LAWRENCE & ASSOCIATES
ENGINEERING GEOLOGY
CIVIL ENGINEERING
GROUND-WATER HYDROLOGY

Technical Memo

To: Mr. Brian Huffaker, Hawkins Companies

From: Ms. Bonnie Lampley

CC: Mr. Paul Reuter, PACE Civil, Inc.

Date: January 20, 2009

Re: Update to preliminary water-supply impacts for Knighton Road development

---

Mr. Huffaker,

As you requested, this technical memo presents an update of the preliminary analysis of potential water-supply impacts from the Hawkins Companies proposed commercial development at Knighton Road and Interstate 5, Shasta County, California. We understand that the development will consist of approximately 741,000 square feet of commercial development, of which about 26,000 square feet will be restaurants and the remainder, retail.

We submitted our initial preliminary analysis to you in May 2008. The intent of the preliminary analysis was to provide initial information to the Shasta County Planning Department (Planning) for their preparation of a "Request for Proposals" for the Project's Environmental Impact Report (EIR). Planning has now selected a consultant to prepare the EIR, and you requested that we update the preliminary analysis to reflect current conditions.

As in the initial memorandum, we are providing no interpretation as to the significance of the potential water-supply impacts. The information presented herein is to be used by Shasta County and their consultant for the EIR.

The analysis is based solely on information from previous studies, information available in-house at L&A, and new information presented by PACE Civil, Inc. (Pace), in part as follows:

> L&A, August 1998, rev. January 1999, *Well Installation, Aquifer Testing and Ground-Water Modeling for Flying J Knighton Road Travel Plaza Shasta County, California*.
>
> L&A, August 2006, *Water-Supply Evaluation for the Proposed Shasta Regional Auto Mall, Knighton & I-5, Shasta County, California*.
>
> Pace, May 2008, pers. comm., water demand calculations for Hawkins Companies development; January 16, 2009, memo re water and wastewater systems.

2001 Market Street • Room 523 • Redding, California 96001 • (530) 244-9703 • fax (530) 244-5021 • info@lwrnc.com

Project Water Demand

Based on information provided by Pace, the maximum-day demand (MDD) for non-irrigation needs will be approximately 122 gpm; and the peak demand (two-hour) will be approximately 337 gpm. For irrigation, Pace calculated a MDD of 63 gpm and a peak demand of 212 gpm. Peak demands will be met from storage, not directly from the well.

Pace calculated the maximum-day demands because that is the value on which water-system design is based. For long-term calculation of water-supply impacts, however, we also need the average-annual demand. We estimated the combined domestic and irrigation average-annual demand at 122 gpm, based on the conversion factor used in the California Waterworks Standards. The Waterworks Standards states that MDD should be at least 1.5 times the average-annual demand. Therefore, taking 122 gpm + 63 gpm and dividing by 1.5 gives an annual-average demand of 122 gpm.

The highest irrigation demand probably will occur at night, while the highest potable demand will occur during the day. Therefore, the potable and irrigation peak demands will not occur at the same time. For analysis of impacts, however, we will assume that both potable and irrigation maximum-day demands occur at the same time, and that the average-annual demands are additive. This approach is conservative and will not lead to underestimation of impacts.

Yearly, the Project would use about 200 acre-feet of water (122 gpm × 1440 minutes/day × 365 days/year ÷ 325,851 gallons/acre-foot). One acre-foot is the amount of water that would cover one acre, one-foot deep. A typical household uses up to one acre-foot of water per year.

Project Water Supply

Water for the Project will be supplied by an on-site water well. There is an existing 350-foot deep, 10-inch cased production well at the site; this well, and the associated observation wells, were installed and tested for the previously proposed Flying J truck-stop project. This well is planned to serve as the supply well for the current Project. **Figure 1** (attached) shows a site plan with the existing well locations.

Results from the Flying J drilling program showed at least three aquifer zones beneath the site – from 108 to 125 feet ("upper"), 158 to 209 feet ("intermediate"), and 240 to 330 feet ("lower"). The upper two zones are separated from the lower zone by a clay layer from 209 to 240 feet below ground surface. The Production Well was completed below the clay layer; the 81-foot-long screened interval extends from 244.5 to 325.5 feet bgs.

Static water levels in the upper and intermediate aquifers are about 30 feet bgs; water level in the lower aquifer is about 52 feet bgs. The similarity in water levels in the upper and intermediate aquifers suggests that these two zones could be considered as one aquifer.

