SCOPE OF WORK

Lake Tahoe Basin Special Framework Groundwater Study

Lake Tahoe Basin, California and Nevada

1.0 INTRODUCTION

1.1 Scope of Project

The U.S. Army Corps of Engineers, Environmental Design Section (EDS) will conduct the Lake Tahoe Basin Special Framework Groundwater Study. This Scope of Work (SOW) describes the tasks scheduled for accomplishment through June 2003. The goal of this study is to estimate nutrient loading (phosphorus and nitrogen) to Lake Tahoe via groundwater, determine known and potential nutrient sources, and recommend potential nutrient reduction alternatives. This information will be used by the Corps to determine potential projects that could be executed to reduce the nutrient loading to the lake from groundwater, by the Tahoe Regional Planning Agency (TRPA) to meet its management goals and by the Lahontan Regional Water Quality Control Board to determine Total Maximum Daily Loads (TMDLs). This study will increase our understanding of nutrient cycling in the basin and provide revised estimates of nutrient contributions through the groundwater system that are a component of the eutrophication processes reducing lake clarity.

2.0 Site Background

Lake Tahoe is a 191 square mile lake located in a fault bounded basin on the border of California and Nevada between the Sierra Nevada and Carson Mountain ranges. Lake clarity has been degrading in Lake Tahoe as documented over the last 30 years. This decrease in clarity has been attributed to accelerated eutrophication due to an increase in nutrients being discharged into the lake (Thodal 1997). Efforts to determine the sources of nutrient and particulate pollutants have been ongoing for several years. Several potential sources have been identified with groundwater potentially being an important source. Some research into the effects of groundwater on lake water quality has been conducted (e.g., Loeb 1987, Thodal 1997), but further assessment is needed. Likely sources of nutrient contribution to the lake through groundwater are residual

effluent from past sewage disposal practices, fertilizer application, and infiltration of urban stormwater runoff. Sewage conveyance lines have also been identified as a potential source. Camp, Dresser & McKee (CDM) has been tasked with studying the risks associated with the conveyance lines.

The special framework groundwater study will consolidate and evaluate information about the loading of nutrients to Lake Tahoe by way of groundwater. The study will focus on a re-evaluation of existing data and the limited compilation of new data generated since the study of Thodal (1997) with a goal of identifying land use practices (current and historic) that could be contributing to nutrient loading to the groundwater system. These results will be presented in terms of loading by political regions and in terms of total loading to Lake Tahoe. No sampling is expected as part of this phase of the study. Recommendations on future work that could be carried out to improve groundwater quality and ultimately lake clarity will be included in the report.

3.0 Description of Work and Services

All work will be completed by 30 June 2003.

Throughout the duration of the project, team meetings will be conducted to allow stakeholders input on the scope of work, provide stakeholders updates on the progress of the study and to allow stakeholders to contribute data useful to the goals of the project. It is expected that these meetings will be held on a monthly basis.

The project will commence with a literature search. An example listing of literature is included in Section 4.0, Literature Review. Data collected will be used to develop an estimate for nutrient loading to Lake Tahoe transported through groundwater. The effort will be focused on compiling existing knowledge of groundwater flow characteristics, geology and existing groundwater and nearshore lake nutrient data for the Tahoe Basin. This information will be linked with identified nutrient source data collected as described in the following paragraph. The nutrient loading to the lake through groundwater will be reported on a regional basis (e.g., by county or some other relevant delineation).

EDS will compile data on current and past land use practices in order to develop a better understanding of potential sources and nutrient routing through the basin. Potential sources include the fertilization of lawns, golf courses, and ski slopes, and the infiltration of road and municipal runoff. Past land uses with the potential to be a current source of nutrients to the lake include abandoned septic tanks and former sewage disposal areas. Stakeholders will be contacted to identify existing maps of the Lake Tahoe Basin land uses. Data gaps will be filled using land use maps, tax records, aerial photographs, discharge permits, nearshore lake data and field surveys, as available. The information will be compiled into a data management system that is compatible with TIIMS.

