HYDRO-SEARCH, INC.
A Tetra Tech Company

Ground-Water Management Plan
Phase 1
Martis Valley Ground-Water Basin
Basin No. 6-67
Nevada and Placer Counties, California

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Prepared for

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Section 1

1.0 EXECUTIVE SUMMARY

This document presents the Phase I Ground-Water Management Plan for the Martis Valley Ground-Water Basin. The purpose of the management plan is to protect the chemical quality of the ground-water resource and to assure continued supply of high quality ground water to the population within and adjacent to Martis Valley.

Assembly Bill 3030, adopted on September 26, 1992, authorizes implementation of a plan to manage ground water within a ground-water basin identified in the California Department of Water Resources Bulletin 118. In that bulletin, the Martis Valley Ground-Water Basin is designated as Basin Number 6-67 within the North Lahontan Hydrologic Study Area.

The Martis Valley Ground-Water Basin lies in the eastern Sierra Nevada, a few miles east of Donner Summit. The basin encompasses approximately 58 square miles and is roughly centered on the town of Truckee. The principal surface-water drainage within the basin is the Truckee River.

Three water companies service customers within the ground-water basin:

(1) Truckee Donner Public Utility District which provides water to customers within a district of approximately 44 square miles;

(2) Glenshire Mutual Water Company which provides water to customers in Glenshire in the eastern portion of the basin; and

(3) Donner Lake Water Company which provides water to customers around Donner Lake.

Municipal, industrial, irrigation, and domestic water wells also tap the ground-water resource within the basin.

The following conclusions were reached during preparation of the Martis Valley Ground-Water Management Plan:

(1) The major water bearing units in the ground-water basin consist of the Lousetown and Truckee formations. These two units provide most of the ground-water produced by municipal, industrial and irrigation wells.

(2) Igneous rocks exist at depth below the Lousetown and Truckee formations and around the ground-water basin periphery. The igneous rocks define an approximate impervious "container" across which

relatively little ground-water flow occurs. Ground-water development within the igneous rocks is limited except in areas of faulting, fracturing, or buried alluvial sediments.

(3) Direct ground-water recharge to the basin is approximately 18,000 acre-feet per year. After accounting for interbasin transfers and other losses, approximately 13,700 acre-feet of ground-water per year are discharged to the Truckee River, Prosser Creek, and Prosser Creek Reservoir.

(4) Ground-water withdrawal within the basin is approximately 7900 acre-feet per year of which 3300 acre-feet is from Truckee Donner Public Utility District, 550 acre-feet is from Glenshire Mutual Water Company, and 4050 acre-feet is from other municipal, industrial, irrigation, and domestic wells.

(5) Total ground water in storage within the basin is approximately 1,050,000 acre-feet which is equal to about 77 years of average annual ground-water discharge to surface water (i.e., 13,700 acre-feet).

(6) Although local dewatering effects have been observed around municipal wells, the ground-water gradient and direction of ground-water flow remains largely unaffected by pumping. Ground-water movement is toward the Truckee River system including tributaries and Prosser Creek Reservoir.

(7) An inventory of wells, based upon state and county records, reveals that over 200 wells exist within and adjacent to the ground-water basin. These wells include municipal, industrial, irrigation, domestic, and monitor (test) wells. State and county records may not be complete and other wells probably exist that were not identified.

(8) Sufficient ground water is available within the basin to support withdrawals in excess of the current withdrawal of 7904 acre-feet per year. 13,000 acre-feet per year is recommended as a maximum withdrawal on an intermediate term basis.

(9) Hydrologic effects associated with current and future ground-water withdrawals should be monitored and evaluated. These effects include changes in ground-water elevations and quality, changes in flow rates of surface water, contraction or expansion of wet areas on the land surface, and others.

(10) Areas exist within the ground-water basin that will support different

levels of ground-water development. Potential well yields within these areas range from greater than 1000 gallons per minute (gpm) to less than 100 gpm. The hydrogeology of an area determines its well yield potential.

The following recommendations are made:

(1) A ground-water monitoring plan should be implemented to establish the elevation of the current ground-water surface in the basin, to track changes in the elevation of the ground-water surface due to ground-water withdrawals and/or changes in recharge, and to maintain a database of ground-water usage to assure a continued supply of high quality water.

(2) The ground-water monitoring plan should include measurements of static water levels, pumping water levels, and pumpage for municipal, industrial, and irrigation wells. Measurements of static water levels should also be made in selected monitor (test) and domestic wells to maintain adequate water level coverage over the basin. These measurements should be done initially for all wells, then monthly for municipal wells and biannually for all others. Locations of all wells should be verified on a map.

(3) As part of the ground-water monitoring plan, wells not included in the initial well inventory or new wells should be added to the database as information becomes available. Biannual static water level maps and annual summaries of ground-water withdrawals should be completed.

Section 2

2.0 INTRODUCTION

This document presents Phase I of the Martis Valley Ground-Water Management Plan for the Martis Valley Ground-Water Basin (Basin No. 6-67), located in Nevada and Placer Counties, California in the vicinity of the Town of Truckee. A location map is presented as Figure 1. The management plan was prepared for the Truckee Donner Public Utility District (TDPUD) in accordance with the Hydro-Search, Inc. (HSI) proposal, dated April 14, 1994.

Phase 1 of the plan delineates the horizontal and vertical extent of the ground-water basin, describes the recharge and discharge relationships between surface and ground water, presents a ground-water budget, discusses the ground-water flow system, summarizes ground-water development, and proposes a ground-water monitoring plan to collect baseline and ongoing data regarding ground-water levels and withdrawal rates. Phase 2 of the management plan, to be completed in 1995, discusses the water quality issues affecting the ground-water basin including distribution of inorganic chemicals in ground water, potential sources of aquifer contamination, wellhead protection program, well abandonment/destruction program, and a water-quality monitoring program. Phase 3 of the management plan, to be completed in 1996, will involve constructing a ground-water flow model to guide development of the ground-water basin. Input to the model will include surface water data, recharge data, water level fluctuations over time, and ground-water withdrawal rates from municipal, industrial, irrigation, and domestic wells in the basin.

2.1 Physical Setting

The Martis Valley Ground-Water Basin, as delineated in Figure 1, encompasses an area of approximately 58 square miles roughly centered on the Town of Truckee, California. The Town of Truckee lies within Martis Valley, an intermountain topographic basin eight to ten miles wide (east-west) by eight to ten miles long (north-south) in Nevada and Placer Counties, California. Martis Valley lies in the eastern Sierra Nevada, a few miles east of Donner Summit. The Truckee River, the principal surface-water drainage, traverses the valley from southwest to northeast in a shallow incised channel. Principal tributaries to the Truckee are Martis, Donner, and Prosser Creeks. Three major surface-water storages exist in the valley, Donner Lake, and Martis Creek and Prosser Creek reservoirs.

Elevation ranges from about 5500 to 7000 feet with peaks along the margins of the valley exceeding 8000 feet. Within and near Truckee, the floor of the valley is flat, ranging from 5700 to 5900 feet elevation, punctuated by round hills rising 1000 feet or more. These hills are either geologically young, extinct volcanoes, e.g., Alder Hill, or eroded remnants of older igneous rocks, e.g., Boca Hill.

The valley is traversed east-west by Interstate Highway 80; all-weather paved roads, Highways 267 and 89, extend south and north-south, respectively, from Truckee, the principal urban center. The nearest major city is Reno, Nevada, 30 miles to the east on I-80.

Much of the valley is underlain by geologically young basin-fill sediments and interlayered volcanic flows. These materials, in places, exceed 1000 feet in thickness, contain excellent quality ground water, and collectively constitute an extensive, prolific multiple aquifer system. This aquifer system is known as the Martis Valley Ground-Water Basin. Andesitic volcanic and granitic intrusive igneous rocks which occur both as surrounding high lands and basement rocks beneath the ground-water basin, in general, contain, transmit, and yield only small quantities of water. However, these rocks may contain substantial ground water in localized pervious zones of extreme fracturing and faulting.

The Truckee-Donner Public Utility District (TDPUD) comprises an area of 43.7 square miles in the central and western portion of Martis Valley (Figure 1) and supplies water to residents within the boundaries of the utility district. Glenshire Mutual Water Company supplies water to residents of Glenshire, located in the eastern portion of the Martis Valley Ground-Water Basin. Donner Lake Water Company supplies water to residents around Donner Lake. Residents in outlying portions of the ground-water basin produce water from domestic wells. Industrial and irrigation users generally produce water from individually owned and operated wells.

2.2 Statement of Purpose

The purpose of the Martis Valley Ground-Water Management Plan is to protect the chemical quality of the ground-water resource and assure continued supply of high-quality ground water to the population within and adjacent to Martis Valley by developing and implementing a monitoring program to guide appropriation and use of ground water.

The authority to establish a ground-water management plan was granted by Assembly Bill (AB) 3030, dated September 26, 1992, in accordance with the California Water Code, Division 6, Part 2.75, Sections 10750 to 10755. AB 3030 authorizes adoption and implementation of a ground-water management plan to manage ground water within a ground-water basin identified in the California Department of Water Resources (DWR) Bulletin 118. DWR Bulletin 118 identifies the Martis Valley Ground-Water Basin as being within the North Lahontan Hydrologic Study Area and designates the basin as Basin No. 6-67.

In accordance with AB 3030, the TDPUD held a public hearing on January 4, 1993 and adopted a resolution to prepare a ground-water management plan for the Martis Valley Ground-Water Basin. This plan was prepared in accordance with guidelines contained in AB 3030.

2.3 Plan Organization

This management plan is organized into five sections. Section 1 is an executive summary; Section 2 is an introductory section; Section 3 discusses the geologic framework; Section 4 discusses the hydrogeology of the basin incorporating the ground-water budget, flow system, well inventory, and ground-water development; and Section 5 presents the ground-water monitoring plan.

2.4 Acknowledgements

HSI technical staff who participated in this project include Messrs. Richard J. Johnson III, hydrogeologist, David J. Herzog, senior engineering geologist, and Forrest L. Fox, senior hydrogeologist. HSI wishes to thank Messrs. David Rully, Mike Connell, and Peter Marcovich of the TDPUD; Mr. Bill Whitener of the Glenshire Mutual Water Company; Mr. John O'Farrell of the Del Oro Water Company; Messrs. Don McKechnie and Richard Pettit of the Tahoe-Truckee Sanitation Agency; Mr. Cliff Block of Teichert Aggregates; Mmes. Kathy Polucha and Janet Mann of the Nevada County Health Department; Mr. Jim Gibboney, Mr. Eric Senter, and Ms. Eula Taber of the DWR; Dr. John Sharp, Mr. Keith Sauers, and Mr. Brian Maher for providing data necessary to complete this plan.

Section 3

3.0 GEOLOGY

The geologic data presented herein are the result of previous work by HSI (1975 and 1980) which has been updated using data collected during recent ground-water exploration and water well drilling (HSI 1993, 1994a, and 1994b). The HSI geologic map presented in Appendix A as Plate A-1 was a compilation of Birkeland (1962 and 1963), Burnett and Jennings (1962), and field mapping performed by HSI in 1973-1974, and 1975-1979. Specifically, important improvements were made to Birkeland (1962 and 1963) and Burnett and Jennings (1962) with respect to delineation of major faults, identification of Tertiary and Quaternary volcanic centers, refinement of outcrop contacts between geologic units, and refinement of subdivision of the Lousetown Formation into individual volcanic and sedimentary units. Geologic cross-sections presented in Appendix A as Plate A-2 use geologic terminology developed by Birkeland (1962 and 1963) as modified by HSI (1975 and 1980).

More recent geologic and geochemical work by Latham (1985) on the stratigraphy and structure of the volcanic rocks in the vicinity of Truckee, California is discussed briefly in Section 3.1.4. Latham (1985) reviewed published geologic work in the Truckee area, performed field mapping between 1980 and 1984, performed a paleomagnetic study of 80 rock samples, analyzed major and trace elements of 120 samples, age-dated several rock samples, and performed two gravity surveys of Martis Valley. Latham's (1985) work resulted in a redefinition of the stratigraphy, structure, and geologic relationships of the Quaternary and Tertiary rocks in the vicinity of Truckee by renaming the geologic units of Birkeland (1962 and 1963) and providing a chronology of the various volcanic and structural events based on paleomegnetic and potassium/argon dating. Latham's (1985) geologic map is presented in Appendix A as Plate A-3.

A correlation diagram of Birkeland's (1962 and 1963) work as modified by HSI (1975 and 1980) and Latham's (1985) geologic nomenclature is presented as Table 1 (Maher 1994). Latham (1985) distinguished between volcanic rock types on the basis of whole-rock chemistry, paleomagnetic polarity, and potassium/argon derived dates. Several of the different volcanic rock types defined by Latham (1985), including the olivine shoshonites and basaltic andesites of the Bald Mountain, Boca Ridge, and Hunter Lake Formations, are indistinguishable in hand specimen and drill cuttings. Additionally, interflow deposits identified in drill cuttings by HSI as Lousetown sediments (Qls), which constitute a major source of ground water within the basin, were not mapped by Latham (1985). Most subsurface geology as portrayed in drill logs prepared by HSI and others used the Birkeland (1962, 1963) terminology. Therefore, this ground-water management plan uses the Birkeland (1962 and 1963) terminology as modified by HSI (1975 and 1980).

3.1 Geologic Units

The following geologic units occur within the Truckee area. The units are listed in ascending chronologic order, i.e., oldest to youngest; location and distribution are shown in Plate A-1.

3.1.1 Cretaceous Age

Igneous granitic intrusives (Kg) - Cretaceous age, igneous intrusive rocks ranging from granite to quartz diorite in composition; characterized by porphyritic texture with phenocrysts of quartz, biotite, plagioclase, and orthoclase, and commonly containing dark mafic inclusions. Granitic rocks are exposed along the western boundary of the ground-water basin.

3.1.2 Tertiary Age

Tertiary andesite undifferentiated (Tau) - undifferentiated andesite and andesite breccia.

Tertiary andesite breccia (Tab) - predominantly andesite mudflows, lithic andesite breccias, and tuff breccias; generally includes abundant large fragments of round to subrounded andesite. These materials were deposited as flows previous to and, in some cases, contemporaneous with Tertiary andesite (Ta) rocks. Occasionally, thin, poorly-sorted andesitic sediments occur within the andesite and tuff breccias; these materials, however, are discontinuous and highly indurated. Thicknesses of Tab in excess of 500 feet occur on the north and west flank of Donner Ridge and on the north slope of Schallenberger Ridge.

Tertiary andesite cone (Tac) - vent site from which Tertiary andesite (Ta) erupted; includes pyroclastic ejecta materials, i.e., cinders, scoria, ash, volcanic bombs, and andesite flow rock. The only identified Tertiary andesite cone within the Truckee area occurs in the eastern half of Section 5, T.17N., R.I6E. and is the source for Tertiary andesite (Ta) cropping out south of Alder Creek and north of Alder Hill. In addition, a possible Tertiary andesite vent is suggested in the vicinity of Boca Hill and may be the source for Ta and Tab cropping out north and east of the ground-water basin.

Tertiary andesite (Ta) - dense, porphyritic, crystalline rock; characterized by hornblende and plagioclase phenocrysts and irregular fracture patterns. Individual flows in excess of 80 feet thick crop out in the western and central portions of the ground-water basin.

Truckee Formation (Tt) - lake and stream deposits derived principally from erosion of Ta and Tab; composed predominantly of two units: 1) fine-grained lake sediments consisting of diatomaceous and tuffaceous silty, sandy claystone and siltstone and 2) coarse-grained stream sediments consisting of slightly- to moderately-consolidated, poorly- to well-sorted conglomerate, sandstone, siltstone, and claystone. Outcrops in excess of 50 feet thick are exposed along the canyon eroded by the Truckee River near the northeastern margin of the ground-water basin. Thicknesses exceeding several hundred feet, however, are encountered within the subsurface by deep wells in the southern and eastern portion of the ground-water basin.

3.1.3 Quaternary Age

The following ten units are collectively assigned to the Lousetown Formation but are treated individually for purposes of this management plan.

Quaternary volcanic cones (Qlc) - source locations for Lousetown volcanic flows; marked by cinders, ash, volcanic bombs, and flow materials. In all, eight vent sites were recognized during field examinations.

Lousetown Formation volcanics undifferentiated (Qlu) - undifferentiated olivine latite and basalt volcanic flows, tuffs, and breccias.

Alder Hill olivine basalt (Qla) - tentative name assigned to three volcanic flows cropping out directly north of Truckee. These volcanic flows emanated from the vent site located on Alder Hill (Plate A-2). Flows can be distinguished by their dense-glassy texture, small unweathered olivine phenocrysts, and presence of layered flow structure. Several volcanic flows identified as belonging to Alder Hill were intersected in the subsurface by TDPUD's Northside and Southside Wells south of Alder Hill.

Trout Creek olivine basalt (Qltc) - tentative name assigned to one or more 60-foot thick olivine basalt flows cropping out in the central portion of the basin; characterized by very abundant, slightly altered, euhedral olivine phenocrysts and occasional pillow lavas and palagonite alteration near the base. The vent site for Trout Creek olivine basalt, located in NW 1/4, Sec. 9, T.17N., R.16E., was largely eroded by subsequent glacial activity. Trout Creek olivine basalt rests unconformably upon Tertiary andesite breccia (Tab) and Tertiary andesite (Ta).

Polaris olivine latite (Qlp) - one or more latitic volcanic flows and tuffs cropping out north and south of the Truckee River in the eastern half of the ground-water basin. Although a distinct vent source was not located for the Polaris, a glacially-eroded remnant is suggested in the middle of Sec. 11, T.17N., R.16E. Flows are distinguishable by their abundance of moderately weathered, euhedral olivine phenocrysts and extremely vesicular flow top. Latitic tuff units exhibit evidence of reworking by fluvial processes. Polaris flow units have been tentatively identified in the subsurface from drill cuttings from TDPUD's Southside and the Airport #2 Wells.

Dry Lake flows (Qld) - a distinctive group of olivine basalt and latite flows that crop out along the eastern margin of the ground-water basin. Flows can be distinguished by their platy jointing, high glass content, and oxyhornblende phenocrysts. Dry Lake flows rest unconformably on the Truckee Formation (Tt) and Tertiary andesite (Ta). Vent sites for Dry Lake flows occur immediately to the east of the basin.

Bald Mountain olivine latite (Qlbm) - two or more latite flows cropping out south of Truckee. Flows are characterized by: abundant, moderate to highly-altered olivine phenocrysts, "salt and pepper" ground-mass texture, and presence of occasional plagioclase and oxyhornblende phenocrysts. In contrast with most of the other Lousetown flows, the Bald Mountain had multiple vent sources: a vent and cinder cone located in SE¼ Sec. 15, T.17N., R.I6E.; Bald Mountain, NE¼ Sec. 27, T.17N., R.16E.; and two vents located immediately south and southwest of Bald Mountain in SE¼ Sec. 27 and NW¼ Sec. 34, T.17N., R.16E. Bald Mountain flows have been identified in the subsurface from drill cuttings from TDPUD's Northside and Southside Wells and Larwin-Joerger #2 exploration hole.