During the aquifer test, maximum drawdown in the Production Well (pumping well) was approximately 33 feet after 24 hours of pumping at 500 gpm. Data from the aquifer test was used to calculate aquifer coefficients (transmissivity and storativity). The calculated transmissivity (approximately 37,500 to 49,500 gpd/foot) was similar to that observed for similar deposits in the

Redding ground-water basin. Calculated storativity (approximately 2.5 to 4.9×10^{-4}) was also similar to that observed for similar deposits in the Redding ground-water basin. The calculated storativity for the lower aquifer indicates that it is confined. Hydraulic conductivity (derived from transmissivity and taking into account aquifer thickness) in the lower aquifer ranged from approximately 60 to 80 feet/day. Vertical permeability in the clay zone between the intermediate and lower aquifers was calculated to be 0.093 gpd/square foot. This is equivalent to approximately 0.125 feet/day.

Well Interference

Interference is the decrease in water level in a well caused by the pumping of a neighboring well. The level of interference caused by pumping a well depends, in part, on the pumping rate, the length of time the pumping occurs, the distance between wells, and geologic conditions. Interference increases with increasing pumping rate and increasing pumping time. Interference will be greater for wells closer to a pumping well. Interference increases with decreasing hydraulic conductivity, which is dictated by geologic conditions.

Interference decreases when pumping decreases or stops. That is, interference can be considered a more-or-less immediate (within hours or days) impact that happens when a pumping well operates.

Because the Hawkins Companies Project will use the same well analyzed previously, we can use the same groundwater model set up for the Flying J and Auto Mall projects, and change the pumping rate to the current maximum-day and annual-average demands to predict groundwater impacts.

For the maximum-day demand of 184 gpm, the model shows about one foot of interference at 2,250 feet (0.4 miles) from the well and about six inches at 4,050 feet (0.8 miles) (**Figure 2**). For the annual-average demand of 122 gpm, the model shows about one foot of interference at 1,200 feet (0.2 miles) from the well and about six inches at 3,000 feet (0.6 miles) in the deep aquifer (**Figure 3**).

In all scenarios, the model shows no detectable interference in the upper and intermediate aquifers. Although interpretation of the 1998 well-testing data suggested that there could be interference in the intermediate aquifer from pumping the deep aquifer, recharge of the treated wastewater for the current Project will ameliorate those effects. Because most domestic wells in the area are screened in the upper or intermediate aquifers, most of the domestic wells would not experience interference from the Project well. Current seasonal variation of water levels is about 20 to 25 feet in the area.

Groundwater Availability

In addition to the relatively short-term or immediate impacts from interference, long-term availability impacts must be considered. If withdrawals from a groundwater basin are greater than long-term recharge (replenishment of the water), “overdraft” occurs. One result of overdraft is declining groundwater levels, usually over a period of years. Therefore, Project water use must be compared to the quantity of water in the aquifer and the amount of annual recharge.

The groundwater budget for the Redding basin as a whole was estimated in the Shasta County Water Resources Master Plan.[1] Total inflow into the groundwater system of the Redding basin is estimated to be 293,600 acre-feet. Groundwater discharge from the basin is estimated to be about 37,300 acre-feet from pumping and about 266,000 acre-feet to surface streams.

The total water demand in the Redding basin as of the date of the Shasta County Water Resources Master Plan (1997) was 280,460 acre-feet. This demand was met mainly with surface water. The projected demand estimated for the year 2030 is 342,350 acre-feet, or an increase of about 62,000 acre-feet. To conservatively estimate groundwater-availability impacts, we will assume that all of the additional year 2030 demand will be supplied by groundwater. This gives a total groundwater pumpage for the year 2030 of 99,300 acre-feet (62,000 + 37,300 acre-feet).

Current total pumpage in the Redding Basin is about 13% of groundwater recharge (37,300 ÷ 293,600 acre-feet). Estimated total future pumpage would be about 33% of groundwater inflow/recharge (99,300 ÷ 293,600 acre-feet). Pumping from the Project (200 acre-feet/year) would be about 0.07% of total Redding basin groundwater inflow.

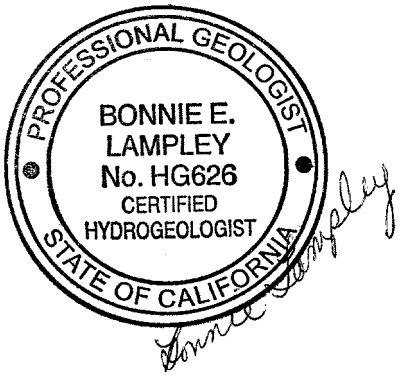
Note that the net amount of water that the Project will remove from the groundwater basin will be less than the 200 acre-feet/year pumped. About 90 acre-feet/year will be returned to the basin from recharge of the treated wastewater. Thus, the net withdrawal will be about 110 acre-feet per year.

Please feel free to contact me if you have additional questions regarding this memo.

