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# 2008 Annual Report:
## Hydrologic Conditions in Baseflow Reaches Pursuant to Conditions 14 and 15, Santa Lucia Preserve, Monterey County, California

Report No. WI-2008-06
15 November 2008


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## Preface

This report presents the results of the 2008 baseflow condition surveys of the four major streams flowing through Santa Lucia Preserve– Lower Las Garzas, Portrero, San Jose, and San Clemente Creeks. This report has been prepared for the Santa Lucia Conservancy and is primarily intended for the staff of Monterey County and California Department of Fish and Game, in accordance with the baseflow monitoring and reporting requirements outlined in County Conditions 14 and 15. The scope of this report is limited to the presentation and evaluation of existing baseflow conditions as required by Conditions 14 and 15, and is not intended as a comprehensive analysis. However, data collected will serve an integral part establishing a long term dataset necessary for future analyses.

## Acknowledgments

We would like to acknowledge Chris Hauser of the Santa Lucia Conservancy and Scott Brown of Balance Hydrologics for providing logistic support and reference information. We thank Zachary Croyle and Bryce Kantz for field assistance and support. Fred Watson reviewed and improved the report.

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# 1 Introduction

The Santa Lucia Preserve (SLP) is a residential community established in 1994 on the 20,000 acre Rancho San Carlos property. The Santa Lucia Conservancy manages 18,000 acres of open space while the remaining 2,000 is occupied by the community. The Monterey County Planning and Building Inspection Department, the lead CEQA agency imposed stipulations on the Preserve before approving the final Environmental Impact Report. Through Conditions 14 and 15, annual baseflow monitoring is required on four major streams flowing through the property.

- *Condition 14*

  "Measured daily base flows in Portrero Canyon, San Clemente and Las Garzas Creeks shall be recorded at approved locations near the boundaries of Rancho San Carlos. An annual survey of pools and base flow conditions in the gaged creeks and in San Jose Creek shall be conducted in September of each year. At least every year, a base flow monitoring report for evaluating base flow conditions shall be prepared and filed with Environmental Health, Water Resource Agency, the Department of Fish and Game, and the Monterey County Planning and Building Inspection Department."

- *Condition 15*

  "If the Base Flow Monitoring Report demonstrates that the base flow in any of the four creeks has dropped below the October 1990 level as a direct result of the project, flow shall be augmented by discharging water into the creek near the upstream end of the affected Base Flow Reach. The rate of augmentation shall be of an amount sufficient to sustain pools and base flow approximately equal to conditions in October 1990; the maximum required combined augmentation for all four creeks is 30 gpm at the points where the augmented water reaches the protected base flow reaches. The proposed augmentation methods, the actual rate(s) of augmentation and the location(s) of augmentation shall be reviewed with the Water Resources Agency prior to implementation of this condition."

Baseflow conditions were surveyed from September 25 through October 9, 2008 and compared to October 1990 conditions pursuant to the requirements of Conditions 14 and 15. This report is a compilation of the findings of the 2008 baseflow conditions mapping and specific conductance profiles of the four creeks flowing through the Santa Lucia Preserve. Although the scope of this report is limited to the requirements of Conditions 14 and 15, the data collected will serve an integral part establishing a long term dataset necessary for future analyses.

# 2 Methods

The baseline comparison for baseflow conditions is an October 1990 study as indicated in Condition 15. The purpose of the study was to develop a "baseline characterization of the physical influences of stream aquatic and associated riparian habitat conditions at Rancho San Carlos" (Napolitano and Hecht 1992). Balance Hydrologics has conducted the annual baseflow survey in previous years, while in 2007 the study was conducted by Zachary Croyle of CSUMB. Methods used in previous surveys have been used here to maintain continuity throughout the study (Woyshner et al. 2004;2005, Croyle 2007).

## 2.1 Baseflow Conditions Mapping

Surveys of the four major creeks in the Santa Lucia Preserve were conducted by walking the length of the creek and recording qualitative observations. Baseflow conditions were described in detail and the locations of changing conditions were recorded with a GPS unit. The results of which were mapped in GIS. The 1990 surveys predate the use of GPS and therefore exact locations of changing stream conditions are not known. For comparison purposes, definitions from previous surveys which describe stream conditions have been retained. Furthermore, the maps presented in this report have been formatted similar to previous surveys to maintain consistency within the dataset. The following definitions are used to describe sub-reach channel conditions (Woyshner et al. 2004;2005, Croyle 2007).

- *"Predominantly wetted channel:* Flowing segments and/or strings of isolated pools, without reference to exact location of segments. Most pools contain at least some water, however riffles may be dry. In the 1990 and 1991 memos and field notes, these segments were referred to as "continuously wetted channel[1]," but we have changed the phrase to avoid confusion with "continuously flowing" and to provide a more general definition that can be applied to all creeks. Some short sections of dry channel may be included, but the reach/sub-reach was defined as having predominantly wetted conditions."

[1] "'Wetted channel,' as used in the 1990 and 1991 reconnaissance reports, described channels with sufficient moisture to sustain riparian vegetation reliably during droughts. Generally, these were channels in which mature riparian vegetation could expect to obtain water from pools, underflow, or springs. In some cases, most notably Portrero creek, a 'wetted' channel had no expression of surface water, but we had reason to believe (often supported by digging in pools) that moist or saturated sands were within a few feet of the bed (Woyshner et al. 2005)."

- *"Predominantly dry channel:* Stream reaches or sub-reaches with isolated pools and completely dry channel (short, predominantly-wetted channel segments separated by long dry channel segments). Some very short sections with flowing water may be included, but reach-wide conditions are predominantly dry or contain only low-volume pools. Many to most pools in these reaches are dry. The current mapping of the 1990/1991 accounts and field notes is based on reach descriptions without reference to exact locations of surface water and dry segments."

- *"Dry:* Stream reaches or sub-reaches having no surface water"

## 2.2 Specific Conductance Profiles

In addition to qualitative descriptions and mapping of baseflow conditions, specific conductance[2], dissolved oxygen, temperature, and pH were measured at select pools during each survey. Specific conductance is used as a proxy for "dryness" in the watershed. As the watershed begins to dry, groundwater with increasing amounts of dissolved solids feeds stream baseflow. This results in higher specific conductance. As streams begin to dry, specific conductance generally increases as demonstrated on Lower Garzas Creek by Wolshner (2003). Specific conductance is used additionally as a quantitative indicator when evaluating stream "dryness" due to changes in baseflow conditions between years.

[2] Specific conductance measures the ability of water to conduct electrical current and is a relative measure of the amount of dissolved solids in water.

# 3 Results

Results for the 2008 baseflow survey are briefly summarized and compared with 1990 reference baseflow conditions.