Hirschdale olivine latite (Qlh) - one or more 50-foot thick olivine latite flows; characterized by an extremely vesicular nature at the surface, abundant olivine phenocrysts, and occasional pillow lavas and palagonite alteration near the base. Qlh crops out along the eastern margin of the ground-water basin and rests unconformably on Tertiary andesite (Ta), Truckee Formation (Tt), and Dry Lake flows (Qld). Hirschdale flows were erupted from a number of vent sites east of the basin. One vent site is located along the eastern boundary in E1/2, Sec. 32, T.18., R.I7E.

Lousetown Formation sediments undifferentiated (Qls) - designation given to unnamed sand, gravel, and clay sequences, penetrated by deep wells, which were deposited contemporaneous to and between eruptions of the Lousetown volcanic flows. These units are older than Qlpc and Qlj (see below) and do not crop out on the surface.

Juniper Flat alluvium (Qlj) - interlayered, slightly consolidated, stream deposited gravel, sand, silt, and clay layers. This alluvium overlies Tertiary andesite (Ta), Truckee Formation (Tt) and Lousetown volcanic flows (Qld, Qlh). Thicknesses approaching 60 feet occur along the eastern border of the basin.

Prosser Creek alluvium (Qlpc) - well-sorted, slightly consolidated lake and stream sediments deposited when Hirschdale olivine latite flows blocked the drainage of ancestral Prosser Creek and Truckee River south of Boca Hill. A thin veneer, less than 20 feet, of Prosser Creek alluvium is exposed along I-80 overlying Hirschdale olivine latite (Qlh) in the SW¼ Sec. 32, T.18N., R.17E. Thicknesses in excess of 100 feet have been penetrated by deep wells in the ground-water basin.

Glacial moraine and till deposits (Qgm) - extremely poorly-sorted, unconsolidated deposits produced during three major glacial episodes; Sherwin, Tahoe, and Tioga. Deposits characterized by hummocky ground and morainal ridges with boulder-strewn surfaces.

Glacial outwash (Qgo) - well- to poorly-sorted, unconsolidated to semi-consolidated, flat-lying, planar deposits of gravels, sands, silts, and clays unconformably overlying Cretaceous granitic intrusive (Kg), Tertiary andesite breccia (Tab), Tertiary andesite (Ta), Truckee Formation (Tt), and volcanic and sedimentary members of the Lousetown Formation. Maximum thickness of this unit is estimated in excess of 100 feet within the ground-water basin.

Recent alluvium (Qal) - unconsolidated gravels, sands, silts, and clays deposited during Recent time and directly associated with active stream drainages. Thickness is estimated not to exceed 30 feet.

3.1.4 Latham's Geologic Chronology

Latham (1985) re-interpreted the geologic history of the volcanic rock units using paleomagnetic dating, potassium/argon dating, and whole-rock chemical analyses. Table 1 correlates geologic units used in this plan with Latham (1985). Presented in Appendix A, Plate A-3 is Latham's (1985) geologic map. Review of Table 1 indicates that the primary changes, with the exception of geologic formation names, are to the timing of half of the Lousetown Formation volcanic units (Qlb, Qltc, Qla, and Qld) from Quaternary age (Birkeland 1962, 1963 and HSI 1975, 1980) to Tertiary age (Latham 1985). Latham (1985) also subdivided the Hirschdale latite (Qlh) into a Quaternary-age unit (Juniper Flat flows-Qpbmj) and a Tertiary-age unit (Hirschdale flows-Tprbh). Lastly, Latham (1985) included the Tertiary andesitic units (Ta, Tab, Tac, Tau) within the widespread Kate Peak Formation (Tmpkp).

The California Division of Mines and Geology recently published the "Geologic Map of the Chico Quadrangle" (Saucedo and Wagner 1992) which includes the Truckee area. This map references both Birkeland (1962 and 1963) and Latham (1985) for geology of the Truckee area. Saucedo and Wagner (1992) do not use formation names but do accept Latham's (1985) chronology of volcanic units.

3.2 Geologic Structure

Four major directions of faulting occur. Evidence used in locating faults of a local extent included presence of offset geologic units, crushed or shear zones, fault scarps, and subsurface information from drill logs and water well logs. In addition, examination of aerial photographs disclosed regional faults based on conspicuous patterns of vegetation, deflected and/or extremely linear stream drainages, and anomalous alignment of topographic trends such as ridges.

Northwest-trending faults dominate in the western half of the ground-water basin (Plate A-1). In addition, a northwest-trending fault east of Bald Mountain is probably continuous with a northwest-trending fault west of Alder Hill. Major northeast-trending faults occur along the southeast margin of Alder Hill, along the upper reach of Alder Creek, and along the southern boundary of the ground-water basin. A prominent east-west fault occurs south of Prosser Hill along lower Alder Creek. North-south faulting is prevalent east of Prosser Hill, Alder Hill, Bald Mountain, and lower Martis Creek.

3.2.1 Structural Activity

The faults are dominantly high angle. Downward vertical movements along these faults, commencing in the late Tertiary and continuing into the present, have resulted in deposition of a thick sequence of lake and stream sediments and associated volcanic flows, i.e., Truckee and Lousetown Formations, comprising the Martis Valley Ground-Water Basin. The low-lying nature of Martis Valley is a topographic expression of these fault movements. Close concordance exists between the topographic valley and underlying ground-water basin. Topographically high areas along the boundaries of Martis Valley, e.g., Boca Hill, Donner Ridge, Prosser Hill, and the high ranges to the west, east, and south of the valley, have been elevated along the aforementioned faults. To a substantial degree, these are the source areas for the sediments deposited in the down-faulted basin area.

Faulting has continued to the present with about 21 seismic events greater than magnitude 4 (Richter scale) recorded during the 1934-1961 period for the Truckee area (California Department of Water Resources, 1964). The 1966 Truckee earthquake is reported by the U.S. Geological Survey (1967) to have had a Richter magnitude of 5.4 and an epicenter near Boca Reservoir.

3.3 Water-Bearing Characteristics

The Martis Valley Ground-Water Basin is a multi-layered aquifer system composed of a wide variety of rock types. The ability to transmit water, transmissivity, has been characterized for many of the basin materials from visual inspection of materials and by analysis of aquifer tests and production performance of water supply wells.

3.3.1 Igneous Basement Rocks

The igneous basement rocks, including granite (Kg) and andesites (Ta, Tab, Tac, Tau), lack intergranular openings. Storage and movement of ground water in these rocks, therefore, occurs only in interconnected fractures and joints. In general, jointing and fracturing are not highly developed and that which does exist is expected to decrease with depth. Consequently, the amount of ground water that can be obtained from the bulk of these rocks is limited.

The intraformational sedimentary units in Tab are not considered to be an important source of ground water due to their lack of lateral and vertical extent.

Although these rocks as a whole are not favorable for developing groundwater, occasional near-vertical faults and highly fractured shear zones possibly contain and transmit sufficient ground water to constitute a useful supply. For example, several springs issue from shear zones within andesitic rocks in Sec. 11, T.17N., R.15E and two productive water wells were recently developed for the Tahoe-Donner Golf Course in Sec. 6, T. 17N, R. 16E. and Sec. 31, T. 18N, R. 16E along a fault bounding the andesitic basement rocks and the Lousetown Formation.

Fault and fracture zones can be located by a combination of detailed surface geologic mapping and aerial photographic and surface geophysical surveys. Well yields within faults and fractures in the igneous basement rocks are unknown but could be in excess of 200 gpm. If wells were widely spaced, a long-term dependable supply might be possible but because of their probable limited storage capacity, such supplies might be subject to seasonal and year-to-year variation in yield and water level.

3.3.2 Truckee Formation (Tt)

This sedimentary unit contains interconnected intergranular pore spaces and, thus, is considerably more pervious than the underlying igneous rocks. The Truckee Formation is composed of a variety of materials and, therefore, ground-water availability is variable. Wells tap this aquifer alone in Glenshire, on the eastern side of the ground-water basin, with production ratings up to 280 gpm.

The Truckee Formation is an important part of the multiple aquifer system of the basin.

3.3.3 Lousetown Formation

The Lousetown volcanic flows (Qlu, Qla, Qltc, Qlp, Qld, Qlbm, and Qlh) lack intergranular openings; consequently, their ability to transmit and store ground water is dependent upon the amount, distribution, and degree of interconnection of fractures. Ground water may also occur in zones between two successive flows where fractures and gas openings were formed during cooling and soils and alluvial deposits may have developed during the time interval between deposition of the flows.

In general, the Lousetown flows are less pervious and yield less ground water than the underlying Truckee Formation and the sedimentary units of the Lousetown.

Due to the wide extent on the ground surface and high degree of surficial fracturing, the Lousetown flows are capable of accepting and transmitting significant recharge to underlying aquifers. In this respect, they are possibly more important from the standpoint of their recharge characteristics than as aquifers within the ground-water basin.

The Lousetown sediments consisting of Prosser Creek alluvium (Qlpc), Juniper Flat alluvium (Qlj), and undifferentiated sediments (Qls) contain interconnected, intergranular pore spaces and, thus, are capable of storing and transmitting significant quantities of ground water.

The Juniper Flat alluvium is not an important aquifer because it is thin, restricted in extent, and topographically high. The Prosser Creek alluvium and associated undifferentiated Lousetown sediments are thick and extensive and, along with the Truckee Formation, are the principal aquifers of the Martis Valley Ground-Water Basin.

Aquifer testing of wells completed in dual aquifers, Lousetown and Truckee Formations, yield transmissivity values ranging from 5,000 gallons per day per foot (gpd/ft) for Sanders #1 to 72,100 gpd/ft for Airport Well No.2. Specific capacity values range from 2 gallons per minute per foot of drawdown (gpm/ft dd) for Sanders #1 to 30 gpm/ft dd for Airport Well No. 2.

3.3.4 Alluvial Deposits

The following alluvial units occur as relatively thin deposits at the ground surface overlying older units. They are pervious to varying degrees but all permit the downward movement of ground water as recharge to the older units. One alluvial unit, Qgo, has some potential as an aquifer.

Glacial moraine and till (Qgm) is generally poorly sorted and contains a high proportion of clay-sized material. Consequently, this material is not favorable for developing large supplies. Moderate well yields may occur locally where the deposits have been reworked and sorted by stream action.

Glacial outwash (Qgo) is generally coarse and well-sorted, providing permeability and storage capacity equal to or exceeding that of the Truckee Formation (Tt) and Lousetown sediments (Qlpc, Qls, Qlj). The glacial deposits are generally thin, up to 100 feet thick, and on the land surface. Consequently, they seldom show significant saturated thickness. However, where thickness and water saturation are favorable, large-yield wells could be developed.

Recent alluvium (Qal), although possessing water-bearing characteristics similar to Qgo, lacks thickness and is of restricted extent, removing this unit from consideration as a potential aquifer.

Section 4

4.0 HYDROGEOLOGY

This section is divided into five subsections. An overview of the Martis Valley Ground-Water Basin is found in Section 4.1. The ground-water budget, including discussions of recharge, discharge, storage, and the ground-water flow system is contained in Section 4.2. A review of the well inventory and data base is contained in Section 4.3. A discussion of ground-water development and water production potential within the Martis Valley Ground-Water Basin is contained in Sections 4.4 and 4.5, respectively.

4.1 Martis Valley Ground-Water Basin

The Martis Valley Ground-Water Basin boundary is delineated in Plate 1. The area encompasses approximately 37,000 acres (57.8 square miles), excluding Prosser Creek Reservoir. The basin boundary delineation and the discussion that follows were originally developed by HSI (1975 and 1980) and were verified and/or modified using DWR water well driller's reports, driller's reports from county and local agencies, and results of ground-water exploration programs by TDPUD and Glenshire Mutual Water Company.

Underlying the ground-water basin are andesitic and granitic igneous rocks that are relatively impervious. A possibility exists that sufficient water to constitute a useable resource may occur in occasional fractured and faulted zones. However, these zones must be confirmed and explored. Therefore the igneous rocks are taken to constitute the impervious "container" of the basin. Geologic relationships and drilling results indicate that these materials occur at depth beneath the basin-fill materials in addition to their occurrence around the periphery of the basin.

The sedimentary Truckee Formation and younger overlying, interlayered sedimentary and volcanic Lousetown Formation constitute the bulk of the basin-fill deposits. The Lousetown volcanics are included as part of the basin materials. Although the volcanics are less pervious than the enclosed sediments, they appear to yield some water and locally are important for transmission of newly recharged ground water.

Locally, surficial alluvial materials, including Qgo, Qgm, and Qal, from which all or part of a useable water supply might be developed, are included within the basin boundary.

Plate A-2 in Appendix A contains interpretive geologic cross-sections through the basin based upon well logs, projections of surface geologic data, and ground-water level data. The cross-sections show the deepening of the basin toward the center. The granitic-andesitic basement may not have been reached in the central portion of the basin because identification of andesites in Larwin-Joerger #1 and Airport Well #2 is uncertain. The basin margins are a combination of high-angle faults (basin-side downthrown) and depositional thinning. A transition occurs from predominantly sedimentary materials in the central basin to predominantly volcanic (Lousetown) materials along the periphery.

4.2 Ground-Water Budget

This section was adapted from HSI (1975). Ground-water basin delineations and report text were verified and updated using new data.

4.2.1 Ground-Water Recharge

The ground-water basin is divided into ten zones, A through J (Plate 1), for estimating recharge and analyzing movement of ground water. Insofar as possible, each zone is selected to be uniform from the standpoint of factors which control recharge and movement of ground water. In some instances, zone boundaries were necessarily arbitrary. Recharge is estimated for each zone and estimation is made of transfer of this water to adjacent zone(s) or discharge to surface-water bodies. A hydrologic budget approach was used in analyzing movement of ground water within and between zones, an example of which is given under Zone G. Table 2 presents a summary of estimated recharge by zone.

Precise methods do not exist for calculating ground-water recharge. Precipitation input to an area can usually be projected reasonably accurately from nearby precipitation gages. Annual precipitation ranges from about 22 inches at Boca Reservoir on the east to greater than 40 inches at Donner Memorial State Park on the west. About 80 percent of the precipitation occurs during the months of November through April.

Disposition of precipitation is by surface-water runoff, evapotranspiration from plants, soils, and snowpack; and recharge to ground water. Surface water runoff can be estimated or projected reasonably accurately from stream gage records and watershed characteristics. Direct estimation of evapotranspiration losses, however, is difficult and requires extensive field investigation within the area or question. This is beyond the scope of this investigation and, thus, indirect calculation of recharge by difference is not possible.

Precise direct calculation of recharge in a given area also requires field investigation. Consequently, approximation methods with fairly high degree of uncertainty must be resorted to. The approximation method adopted herein is the best possible under the circumstances.

Application of the method is deliberately biased on the conservative side, attempting not to overestimate recharge. Values obtained possibly fall in the range of 25 percent too high to 50 percent too low. A significant improvement in accuracy would require substantial investigation.

Basically in a zone with favorable ("good") recharge characteristics, 25 percent of the precipitation is considered to be recharged to the ground-water system. Other zones are rated relatively higher or lower. The rating is essentially qualitative and depends upon a combination of factors, including infiltration characteristics of soil and geologic materials, evapotranspiration losses, nature of aquifers, depth to ground water, and amount of precipitation. The basic 25 percent attributed to recharge is substantiated by field evidence in Zone C, discussed later. Also, this is the value used by the U.S. Geological Survey in estimating recharge in similar high altitude-high precipitation portions of the Carson Range, easternmost range of the Sierra Nevada, southeast of the Martis Valley Ground-Water Basin (Worts, 1966; Rush, 1967).

Considering that most of the recharged ground water is ultimately discharged to the Truckee River, it is possible to perform a mass balance of Truckee River flows within the ground-water basin, including gaged input and output on the mainstem and known intra-basin surface-water inputs, to estimate the unknown ground-water input (discharge) by difference. J.A. Westphal (1975) has independently estimated ground-water discharge to the Truckee River within the ground-water basin by the above method. His findings corroborate recharge-discharge estimates of this investigation as given below.

<u>Zone A (Bald Mountain)</u>

Estimated average annual recharge is 3,142 acre-feet (Plate 1, Table 2). An estimated 50 acre-feet per year each are lost by combined spring flow, seepage, and ground-water underflow: 1) out of the basin to the south, 2) to Martis Creek, and 3) to the Truckee River to the west. Of the remainder, an estimated 950 acre-feet per year move downgradient to each of Zones B and D. The remainder, 1,092 acre-feet per year, passes to the northwest into Zone G and the Truckee River. These patterns of ground-water movement are consistent with those shown in Plate 2.

TDPUD water sources at Southside Wells #1 and #2 are largely supported by recharge originating in Zone A.

Zone B (Martis Valley)

Estimated average annual recharge from precipitation is 1,995 acre-feet. Martis Creek and associated tributaries are influent, contributing water to the ground-water body. This loss in stream flow by recharge is estimated to be on the order of a minimum of 1,000 acre-feet per year, about five percent of the average annual discharge of Martis Creek.

Total transfer from Zone B to Zone D is (950 + 1,995 + 1,000 =) 3,945 acre-feet per year.

Zone C (Dry Lake)

Estimated average annual recharge is 2,732 acre-feet. A number of springs, fed by locally-recharged ground water, constitute a local discharge system on the north and west flanks of the area (Plate 2). Data presented by Bateman (1970) indicate an average annual spring discharge of 1,444 acre feet. The remaining recharge, thus, is (2,732 -1,444 =) 1,288 acre-feet per year. A portion of this recharge finds its way to East Martis and Juniper creeks roughly estimated as 100 and 50 acre-feet per year, respectively (Plate 1). The remainder of the recharge, (1,288 - 150 =) 1,138 acre-feet, flows to the north to Zone E (40% - 455 acre-feet per year) and to the west to Zone D (60% - 683 acre-feet per year).

Estimated precipitation in Zone C is 12,416 acre-feet per year (Table 2). Of this, 1,444 acre-feet, 11.6 percent, is discharged by the aforementioned local springs. The surficial Dry Lake flows (Qld), from which the local discharge springs issue, are underlain by older Dry Lake flows and these, in turn, probably are underlain by Lousetown sediments (Qls) and/or Truckee Formation (Tt). The sequence, older Dry Lake through Truckee, receives recharge from the surficial Dry Lake flows above and transmits ground water laterally to the north and west. With 11.6 percent of the available precipitation discharged from the local springs, a total recharge of 22 percent of precipitation (2732 acre-feet/year of recharge divided by 12,416 acre-feet/year of precipitation) is reasonable, if not conservative.

<u>Zone D (Martis Flat)</u>

Estimated average annual recharge is 995 acre-feet. This plus ground-water inflows to Zone D, (995 + 950 + 3,945 + 683 =) 6,573 acre-feet per year, are discharged to the Truckee River along the reach from Truckee to the confluence with Martis

Creek.

