

Site No.	Elevation ft above msl	Depth of Well	
		meters	(ft)
001	6235	2	(8)
002	6235	3	(10)
004	6245	7	(23)
188	6275	61	(200)
193	6260	8	(25)
198	6360	5	(18)
186	6320	2	(8)
219	6335	--	--

Notes:

1. The source agency code associated with each site number can be found in Appendix A.
2. -- indicates the elevation or well depth is unknown.
3. Data obtained from USGS, LRWQC, CTC, TRPA, El Dorado EM, STPUD, Nevada BHPS, California DHS, California DWR, and Nevada DWR.

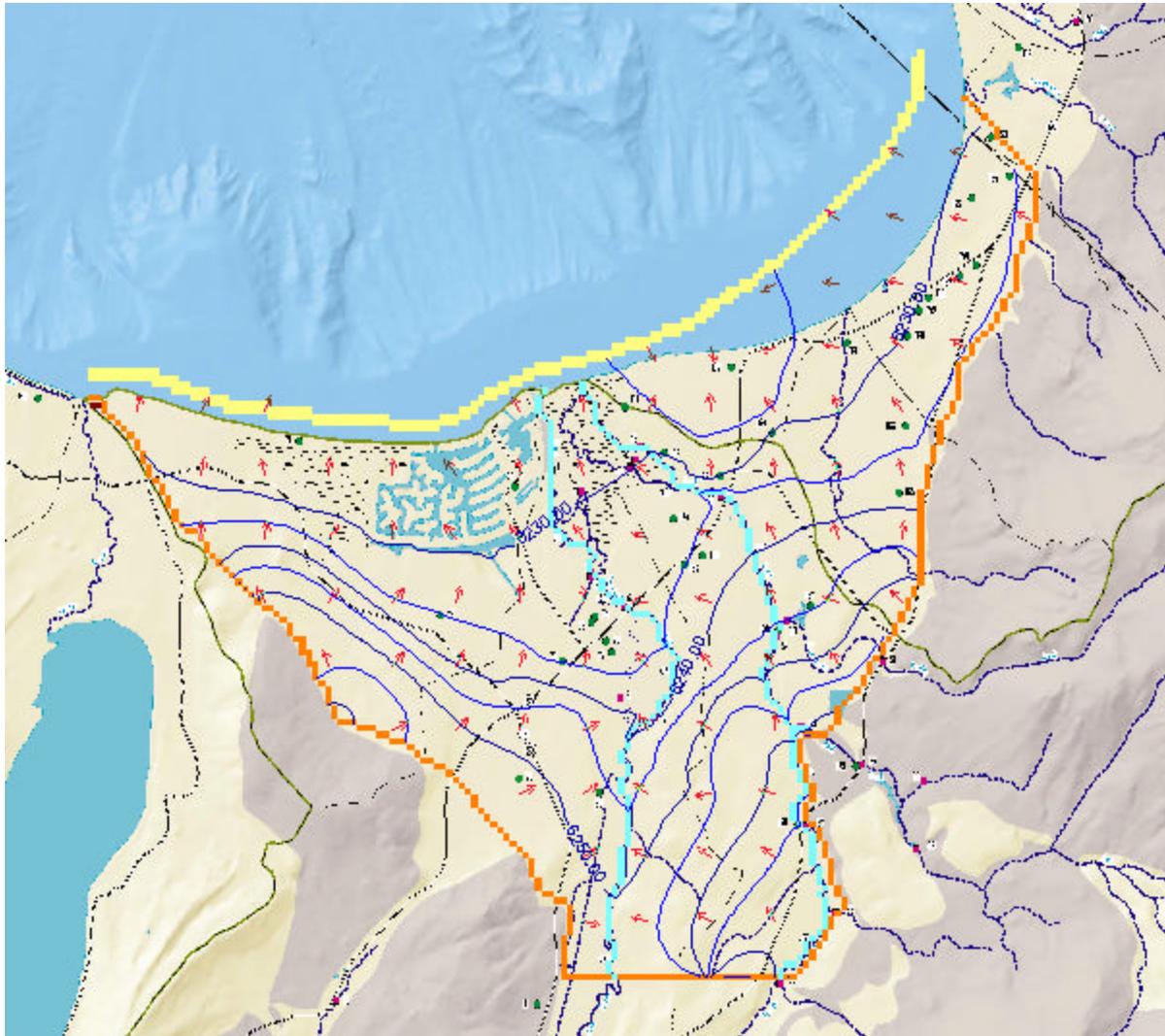
Monitoring data available from agencies date back to 1980. Monitoring of some wells still continues as part of the USGS basin-wide monitoring network and local groundwater monitoring networks. This data is collected to monitor both environmental and public health. See Section 4.3 for a detailed description of the nutrient data.

