EXECUTIVE SUMMARY

The long-term data set collected on the Lake Tahoe ecosystem by the University of California, Davis, and its research collaborators is an invaluable tool for understanding ecosystem function and change. It has become essential for responsible management by public agencies tasked with restoring and managing the Tahoe ecosystem, in part because it provides a basis for monitoring of progress toward reaching Tahoe's restoration goals and desired conditions.

This annual *Tahoe: State of the Lake Report* presents data from 2010 in the context of the long-term record. While the focus is on data collected as part of our ongoing, decades-long, long-term measurement programs, this year we have also included several detailed sections on lake clarity, trophic status and progress on the efforts to control Asian clams. Last year's report provided similar detailed information on the expected effects of climate change in the Lake Tahoe Basin during the 21st Century on meteorology, hydrology, sediment and nutrient loading, BMP capabilities, lake mixing and downstream water supply.

This year's report also includes data about changes in the algae composition and concentration, lake clarity, and the current effects of climate change on precipitation, lake water temperature and density stratification. The UC Davis Tahoe Environmental Research Center (TERC) has developed sophisticated computer models that help scientists predict and understand how Lake Tahoe's ecosystem behaves. Long-term data sets are essential to refine the accuracy of those models and to develop new models as knowledge increases and new challenges arise. In times of rapid change, reliable predictive models are indispensable tools for Lake Tahoe Basin resource managers.

This report is available on the UC Davis Tahoe Environmental Research Center website (http://terc.ucdavis.edu).

In many respects 2010 was an average year for Lake Tahoe. From the point of view of weather, precipitation and air temperature were very close to average. More of the precipitation occurred as snow than has been the trend lately, and the spring snowmelt timing was relatively late.

Lake level was very low at the beginning of 2010, but by the end of the year it had risen by over 22 inches. The average surface water temperatures fell from the levels of a few years ago, even in July, the warmest month at Lake Tahoe. As a result, the density stratification of the surface waters, while higher than it had been ten or twenty years ago, was significantly lower than last year. A factor similar to last year was the depth of mixing. This year it only extended to 550 feet, a far cry from the complete mixing that homogenizes water down the entire 1645-foot depth of the lake.

Despite these seemingly "normal" appearances, Lake Tahoe was very different in 2010. The factor that was most different was its famed clarity. The annual

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[1]*"Previous year" for some parameters means data collated in terms of the water year, which runs from October 1 through September 30; for other parameters, it means data for the calendar year, January 1 through December 31. Therefore, for this 2011 report, water year data are from Oct. 1, 2009 through Sept. 30, 2010. Calendar year data are from Jan. 1, 2010 through Dec. 31, 2010.*

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average Secchi depth in Lake Tahoe decreased in 2010 by 3.7 feet from last year's value. Such a large interannual rate of change is not remarkable on its own, although the low clarity is unusual. Analysis of the data has shown that underlying the long-term trend in the annual average Secchi depth includes both a general improvement in winter clarity and a continued decline in summer clarity. The annual average is a combination of both these factors.

The improvement in winter clarity may be due to recent efforts to reduce urban stormwater flows to the lake. However, an independent, comprehensive urban stormwater monitoring program is needed to establish reliable data to substantiate this hypothesis. The decline in summer clarity may be related to the impacts of climate change. Stabilizing of the water column is producing conditions that strongly favor *Cyclotella*, a tiny (4-10 micron) diatom-algae cell. Numbers of *Cyclotella* have grown exponentially in the last four years. This year in particular they were concentrated very close to the surface, thereby having an unusually large impact on clarity. These small cells strongly scatter light, producing lower Secchi disk values. While some of the conclusions presented herein are still working hypotheses, they serve to remind us of the importance of controlling both inorganic particles and nutrients to Lake Tahoe.

For the first time, clarity data derived from remote sensing are presented. Unlike the regular clarity measurements, remotely sensed data are available over the entire lake. Of particular interest is clarity in the nearshore (one mile or less out into the Lake). The remotely sensed clarity data indicates that clarity on the eastern shore is significantly lower than the west shore for most of the year. It also shows that lake-wide, clarity is typically better at a distance of one mile offshore than at 0.5 miles offshore, highlighting the importance of managing nearshore water quality. This conclusion is based on eight years of data, and is an important new finding. Differences are currently being studied, but it appears to be closely linked to the patterns of water movements around the lake. While land use activities, resource management activities and policy can be controlled to conform to geopolitical boundaries, the waters of Lake Tahoe are not constrained by these human boundaries. What happens in the waters of Lake Tahoe is a direct reflection of activities in both states. If a concrete example of why Lake Tahoe needs to be managed jointly by the two states is needed, then this is one.