## 3.1 Lower Las Garzas Creek

The baseflow survey of Lower Las Garzas Creek was conducted on October 9, 2008. The survey was initiated at the confluence of the Las Garzas Creek with the Carmel River and extended upstream to Moore's Lake at Robinson Canyon Road.

The water year 2008 was slightly drier than average, receiving 20.0 inches of rain (Figure 1). However, the majority of rain occurred during two storm evens in January delivering 12.6 inches during the entire month. Such brief large scale rain events do not significantly contribute to groundwater and may provide a false sense of security when looking at overall precipitation averages. Discounting these two rain events, the 2008 water year proved to be very dry for this region, similar to water year 2007 when 11.3 inches were received.

Baseflow conditions for 2008 were found to be slightly "wetter" than 1990 conditions. Although different sections of the creek were found to have different baseflow conditions, 2008 data in aggregate display wetter conditions than 1990. October 2008 conditions (Figure 2) include predominantly wetted channel in the lower section of the Alluvial Terrace Reach, extending into the Alluvial Fan Reach. The Lower SLP Reach of Lower Garzas Creek had disconnected pools with small amounts of surface flow between certain sections during the 2008 survey, while in 1990 they are displayed as completely dry (Figure 3).

The specific conductance profiles show 2008 data to be lower on average than 1990 (Figure 4). There is a disparity between sampling locations of the surveys which makes comparisons difficult. The lower values for 2008 denote "younger" water and therefore "wetter" conditions.

## 3.2 Portrero Creek

The Potrero Creek baseflow survey was conducted on October 1 and 2, 2008 and extended from the SLP property line to approximately 1,800 feet beyond dead rat spring (Figure 5). The channel flows continuously from 1,800 feet above the "Protected Baseflow Reach" to approximately 200 feet below the Lot 187 Bridge. Wolshner et al. (2004) describes the "Pretoected Baseflow Reach" section as surveyed in 1990 as having locally discontinuous flow (Figure 6), while the flow was continuous for the same stretch in 2008. Given this description, Potrero Creek seems "wetter" than 1990 conditions.

Only two specific conductance measurements were taken during the 1990 survey and only four during the 1991 survey. Conditions in 1991 were wetter than 1990, but still well below average. Potrero specific conductance measurements (Figure 7) display values that vary widely. Average measurements taken in 2008 are slightly lower than those of 1991.

## 3.3 San Jose Creek

The San Jose Creek baseflow survey was conducted on September 25 and 27, 2008. The survey began at the SLP property line and extended upstream to Stickleback Pond (Figure 8). Continuous flow was documented from the property line until approximately 3,000 feet above the William's Canyon confluence, although volume was significantly reduced. The 1990 survey was discontinued above Van Winkley's Canyon and found predominantly dry conditions for the majority of the survey (Figure 9). San Jose Creek was clearly "wetter" in 2008 than in 1990.

The specific conductance profile for San Jose Creek display data for 2008 that are much lower than data collected in 1990 (Figure 10).

## 3.4 San Clemente Creek

The baseflow survey for San Clemente Creek was conducted on October 3, 2008. The survey began at the SLP property line (Dormody Road) and continued upstream to Robinson Canyon Road. Continuously flowing water was recorded from the property line until it abruptly ends approximately 4,200 feet later, nearly the entire length of the "Protected Baseflow Reach" (Figure 11).

During the 1990 survey, San Clemente Creek was surveyed from the San Clemente Trail Bridge to Robinson Canyon Road (Figure 12). No data for the conditions through the "Protected Baseflow Reach" exist. Only one short section was described as continuously flowing, while the remainder of the creek was described as predominantly dry. In 2008, apart from a small section upstream from the Golf Course Tributary, the entire length of San Clemente Creek from the San Clemente Trail Bridge to Robinson Canyon Road was completely dry. Discharge at the gage site was estimated to be approximately 0.05 $ft^3/s$ on October 3, 2008 while August 23 and November 5, 1991 estimates are 0.04 $ft^3/s$. Specific conductance data from 2008 are all lower than data from 1990 and 1991(Figure 13). Although little reference data exists for 1990 conditions, judging by conductance values and discharge estimates, San Clemente Creek is "wetter" than 1990 conditions.

# 4 Discussion

Although the 2008 water year rainfall (20.0 inches) was significantly higher than 1990 (13.1 inches), conditions of the streams resemble that of 2007, which was a critically dry year (11.3 inches). Aquifer recharge depends not only on the amount of rain, but the distribution of rain throughout the year. Due to the intensity of rainfall in January of 2008, it can be concluded that much of the rain contributed to runoff rather than direct aquifer recharge. As noted in Croyle (2007) baseflow conditions in a given year are influenced by rainfall totals of previous years. This effect is known as "carry-over" and has been studied in this region (Figure 14) on streams that flow through the SLP (James 2003; Leffler 2003; Smith et al. 2004). It is vital to baseflow conditions that in upcoming years the region receives not only large quantities of rainfall but rainfall distributed in such a way that aquifers are recharged and can supply adequate baseflow given the uncertainty of dry conditions in the future.

# 5 Conclusion

Baseflow conditions were surveyed on the four major streams which flow through the Santa Lucia Preserve – Lower Las Garzas, Potrero, San Clemente, and San Jose. The baseflow characteristics of these streams were collected and compared with conditions in 1990 reference conditions as stipulated in County Condition 15. Results from baseflow mapping and specific conductance plots suggest 2008 conditions are “wetter” than those of 1990 for all four streams.

# 6 References

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Woyshner M, Brown S, Hecht B. 2005. 2005 Annual report: hydrologic conditions in baseflow reaches pursuant to conditions 14 and 15, Santa Lucia Preserve, Monterey County, California. Consulting report prepared by Balance Hydrologics for the Santa Lucia Conservancy. 29 pp.