Sincerely,

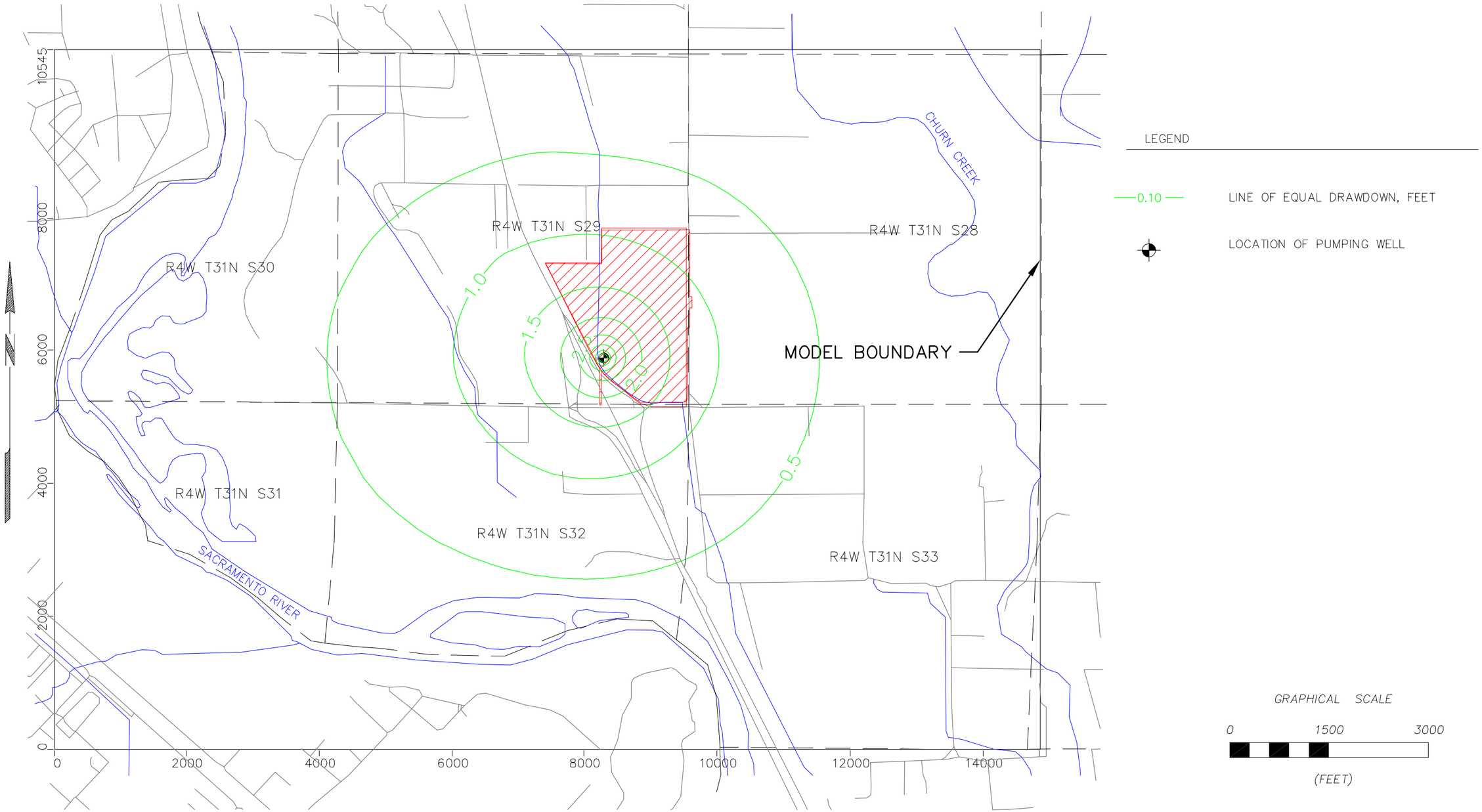
Bonnie E. Lampley

Bonnie Lampley
Principal Hydrogeologist



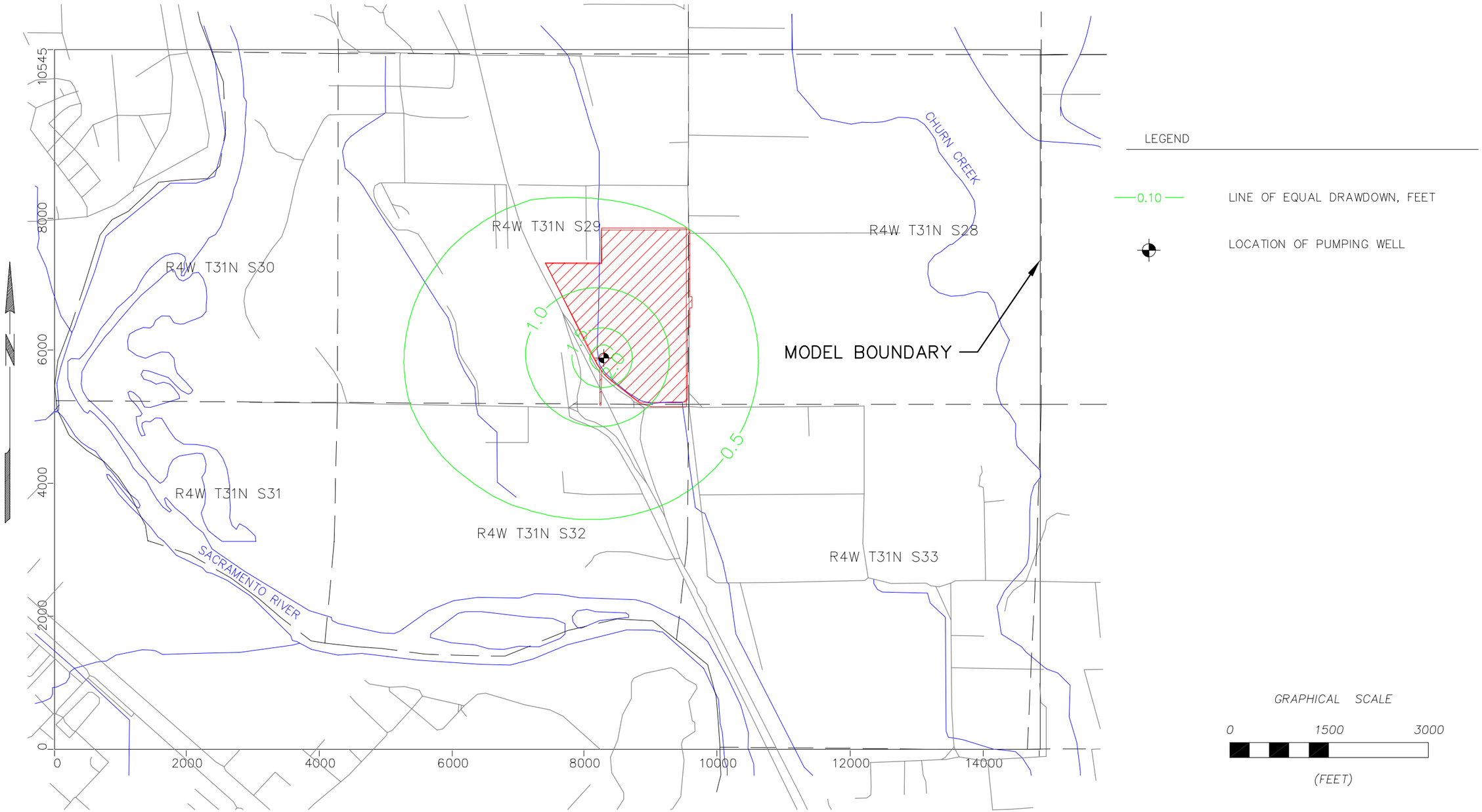
enc.: Figure 1. Site plan showing well locations
Figure 2. Predicted drawdown at maximum-day demand
Figure 3. Predicted drawdown at annual-average demand

[1] Shasta Co. Water Agency, CH2M Hill, 1997, *Shasta County Water Resources Master Plan, Phase 1 Report, Current and Future Water Needs*, Figure 19 and pp. 101 – 103.



P:\007103.02_hawkins companies_knighton road\184gpm_max day demand.dwg D.B.Z. 1/20/2009