Groundwater elevations have been recorded periodically as well. These elevations were used in the numerical model for calibration in addition to stream gage elevation data. See Appendix B for a comprehensive report of the groundwater modeling effort.

4.3 Nutrient Concentrations

Groundwater wells are spread throughout the area from Christmas Valley to the Lake shore. The groundwater that is likely to discharge directly to the lake is within 1,500 meters (4,921 ft) of the shoreline. Additionally, groundwater located within 2,000 meters (6,562 ft) directly south of the Tahoe Keys is likely to discharge into the Keys and subsequently into Lake Tahoe. Figure 4-7 shows the flow lines and groundwater contours in the model area. To the south and east of Tahoe Keys, the groundwater tends to travel towards the Upper Truckee River and Trout Creek (Fenske 2003). Because of the extensive monitoring system, this discussion will focus on the wells within the area where groundwater likely discharges directly to the Lake.

Figure 4-7. South Lake Tahoe Model Area Groundwater Contours and Flow Lines



Notes:

1. Figure obtained from Fenske (2003)

LRWQCB requires groundwater monitoring at Bijou golf course to establish baseline conditions in early spring, monitor the effects of chemicals applied during the summer season and determine the residual effects once the active season has ceased. LRWQCB also requires the golf course to build a database adequate to provide effective feedback for golf course chemical and irrigation management with respect to environmental protection (LRWQCB 2000b). To build the database, LRWQCB has required that ground water be monitored on a monthly basis. The golf course is required to sample groundwater for dissolved chemical constituents passing through a 0.45 micron filter. The nutrient constituents requiring analysis are dissolved Kjeldahl Nitrogen, dissolved nitrite plus nitrate, and dissolved orthophosphorus and total dissolved phosphorus. TRPA also requires Edgewood Golf Course to collect groundwater samples. Edgewood golf course is required to sample groundwater quality to assure that the fertilizer management plan will meet the water quality thresholds. The sample testing focuses on nutrients representative of types of fertilizers used on the property. Three groundwater sites are monitored on a monthly basis, and the samples are tested for nitrate plus nitrite, ammonia, and total phosphorus.

USGS has been collecting samples periodically for many years. These wells are sampled as part of a Tahoe basin-wide monitoring program. The USGS typically tests for dissolved ammonia, dissolved Kjeldahl nitrogen, dissolved nitrate plus nitrite, dissolved orthophosphorus, and total dissolved phosphorus. The specific analytical profiles per well may vary.

The California DHS, Nevada BHPS, STPUD and El Dorado County EM require sampling for nitrate and nitrite in drinking water wells. These samples have been added to the larger data set to combine as much nutrient chemistry collected in the basin as possible.

The average concentrations and top of open interval for wells located near the lake are included in Table 4-3 through Table 4-8. The top of open interval represents the depth below ground surface that groundwater can freely enter the well (e.g. top of screen or bottom of casing in fractured rock). The well locations and land use in each are shown in Figure 4-8 through Figure 4-13.

4.3.1 Emerald Bay to Taylor Creek Nutrient Concentrations

The wells and land use in the area are depicted in Figure 4-8. Well 041 is the only well that has been monitored for all applicable forms of dissolved nitrogen and phosphorus. Well 041 has been sampled since 1995. Wells 027, 058, 059 and 066 have only been sampled to monitor drinking water standard compliance which includes only total nitrate and nitrite testing.