# 7 Figures

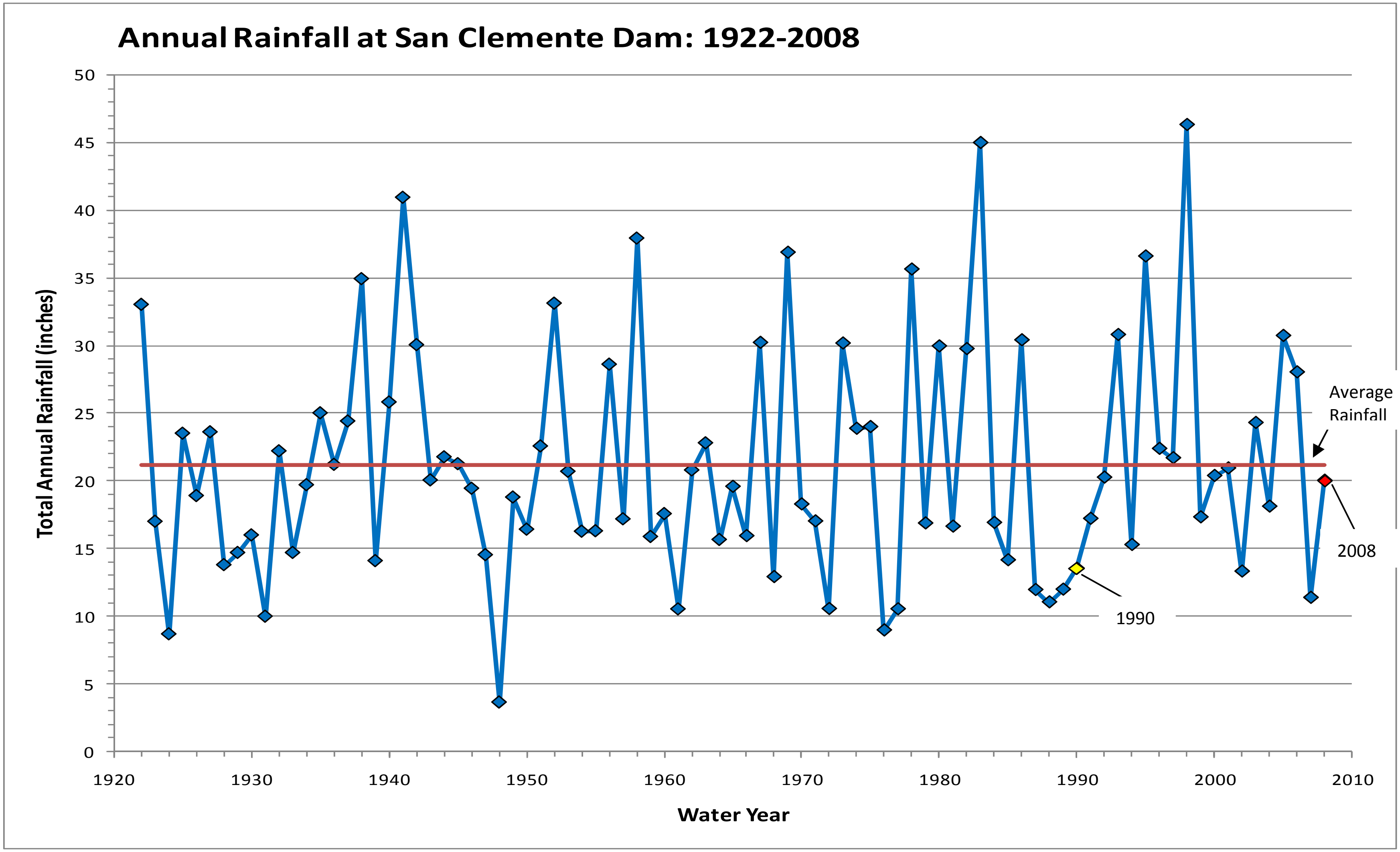


Figure 1. Total rainfall at San Clemente Dam for water years 1922-2008. Water years 2008 had more rainfall than 1990 but the majority fell during two intense storm events in January which minimized groundwater recharge. Above average rainfall from water years 2005 and 2006 help explain why baseflow conditions in 2008 were “wetter” than 1990 baseflow conditions and comparable to conditions in 2007.

October 9, 2008: Lower Las Garzas Creek Generalized Wetted and Dry Conditions

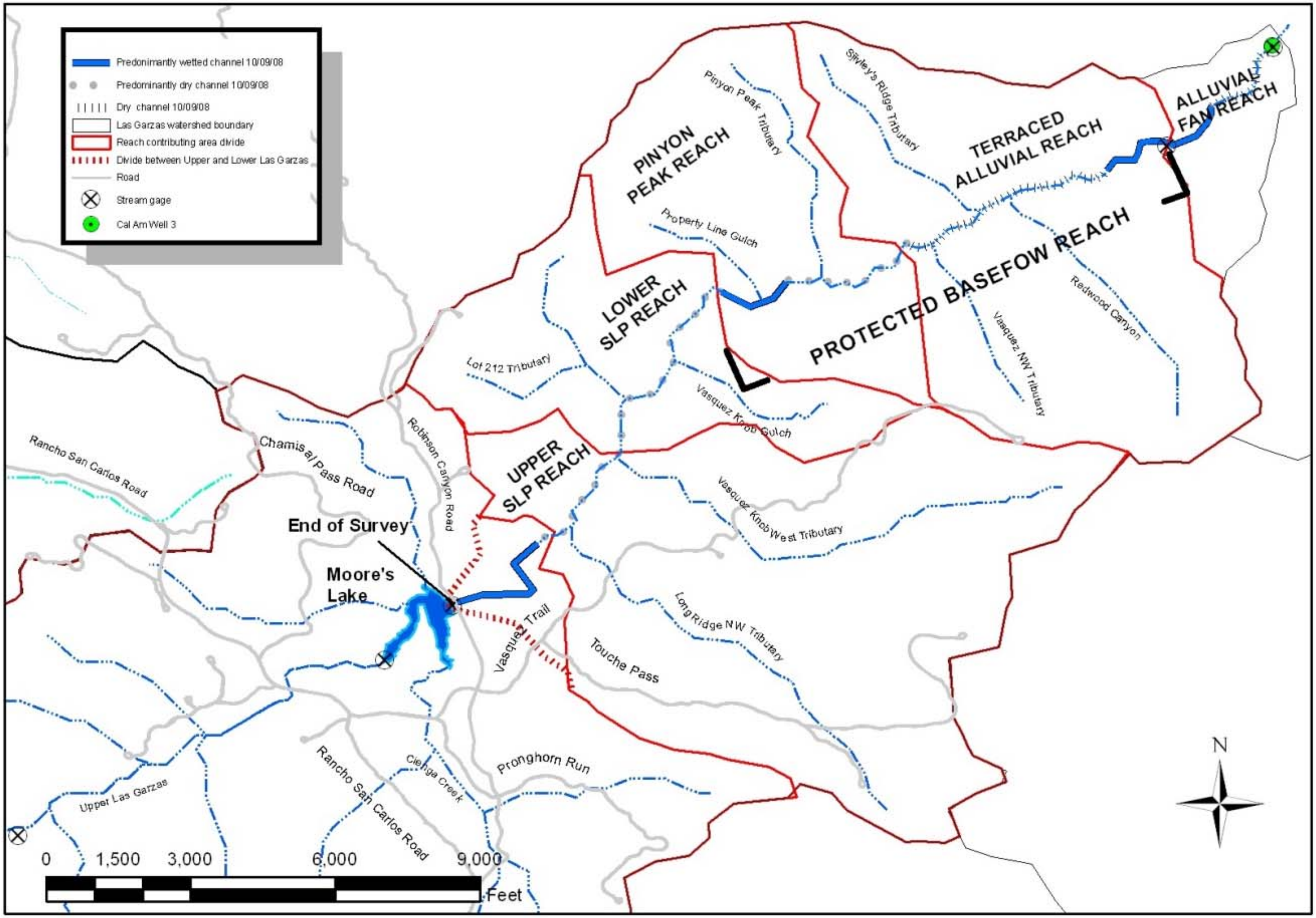


Figure 2. Map showing generalized flow conditions for lower Las Garzas Creek on October 9, 2008.