PREDICTED DRAWDOWN AT MAXIMUM DAY DEMAND (184 GPM FOR 30 DAYS	LAWRENCE & ASSOCIATES 2001 MARKET STREET, RM. 523 REDDING, CA 96001 PHONE (530) 244-9703 FAX (530) 244-5021	SCALE: 1"=1500'	
		DATE: 1/20/09	
		JOB NO.: 007103.02	
CLIENT: HAWKINS COMPANIES	PROJECT: WATER SUPPLY	DRAWN BY: D. ZAITZ	CHECKED BY: B. LAMPLEY
		FIGURE 2	



P:\007103.02_hawkins companies_knighton road\122gpm_annual ave demand.dwg D.B.Z. 1/20/2009

PREDICTED DRAWDOWN AT ANNUAL AVERAGE DEMAND (122 GPM 365 DAYS/YEAR)	LAWRENCE & ASSOCIATES 2001 MARKET STREET, RM. 523 REDDING, CA 96001 PHONE (530) 244-9703 FAX (530) 244-5021	SCALE: 1"=1500'	
		DATE: 1/20/09	
		JOB NO.: 007103.02	
CLIENT: HAWKINS COMPANIES	PROJECT: WATER SUPPLY	DRAWN BY: D. ZAITZ	CHECKED BY: B. LAMPLEY
		FIGURE 3	