The dissolved ammonia + organic nitrogen concentrations for well 041 range from 0.001 mg/L to 0.09 mg/L, averaging 0.045 mg/L. The dissolved nitrate concentrations, which include nitrite, range from 0.034 mg/L to 0.064 mg/L with an average of 0.051 mg/L. This results in an average total dissolved nitrogen concentration of 0.096 mg/L. The average total nitrate concentrations found in wells 027, 058, 059 and 066 range from 0.012 mg/L to 0.4584 mg/L. Lower concentrations of nitrogen are found in well 041. This may be indicative of

denitrification, which occurs as the groundwater travels towards the lake, or the difference in dissolved versus total nitrogen concentrations. Table 4-3 includes the dissolved nitrogen concentrations for well 041.

Orthophosphorus concentrations for well 041 range from 0.022 mg/L to 0.085 mg/L, averaging 0.071 mg/L. The range of total dissolved phosphorus is 0.06 mg/L to 0.101 mg/L, averaging 0.085 mg/L. No phosphorus concentrations have been measured in the other wells in the area. Table 4-3 includes the dissolved phosphorus concentrations for well 041.

Well 041 is well placed to represent the downgradient conditions for the area. It is likely an accurate reflection of the majority of the groundwater discharging across this area (Figure 4-8).

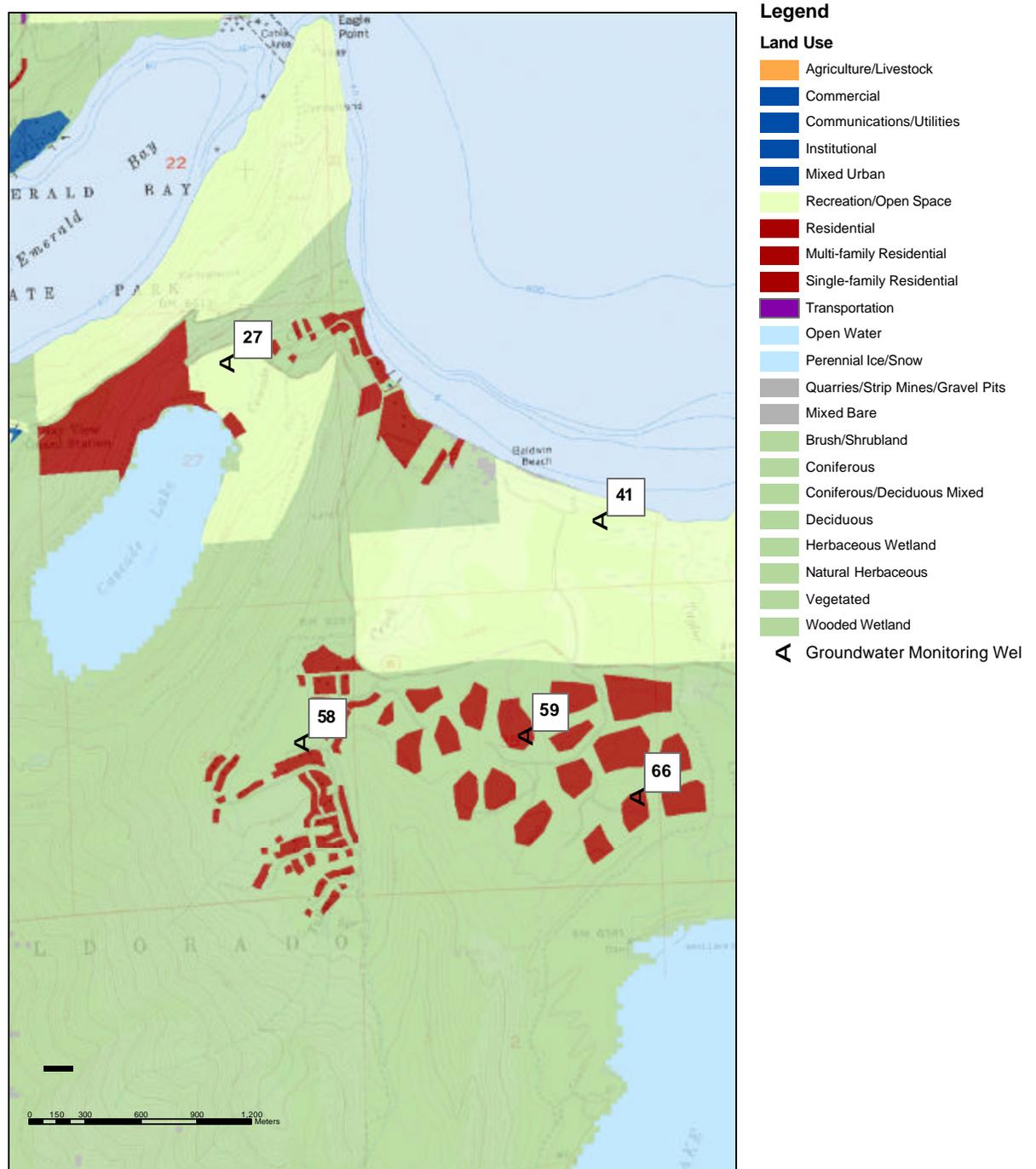
Table 4-3. Emerald Bay to Taylor Creek Average Nutrient Concentrations (mg/L)