October 30, 1990: Lower Las Garzas Creek Generalized Wetted and Dry Conditions

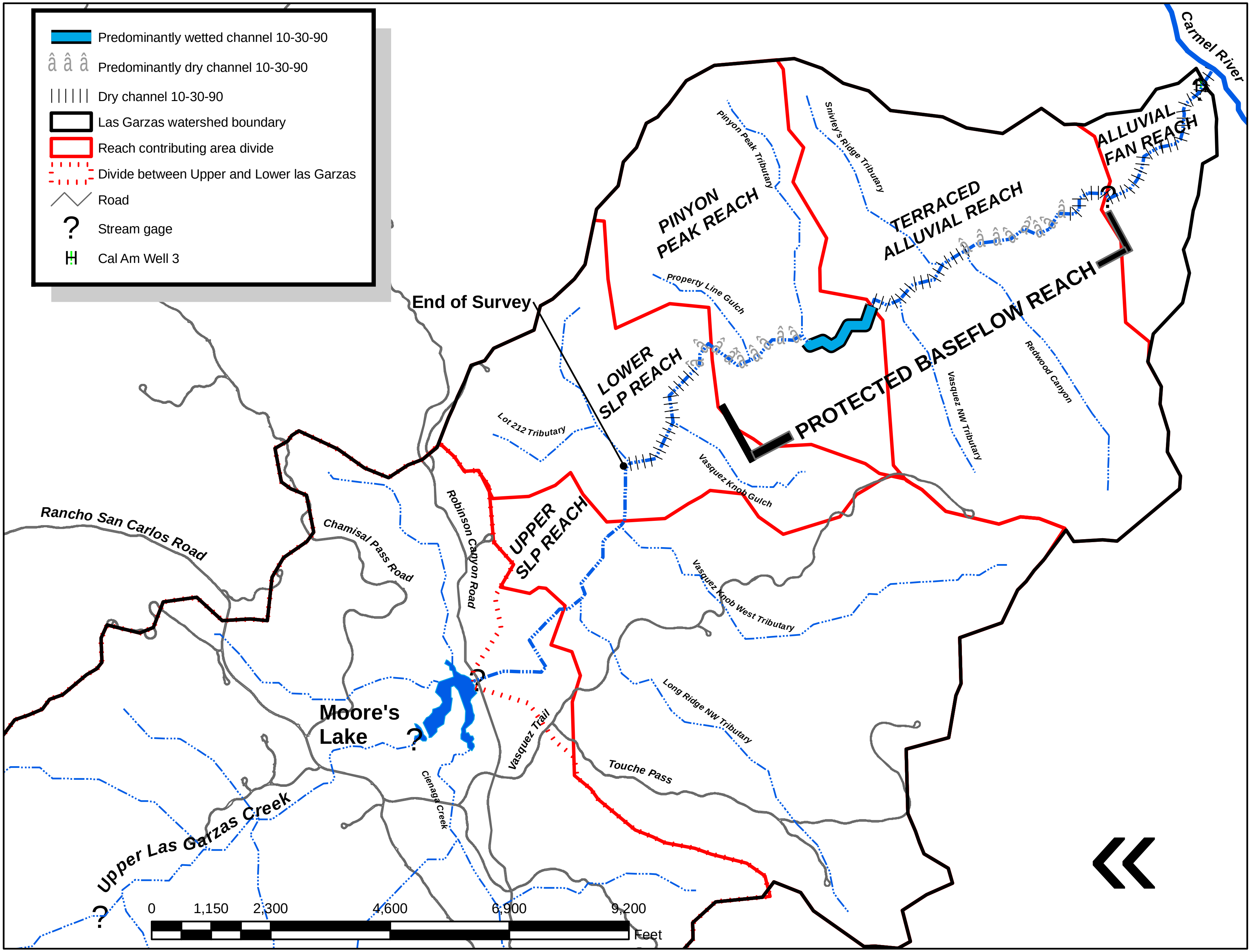


Figure 3. Generalized flow conditions on Lower Las Garzas Creek on October 30, 1990. In 1990, the upper part of Pinyon Pk. Reach consisted of isolated pools while the lower part of that reach had some continuous flow. Surface flow was not observed in the lower reaches.