Zone E (Juniper Flat)

Estimated average annual recharge from precipitation is 819 acre-feet. Juniper Flat Creek flows across Zone E with estimated average annual flow of 1700 acre-feet from runoff of precipitation and discharge of the local springs in the Dry Lake flows. Ground-water relationships indicate that Juniper Flat Creek should be influent, contributing perhaps five percent of its flow, 85 acre-feet per year, to the ground-water body in the underlying Qld and Tt.

Total of recharge and transfer by flow from Zone C is (455 + 819 + 85 =) 1,359 acre-feet per year. Seepage and minor spring discharge occurs from the Truckee Formation north toward Boca and east toward Hirschdale. These are estimated as 25 acre-feet per year each, leaving a total of 1,309 acre-feet per year discharging from the Truckee Formation (Tt) to the Truckee River in the reach between the confluence with Martis Creek and Boca Hill.

Zone F (Trout Creek)

Estimated average annual recharge is 2,439 acre-feet. Of this, 783 acre feet flow to the north and are lost to the basin by discharge to Alder Creek (Table 2). The remainder, 1,656 acre-feet, flows through Qgm and Qltc materials and discharges to the alluvium-filled flat between Donner Lake and Truckee (Zone G).

TDPUD water sources at Northside Well (in part) are supported by recharge in Zone F.

Zone G (Donner Flat)

This zone is extremely complex from a hydrologic standpoint. A ground water budget may be expressed as follows:

$$D_{SS} + D_{TU} + D_{ET} + D_S + D_P = T_A + T_F + R_P + R_{SW} \qquad (1)$$

where:

D_{SS} = discharge of ground water by seepage to streams,

D_{TU} = discharge by ground-water flow beneath Truckee River toward the east,

D_{ET} = evapotranspiration losses from the ground-water body,

D_S = discharge of springs within Zone G,

D_P = removal of ground water by pumping,

T_A and T_F = transfer of ground water from Zones A and F, about 1,092 and 1,656 acre-feet per year, respectively;

R_P = average annual recharge from precipitation, estimated 728 acre feet; and

R_{SW} = average annual recharge from infiltration of surface water.

No attempt is made at this time to evaluate all terms of equation (1); however, several relationships are of interest, considering that a change in any of the terms in equation

(1) would result in equal and opposite changes in other terms. First, an increase in discharge by pumping (D_P) would be reflected by decrease in other discharges and/or increase in inputs, most likely recharge from surface waters (R_{SW}) and/or precipitation (R_P). Second, decrease in input from Zones A and F (T_A, T_F) due to removal of ground water in these zones would require compensating increases in recharge (R_P, R_{SW}) and/or decrease in discharge terms. Term D_{TU} is of interest because it pertains to the availability of ground water to the east. A substantial thickness of basin materials under the Truckee River at Truckee, California is available for movement of ground water east along the axis of the river.

An approximation of this transfer can be obtained by:

$$D_{TU} = TWI \qquad (2)$$

where:

T = transmissivity, 15,000 gpd/ft from pumping test recovery results at TDPUD's Northside Well;

W = width of flow section., about 3,000 feet; and

I = potentiometric gradient, at Truckee about 100 feet per mile (0.02 ft/ft) toward the east.

Substitution gives an approximate value of D_{TU} = 1,008 acre-feet per year.

Zone H (Alder Hill)

Estimated average annual recharge is 1,615 acre-feet. An estimated 25 acre-feet are lost to the basin by discharge to Alder Creek to the north. Of the remainder, approximately 150 acre-feet move down-gradient to the north to Zone J and 1,440 acre-feet move eastward to Zone I.

Part of the recharge in support of TDPUD's Northside (Zone F) and Prosser Heights (Zone I) Wells originates in Zone H.

Zone I (Prosser Flat)

Estimated annual recharge is 1,445 acre-feet. Of this, 100 acre-feet are considered to discharge to Prosser Creek Reservoir and 300 acre-feet to Prosser Creek below the reservoir. The remainder (1,445 - 100 - 300 =) 1,045 acre-feet, plus input from Zone H, discharge to the Truckee River in the reach between Truckee and the confluence with Prosser Creek. This amounts to (1,045 + 1,440 =) 2,485 acre-feet per year. The underflow from Zone G also discharges to the Truckee River over this reach.

Zone J (Prosser Creek Reservoir)

Estimated annual recharge from precipitation is 1,184 acre-feet. This plus ground-water inflow from Zone H, (1,184 + 150 =) 1,334 acre-feet per year, are discharged to Prosser Creek Reservoir. Prosser and Alder creeks probably are influent where they leave the mountains and pass across alluvial areas. No attempt has been made at this time to approximate this recharge from surface water.

Upgradient Watershed

The watershed which contains the ground-water basin is shown in Plate 1. The upgradient watershed to the west and south of the ground-water basin was not included in the recharge calculations. Approximately 71,000 acres are contained in the upgradient watershed. Annual precipitation within the upgradient watershed ranges from 30 inches in the southeast to 40 inches in the west near Donner Lake.

The upgradient watershed is a large land area with large amounts of precipitation, most of which emerges as streamflow and enters the Truckee River, Donner Lake, or Prosser Creek Reservoir. Infiltration characteristics in the upgradient watershed are very poor because of shallow soil or bedrock exposure at ground surface. Once ground water has entered the Truckee River it does not recharge the ground-water basin. The interaction of the river and the ground-water basin are discussed in section 4.2.2. Leakage from Donner Lake and Prosser Creek Reservoir was not evaluated.

Small amounts of ground-water leakage by fracture flow probably occur from these upgradient areas to adjacent subbasins A through J described in this section. Ground-water leakage probably represents a small amount of the total ground-water budget and is difficult to quantify.

Even though the upgradient watershed probably does not contribute significant recharge to the ground-water basin, the watershed along with all areas within the basin should be regarded as areas where contamination could impact ground-water quality.

4.2.2 Ground-Water Discharge

The present annual water withdrawals from the ground-water basin are summarized in Table 3. The withdrawals are estimated based upon average pumping rates of municipal wells, well yield ratings of industrial wells or average pumping rates if known, and an assumed rate of 500 gallons per day (gpd) for domestic wells. The present average annual withdrawal is estimated to be 7904 acre-feet per year.

An examination of static ground-water levels in wells adjacent to the Truckee River indicates that ground-water levels are higher than the elevation of the Truckee River and therefore, the river is a gaining stream within the ground-water basin. Water flow is therefore from the ground-water basin to the Truckee River at all points along the river.

Discharge to the Truckee River and Prosser Creek (and Reservoir) can be estimated from the preceding estimates of recharge, inter-zone transfers, and intra- and extra-basin discharges to surface water (Section 4.2.1). Intra-basin evapotranspiration losses from the ground-water body probably are relatively small compared to the total amount of ground water being considered and are disregarded. Average annual discharge of ground water within the basin is summarized in Table 4.

A balance for the basin as a whole is as follows:

$$R_P + R_{SW} = D_T + D_{PR} + D_o + D_{ET}$$

where:

R_P = recharge from precipitation,

R_{SW} = recharge from infiltration of surface water,

D_T = discharge to Truckee River,

D_{PR} = discharge to Prosser Creek and Reservoir,

D_o = intra- and extra-basin discharges to surface water, and

D_{ET} = evapotranspiration losses from the ground-water body, taken to be zero.

Substitution, all in acre-feet per year, gives:

$$17{,}094 + 1{,}085 = 11{,}971 + 1{,}734 + 4{,}474$$

$$18{,}179 = 18{,}179 \text{ acre-feet/year}$$

4.2.3 Ground-Water Storage

The surface area of the ground-water basin is approximately 37,600 acres (58.8 square miles, including Prosser Creek Reservoir. Average thickness of water-saturated basin materials is estimated as 400 feet. Taking specific yield of basin materials to be seven percent (0.07), total ground water in storage is 1,050,000 acre-feet. This is equivalent to about 77 years of average annual recharge to intra-basin storage (defined as D_T + D_{PR} = 13,700+ acre-feet per year). The upper 100 feet of water-saturated materials contain an estimated 260,000 acre-feet in storage.

These values are probably on the conservative, low side.

4.2.4 Ground-Water Flow System

Plate 2 is a contour map of ground-water elevation (i.e., potential) within the basin. Ground-water elevation, as presented in Plate 2, is: 1) the pressure elevation to which water will rise when under confined (artesian) condition or 2) the free ground-water level (water table) when under unconfined conditions. Data for Plate 2 are presented in Table 5 and consist of static water elevations in water wells, test wells, and fluid elevations in exploration holes. Where data are lacking, the ground-water surface is projected to be a subdued replica of the land surface.

Ground water flows from high potential to low potential; flow lines showing generalized directions of ground-water flow are included in Plate 2. Ground-water gradients are steep in the recharge areas of the basin and in areas containing aquifer materials with low transmissivity. Ground-water gradients are flat in the center of Martis Valley where large thicknesses of highly transmissive aquifer materials are present.

In general, ground water is recharged in areas of high elevation on the southwest, southeast, and west, and flows downgradient toward discharge areas along the Truckee River, Prosser Creek, and Prosser Creek Reservoir. Discharge of this regional flow is by springs and upward seepage along and beneath the surface-water bodies. The Martis Valley Ground-Water Basin is essentially isolated; negligible inter-basin transfer occurs by underflow to adjacent ground-water basins.

Several areas of local discharge occur within the basin. Of principal importance is a series of springs and seeps along the periphery of Dry Lake area on the southeast (Plate 2) and a less important local discharge on the extreme southwest.

4.3 Well Inventory and Database

An inventory of wells in the Martis Valley Ground-Water Basin was compiled by a search of DWR water well driller report files by TDPUD personnel, and DWR monitoring well network files, TDPUD records, HSI files, Glenshire Mutual Water Company files, Nevada County Environmental Health Department files, Truckee-Tahoe Sanitation Agency files, and Teichert Aggregate files by HSI personnel. These wells were compiled into an electronic database by TDPUD according to township, range, and section. The information in the database includes type of well, depth, screened interval, static water level, and production capacity. Table 6 presents an inventory of wells and Plate 3 locates all wells found during preparation of this plan.

The database was updated by HSI and will be maintained in the future by TDPUD.

4.4 Ground-Water Development

An inventory of annual ground-water withdrawals is presented in Table 3. Withdrawals by TDPUD wells were calculated as an average of the total volume pumped from each well for 1991 through 1993. Tahoe-Donner Wells A and B, owned by TDPUD, were not included in the inventory because these wells are outside the limits of the ground-water basin. Glenshire Mutual Water Company withdrawals were averages for the years 1993 and 1994. Domestic well withdrawals were based upon an assumed useage of 500 gallons per day (gpd) per well. Other well withdrawals were calculated using a known average pumping rate or using the well yield rating as the pumping rate.

Total annual ground-water withdrawals represent approximately 60 percent of the annual ground-water recharge to intra-basin storage (Section 4.2.3). Current annual withdrawal is approximately 7904 acre-feet, of which 3300 acre-feet is from TDPUD, 550 acre-feet is from Glenshire Mutual Water Company, and 4054 acre-feet is from other sources.

Present ground-water levels and directions of flow (Plate 2) are similar to those observed by HSI in 1975. Local dewatering of the aquifer has been observed around some TDPUD production wells. The effects of current ground-water withdrawals on water surface elevations will be evaluated using data collected as part of the monitoring plan (Section 5.0).

Development of the ground-water resource should be done in conjunction with on-going monitoring to evaluate the effects of those withdrawals on water elevations and water quality.

4.4.1 Withdrawal

Sufficient ground water is available to support additional withdrawals in excess of the current withdrawal of 7904 acre-feet. 13,000 acre-feet per year is recommended as a maximum withdrawal on an intermediate term basis. This value is derived from consideration of: 1) estimated average annual recharge to the Martis Valley Ground-Water Basin, 18,000 acre-feet per year (Section 4.2.1), 2) estimated ground-water discharge within the basin to the Truckee River, 12,000 acre-feet per year, and Prosser Creek and Prosser Creek Reservoir, 1,700 acre-feet per year (Section 4.2.2) and 3) recycling of approximately 70 percent of the withdrawn water by return of treated wastewaters and infiltration to ground water, i.e., 9,100 acre-feet per year. Thus, net consumptive disappearance associated with the 13,000 acre-foot withdrawal is about 3,900 acre-feet per year.

The net annual consumptive loss of 3,900 acre-feet is relatively small compared to the amount of water passing through the basin on an annual basis. Nevertheless, an annual withdrawal of 13,000 acre-feet could have substantial local effects and, for the intermediate term, prudence dictates a value on this order.

The 13,000 acre-foot withdrawal is proposed as an intermediate-term value, subject to revision as information from monitoring becomes available on hydrologic effects accompanying withdrawals. The monitoring plan is outlined in Section 5.0.

4.4.2 Hydrologic Effects

Hydrologic effects that may be anticipated include: change in flow rates in portions of the Truckee River and smaller streams, modification of wet areas, change in ground-water levels, variation in ground-water chemical quality, and subsidence of land surface. These effects are due to stresses accompanying withdrawal and redistribution of ground water on the natural dynamic equilibrium state of the hydrologic system. However, due to the large inflow to the Truckee-Tahoe Sanitary District (TTSA) treatment plant from outside the ground-water basin, which is subsequently infiltrated back into the ground-water system, changes to the flow rate of the Truckee River as it leaves Martis Valley will most likely not occur. Inflows to the TTSA treatment plant from outside the ground-water basin (North Tahoe, Incline Village, Squaw Valley, and Alpine Meadows) are greater than inflows generated from within the ground-water basin.

Ground-water levels would be expected to decrease in areas of active pumping and to increase in areas where water is utilized. The latter is due to induced recharge from irrigation, lawn watering, septic tank leach fields, wastewater releases, and the like. Modification of ground-water levels would alter the direction and quantity of ground-water flow within the basin and, thus, would eventually affect the amount of ground water locally discharging to the Truckee River and smaller streams.

A net decline in water levels within the ground-water basin would be expected to decrease the amount of water discharging to the Truckee River. This is due to lowering of ground-water potential gradients toward stream discharge sites and inducing recharge of surface waters in an amount greater than that which occurs under natural conditions. However, pumping of water from subsurface storage at locations removed from streams could result in augmentation of stream flows due to artificial recharge and/or return of treated wastewater at or near the streams. A net lowering of ground-water levels within the basin would tend to diminish the areal extent of wet areas and marshes.

A lowering of ground-water levels within poorly consolidated, readily deformable geologic materials can lead to compaction of the materials and land subsidence. Ground-water declines, however, would have to be very substantial and areally extensive before land subsidence would have a perceptive adverse effect on surface structures.

Urbanization alters characteristics of the hydrologic system. Surface water runoff is increased in quantity and occurs sooner, resulting in greater streamflow which may be accompanied by increased erosion and sediment transport. Evapotranspiration tends to decrease. Recharge tends to decrease because of greater extent of impervious surface. However, the possibility exists for increasing recharge with waters saved by reduction of evapotranspiration.

Utilization of ground water modifies its chemical quality. Irrigation, household usage, and treatment of wastewater adds to and/or concentrates the dissolved chemical constituents. Degradation of chemical quality is expected in areas where utilized water is returned to the hydrologic system, e.g., septic tank leach fields and treated wastewater discharges.

Based on the size of the Martis Valley Ground-Water Basin, geologic materials contained therein, projected amount of ground water removed and returned to the system, imported water from outside the ground-water basin returned to the ground-water system, and anticipated declines in ground-water levels, hydrologic effects associated with an intermediate ground-water withdrawal rate (13,000 acre-feet per year) are expected to be minor. In addition, means exist for monitoring hydrologic effects and negating and/or limiting such adverse effects as may occur; particularly if withdrawal of ground water increases at a gradual rate under controlled conditions.

4.4.3 Controlled Development

Ground-water supply from existing wells and exploration hole sites is sufficient to meet current and near-term demands and hasty, uncontrolled development of new supplies can be avoided. Ample opportunity exists to document the current, undeveloped basin condition, to plan the location and rate of growth of withdrawal, to monitor this growth and accompanying hydrologic effects, and to negate or limit such adverse effects as may occur.

Specific recommendations, designed to monitor hydrogeologic conditions within the ground-water basin, are presented in Section 5.0.

4.5 Water Production Potential

Water production potential zones within the ground-water basin are shown in Plate 4. This plate is a modification of production potential maps by HSI (1975, 1980 and 1992).

The ground-water supply potential map of Plate 4 is based on geologic and ground-water hydrologic information and interpretations available as of this date. Yield calculations for the several areas are based on aquifer testing and production pumping results from the various wells, recent ground-water exploration programs, and DWR drillers reports. Yield ratings assume well construction to industry standards and complete penetration of water-bearing materials. The definition of yield areas is necessarily generalized and subject to a varying degree of uncertainty. HSI does not assume responsibility for failure of a well to yield to the potential suggested by its area designation.

The ground-water basin is divided into four areas (A_1, A_2, A_3, and B) of contrasting favorability for new municipal-type wells (Plate 4). Favorability for development of new wells is generally uniform within each area; however, conditions determining a particular favorability rating may vary within each area.

The basis of the ratings within each area are listed below.

Included are limitations and precautions applicable to utilization of available ground-water supplies.

<u>Area A_1</u>

Yield rating: greater than 1,000 gpm.

Basis of rating:

1. Area of thickest sequence of prolific water-bearing units (Qgo, Qlpc, Qls, Tt); relatively shallow depth to water.
2. Most of the ground-water recharge within the basin passes through this area.
3. Excellent water quality in both shallow and deep existing wells.
4. Includes three high performance wells (Teichert, TDPUD-Airport #2, and Larwin-Joerger #1) and one TDPUD test well (Glenshire Drive) with high yield potential.

Limitations and precautions:

1. Wells should be located some distance from basin boundaries, volcanic vent sites, and major faults; precise distances can be determined through detailed geologic examination, possibly supplemented by surface geophysical surveys.
2. Wells should be spaced so as not to interfere with each other or surface-water features and to intercept the maximum amount of ground water passing through the area.

Area A_2

Yield rating: probable range 500 to 1,000 gpm.

Basis of rating:
1. Area of moderate to thick sequence of prolific water-bearing Units; shallow to moderate depth to water.
2. A transition zone through which passes much of the recharge originating to the west.
3. Water quality in northern part of area is excellent; uncertain, but probably excellent quality water in southern part of area.
4. Includes three shallow to moderate depth wells (TDPUD-Southside #1 & #2 and TDPUD-Donner Creek #2) which tap only upper portion of basin aquifer system. Fully penetrating wells are expected to yield substantial amounts of water, but water quality problems exist in some areas at depths approaching the basement rock. A deep well exists at TDPUD-Northside that is situated in a graben which is south and west of the two principal faults that intersect immediately north of Truckee (Plates A-1 and A-2). Also located in this deep fault trough is the TDPUD-Central Truckee Test Well with a possible production potential of 500 to 800 gpm.
5. Buried alluvial units interbedded with volcanic flows at depth have the potential to yield significant quantities of water east of Alder Hill. TDPUD-Prosser Annex well, completed in this zone; is rated at 900 gpm.