Constituent	Well ID
	041
Ammonia + Organic	0.045
Nitrate	0.051
Total Nitrogen	0.096
Orthophosphorus	0.071
Total Phosphorus	0.085
Top of Open Interval (ft bgs)	70

Notes:

1. All concentrations reported are dissolved.
2. Data obtained from USGS.
3. Top of Open Interval with a -- indicates the open interval is unknown. A < indicates less than the total depth of the well.
4. na – not analyzed
5. Total Nitrogen is calculated for those wells with both ammonia + organic and nitrate concentrations
6. Nitrate concentrations include nitrite.

Figure 4-8. Emerald Bay to Taylor Creek Groundwater Wells and Land Use



Notes:

1. Land use coverage provided by Tahoe Research Group
2. Only wells with groundwater elevation and/or analytical data are shown.

4.3.2 Subregion 1 Nutrient Concentrations

The wells and land use in the area are depicted in Figure 4-9. Wells 043, 047, 048 and 051 - 057 have been monitored for all forms of dissolved nitrogen and phosphorus that are of concern as part of this evaluation.

The dissolved ammonia + organic nitrogen concentrations range from 0.01 mg/L to 2.8 mg/L, averaging 0.26 mg/L. The dissolved nitrate concentrations, which include nitrite, range from 0.002 mg/L to 0.108 mg/L with an average of 0.031 mg/L. This results in an average total dissolved nitrogen concentration of 0.289 mg/L. Table 4-4 includes the dissolved nitrogen concentrations for wells in subregion 1.

Orthophosphorus concentrations in subregion 1 range from 0.001 mg/L to 0.051 mg/L, averaging 0.025 mg/L. The range of total dissolved phosphorus is 0.012 mg/L to 0.098 mg/L, averaging 0.035 mg/L. Table 4-4 includes the dissolved phosphorus concentrations for wells in subregion 1.

Wells 043, 047 and 048 are considered the downgradient wells in subregion 1. They are well placed to represent the downgradient conditions for the area. The data shows that the concentrations of nutrients are higher in the downgradient wells versus the upgradient wells. The predominant land use in this area is recreational (Camp Richardson) (Figure 4-9). Large numbers of geese that are typically present in this area could contribute to the increased nutrient concentrations. Because all of the wells in this area are shallow, they likely represent the highest nutrient concentrations in this area.

