten year average has not met the 7 ug/L total phosphorous goal. Dissolved oxygen throughout the water column at all sampled locations was well above the minimum state standard of 6 mg/L.

Water quality station data do not measure the amount of phosphorous entering the lake. The Forest Service and DEQ are collecting the data that will make these estimates possible on a yearly basis. Water quality station data are not the most sensitive indicator of changes occurring in the lake water quality. Since bays, and especially the Northern Arm of Hayden Lake that was a marsh prior to construction of the outlet dike, have higher algae growth (Figure 5), a change in the level of algae growth along the transect from the mid-lake area towards Sportsman's Access will be a sensitive indicator of the improvement or decline of lake water quality. The initial year of relative algae growth data collection in real time and at known global position was completed. Additional collection of these data will be required in successive years to scientifically assess any change in water quality status.

Final Note: Citizen's volunteer monitoring of Hayden Lake water quality is conducted from May through October by the Hayden Lake Watershed Association in cooperation with the Idaho Department of Environmental Quality. If you would like to participate in a monitoring activity to gain a better appreciation of how measurements are made, please contact Geoff Harvey at ziggys@icehouse.net or 208-762-1246. Participation is limited to space available on the boat.