Alternatives for reducing the nutrient loading to Lake Tahoe through groundwater will be assessed. The identification of best management practices (BMPs) will be included to identify measures for reduction of nutrient loading to Lake Tahoe. Potential projects that could be executed to reduce the nutrient loading to the Lake will also be presented as part of the study.

Throughout the entire process, EDS will provide recommendations for additional work that would be useful in gaining a better understanding of the influence of groundwater on Lake Tahoe. Recommendations will be made on methods to fill data gaps through field sampling, refining the knowledge of the geology of specific areas, and further source assessments to determine a more accurate nutrient loading to Lake Tahoe from groundwater.

The information listed above will be presented in two reports. A groundwater study report will be submitted to the local stakeholders for their use in developing TMDLs and updating the Regional Plan and Forest Management Plan. A second report will be developed as an Appendix to the authorization report. The appendix to the authorization report will focus on Corps projects that could be executed to reduce the amount of nutrients reaching the lake through groundwater.

4.0 Literature Review

Partial bibliography of existing documents relevant to this study:

Loeb, S.L. 1986. Algal biofouling of oligotrophic Lake Tahoe: causal factors affecting production. *In:* L.V. Evans and K.D. Hoagland (eds.), Algal Biofouling. Elsevier Science (Pub.) B.V. Amsterdam.

Loeb, S.L. 1987. Groundwater quality within the Lake Tahoe Basin. Institute of Ecology, Division of Environmental Studies, University of California, Davis.

Loeb, S.L. 1990. Evidence of land use impacts on water quality within the Lake Tahoe Basin. pp. 25-41. *In:* Poppoff, I.G. et al., eds., International Mountain Watershed Symposium: Subalpine Processes and Water Quality. 8-10 June 1988, Lake Tahoe. Tahoe Resource Conservation District, South Lake Tahoe, CA.

Loeb, S.L. and C.R. Goldman. 1979. Water and nutrient transport via groundwater from Ward Valley into Lake Tahoe. Limnol. Oceanogr. 24(6): 1146-1154.

Thodal, C.E. 1995. Hydrogeologic setting and ground-water quality of areas tributary to Lake Tahoe in Douglas County and Carson City, Nevada, through 1987. U.S. Geological Survey Water-Resources Investigations Report 94-4079.

Thodal, C.E. 1997. Hydrogeology of Lake Tahoe Basin, California and Nevada, and results of a ground-water quality monitoring network, water years 1990-92. U.S. Geological Survey Water Resources Investigations Report 97-4072.

5.0 Assumptions and Risks

To date, little effort has been taken to perform a detailed study of the effects of groundwater on Lake Tahoe. This study will develop a baseline of current knowledge as

it related to groundwater flow and refine the assessments of nutrient loading based on land use practices in the Tahoe Basin. There will be broad assumptions made on the specifics of groundwater movement and nutrient loading at sources. The primary risk associated with making broad assumptions is that the nutrient loading may be overestimated while making conservative assumptions. The information generated will be useful in any follow-up studies that are conducted to refine the loading estimates of nutrients to Lake Tahoe. In addition, this study is not intended to address contaminants not specifically related to nutrient sources.

6.0 Project Deliverable Schedule

The following deliverables and milestones shall be completed and/or submitted on or before the required date of completion.

Deliverable or Milestone	Required Date of Completion
Attend monthly team meetings to brief stakeholders on progress.	Monthly
Kick off meeting	17 Dec 01
Initial stakeholder meeting to discuss scope	23 Jan 02
Draft Technical Project Management Plan	16 Jan 02
Final Technical Project Management Plan	TBD
Interim Study Update	Apr 02
Attend public and stakeholder meeting to discuss study	14 May 02
In Progress Review	31 May 02
Draft Special Framework Groundwater Study Report	13 May 03
Comment Resolution Conference	TBD
Final Special Framework Groundwater Study Report	30 June 03
Feasibility Scoping Meeting (F3)	TBD
Alternative Formulation Briefing (F4)	TBD
District Engineer's Public Notice	TBD

Note: Some milestones indicate work beyond the initial year's work.