Table 4-4. South Lake Tahoe Subregion 1 Average Nutrient Concentrations (mg/L)

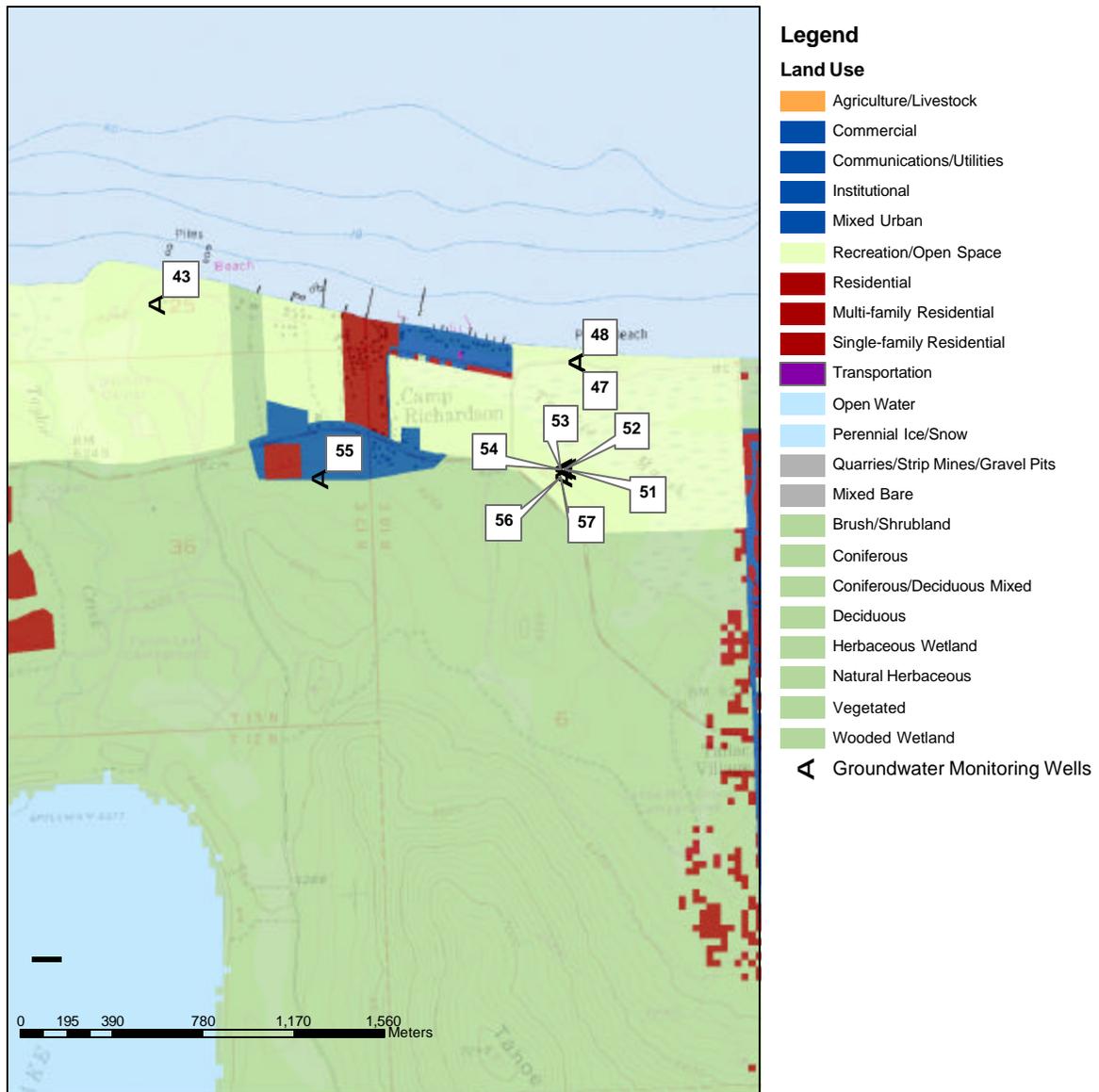
Constituent	Well ID				
	055	056	057	051	052
Ammonia + Organic	na	0.01	0.02	0.07	0.01
Nitrate	0.058	0.023	0.005	0.028	0.02
Total Nitrogen	--	0.033	0.025	0.098	0.03
Orthophosphorus	0.1	0.015	0.003	0.017	0.005
Total Phosphorus	na	0.034	0.018	0.043	0.019
Top of Open Interval (ft bas)	--	10.25	3.7	8.28	5.15