Limitations and precautions:

1. Thickness of saturated prolific water-bearing materials is dependent upon location and displacement of faults and degree of thinning of sedimentary units (Qgo, Qlpc, Qls, Tt) north and west of Area A_1. In each case detailed geologic mapping and, possibly, geophysical surveys would assist in determination of most favorable locations.

2. Wells should be located away from basin boundaries, other wells, and surface-water features.
3. Wells should be spaced to minimize mutual interference and to maximize interception of through-passing recharge.

Area A_3

Yield rating: probable range 100 to 500 gpm.

Basis of rating:

1. Area of fairly thin sequence of water-bearing units, particularly Truckee Formation (Tt) which may be absent in places; moderate to deep water levels.
2. A transition zone similar to A_2 through which considerably less recharge passes.
3. Water quality expected to be excellent on basis of water from wells and springs in Glenshire and Dry Lake regions, TDPUD-Sanders Well, TDA-1 and TDA-2.
4. Includes Glenshire Mutual Water Company Wells #9, 10, 11, and 12; some uncertainty exists as to possible maximum yields of wells which fully penetrate the basin aquifer(s).

Limitations and precautions:

1. Only moderate to thin thicknesses of water-bearing materials exist in this area; in places Truckee Formation may be absent; where the Truckee is present and is the principal source of ground water, as at Glenshire the depth to water is about 200 feet and unit thickness is 200 feet or less.
2. In the Prosser Creek Reservoir region the depth to andesitic rocks may be less than 100 feet in places.
3. In the Dry Lake area, it would be necessary to drill through several hundred feet or more of Dry Lake flows before intersecting possible underlying Truckee and/or Lousetown sediments.
4. Presence of water-bearing units, unit thickness and extent, and best specific locations for wells should be investigated by detailed geologic and geophysical surveys.
5. Wells should be located away from basin boundaries, other wells, volcanic vent sites, and surface-water features.
6. Well spacing in this area is more critical than in Areas A_1 or A_2 to avoid mutual interference of wells intercepting waters from a more limited supply source.

Area B

Yield rating: less than 100 gpm.

1. Area containing negligible to extremely thin sequence of the water-bearing sedimentary units, i.e., Qgo, Qlpc, Qls and Tt. Water levels are variable, but for the most part are moderate to deep.
2. Water quality expected to be excellent based on water from wells in the Glenshire area.
3. Well yields of 100 gpm or more possible in fractures or faulted zones.

Limitations and precautions:

1. Detailed field geologic investigation and coordinated surface geophysical surveys would be necessary to locate zones of higher ground-water favorability.
2. Prolific aquifers are expected to be absent or quite limited in thickness over the majority of the area.
3. Deep water levels are anticipated in the Bald Mountain, Juniper Flat, and Dry Lake areas and for the majority of the Trout Creek drainage.
4. Presence of the relatively impermeable andesitic rock sequence (Ta, Tab and Tau) underlying the area at a shallow depth. This is particularly the case in the Trout Creek drainage and the area west of Bald Mountain.
5. Wells should be located away from basin boundaries, volcanic vent sites, other wells, and surface-water features.
6. Well spacings are more critical in area B than in the other areas. Every effort should be made to avoid mutual interference of closely spaced wells intercepting a limited supply of water within the same geologic structure or thin aquifer sequence.
7. Well yields subject to seasonal recharge.

Section 5

5.0 GROUND-WATER MONITORING PLAN

A ground-water monitoring plan is recommended to 1) establish the current static ground-water level surface to enable comparison with historic water levels; 2) track static water levels over time to evaluate changes due to recharge variations (drought conditions) and ground-water pumping; and 3) maintain a database of ground-water usage for all users to assure a continued supply of high quality water for the residents of the Truckee area.

5.1 Data Collection

Data collection activities includes initial (one-time) data collection followed by on-going data collection.

5.1.1 Initial Data Collection

Initial data collection activities are summarized below and in Table 7.

1) Measure current static water levels and pumping rates of all TDPUD municipal wells, Glenshire Mutual Water Company wells, Donner Lake Water Company wells, Teichert wells, Sha-Neva well, Hobart Mills well, and other municipal, industrial, and irrigation wells. It is important to obtain current static water levels as the levels used to construct Plate 2 were measured over a time period of more than 30 years. Wells are

listed in Table 7.

2) Measure static water levels in selected domestic and monitor wells including wells owned by TDPUD, Glenshire Mutual Water Company, California Department of Water Resources, and Truckee-Tahoe Sanitation Agency (TTSA). Wells are listed in Table 7.

3) Update well inventory and estimate ground-water usage for all users. Nevada County and Placer County files containing well logs and well permits should be checked against the DWR wells entered into the TDPUD database.

Efforts will be made to coordinate initial data collection activities with the existing schedule of water level monitoring performed by DWR and TTSA staff. DWR staff monitor water levels biannually in the spring and fall. TTSA staff monitor water levels monthly with more extensive monitoring occurring annually.

Static water levels will be compiled from the various well owners, placed into a database that will be managed by TDPUD, and an initial static water level map will be prepared after field checks of well locations.

Pumping rates and other well information will also be placed into a database managed by TDPUD.

5.1.2 On-Going Data Collection

On-going data collection activities are summarized below and in Table 7.

1) Measure static and pumping water levels on a monthly basis for municipal wells and biannually for industrial wells, irrigation wells, selected monitoring wells, and selected domestic wells.

2) Measure pumping rates and cumulative volumes pumped monthly for all municipal, industrial, and irrigation wells.

3) Enter data into database and construct biannual static water level maps and annual summary of ground-water withdrawal.

Section 6

6.0 SOURCES OF INFORMATION

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Letters

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Tables

Table 1. CORRELATION OF GEOLOGIC UNITS

Birkeland (1962,1963)as modified by HSI (1975, 1980)		**Latham (1985)**	
Qal	Alluvium	Qpal	Recent Alluvium
		Qpls/Qpt	Landslide/Talus
Qgm	Glacial moraine and til	Qpg	Glacial deposits
Qgo	Glacial Outwash		
		Qpf/Qpter	Alluvial fan/terrace deposits
LOUSETOWN FORMATION		**MARTIS VALLEY FORMATION**	
Qlpc	Prosser Creek Alluvium	Qpmvp	Prosser Creek Member
Qlj	Juniper Flat Alluvium	Qpmvu	Union Valley Member
		BALD MOUNTAIN FORMATION	
Qlc	Lousetown Formation cone	Qpbmc	Olivine shoshonite cinder cones
Qlcc	Lousetown Formation cinders		
Qlbm	Bald Mountain latite	Qpbm	Olivine shoshonite flows
Qlh	Hirschdale latite	Qpbmj	Juniper Flat flows
		Qpbmt	Basaltic tuff
Qlbc	Big Chief basalt	Qpbu	Olivine basalt
		BOCA RIDGE FORMATION	
Qlb	Boca Ridge flows	Tpbr	Olivine basalt
Qltc	Trout Creek flow	Tpbrac	Alder Creek flow
Qlc	Lousetown Formation cone	Tpbrb	Beacon Hill flow
Qlp	Polaris latite	Tpbrp	Polaris flow
Qlh	Hirschdale latite	Tpbrh	Hirschdale flows
		Tpbrbm	Big Meadows flow
		HUNTER LAKE FORMATION	
		Tphl	Hypersthene andesite
Qla	Alder Hill basalt	Tphla	Alder Hill flows
		Tphli	Intrusion
Qlu	Lousetown volcanics, undifferentiated		
Qls	Lousetown sediments, undifferentiated		
		COAL VALLEY FORMATION	
Qld	Dry Lake flows	Tpcvd	Dry Lake flows
	TRUCKEE FORMATION		
Tt	Truckee Formation	Tpcv	Stream and lake deposits
		KATE PEAK FORMATION	
Ta	Andesite flow	Tmpkp	Andesite lava flows, tuff-breccias, and tuffs
Tab	Andesite breccia		
Tau	Andesite, undifferentiated		
Tac	Andesite cone		
Kg	Granitic intrusives	Mgr	Plutonic rocks, primarily granodiorite

Table 2. Estimated Recharge by Zone(1), Martis Valley Ground-Water Basin.

Zone	Estimated Average Elevation (feet, msl)	Infiltration Characteristics	Average Annual Precipitation (inches)	Area (acres)	Precipitation (acre-feet/year)	Recharge (percent)	Recharge (acre-feet/year)	Other Recharge
A	6250	good	32	4,707	12,568	25	3,142	
B	5900	good	28	3,424	7,978	25	1,995	Estimated 1,000 acre-feet additional recharge from infiltration of streamflow.
C	645	good	24	6,208	12,416	22	2,732	
D	5825	poor to fair	27	3,539	7,963	12.5	995	
E	5900	poor to fair	23	3,418	6,551	12.5	819	Estimated 85 acre-feet additional recharge from infiltration of streamflow.
F (south) (north)	6325 6525	fair to good good	36 37.5	2,208 928	6,624 2,900	25 27	1,656 783	
G	5900	good to excellent	35	998	2,912	25	728	No estimate made of possible recharge by infiltration of streamflow.
H	6200	good	32	2,419	6,459	25	1,615	.
I	5825	poor to fair	27	5,139	11,563	12.5	1,445	
J	5850	poor to fair	30	3,789(2)	9,472	12.5	1,184	No estimate made of possible recharge by infiltration of Alder and Prosser Creek waters
Totals	---	---	---	36,777	---	---	18,179(3)	

(1) See Plate 1
(2) Does not include Prosser Creek Reservoir, 829 acres.
(3) 18,179 acre-feet/year total recharge includes 17,094 acre-feet/year recharge by precipitation plus 1,000 and 85 acre-feet/year recharge by infiltration of streamflow in zones B and E, respectively.
msl = mean sea level

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Table 3. Annual Ground-Water Withdrawals by Water Wells, Martis Valley Ground-Water Basin

Township	Range	Section	Well Designation [1]	Average Discharge [2]		
				Gallons per minute (gpm)	Gallons per year	Acre-feet per year
17N	16E	1	3-Domestic	3x500 gpd	547,500	1.68
		1	108026	300	157,680,000	483.68
		1	108046	300	157,680,000	483.68
		3	62534 (Prosser Heights)	185	97,236,000	298.27
		6	Tahoe Donner #1	unknown	unknown	unknown
		6	TDA - 1[3]	267	82,278,720	252.39
		6	TDA - 2[3]	140	43,142,400	132.34
		9	Tahoe Donner #2	unknown	unknown	unknown
		10	37905 (Sanders)	53	27,734,133	85.07
		11	65422	400	210,240,000	644.91
		11	1 - Domestic	1x500 gpd	182,500	0.56
		13	116960 (Airport #2)	1200	630,608,333	1934.38
		14	Ponderosa Golf Course	unknown	unknown	unknown
		14	62502 (Southside #1)	65	34,244,667	105.04
		15	116952 (Northside)	324	170,307,000	522.41
		16	2 - Domestic	2x500 gpd	365,000	1.12
		16	10612 (Donner CK #2)	222	116,675,333	357.90
		17	155334	70	36,792,000	112.86
17N	17E	3	2 - Domestic	2x500 gpm	365,000	1.12
		4	3 - Domestic	3x500 gpd	547,500	1.68
		4	Glenshire #1A	23	11,910,531	36.54
		4	Glenshire #14	18	9,546,400	29.28
		4	Glenshire #15	21	10,918,530	33.49
		5	1 - Domestic	1x500 gpd	182,500	0.56
		5	75013 (Glenshire #9)	23	12,307,153	37.75
		5	Glenshire #10	71	37,404,074	114.74
		5	Glenshire #11	125	65,764,972	201.73
		5	75014 (Glenshire #12)	60	31,485,071	96.58
		6	1 - Domestic	1x500 gpd	182,500	0.56
		7	1 - Domestic	1x500 gpd	182,500	0.56

Table 3. Annual Ground-Water Withdrawals by Water Wells, Martis Valley Ground-Water Basin (Continued)

Township	Range	Section	Well Designation [1]	Average Discharge [2]		
				Gallons per minute (gpm)	Gallons per year	Acre-feet per year
17N	17E	8	290869 (Teichert)	1200 [4]	285,120,000	874.60
		8	Teichert 5	250 [4]	59,400,000	182.21
		8	Teichert 6	250 [4]	59,400,000	182.21
		8	3 - Domestic	3x500 gpd	547,500	1.68
		9	12 - Domestic	12x500 gpd	2,190,000	6.72
		10	6 - Domestic	6x500 gpd	1,095,000	3.36
		29	Northstar Golf Course	unknown	unknown	unknown
18N	16E	22	1 - Domestic	1x500 gpd	182,500	0.56
		22	302423	150	78,840,000	241.84
		35	1 - Domestic	1x500 gpd	182,500	0.56
		36	47333	146	76,737,600	235.39
		36	50- Domestic	50x500 gpd	9,125,000	27.99
18N	17E	27	1 - Domestic	1x500 gpd	182,500	0.56
		27	233946	100	52,560,000	161.23
		28	7 - Domestic	7x500 gpd	1,277,500	3.92
		32	1 - Domestic	1x500 gpd	182,500	0.56
		33	1 - Domestic	1x500 gpd	182,500	0.56
		34	1 - Domestic	1x500 gpd	182,500	0.56
		34	199696 (Hirschdale)	5	2,708,933	8.31
Total						7904

(1) California Department of Water Resources Water Well Driller's Report (DWR Report) number listed if available. The total number of domestic wells within a section are listed without DWR Report numbers.

(2) Discharge is calculated based upon flowmeter readings (1991 - 1994) or average pumping rate if known, otherwise the well yield rating is used. Domestic wells are assumed to pump 500 gallons per day (gpd). Discharge for domestic wells is the combined discharge for all wells within a section. Truckee Donner Public Utility District's (TDPUD) Prosser Annex, Southside #2, and Donner Creek #1 are not included because the wells are not presently part of the water system.

(3) Wells assumed to be pumped April 1 - October 30.

(4) Wells pumped April 1 - November 20.

Table 4. Average Annual Discharge of Ground Water, Martis Valley Ground-Water Basin

	Zone					
	A	G	D	I	E	Total
Truckee River (West of Bald Mountain to its confluence with Prosser Creek).	50 + 546[1]	1,008 +[2]	6,573	2,485	1,309	11,971 + 12,000 + (rounded)

	I	J	Total
Prosser Creek and Reservoir	400	1,334[3]	1,734 + 1,700 + (rounded)

(1) One-half transfer of 1,092 acre-feet from Zone A to Zone G assumed to discharge to Truckee River (Plate 1).

(2) Includes 1,008 acre-feet per year transferred to Zone I and ultimately discharged to Truckee River but does not include discharge of unknown quantity of ground water to Truckee River within Zone G (Plate 1).

(3) Does not include unknown discharge of possible ground-water recharge from Alder Creek.

Table 5. Ground-Water Elevations of Selected Wells, Martis Valley Ground-Water Basin.

Township	Range	Section	Well [1] Designation	Well Depth (feet, bgs)	Ground Surface Elevation (feet, msl)	Depth to Water (feet, bgs)	Ground Water Elevation (feet, msl)
17N	15E	01M	10624	317	6980	150	6830
17N	16E	1C	10613	208	5840	39	5801
		1K	312953	210	5920	90	5830
		3A	Prosser Annex	859	6256	356	5900
		3R1	62534	406	6000	246	5754
		6N	TDA-1	810	6600	482	6118
		10H	37905	783	5980	140	5840
		11P	57837	40	5770	9	5761
		12J	Glenshire Dr. Test	1006	5740	31	5709
		13H	13H1	64	5791	56	5735
		13R1	116960	1027	5880	172	5708
		14E	62502	578	5860	63	5797
		15C	116952	927	5960	191	5769
		15E	Central Truckee Test	776	5880	58	5822
		16L	10612	112	5880	36	5844
		17D	155334	400	6240	180	6060
		17F	17F2	---	5923	13	5910
		19G1	372323	98	6133	26	6107
		23R	Larwin-Joerger #2	---	6000	74	5926
17N	17E	4A	Glenshire #15	---	5895	113	5782
		4K	Glenshire #1A	---	5920	201	5719

Table 5. Ground-Water Elevations of Selected Wells, Martis Valley Ground-Water Basin. (Continued)

Township	Range	Section	Well [1] Designation	Well Depth (feet, bgs)	Ground Surface Elevation (feet, msl)	Depth to Water (feet, bgs)	Ground Water Elevation (feet, msl)
		5A	75014	284	5850	210	5640
		5D1	365666	109	5684	76	5608
		5F	75013	300	5760	190	5570
		6D1	372324	185	5828	86	5742
		7A	TTSA-21	---	5682	13	5669
		7J	TTSA-23	---	5758	58	5700
		7P	7P1	64	5793	50	5743
		8A	433296	620	6200	520	5680
		8H	233973	530	6240	350	5890
		8N	290869	960	5815	37	5778
		9E	233929	463	6320	301	6019
		9K	108047	400	6520	360	6161
		9P	312980	785	6640	650	5990
		10P	312970	970	6700	521	6179
		11C	65430	610	6500	150	6350
		18C	18C1	64	5793	56	5737
		19H	Larwin-Joerger #1	---	5880	90	5790
		19K1	372325	197	5863	72	5791
		29B2	372831	100	5883	5	5878
18N	16E	14D	75001	300	6080	167	5913

Table 5. Ground-Water Elevations of Selected Wells, Martis Valley Ground-Water Basin.
(Continued)

Township	Range	Section	Well [1] Designation	Well Depth (feet, bgs)	Ground Surface Elevation (feet, msl)	Depth to Water (feet, bgs)	Ground Water Elevation (feet, msl)
		22A	302423	250	5880	40	5840
		31P	TDA-2	834	6600	250	6350
		36L	65419	140	5800	30	5770
		36R	119902	100	5820	43	5777
18N	17E	28R	199655	410	5920	280	5640
		33L	365669	195	5923	181	5742
		34F	199696	383	5540	117	5423

(1) California Department of Water Resources Water Well Driller's Report (DWR Report) number listed if available.
bgs = below ground surface
msl = mean sea level