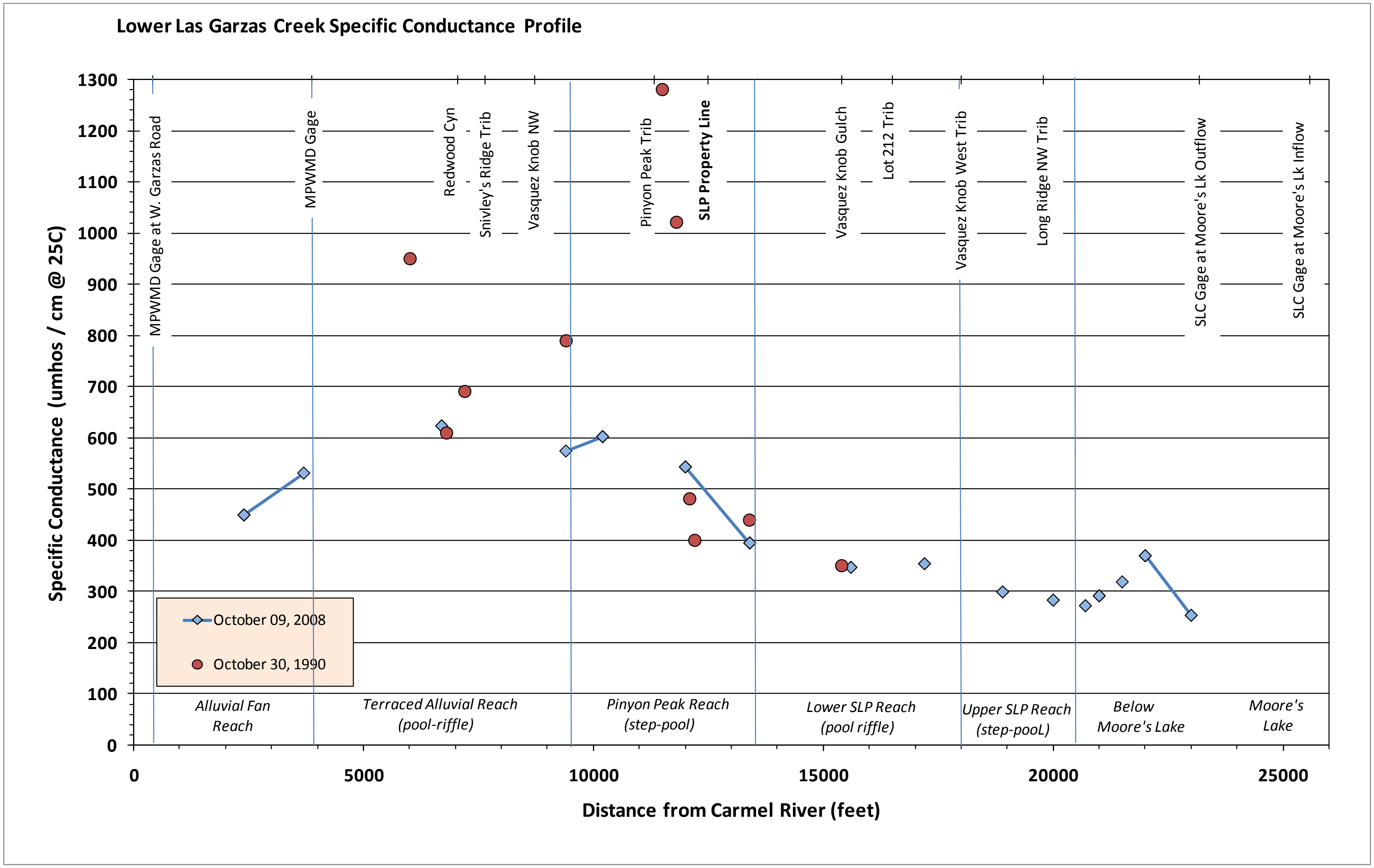


Figure 4. Lower Las Garzas Creek specific conductance measurements for 1990, 2008. For 2008 data, line breaks indicate discontinuous flow between two points.

October 1 & 2, 2008: Potrero Creek Generalized Wetted and Dry Conditions

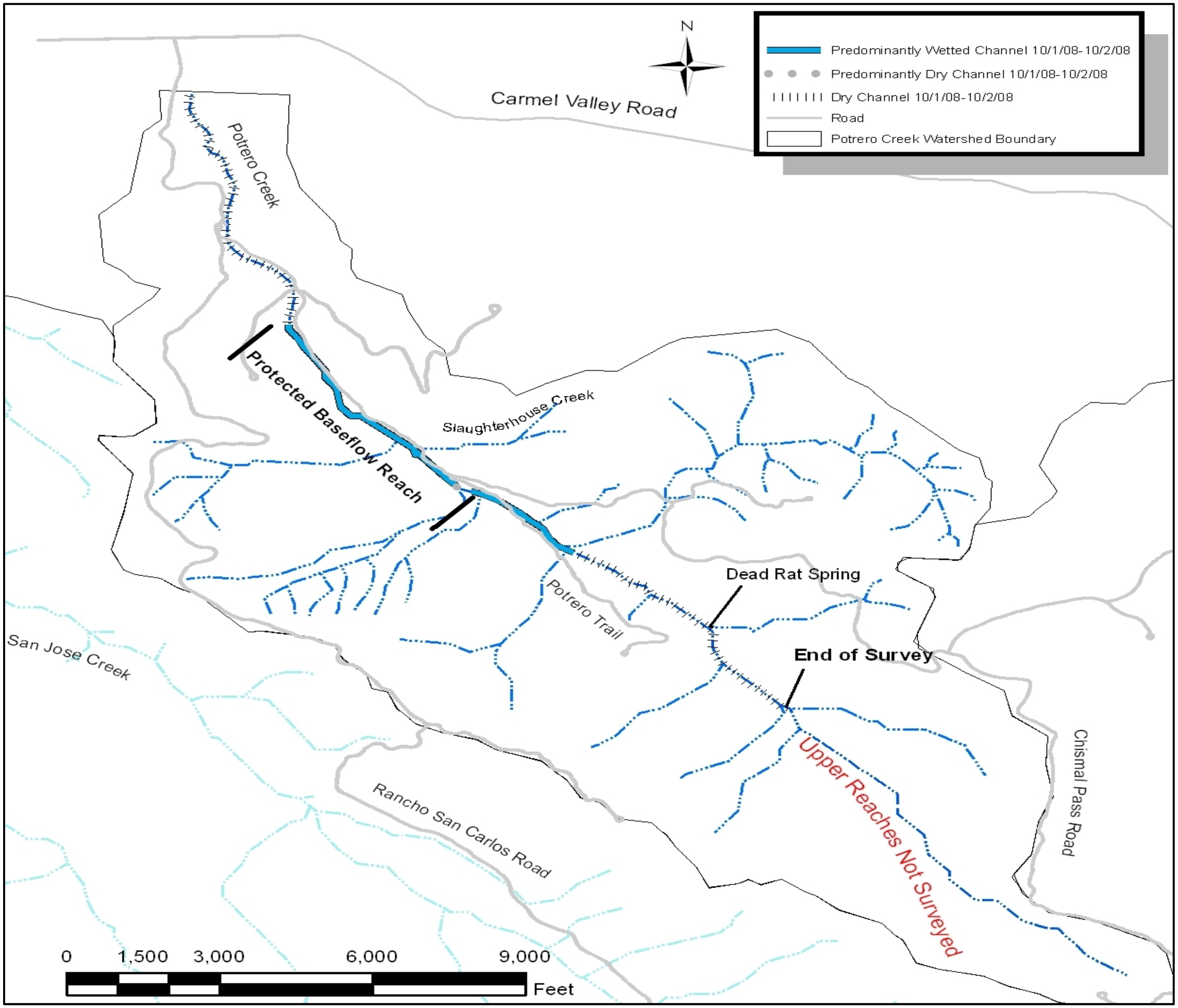


Figure 5. Map showing generalized flow conditions for lower Potrero Creek on October 1 & 2, 2008.