Constituent	Well ID				
	053	054	047	048	043
Ammonia + Organic	0.05	0.04	1.4218	0.64	0.08
Nitrate	0.007	0.002	0.0678	0.038	0.064
Total Nitrogen	0.057	0.042	1.4896	0.678	0.144
Orthophosphorus	0.011	0.003	0.0337	0.031	0.0325
Total Phosphorus	0.025	0.012	0.0502	0.046	0.0693
Top of Open Interval (ft bgs)	17	3.4	15.45	5	--

Notes:

1. All concentrations reported are dissolved.
2. Data obtained from USGS and STPUD.
3. Top of Open Interval with a -- indicates the open interval is unknown. A < indicates less than the total depth of the well.
4. na -- not analyzed
5. Total Nitrogen is calculated for those wells with both ammonia + organic and nitrate concentrations.
6. Nitrate concentrations include nitrite.

Figure 4-9. South Lake Tahoe Subregion 1 Groundwater Wells and Land Use



Notes:

1. Land use coverage provided by Tahoe Research Group
2. Only wells with groundwater elevation and/or analytical data are shown.

4.3.3 Subregion 2 Nutrient Concentrations

The wells and land use in the area are depicted in Figure 4-10. Well 050 has been monitored for all forms of the dissolved nutrients of interest to this evaluation. The remaining wells shown in Table 4-5 have only been sampled for dissolved nitrate and total dissolved phosphorus. Wells 076, 081 and 083 have only been sampled to monitor drinking water standard compliance which includes only total nitrate and nitrite.

The dissolved ammonia + organic nitrogen concentrations for well 050 range from 0.001 mg/L to 0.2 mg/L, averaging 0.043 mg/L. The dissolved nitrate concentrations for all wells shown in Table 4-5, which include nitrite, range from 0.01 mg/L to 2.36 mg/L with an average of 0.678 mg/L. Well 050 has an average total dissolved nitrogen concentration of 0.418 mg/L. The average total nitrate concentrations found in wells 076, 081 and 083 range from 0.415 mg/L to 1.01 mg/L. Table 4-5 includes the dissolved nitrogen concentrations for wells 050, and 084 - 087.

Orthophosphorus concentrations for well 050 range from 0.015 mg/L to 0.02 mg/L, averaging 0.018 mg/L. The range of total dissolved phosphorus for all wells shown in Table 4-5 is 0.01 mg/L to 0.78 mg/L, averaging 0.039 mg/L. No phosphorus concentrations have been measured in the other wells in the area. Table 4-5 includes the dissolved phosphorus concentrations for wells 050, and 084 - 087.

The distribution of wells in the area is not suited to characterize the area (Figure 4-10). The downgradient well, 050, would not detect nutrients migrating from the residential neighborhoods to the southwest. There is a noticeable difference in nitrogen concentrations between the deep wells and those in the upper aquifer. The phosphorus concentrations do not vary much downgradient or from upper to lower aquifer. The distribution of nitrogen concentrations in this area seems to be related to nearby sources, and an assessment of cumulative sources is not possible as there are no wells suited to make this assessment. The upgradient cluster of wells located within a residential land use only (wells 084 – 087) does not seem to have a defined trend in nitrate concentrations in the downgradient direction.

Table 4-5. South Lake Tahoe Subregion 2 Average Nutrient Concentration (mg/L)

Constituent	Well ID				
	084	087	085	086	050
Ammonia + Organic	na	na	na	na	0.043
Nitrate	0.719	1.017	0.029	1.252	0.375
Total Nitrogen	--	--	--	--	0.418
Orthophosphorus	na	na	na	na	0.018
Total Phosphorus	0.027	0.077	0.024	0.037	0.029
Top of Open Interval (ft bgs)	40	65	190	87	<341

Notes:

1. All concentrations reported are dissolved.
2. Data obtained from USGS, and STPUD.
3. Top of Open Interval with a – indicates the open interval is unknown. A < indicates less than the total depth of the well.
4. na – not analyzed
5. Total Nitrogen is calculated for those wells with both ammonia + organic and nitrate concentrations.
6. Nitrate concentrations include nitrite.