TABLE 6. Well Inventory, Martis Valley Ground-Water Basin

Township	Range	Section	DWR Well No.	Well Owner	Well Depth (feet)	Static Water Level (feet)	Well Yield (gpm)
17N	15E	01M	10624	Truckee Donner PUD	317.	150.	285
17N	15E	01M	10625	Truckee Donner PUD	0.	150.	100
17N	15E	13B	0	Mac Keever A	32.	0.	0
17N	16E	04	312951	BLARE DUANE	485.	90.	50
17N	16E	1	108026	Roth John	500.	100.	300
17N	16E	1	108046	Roth John	500.	330.	300
17N	16E	1	129663	Giantvalley R. L.	90.	25.	15
17N	16E	1	144038	JOERGER TOM	103.	0.	25
17N	16E	10H	37905	TDPUD	783.	140.	300
17N	16E	11F1	365670	BANK OF CALIFORNIA C/O TRUST 250.	208.	0	
17N	16E	11M	65422	SHANE PAT	673.	0.	400
17N	16E	11P	57837	DANIELS FLOYD	40.	9.	30
17N	16E	13	290872	A. TEICHERT & SON			
17N	16E	13H			64.	47.5	
17N	16E	13K1	364901	TT AIRPORT DISTRICT	500.	0.	0
17N	16E	13K3	375721	TT AIRPORT DISTRICT	500.	0.	0
17N	16E	13K4	374803	TT AIRPORT DISTRICT	500.	0.	0
17N	16E	13R1	116960	Truckee Donner PUD	027.	172.	140
17N	16E	14E	62502	TDPUD	578.	0.	164
17N	16E	15C	116952	TDPUD	927.	103.	700
17N	16E	16C	304317	BIG O TIRES	10.	4.	0
17N	16E	16C	384318	BIG O TIRES	5.	4.	0
17N	16E	16F	43631	TTUSD	30.	12.	50
17N	16E	16F	62503	TTUSD	300.	9.	118
17N	16E	16F	271545	WALTON ENGINEERING	10.	0.	0
17N	16E	16L	10612	Truckee Donner PUD	112.	36.	580
17N	16E	16L	10612	Truckee Donner PUD	112.	36.	580
17N	16E	16L	27394	TDPUD	85.	20.	250
17N	16E	16N	10559	VITA-BARK, INC.	0.	0.	0
17N	16E	16Q	10602	WALLING DAVE	160.	90.	35
17N	16E	17A	37901	DART RESORTS	931.	0.	0
17N	16E	17A	180922	DART RESORTS	0.	0.	0
17N	16E	17D	155334	DONNER LAKE UTILITY CO.	400.	180.	135
17N	16E	17F	27055	TDPUD	200.	0.	8
17N	16E	17F	27056	TDPUD	142.	0.	6
17N	16E	17F	272119	CHEVRON USA IN.	30.	8.	0
17N	16E	17F	272139	CHEVRON USA INC.	30.	8.	0
17N	16E	17F			13.6		
17N	16E	19G	372323	HARVEY WALTER	100.	26.	0
17N	16E	1C	10613	TRUCKEE DONNER PUD	208.	39.	250
17N	16E	1K	312953	THOMAS BILL	210.	90.	70
17N	16E	3R1	62534	Truckee Donner PUD	406.	246.	36
17N	16E	7N	0	DONNER LAKE DEVELOPMENT	115.	0.	80
17N	17E	-0-	81008	SHEPARD ROBERT	180.	90.	5
17N	17E	02	233952	LAKE THOMAS	115.	30.	10
17N	17E	03	119926	MC LANEY RON	500.	0.	1
17N	17E	03	233934	HOPKINS REALTY	252.	0.	12
17N	17E	03A	197306	SULLIVAN MIKE	195.	0.	6
17N	17E	03A	233980	LAKE THOMAS	115.	30.	10
17N	17E	03D	197307	LENEY GLEN	195.	0.	22
17N	17E	05	54753	GENERAL AMERICAN DEV CORP	355.	0.	0
17N	17E	05F	75013	INNISFREE CORPORATION	300.	190.	200
17N	17E	07	119958	WEEM CLYDE	237.	180.	20
17N	17E	08A	433296	AUERBACH WALTER	620.	520.	5
17N	17E	08A	433312	AUERBACH WALTER	620.	0.	5
17N	17E	08H	233973	HOLLOWAY K.C.	530.	350.	12
17N	17E	08N	290869	A. TEICHERT & SON	960.	37.	150

TABLE 6. Well Inventory, Martis Valley Ground-Water Basin (Continued)

Township	Range	Section	DWR Well No.	Well Owner	Well Depth (feet)	Static Water Level (feet)	Well Yield (gpm)
17N	17E	09	119970	ORME DONALD J.	180.	35.	15
17N	17E	09	119971	HARBERT RICHARD	0.	350.	60
17N	17E	09C	137288	HARTWELL DAN	165.	0.	3
17N	17E	09E	233929	BEAM TIM	463.	301.	25
17N	17E	09G	101016	GOODSTEIN ROBERT	600.	0.	0
17N	17E	09H	119949	QUINAM JIM/MARYANNE	475.	0.	1
17N	17E	09H	233988	SLATER FRED	420.	350.	20
17N	17E	09J	233949	SAHLIN HEBERT	341.	250.	15
17N	17E	09K	65423	OLDHAM JAMES	615.	490.	0
17N	17E	09K	108047	WALTERSCHEID STANLEY	400.	360.	9
17N	17E	09L	233960	GOODSTEIN ROBERT	675.	575.	12
17N	17E	09M	433551	SINDT EDDIE	578.	0.	0
17N	17E	09P	312980	FERRIN DAVID	785.	650.	20
17N	17E	10E	137290	HUGHES DAVID	200.	0.	4
17N	17E	10F	137289	DONNELLY D.	230.	0.	0
17N	17E	10F	137291	DONNELLY DR.	0.	0.	0
17N	17E	10M	233992	NORTON PHILLIP	711.	456.	15
17N	17E	10N	119946	MARGROFF JOHN	260.	0.	30
17N	17E	10P	312970	MEANS GARY	970.	521.	25
17N	17E	10R	101080	HOSKINS RICHARD	350.	0.	0
17N	17E	11	65416	BOSDA & SKIDMORE	660.	0.	0
17N	17E	11	119961	KNEEDLEN BILL	340.	100.	12
17N	17E	11	233953	BERGER ROBERT	105.	30.	15
17N	17E	11	233965	AMIS WOODY	436.	35.	40
17N	17E	11	233971	INMAN ARTHUR	836.	450.	3
17N	17E	11C	65430	KNOX DONNA	610.	150.	70
17N	17E	11H	119968	BARTON ERNIE	183.	90.	25
17N	17E	11H	119969	CLOSE CRAIG	0.	190.	30
17N	17E	11J	65412	THOMPSON GEORGE	310.	50.	25
17N	17E	11K	119952	HALL SHERWOOD	260.	160.	20
17N	17E	11M	59881	RIDGLEY STEVE	450.	0.	60
17N	17E	11P	233995	SKIDMORE CYNTHIA	610.	400.	10
17N	17E	12P	233974	HARRIS BOB	205.	35.	70
17N	17E	13	233986	CLARK RICHARD	289.	60.	40
17N	17E	13G	312988	SCHUCK JOHN	335.	130.	20
17N	17E	14	81033	BRICE BOB	250.	84.	2
17N	17E	14A	233961	CAREY ED	510.	60.	10
17N	17E	18C			64.	59.4	
17N	17E	18E			300.	87.5	
17N	17E	19K1	372325	U.S.ARMY CORPS/ENGINEERS	201.	73.	0
17N	17E	29B1	372832	FIBERBOARD CORP.	148.	5.	0
17N	17E	29B2	372831	FIBERBOARD CORP.	100.	5.6	0
17N	17E	4	137221	CAREY LENARD	285.	135.	35
17N	17E	4	137226	CAREY LEANARD	205.	83.	40
17N	17E	4F		LODATO J.S.	96.	8.	9
17N	17E	5	60804	INNISFREE CORPORATION	300.	0.	0
17N	17E	5	60806	INNISFREE CORPORATION	288.	0.	4
17N	17E	5	60814	WALDORF J.M.	125.	0.	0
17N	17E	5A	75014	INNISFREE CORPORATION	284.	210.	30
17N	17E	5D1	365666	SAN FRANCISCO FLY CASTING	140.	76.6	0
17N	17E	6D	27057	FOX JACK	161.	65.	75
17N	17E	6D1	372324	ROTH JULIE	202.	86.9	0
17N	17E	7P			64.	52.2	
17N	17E	9H	290892	BROWN TOM	615.	500.	10
18N	16E	12	45961	SCIARONI WILLIAM	100.	0.	50
18N	16E	12	45965	WETTEMANN DENNIS	120.	0.	25
18N	16E	12	45966	HUGHES ROBERT	115.	0.	10
18N	16E	12	119931	WILBER VERILE	322.	277.	10
18N	16E	12J	101078	COLSON TOM	325.	0.	40

TABLE 6. Well Inventory, Martis Valley Ground-Water Basin (Continued)

Township	Range	Section	DWR Well No.	Well Owner	Well Depth (feet)	Static Water Level (feet)	Well Yield (gpm)
18N	16E	12R	59876	MORGAN MICHAEL	460.	200.	7
18N	16E	14D	75001	TIMBER TRAILS INC.	300.	167.	60
18N	16E	22	52304	COMBS EARL	148.	100.	15
18N	16E	22A	302423	FIBREBOARD CORPORATION	250.	40.	150
18N	16E	22H01	365668	FIBERBOARD CORPORATION	200.	38.	0
18N	16E	34	52305	PARODEE R.B.	140.	10.	12
18N	16E	35	129565	DUTTWEILER JACK	86.	50.	15
18N	16E	36	19090	COLTREN	73.	0.	0
18N	16E	36	31612	DUTTWIELER JACK	175.	0.	30
18N	16E	36	38882	CROSS EMBREE	100.	0.	10
18N	16E	36	45962	PAGE DAVID	115.	0.	40
18N	16E	36	47333	GARDAI GEORGE	200.	135.	146
18N	16E	36	49563	OLSON ERWIN	125.	0.	60
18N	16E	36	49564	RUSSELL RANDY	125.	0.	75
18N	16E	36	59895	BERGSTROM GREG	170.	50.	15
18N	16E	36	59896	ROSS FRANK	170.	50.	15
18N	16E	36	101008	MC COY STEVE	0.	0.	80
18N	16E	36	111413	USRI JAMES	71.	0.	10
18N	16E	36	119910	THOMAS BOB	122.	60.	30
18N	16E	36	119947	MITCHELL RICHARD	121.	63.	20
18N	16E	36	119948	MITCHELL RICHARD	158.	69.	29
18N	16E	36	129587	DUTTWEILER JACK	80.	50.	6
18N	16E	36	129588	BALDING DON	90.	60.	6
18N	16E	36	129652	GARDAI GEORGE	82.	20.	0
18N	16E	36	129666	DUTTWEILER JACK	90.	80.	10
18N	16E	36	129667	KERSHAW BERT	70.	30.	10
18N	16E	36	129669	MILLER BOB	60.	25.	16
18N	16E	36	129683	SPENCER CHARLES	140.	100.	12
18N	16E	36	137104	POPPOFF MARK	100.	69.	6
18N	16E	36	153113	MORRISON JAMES	150.	0.	0
18N	16E	36	155710	MC COY STEVE	155.	0.	60
18N	16E	36	168296	DAVE	135.	18.	20
18N	16E	36	186854	DAVIS STEVE/NANCY	125.	28.	50
18N	16E	36	199676	JOHNSON LLOYD/LISSA	118.	45.	20
18N	16E	36	233993	AIELLO DAVE	126.	20.	35
18N	16E	36	238488	FAIFEREK ROLAN/LEE	80.	0.	60
18N	16E	36J	59873	MC KINZIE PAUL	90.	40.	35
18N	16E	36J	302419	GALLAHER STEVE	150.	105.	12
18N	16E	36L	65419	BRANNON DONALD	140.	30.	20
18N	16E	36L	65426	DE GRAZIER MARK	131.	30.	20
18N	16E	36L	65427	HEYDON TERRY	130.	0.	40
18N	16E	36L	233904	WATTS JOHN	100.	30.	20
18N	16E	36L	233905	SAYLOR BARRY	51.	19.	25
18N	16E	36L	233989	OSBURN JIM	113.	30.	30
18N	16E	36M	31616	DUTTWEILER JACK	183.	0.	80
18N	16E	36M	150940	BRAND JOHN	100.	0.	15
18N	16E	36N	31618	SPENCER JOAN	150.	0.	20
18N	16E	36N	38890	DUTTWEILER JACK	158.	75.	50
18N	16E	36N	65425	HISKENS ROD	131.	30.	22
18N	16E	36N	150939	HART RICHARD	155.	0.	20
18N	16E	36P	168276	OLSON KEN/BARBARA	100.	30.	20
18N	16E	36P	207732	PHILLIPS CATHERYN	92.	58.	30
18N	16E	36Q	59894	ROGHERS BERNIE	160.	50.	15
18N	16E	36Q	119903	STELLA JOE	122.	50.	30
18N	16E	36Q	119905	GARDAI GEORGE	150.	0.	30
18N	16E	36Q	119915	GAUCTHI RUDY	175.	89.	20
18N	16E	36R	119902	HEDSTRUM NORM	100.	43.	25
18N	16E	36S	111410	GARDAI GEORGE	120.	0.	0
18N	17E	06	60641	WOOD VANCE	140.	0.	20

TABLE 6. Well Inventory, Martis Valley Ground-Water Basin (Continued)

Township	Range	Section	DWR Well No.	Well Owner	Well Depth (feet)	Static Water Level (feet)	Well Yield (gpm)
18N	17E	06	119904	ZARKER BILL	122.	30.	8
18N	17E	06	207716	WALLER RICHARD	260.	86.	7
18N	17E	06	379858	CAROLL RON/ISABELL	192.	80.	30
18N	17E	06C	60649	DUNCAN MASON J.	350.	0.	12
18N	17E	06F	60642	RILEY DOHN	100.	0.	15
18N	17E	06F	184751	OESTENEICH KEN	120.	35.	1
18N	17E	06G	60643	SEABORG DAN	200.	0.	8
18N	17E	06M	19082	DUTTWEILER J.R.	103.	0.	0
18N	17E	06N	60645	JOHNSON RUSSELL	135.	0.	100
18N	17E	27	233946	SHA NEVA PLANT #2	702.	450.	100
18N	17E	27E	312977	ACEVEDO RICHARD	189.	120.	125
18N	17E	27J	219192	WEST DICK	365.	0.	15
18N	17E	28	119938	JOHNSON WILLIAM	280.	222.	25
18N	17E	28	199654	WALKER ROBERT/LILY	152.	83.	80
18N	17E	28	233950	ACEVEDO JOE	315.	205.	0
18N	17E	28	233955	ACEVEDO JOE	325.	250.	50
18N	17E	28	233956	ACEVEDO JOE	325.	250.	17
18N	17E	28R	65421	HARTWELL CLIFF	610.	440.	45
18N	17E	28R	199655	STICKKINEN RISTO/JUDY	410.	280.	23
18N	17E	32F	75002	THE ENNISFREE CORPORATION	199.	0.	420
18N	17E	32M	181525	CA DEPT OF TRANSPORTATION	250.	0.	100
18N	17E	33	233926	ACEVEDO RICHARD	611.	453.	25
18N	17E	33L1	365669	TRUCKEE FIRE PROTECTION	200.	180.5	0
18N	17E	34	121879	SIERRA SKIES	125.	48.	35
18N	17E	34F	199661	Truckee Donner PUD	700.	0.	20
18N	17E	34F	199661	Truckee Donner PUD	700.	0.	20
18N	17E	34F	199662	Truckee Donner PUD	383.	117.	0
18N	17E	34F	199662	Truckee Donner PUD	383.	117.	0
18N	17E	34F	199669	Truckee Donner PUD	130.	0.	0
18N	17E	34FO1M	199696	Truckee Donner PUD	383.	0.	73
18N	17E	34FO1M	199696	Truckee Donner PUD	383.	0.	73

Table 7. Monitoring Program, Martis Valley Ground-Water Basin							
Well Owner	Well Type	Well Designation[1]	Measurement	Frequency	Town-ship	Range	Section
TDPUD	Municipal	Tahoe Donner A (10624)	SWL, PWL, P	I, M	17N	15E	1M
	Municipal	Prosser (10613)	SWL, PWL, P	I, M	17N	16E	1C
	Municipal	Prosser Annex	SWL, PWL, P	I, M			3A
	Test	Prosser Annex	SWL	I, B			3A
	Municipal	Prosser Heights (62534)	SWL, PWL, P	I, M			3R
	Municipal	Sanders (37905)	SWL, PWL, P	I, M			10H
	Municipal	Airport #2 (116960)	SWL, PWL, P	I, M			13R
	Test	Southside	SWL	I, B			14E
	Municipal	Southside #1 (62505)	SWL, PWL, P	I, M			14E
	Municipal	Southside #2	SWL, PWL, P	I, M			14E
	Municipal	Northside (116952)	SWL, PWL, P	I, M			15C
	Test	Central Truckee	SWL	I, B			15E
	Test	Intermediate School	SWL	I, B			16F
	Municipal	Donner Creek #2 (10612)	SWL, PWL, P	I, M			16L
	Municipal	Hirschdale (199696)	SWL, PWL, P	I, M	18N	17E	34F
	Municipal	Tahoe Donner #1	SWL, PWL, P	I, M	17N	16E	6N
	Municipal	Tahoe Donner #2	SWL, PWL, P	I ,M			9D
Glenshire Mutual Water Company	Municipal	Glenshire #1A	SWL, PWL, P	I, M	17N	17E	4J

Table 7. Monitoring Program, Martis Valley Ground-Water Basin							
Well Owner	Well Type	Well Designation[1]	Measurement	Frequency	Township	Range	Section
Glenshire Mutual Water Company	Test	Glenshire #8	SWL	I, B	18N	17E	32F
	Municipal	Glenshire #9 (75013)	SWL, PWL, P	I, M	17N	17E	5F
	Municipal	Glenshire #10	SWL, PWL, P	I, M			5C
	Municipal	Glenshire #11	SWL, PWL, P	I, M			5F
	Municipal	Glenshire #12 (75014)	SWL, PWL, P	I, M			5A
	Municipal	Glenshire #14	SWL, PWL, P	I, M			4A
	Municipal	Glenshire #15	SWL, PWL, P	I, M			4A
Tahoe Donner	Irrigation	TDA-1	SWL, PWL, P	I, B	17N	16E	6N
Tahoe Donner	Irrigation	TDA-2	SWL, PWL, P	I, B	18N	16E	31P
Donner Lake Utility Co.	Municipal	155334	SWL, PWL, P	I, M	17N	16E	17D
Shane	Industrial	65422	SWL, PWL, P	I, B			11M
Roth	Municipal	108026	SWL, PWL, P	I, B			1
Roth	Municipal	108046	SWL, PWL, P	I, B			1
Teichert	Industrial	290869	SWL, PWL, P	I, B	17N	17E	8
Teichert	Industrial	Teichert #5	SWL, PWL, P	I, B			8
Teichert	Industrial	Teichert #6	SWL, PWL, P	I, B			8
Fiberboard Corporation	Industrial	302423	SWL, PWL, P	I, B	18N	16E	22A
Fiberboard Corporation	Test	365668	SWL	I, B			22H
Sha Neva	Industrial	233946	SWL, PWL, P	I, B	18N	17E	27P
DWR	Test	11F1	SWL	I, B	17N	16E	11F
		13H1	SWL	I, B			13H
		17F2	SWL	I, B			17F
		19G1	SWL	I, B			19G
		5D1	SWL	I, B	17N	17E	5D
		6D1	SWL	I, B			6D
		7P1	SWL	I, B			7P