October 06, 1990: Portrero Creek Generalized Wetted and Dry Conditions

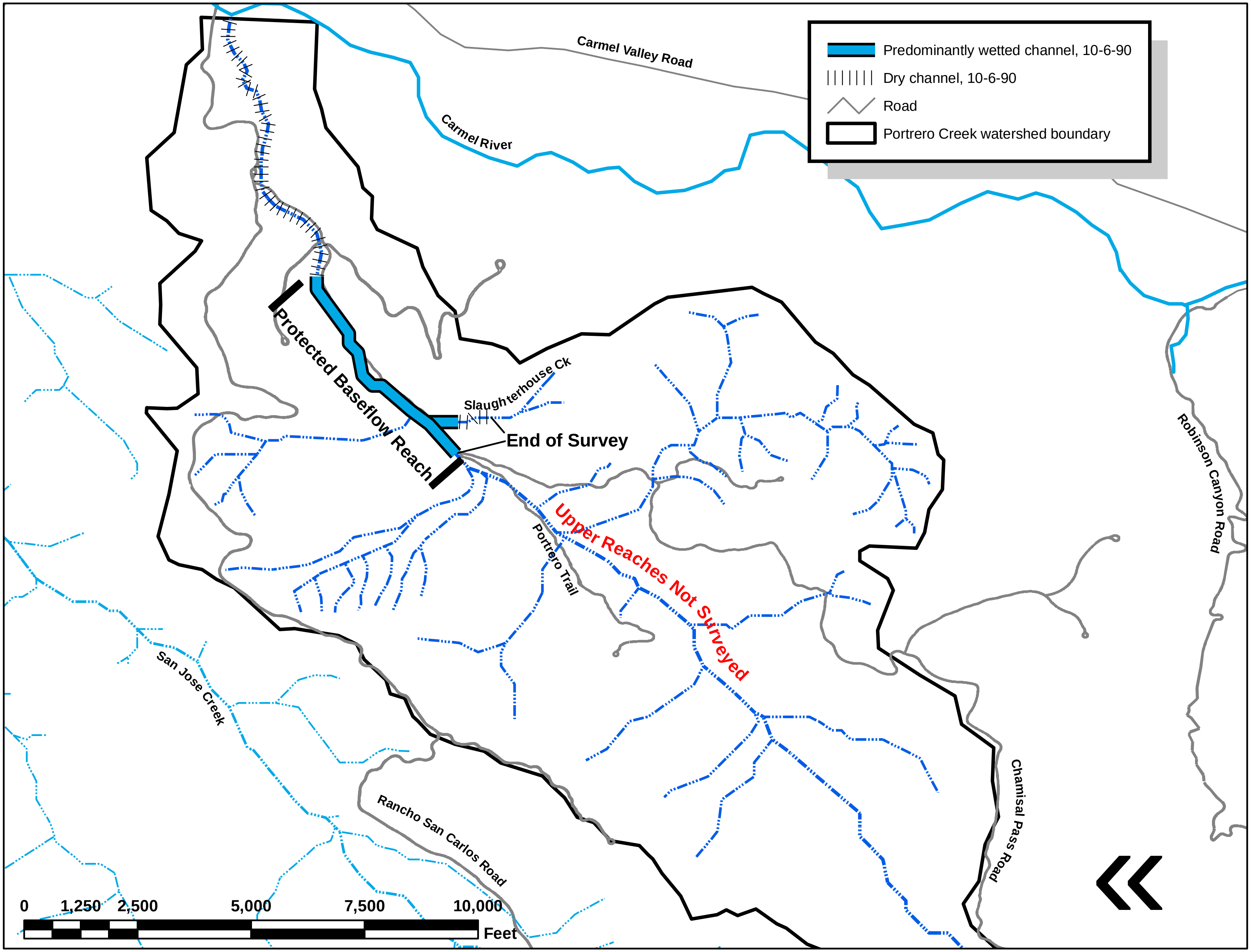


Figure 6. Generalized flow conditions on Portrero Creek on October 30, 1990.

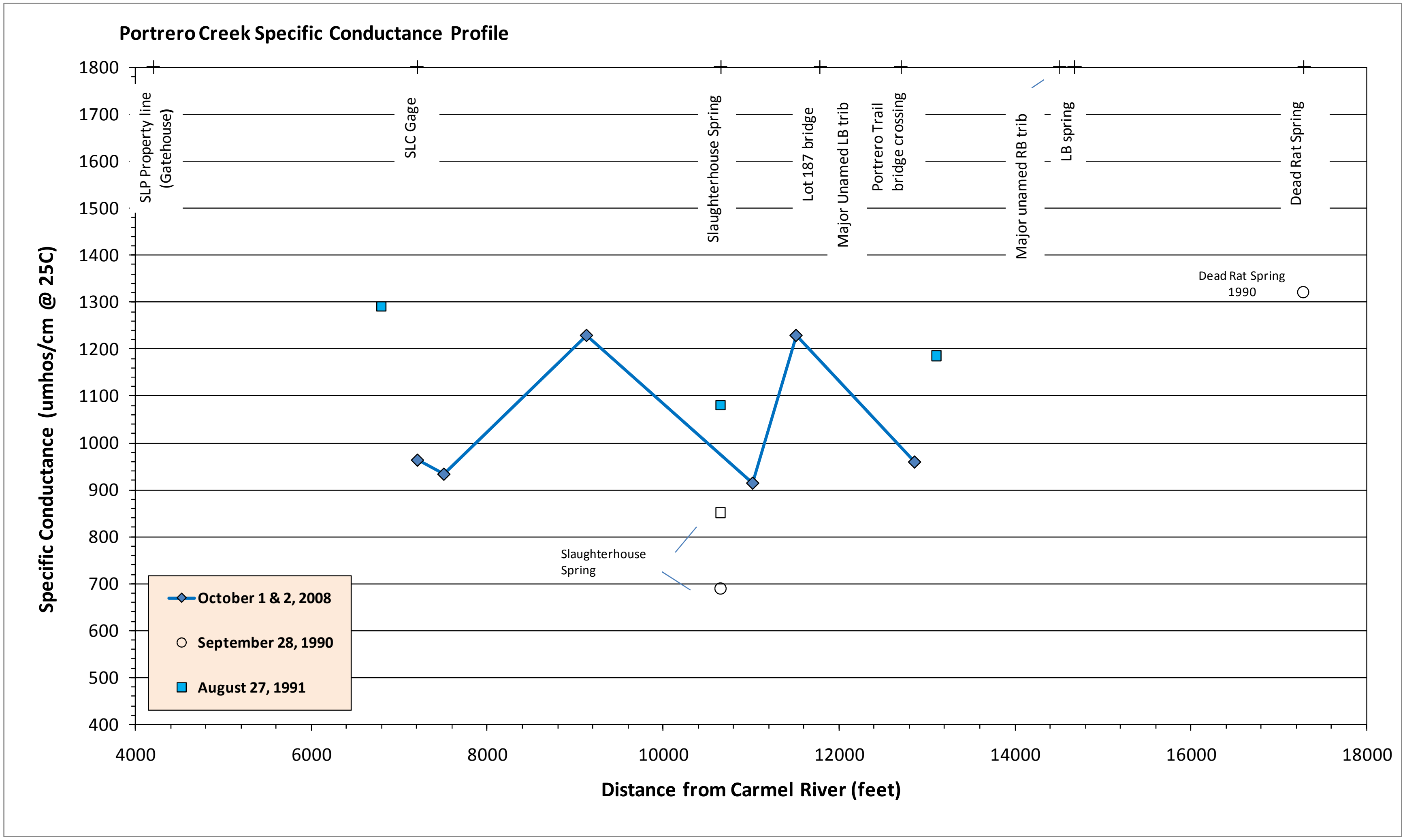


Figure 7. Potrero Creek specific conductance measurements for 1990, 1991, and 2008. For 2008 data, line breaks indicate discontinuous flow between two points. Hollow points represent springs and tributaries.

September 25 & 27, 2008: San Jose Creek Generalized Wetted and Dry Conditions

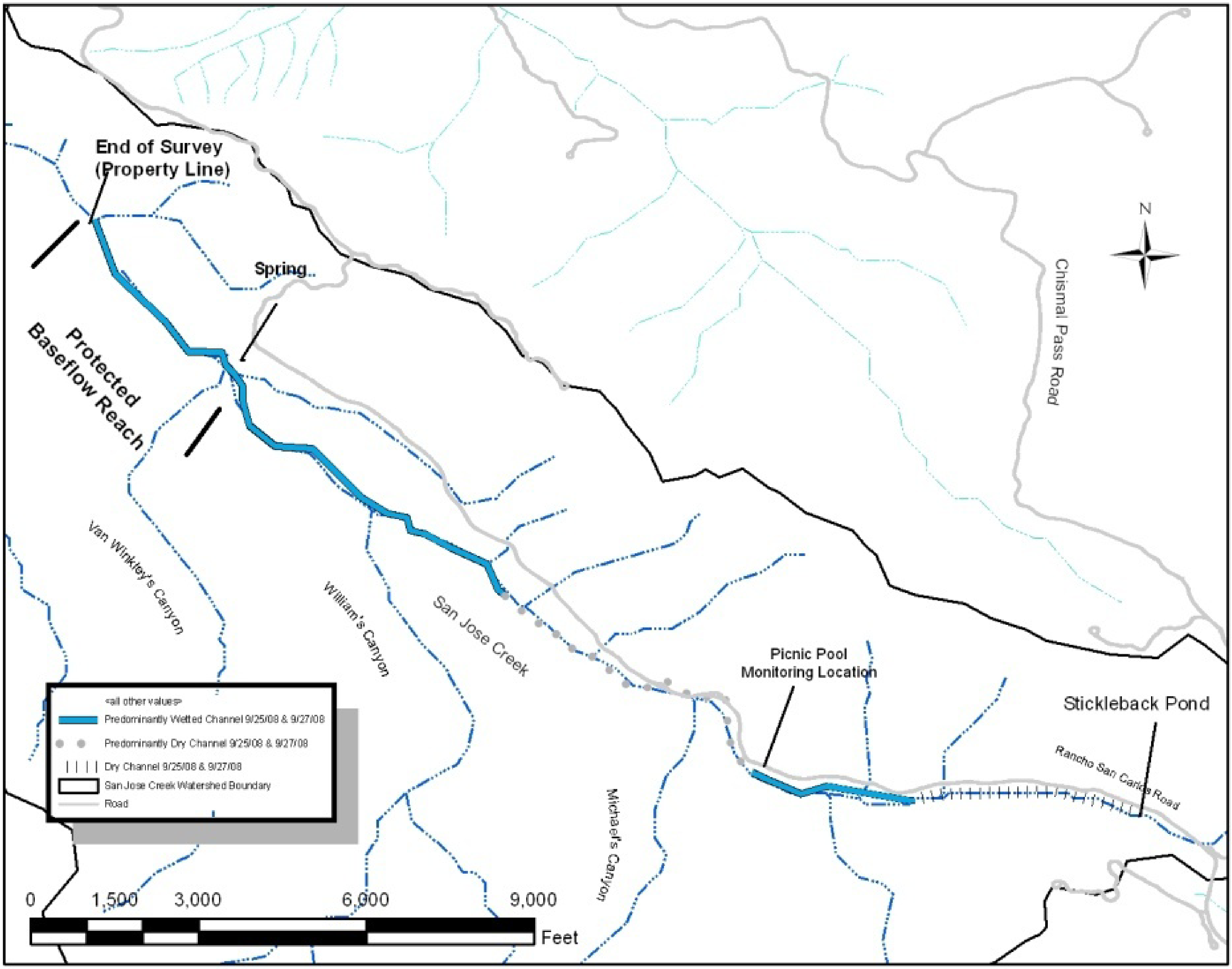


Figure 8. Map showing generalized flow conditions for San Jose Creek on September 25 & 27, 2008.