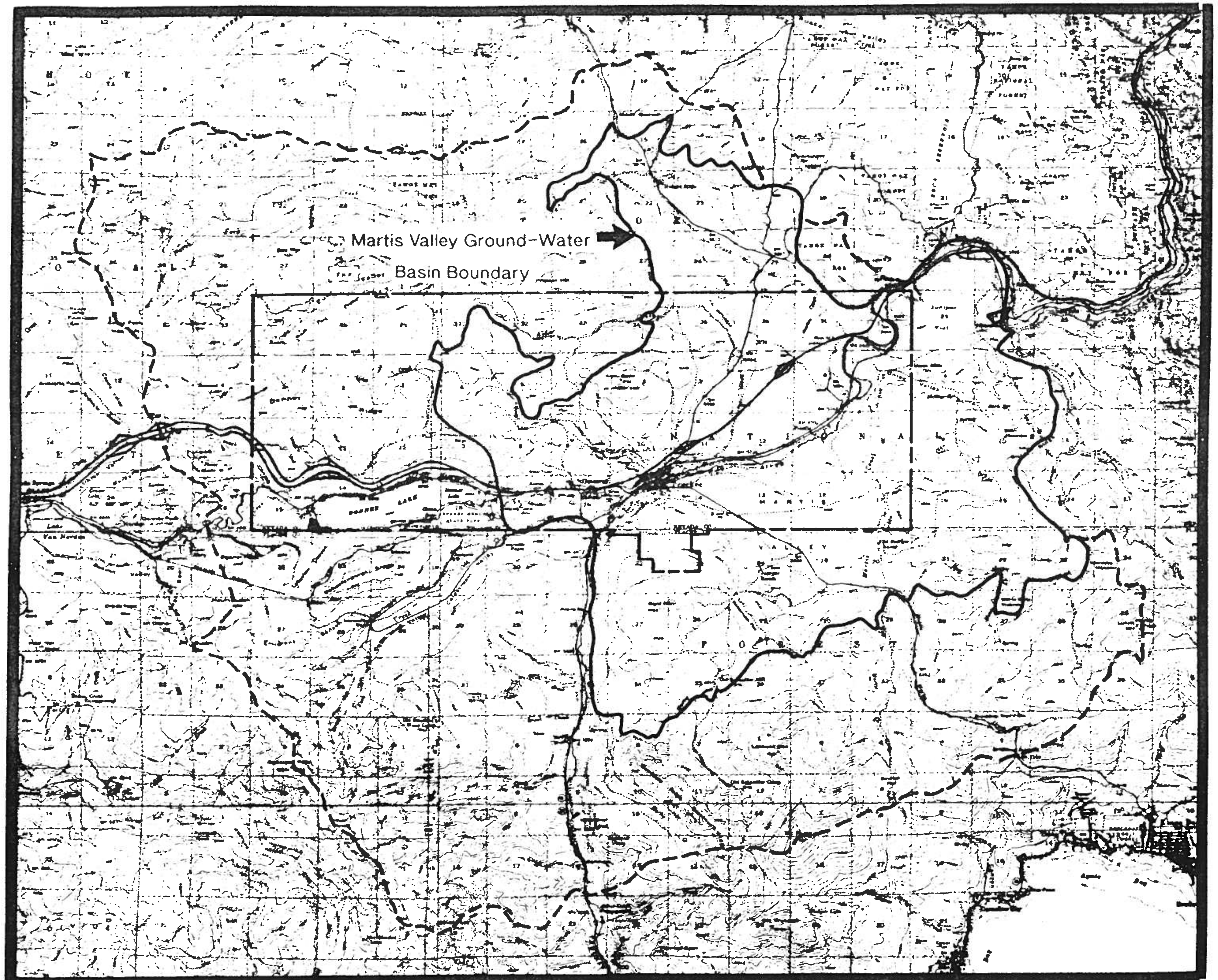
Table 7. Monitoring Program, Martis Valley Ground-Water Basin

Well Owner	Well Type	Well Designation(1)	Measurement	Frequency	Town-ship	Range	Section
DWR	Test	18C1	SWL	I, B	17N	17E	18C
	Test	18E1	SWL	I, B			18E
	Test	19K1	SWL	I, B			19K
	Test	29B1	SWL	I, B			29B
	Test	33L1	SWL	I, B	18N	17E	33L
TTSA	Test	TTSA-4	SWL	I, B	17N	17E	7
	Test	TTSA-5	SWL	I, B			7
	Test	TTSA-31	SWL	I, B			5
	Test	TTSA-33	SWL	I, B			8
	Test	TTSA-35	SWL	I, B			8
Daniels	Domestic	57837	SWL	I, B	17N	16E	11P
Vita-Bark	Industrial	10559	SWL, PWL, P	I, B	17N	17E	16N
Walterscheid	Domestic	108047	SWL	I, B			9K
Means	Domestic	312970	SWL	I, B			10P
Joerger	Domestic	Larwin-Joerger #1	SWL	I, B			19H
Knox	Domestic	65430	SWL	I, B			11C
Timber Trails	Municipal	75001	SWL, PWL, P	I, B	18N	16E	14D
Brannon	Domestic	65419	SWL	I, B			36L
Hedstrum	Domestic	119902	SWL	I, B			36R
Stickkinen	Domestic	199655	SWL	I, B	18N	17E	28R
Ponderosa Golf Course	Irrigation	---	SWL, PWL, P	I,B	17N	16E	14
Northstar Golf Course	Irrigation	---	SWL, PWL, P	I,B	17N	17E	29

(1) California Department of Water Resources, Water Well Driller's Report Mumber listed where availble.

SWL = Static Water Level
PWL = Pumping Water Level
P = Pumpage; i.e., flow meter readings.
I = Initial measurement
M = Monthly measurement
B = Biannual measurement

Figures



Explanation

— — — — Martis Valley Ground-Water Basin Watershed Boundary

———— Martis Valley Ground-Water Basin Boundary

—— — —— Truckee Donner Public Utility District (TDPUD) Boundary

Sources:

1. USGS 15 minute Topographic Quadrangles:
   Donner Pass, CA
   Granite Chief, CA
   Tahoe, CA-NV
   Truckee, CA-NV
2. Hydro-Search, Inc. (1975)

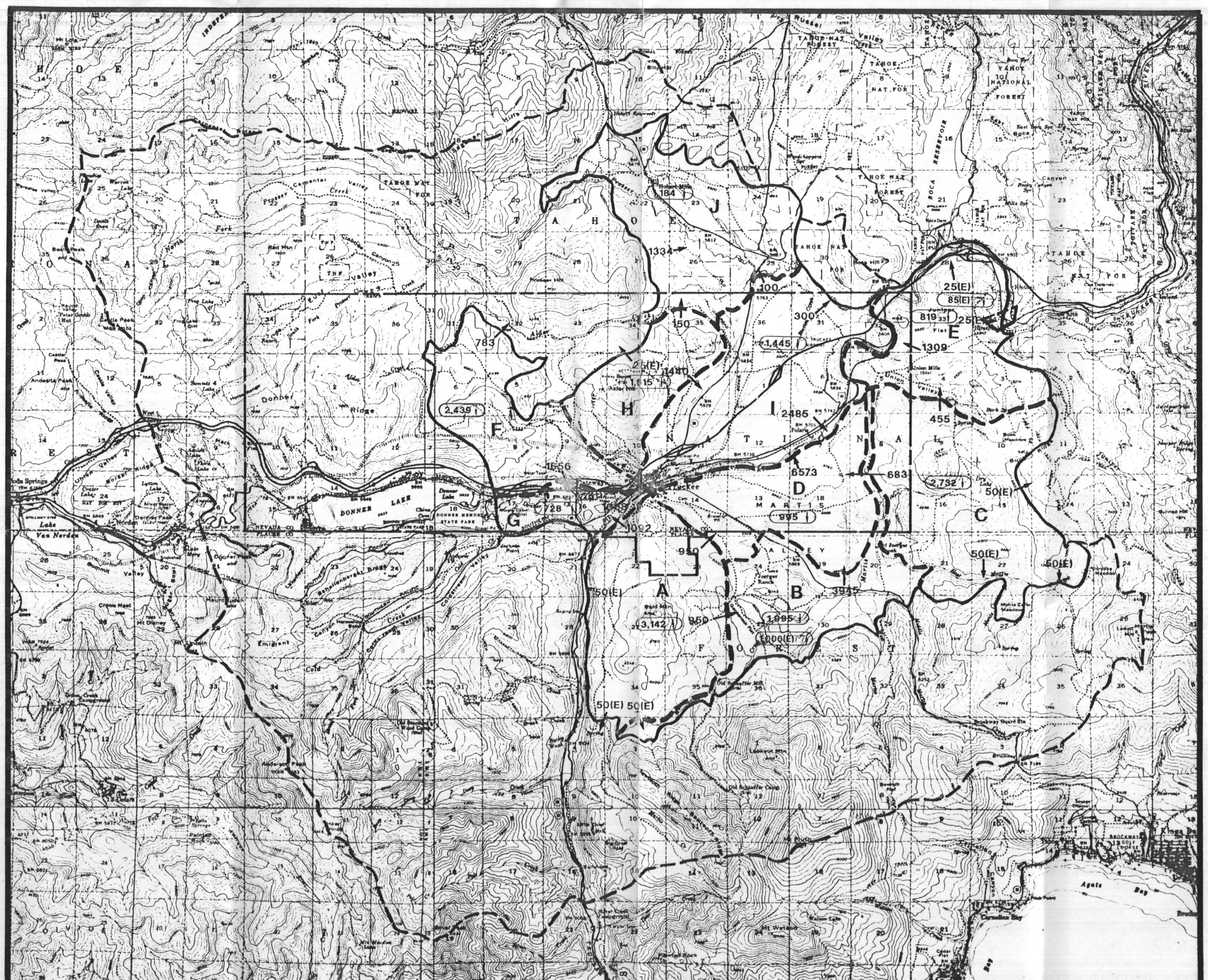
Scale: 1" = 2 Miles

0 — 2 Miles — 4 Miles

Contour Interval = 80 feet

Truckee Donner Public Utility District Truckee, California	DATE: 12/09/94
Location Map Martis Valley Ground-Water Basin	DESIGNED: RJJ CHECKED: RJJ APPROVED: DJH DRAWN: RAS PROJ.: 101351119
HYDRO-SEARCH, INC. A Tetra Tech Company	**Figure 1**

/usr4/truckee/1351119/13br01-b.dwg



Explanation

- Martis Valley Ground-Water Basin Watershed Boundary
- Martis Valley Ground-Water Basin Boundary
- Truckee Donner Public Utility District (TDPUD) Boundary
- A — Zone Designation
- Zone Boundary
- 3,142 — Recharge from Precipitation, Acre-Feet, Per Year
- 1,000(E) — Recharge (Estimated) from Surface Water, Acre-Feet Per Year
- 950 → Intra-or-Inter-Zone Transfer, Acre-Feet Per Year
- (E) Estimated

Sources:

1. USGS 15 minute Topographic Quadrangles:
   Donner Pass, CA
   Granite Chief, CA
   Tahoe, CA-NV
   Truckee, CA-NV
2. Hydro-Search, Inc. (1975)

N

Scale: 1" = 1 Mile
0 1 Mile 2 Mile
Contour Interval = 80 feet

Truckee Donner Public Utility District Truckee, California	DATE: 12/10/94
Recharge and Movement of Ground Water; Martis Valley Ground-Water Basin	DESIGNED: RJJ CHECKED: RJJ APPROVED: DJH DRAWN: RAS PROJ.: 101351119
HYDRO-SEARCH, INC. A Tetra Tech Company	Plate 1

/usr4/truckee/1351119/13br81-d.dwg

Explanation

M116952 5769' — Production Well(1) (M=Municipal Well; I= Industrial Well; 116952=California Department of Water Resources Water Well Driller's Report (DWR Report) number; 5769'=Static Water Level (ft,msl).

312970 6179' — Domestic Water Well(1) (312970=DWR Report number; 6179'=Static Water Level (ft,msl).

365669 (33L1) 5742' — Test Well(1) (365669=DWR Report number; Test Wells include monitor wells and ground-water exploration test wells; (33L1)=Monitor well within DWR monitoring network; 5742'=Static Water Level (ft,msl).

Martis Valley Ground-Water Basin Boundary

Truckee Donner Public Utility District (TDPUD) Boundary

6100 — Ground-Water Elevation Lines, in feet above Mean Sea Level (ft,msl)

Generalized Direction of Ground-Water Flow

Note: (1) Well locations are within a 1/4,1/4 section where possible. If 1/4,1/4 section is unknown, the wells are plotted at the center of the appropriate section. DWR Report numbers are listed where available. $\ast$= Static water level not used in plotting ground-water elevation lines.

Sources:

1. USGS 7.5 minute Topographic Quadrangles:
   Boca, CA-NV.
   Hobart Mills, CA
   Independence Lake, CA
   Martis Peak, CA-NV
   Norden, CA
   Truckee, CA
2. DWR Reports
3. Hydro-Search, Inc. (1975)
4. Hydro-Search, Inc. (1980)

Scale: 1" = 4000'

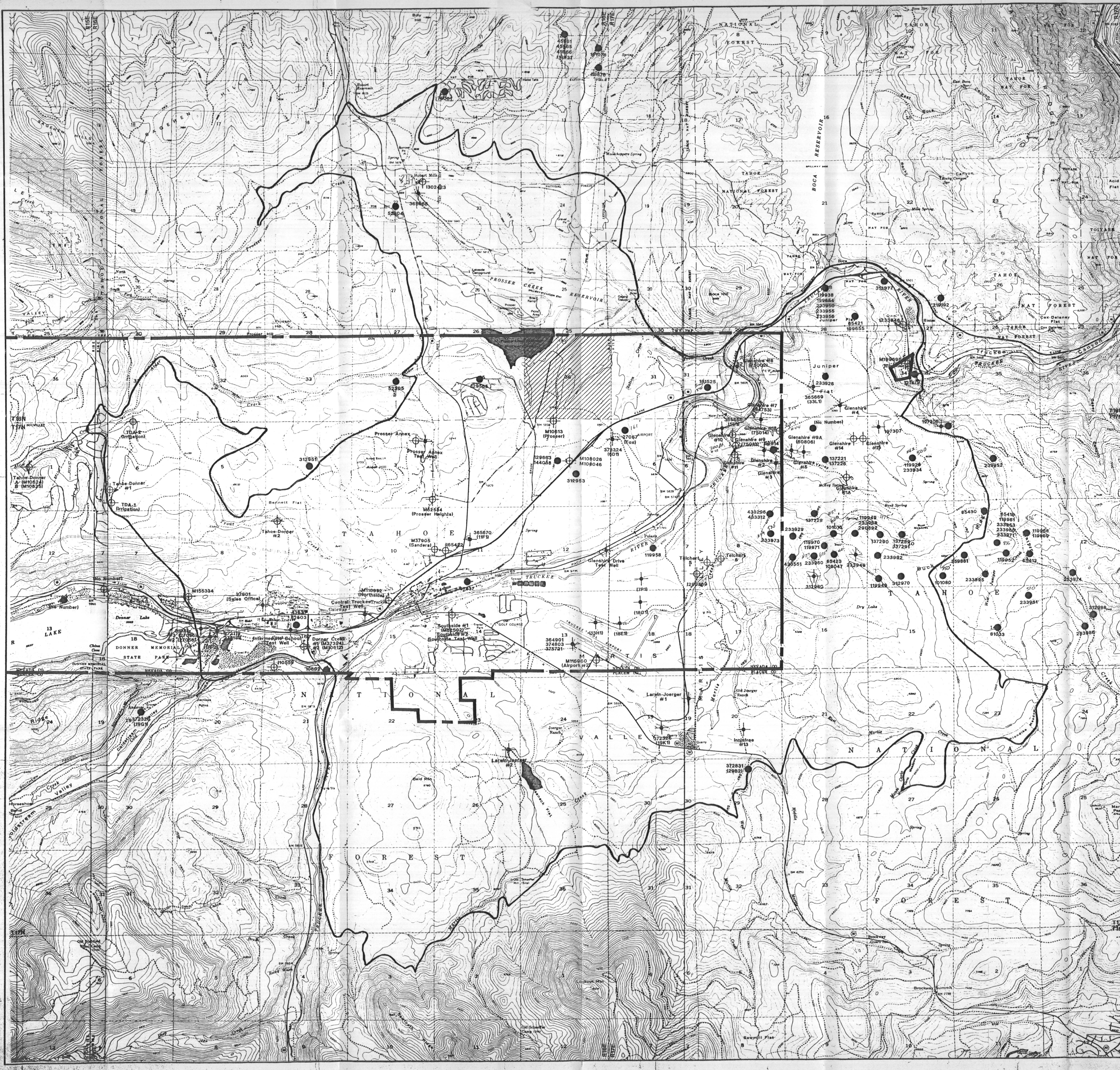
0 4000' 8000'

Contour Interval = 40 feet

N

Truckee Donner Public Utility District Truckee, California	DATE: 12/06/94
	DESIGNED: RJJ
Ground-Water Flow System Martis Valley Ground-Water Basin	CHECKED: RJJ
	APPROVED: DJH
	DRAWN: RAS
	PROJ.: 101351119
HYDRO-SEARCH, INC. A Tetra Tech Company	Plate 2

/usr4/truckee/1351119/13br02-c.dwg



Explanation

- Production Well[1] (M=Municipal Well; I= Industrial Well; 116952= California Department of Water Resources Water Well Driller's Report (DWR Report) number) — M116952
- Domestic Water Well[1] (312951=DWR Report number) — 312951
- Test Well[1] (365669=DWR Report number; Test Wells include monitor wells and ground-water exploration test wells. (33L1)=Monitor well within DWR monitoring network) — 365669 (33L1)
- Martis Valley Ground-Water Basin Boundary
- Truckee Donner Public Utility District (TDPUD) Boundary
- Wells too numerous to plot are listed in Table 1. (All wells are domestic, except 47333 which is an irrigation well). — 36
- Well locations within a section based upon DWR numbering system.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Table 1

Township 18N Range 16E

Section	DWR Report No.	Section	DWR Report No.
36	19090	36	119947
36	31612	36	119948
36M	31616	36	129587
36N	31618	36	129588
36	38882	36	129652
36N	38890	36	129666
36	45962	36	129667
36	47333	36	129669
36	49563	36	129683
36	49564	36	137104
36J	59873	36N	150939
36Q	59894	36M	150940
36	59895	36	153113
36	59896	36	155710
36L	65419	36P	168276
36N	65425	36	168296
36L	65426	36	186854
36L	65427	36	199676
36	101008	36P	207732
36S	111410	36L	233904
36	111413	36L	233905
36R	119902	36L	233989
36Q	119903	36	233993
36Q	119905	36	238488
36	119910	36J	302419
36Q	119915		

Sources:

1. USGS 7.5 minute Topographic Quadrangles:
   Boca, CA-NV.
   Hobart Mills, CA
   Independence Lake, CA
   Martis Peak, CA-NV
   Norden, CA
   Truckee, CA
2. DWR Reports
3. Hydro-Search, INC. (1975)
4. Hydro-Search, INC. (1980)

Note: (1) Well Locations are within a 1/4,1/4 section where possible. If 1/4,1/4 section is unknown, the wells are plotted at the center of the appropriate section. DWR Report numbers are listed where available.

Scale: 1" = 2000'
0 2000' 4000'

Contour Interval = 40 feet

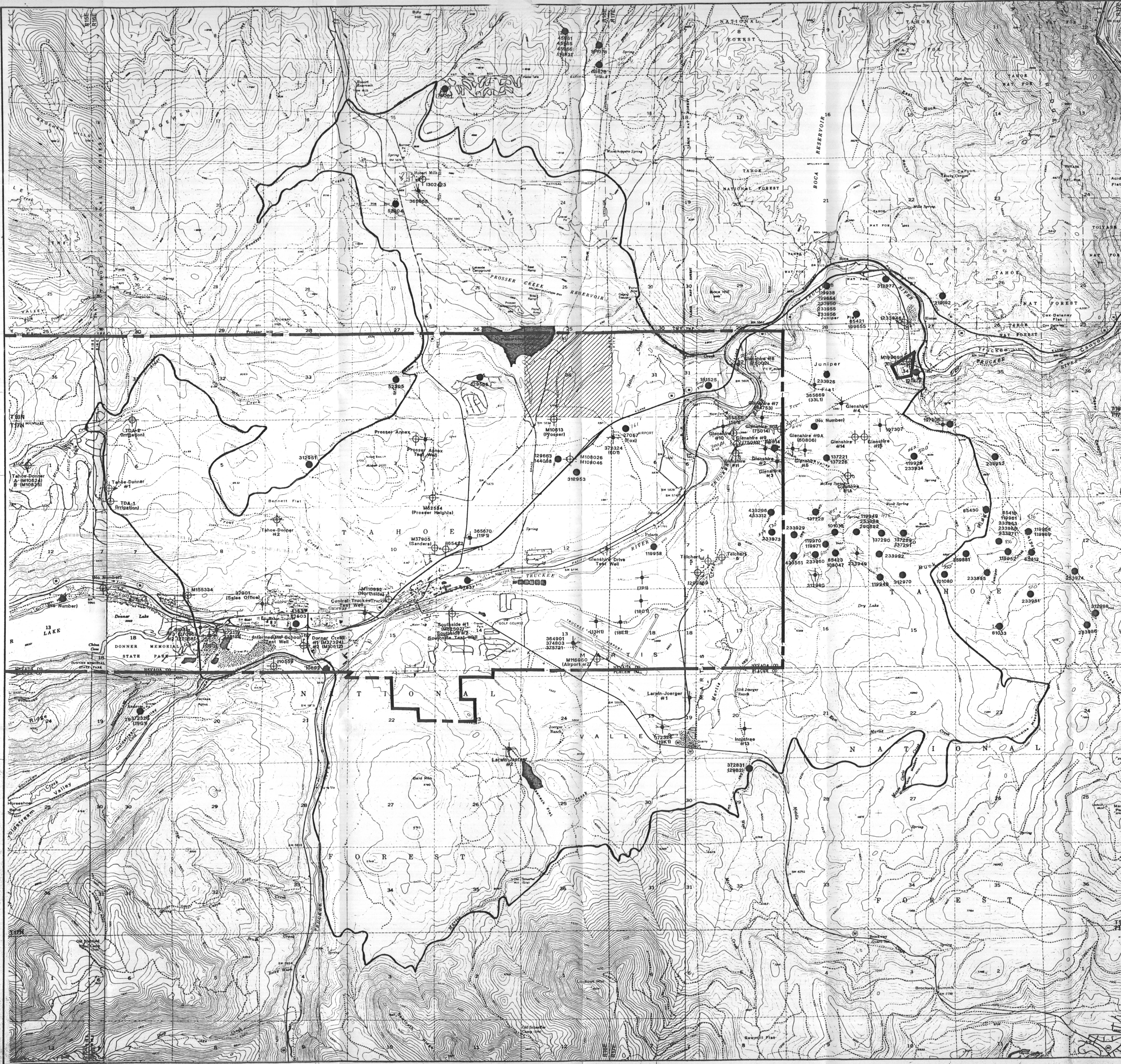
Truckee Donner Public Utility District
Truckee, California

Ground-Water Development
Martis Valley
Ground-Water Basin

HYDRO-SEARCH, INC.
A Tetra Tech Company

DATE:	11/23/94
DESIGNED:	RJJ
CHECKED:	RJJ
APPROVED:	DJH
DRAWN:	RAS
PROJ.:	101351119

Plate 3



Explanation

- M116952 — Production Well[1] (M=Municipal Well; I= Industrial Well; 116952= California Department of Water Resources Water Well Driller's Report (DWR Report) number)
- 312951 — Domestic Water Well[1] (312951=DWR Report number)
- 365669 (33L1) — Test Well[1] (365669=DWR Report number; Test Wells include monitor wells and ground-water exploration test wells. (33L1)=Monitor well within DWR monitoring network)
- Martis Valley Ground-Water Basin Boundary
- Truckee Donner Public Utility District (TDPUD) Boundary
- 36 — Wells too numerous to plot are listed in Table 1. (All wells are domestic, except 47333 which is an irrigation well).
- Well locations within a section based upon DWR numbering system.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Table 1

Township 18N		Range 16E	
Section	DWR Report No.	Section	DWR Report No.
36	19090	36	119947
36	31612	36	119948
36M	31616	36	129587
36N	31618	36	129588
36	38882	36	129652
36N	38890	36	129666
36	45962	36	129667
36	47333	36	129669
36	49563	36	129683
36	49564	36	137104
36J	59873	36N	150939
36Q	59894	36M	150940
36	59895	36	153113
36	59896	36	155710
36L	65419	36P	168276
36N	65425	36	168296
36L	65426	36	186854
36L	65427	36	199676
36	101008	36P	207732
36S	111410	36L	233904
36	111413	36L	233905
36R	119902	36L	233989
36Q	119903	36	233993
36Q	119905	36	238488
36	119910	36J	302419
36Q	119915		

Sources:

1. USGS 7.5 minute Topographic Quadrangles:
   Boca, CA-NV.
   Hobart Mills, CA
   Independence Lake, CA
   Martis Peak, CA-NV
   Norden, CA
   Truckee, CA
2. DWR Reports
3. Hydro-Search, INC. (1975)
4. Hydro-Search, INC. (1980)

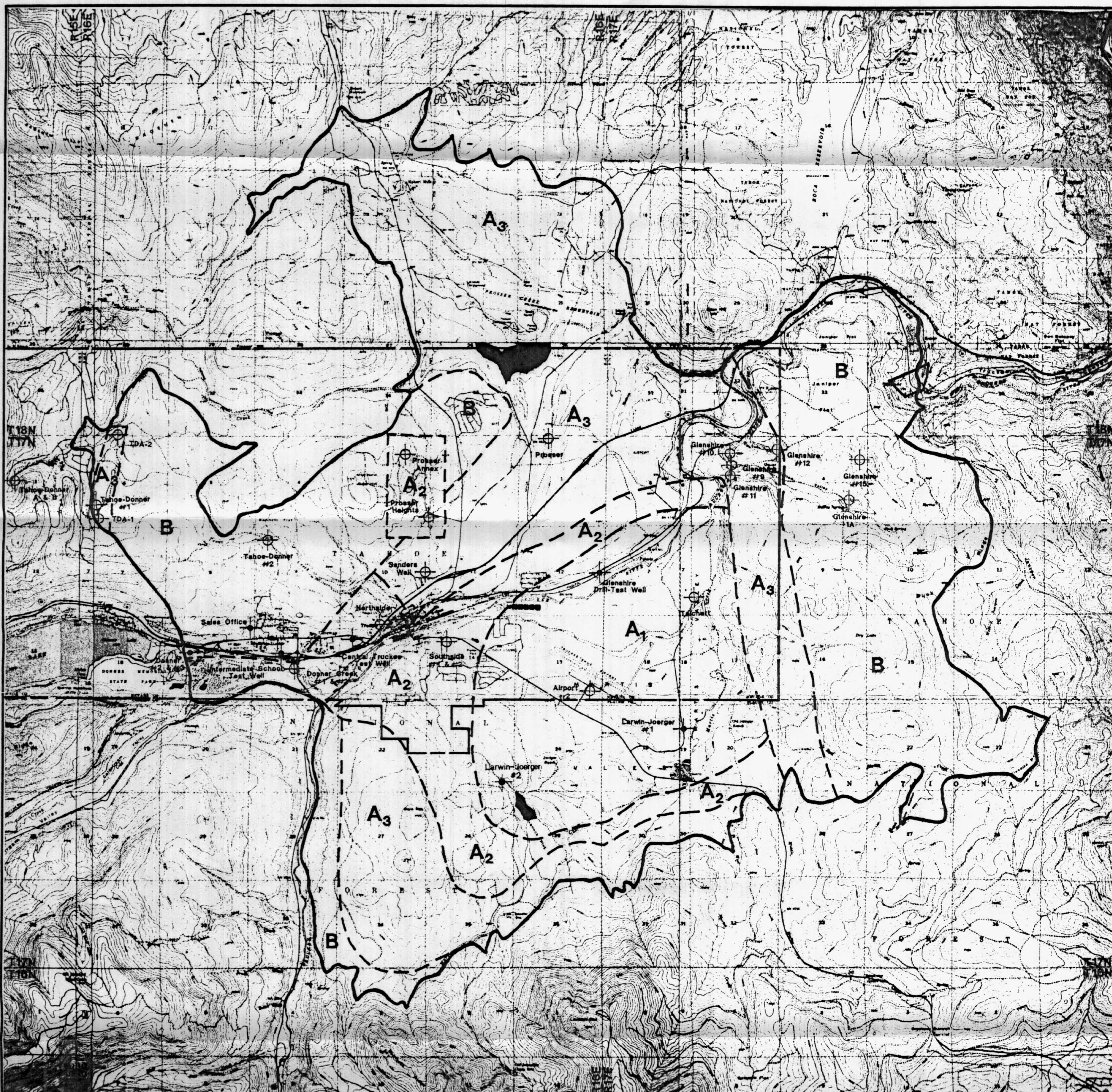
Note: (1) Well Locations are within a 1/4,1/4 section where possible. If 1/4,1/4 section is unknown, the wells are plotted at the center of the appropriate section. DWR Report numbers are listed where available.

Scale: 1" = 2000'

0 2000' 4000'

Contour Interval = 40 feet

Truckee Donner Public Utility District Truckee, California	DATE: 11/23/94	
Ground-Water Development Martis Valley Ground-Water Basin	DESIGNED:	RJJ
	CHECKED:	RJJ
	APPROVED:	DJH
	DRAWN:	RAS
	PROJ.: 101351119	
HYDRO-SEARCH, INC. A Tetra Tech Company	Plate 3	



Explanation

Martis Valley Ground-Water Basin Boundary

Truckee Donner Public Utility District (TDPUD) Boundary

Production Wells

Exploration Test Wells

Area	Probable Well Yield, gallons per minute (gpm)
A_1	Greater than 1000
A_2	500 - 1000
A_3	100 - 500
B	Less than 100
— — —	Area Boundary

Sources:

1. USGS 7.5 minute Topographic Quadrangles:
   Boca, CA-NV.
   Hobart Mills, CA
   Independence Lake, CA
   Martis Peak, CA-NV
   Norden, CA
   Truckee, CA
2. California Department of Water Resources (DWR) Water Well Driller's Reports
3. Hydro-Search, Inc. (1975)
4. Hydro-Search, Inc. (1980)

N

Scale: 1" = 4000'

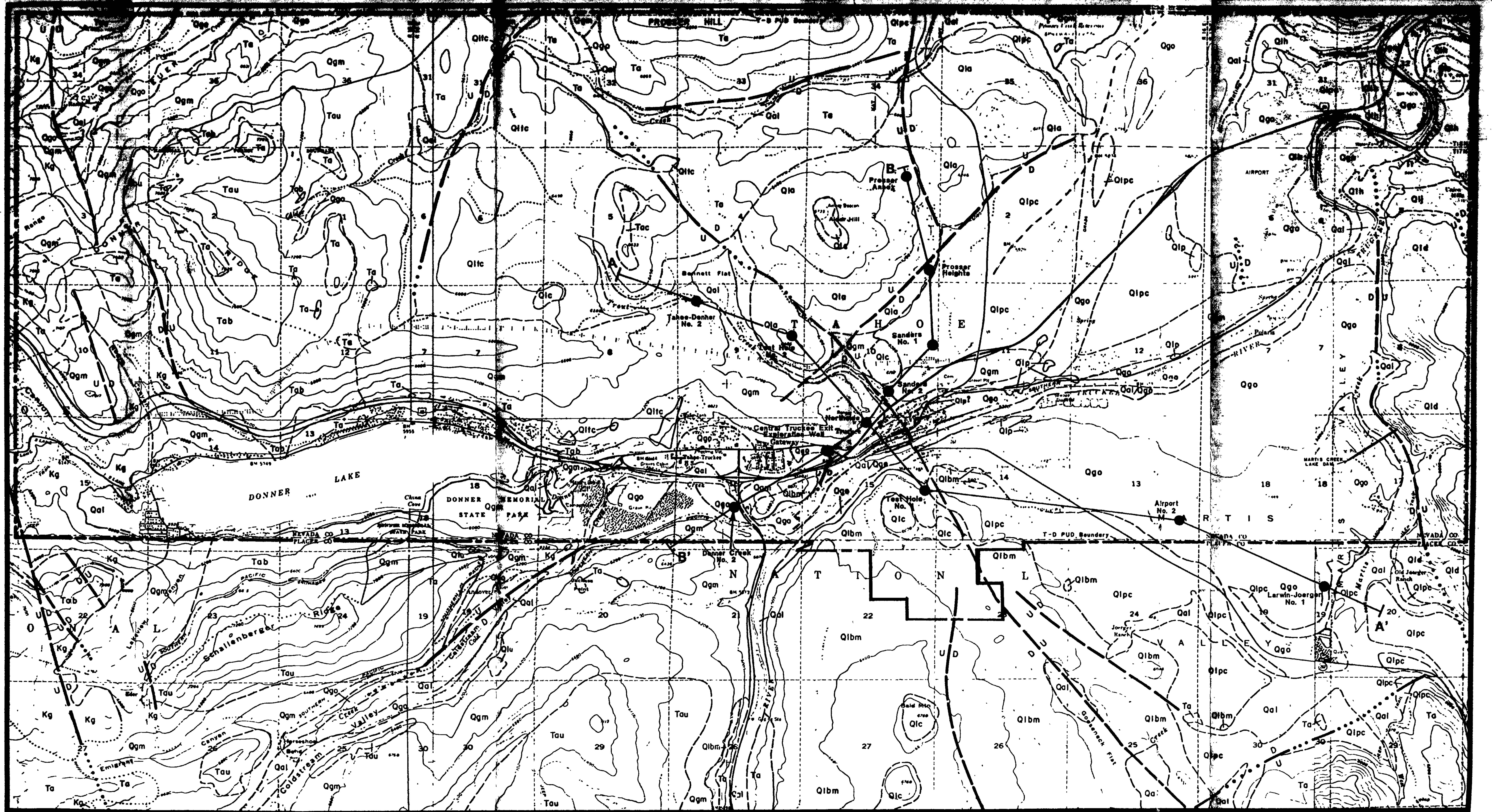
0 4000' 8000'

Contour Interval = 40 feet

Truckee Donner Public Utility District Truckee, California	DATE: 12/06/94
Water Supply Potential Martis Valley Ground-Water Basin	DESIGNED: RJJ CHECKED: RJJ APPROVED: DJH DRAWN: RAS PROJ.: 101351119
HYDRO-SEARCH, INC. A Tetra Tech Company	Plate 4

/usr4/truckee/1351119/13br01-c.dwg

Appendix A



Explanation

Recent	Qal	Alluvium	
Pleistocene	Qgm	Glacial moraine and fill deposits	Qgo Glacial outwash
Pleistocene – Lousetown Formation	Qlh	Hirschdale olivine latite	
	Qlbm	Bald Moutain olivine latite	
	Qld	Dry lake flows	
	Qlp	Polaris olivine latite	
	Qltc	Trout Creek olivine basalt	
	Qla	Alder Hill olivine basalt	
	Qlu	Lousetown volcanics, undifferentiated	
	Qlc	Lousetown Formation cone	
	Qlbm	Juniper Flat alluvium	
	Qlbm	Prosser Creek alluvium	
	Qlbm	Lousetown sediments, undifferentiated	
Tertiary	Tt	Truckee Formation	
	Ta	Andesite	Tab Andesite breccia
	Tac	Andesite cone	
	Tau	Andesite, undifferentiated	
Cretaceous	Kg	Granitic intrusives	

Contact, dashed where location is approximate, dotted where inferred

Fault, dashed where location is approximate, dotted where concealed U–upthrown side, D–downthrown side

A—A' Cross-Section Locations

● Locations of Wells/Test Holes

Scale: 1 – 1/2 – 0 – 1 Mile; 1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

Contour Interval = 40 Feet

Sources:
1. USGS 7.5 minute Topographic Quadrangles:
   Norden, CA
   Truckee, CA–NV
   Martis Peak, CA–NV
2. Geology:
   Hydro-Search, Inc. (1973, 1974, & 1980)

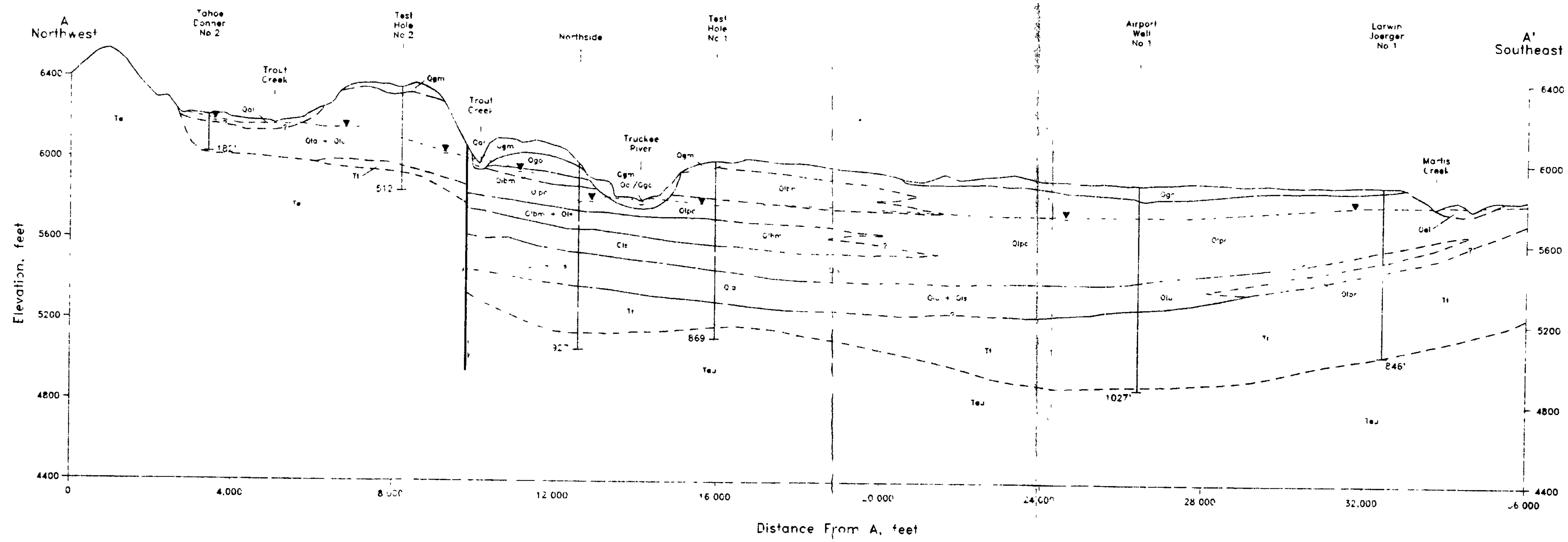
Truckee Donner Public Utility District
Truckee, California

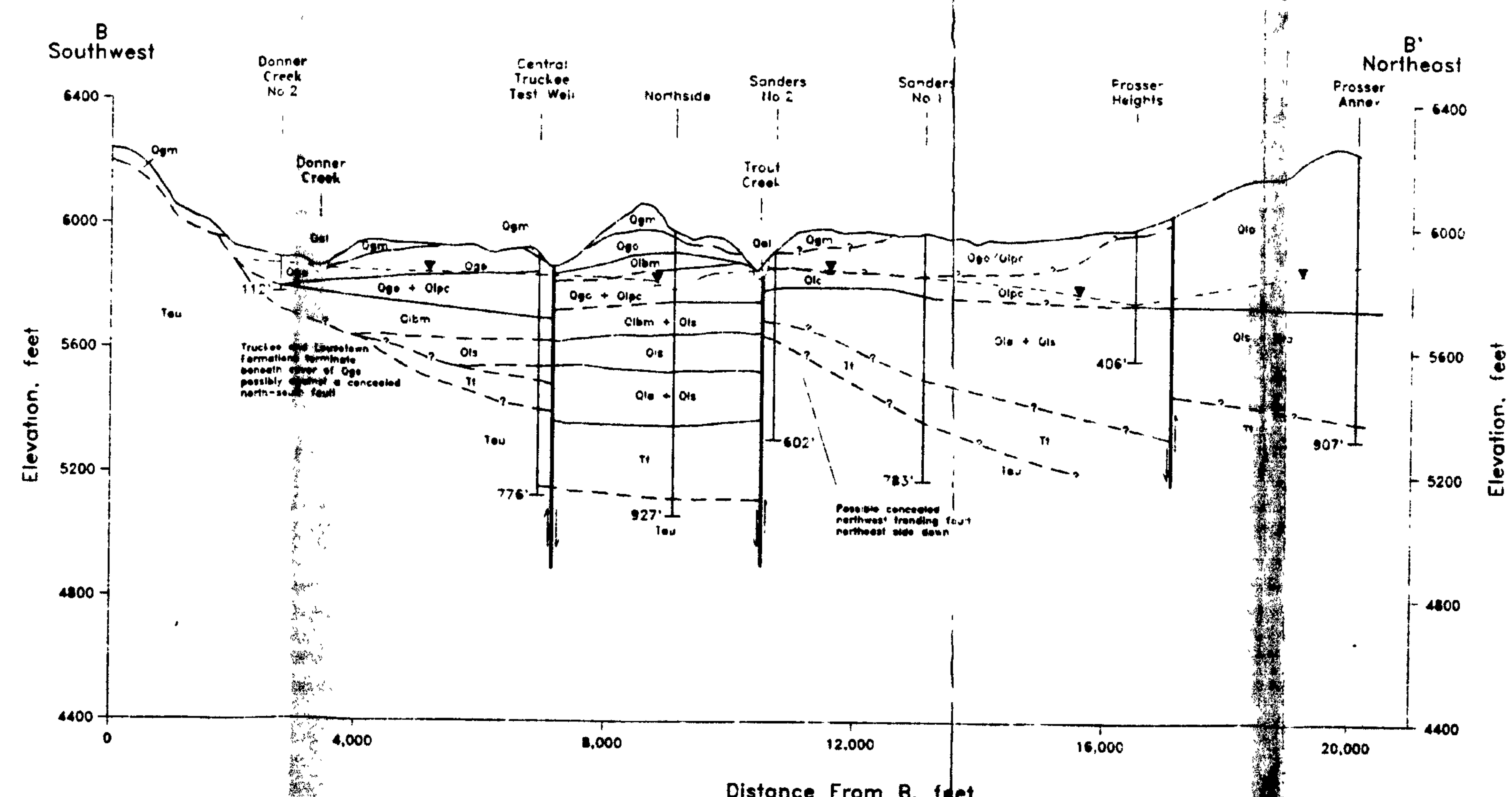
Geology of Truckee and Vicinity, Nevada and Placer Counties, California

DATE	12/12/94
DESIGNED:	RJJ
CHECKED:	RJJ
APPROVED:	DJH
DRAWN:	RAS
PROJ:	101351119

HYDRO-SEARCH, INC.
A Tetra Tech Company

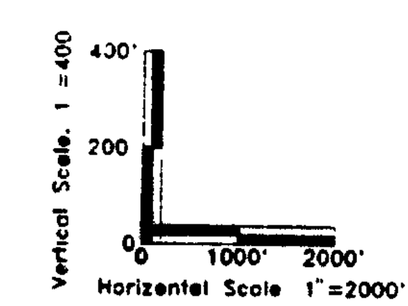
Plate A-1





Explanation

—▼— Potentiometric Surface



5X Vertical Exaggeration

Truckee Donner Public Utility District Truckee, California	DATE: 12/10/84
	DESIGNED: RJJ
Interpretive Hydrogeologic Cross Sections, Truckee and Vicinity, Nevada and Placer Counties, California	CHECKED: RJJ
	APPROVED: DJH
	DRAWN: RAS
	PROJ: 101381119
HYDRO-SEARCH, INC. A Tetra Tech Company	Plate A-2

GEOLOGIC MAP OF THE TRUCKEE AREA, SIERRA NEVADA - BASIN AND RANGE BOUNDARY, NORTH OF LAKE TAHOE, CALIFORNIA

THOMAS S. LATHAM, JR. 1985

PLATE A-3

Geology by T. S. Latham (1980-1984) except:

(1) Area southwest of Schallenberger Ridge compiled from Birkeland (1962) and Daley and Poole (1949).

(2) Area north of Hobart Mills (except faults) generalized from Birkeland (1962).

(3) East wall of Truckee River canyon north of 39°27' generalized from Thompson and White (1964).

Areas mapped in reconaissance only: East slope of the Verdi Range, area north of Boca Reservoir.

Base map compiled from Norden (1979), Truckee (1969), Martis Peak (1969), Hobart Mills (1981), Boca (1969), and Mt. Rose Northwest (1980) USGS 7.5 minute quadrangles. Dates given are original publication date or, where applicable, date of most recent air-photo revision.

LOCATION

Depositional or igneous contact

Long dash — uncertainty less than

Short dash — uncertainty 100 m

Dotted — covered or inferred

Fault, side of displacement

Dashed — location approximate

Dotted — covered

Queried where extension uncert

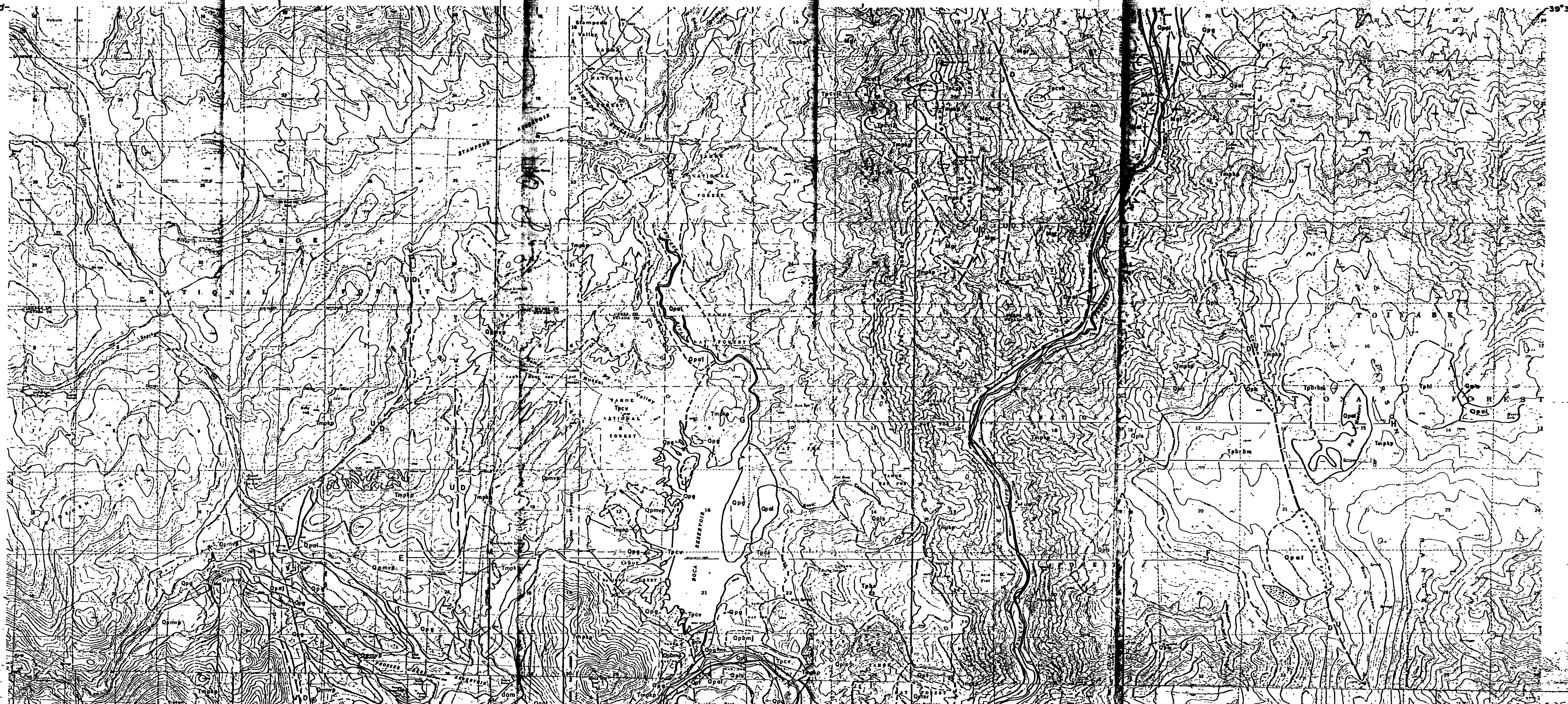
A a b B Cross section line (plate 2)
Lower case letters — section in text

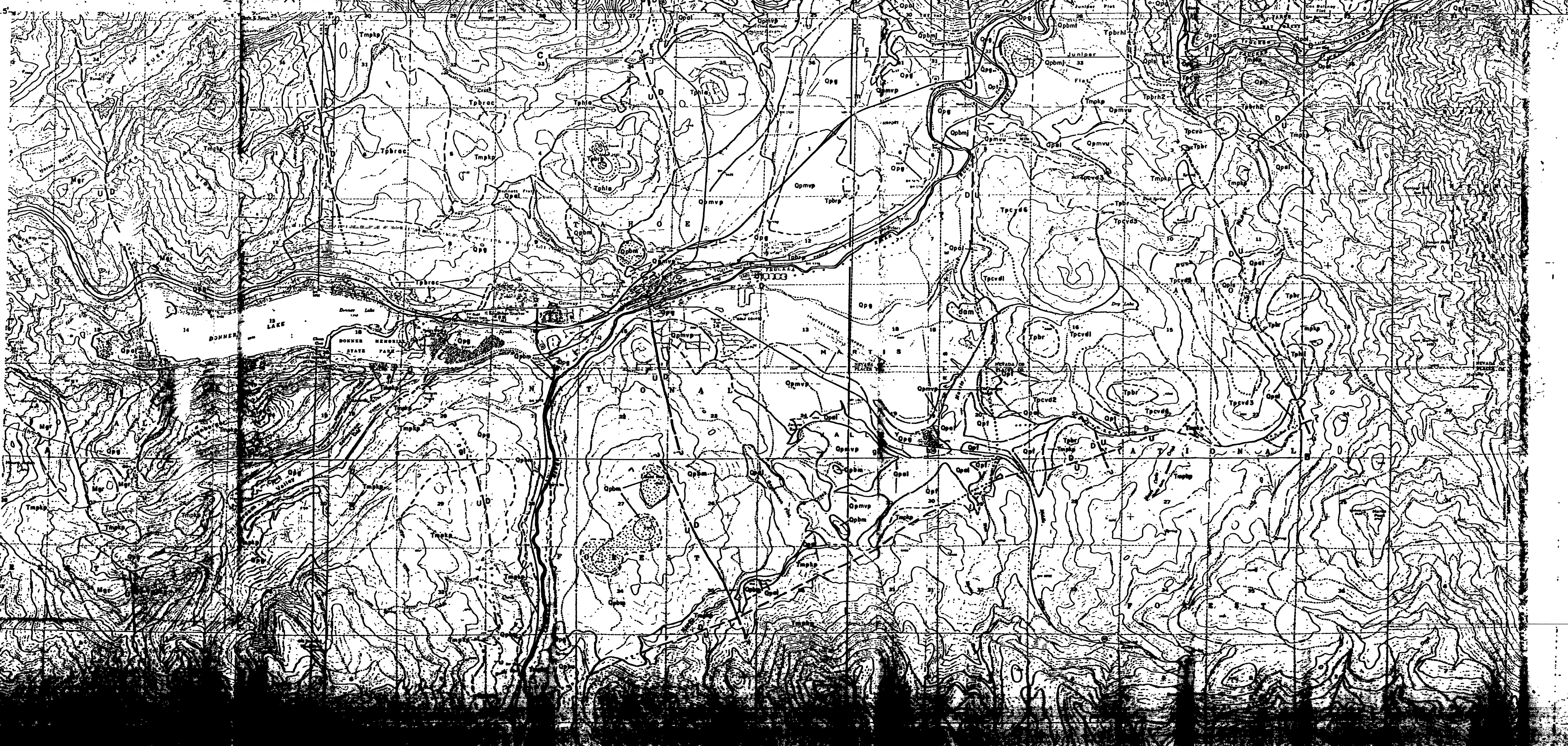
1 .5 0 1 mile

1 .5 0 1 km

1:31000

CI 40'





LEGEND

PLEISTOCENE SURFICIAL DEPOSITS

Qpal	Pleistocene or Recent alluvium in and near present-day streams.
Qpls/Qpt	Pleistocene or Recent landslide and talus deposits. Mapped separately only where most extensive or where obscuring underlying units.
Qpg	Glacial deposits, undifferentiated. Mostly moraine west of Truckee, outwash east of Truckee.
Qpf/Qpter	Dissected alluvial fans, terrace deposits.

MARTIS VALLEY FORMATION

Qpmvp	Prosser Creek member. Alluvial sandstones and conglomerates. Moderately indurated. Derived mainly from the Kate Peak Formation. Overlies Qpbmj and underlies the Bald Mountain flow of Qpbm.
Qpmvu	Union Valley member. Contains abundant cobbles of silicified andesite, but is otherwise similar to Prosser Creek member. Underlies Qpbmj.

BALD MOUNTAIN FORMATION

Qpbm	Olivine shoshonite flows, scoria, and tuff. Stippled pattern indicates cinder cones.
Qpbmj	Juniper Flat flow of the Bald Mountain formation.
Qpbmt	Basaltic tuff.
Qpbu	Single flow of nearly aphyric olivine basalt. Relationship to Qpbm is not certain.

Pleistocene

BOCA RIDGE FORMATION

Tpbr	Olivine-phyric basaltic andesite, shoshonite, latite, and mugearite flows. Includes latite flow at type locality and several flows not given separate names. Stippled pattern indicates cinder cone.
Tpbrac	Alder Creek flow. Olivine shoshonite.
Tpbrb	Beacon flow (Alder Hill). Olivine shoshonite flow and eroded cinder cone. Overlies Alder Hill flows of the Hunter Lake formation.
Tpbrp	Polaris flow. Olivine-augite-plagioclase phyric shoshonite flow. Includes a small exposure of basaltic tuff along the Truckee River.
Tpbrh	Tpbrh1: Lower Hirschdale flow. Basaltic andesite. Tpbrh2: Upper Hirschdale flow. Olivine shoshonite.
Tpbrbm	Big Meadows flows (Carson Range). Olivine-phyric mugearite.

HUNTER LAKE FORMATION

Tphl	Hypersthene andesite flows. Generally has pronounced platy fracture and appears aphyric in hand specimen.
Tphla	Alder Hill flows. Flows along Highway 89 are similar to the flow at the type locality in the Carson Range. Flows on Alder Hill are more porphyritic and contain some olivine in addition to hypersthene.
Tphli	Intrusion. Indistinguishable in outcrop from the flow at the type locality.

COAL VALLEY FORMATION

Tpcv	Stream and lake deposits including sandstone, conglomerate, diatomite, and rhyolite tuff. Primarily diatomaceous ash at Boca Ridge and in Martis Valley.
Tpcvb	Porphyritic augite-olivine basalt and basaltic andesite flows not given separate names. Includes basaltic tuff at Ladybug Peak.
Tpcvl	Ladybug Peak flows. Tpcvl1: Dark gray, nearly aphyric basaltic andesite. Tpcvl2: Porphyritic olivine-augite basaltic andesite. Tpcvl3: Nearly aphyric olivine basaltic andesite. Tpcvli: Intrusion. Same lithology as Tpcvl1.
Tpcvd	Dry Lake flows. Aphyric and porphyritic hornblende and pyroxene andesite flows. Tpcvd1: Glassy, nearly aphyric pyroxene-hornblende andesite. Tpcvd2: Very fine-grained, black, massive hornblende andesite. Tpcvd3: Light gray to brown porphyritic hornblende andesite. Tpcvd4: Light gray porphyritic hornblende andesite, similar in appearance to Tpcvd3. Tpcvd5: Dark gray plagioclase-augite phyric andesite. Tpcvd6: Dark gray to red aphyric, glassy andesite.

Pliocene

KATE PEAK FORMATION

Tmpkp	Hornblende and pyroxene andesite lava flows, tuff-breccias, and tuffs. Rarely includes olivine basalt flows. Includes intrusive bodies in the Truckee River Canyon north of Floriston.

Mio-Pliocene

MESOZOIC BASEMENT

Mgr	Plutonic rocks, primarily granodiorite.
Mmv	Metavolcanic and metasedimentary rocks.

Mesozoic