September 1990: San Jose Creek Generalized Wetted and Dry Conditions

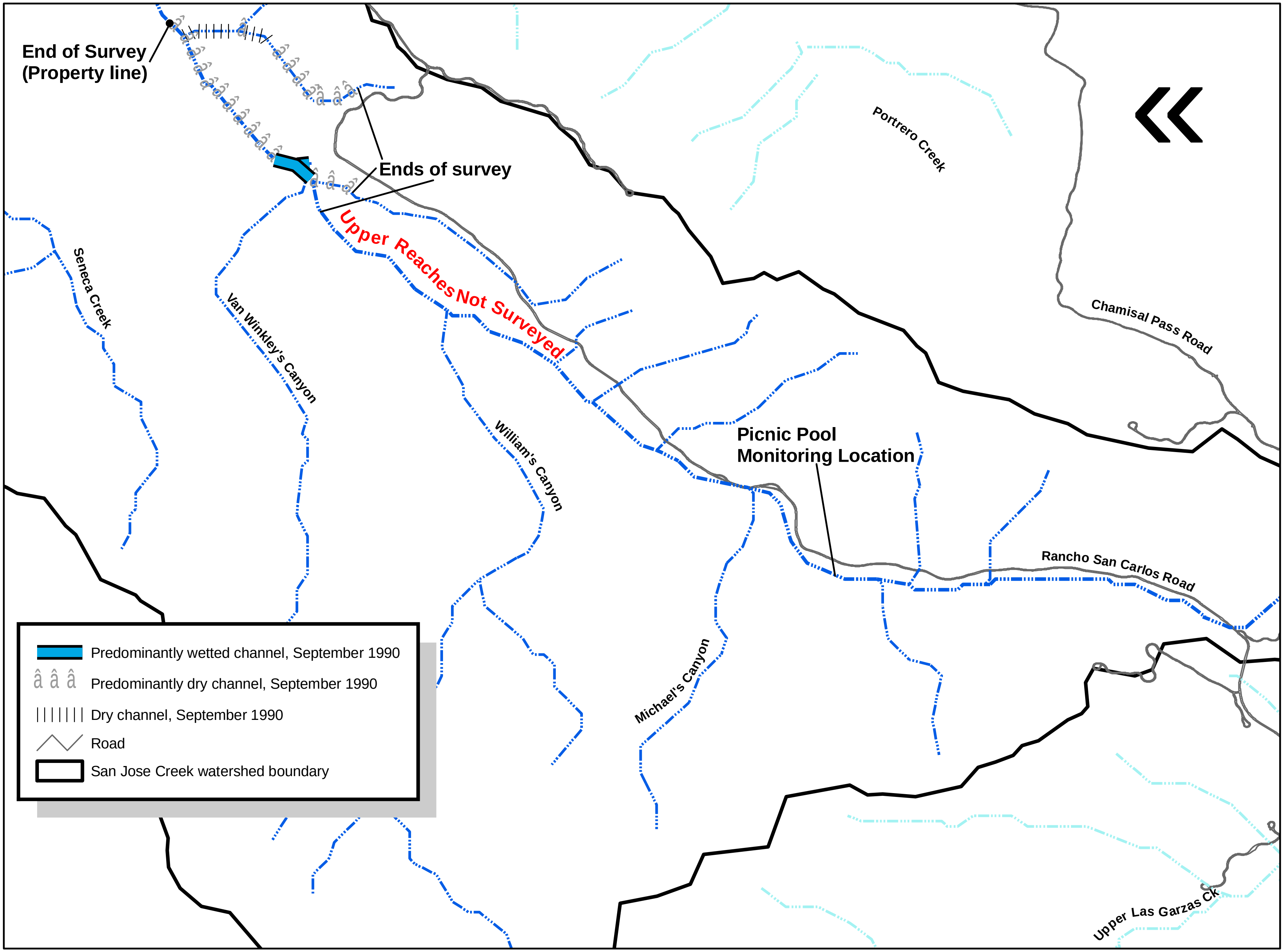


Figure 9. Generalized flow conditions on San Jose Creek in September1990.

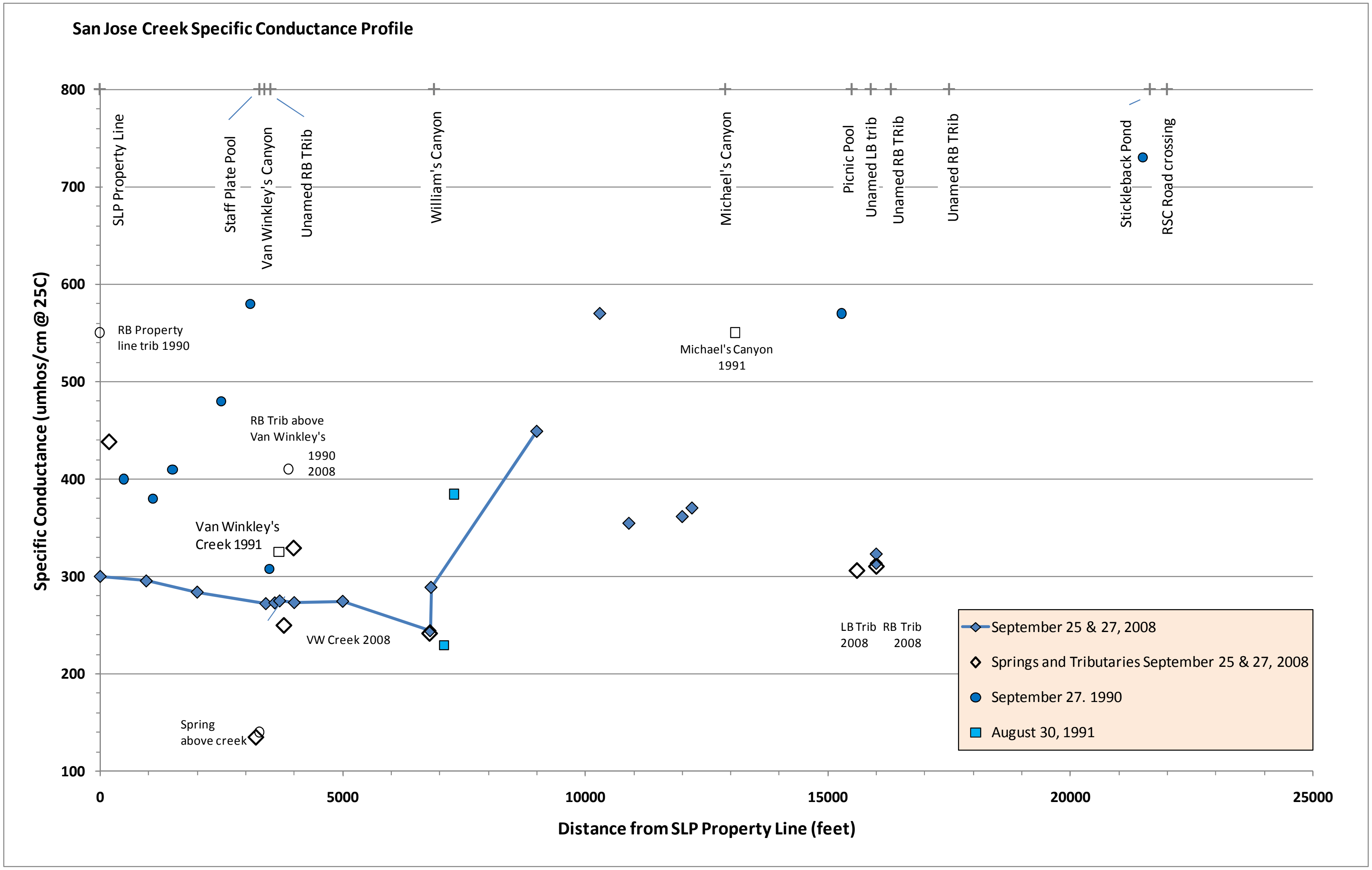


Figure 10. San Jose creek specific conductance measurements for 1990, 1991, and 2008. For 2008 data, line breaks indicate discontinuous flow between two points. Hollow points represent springs and tributaries.

October 3, 2008: San Clemente Creek Generalized Wetted and Dry Conditions

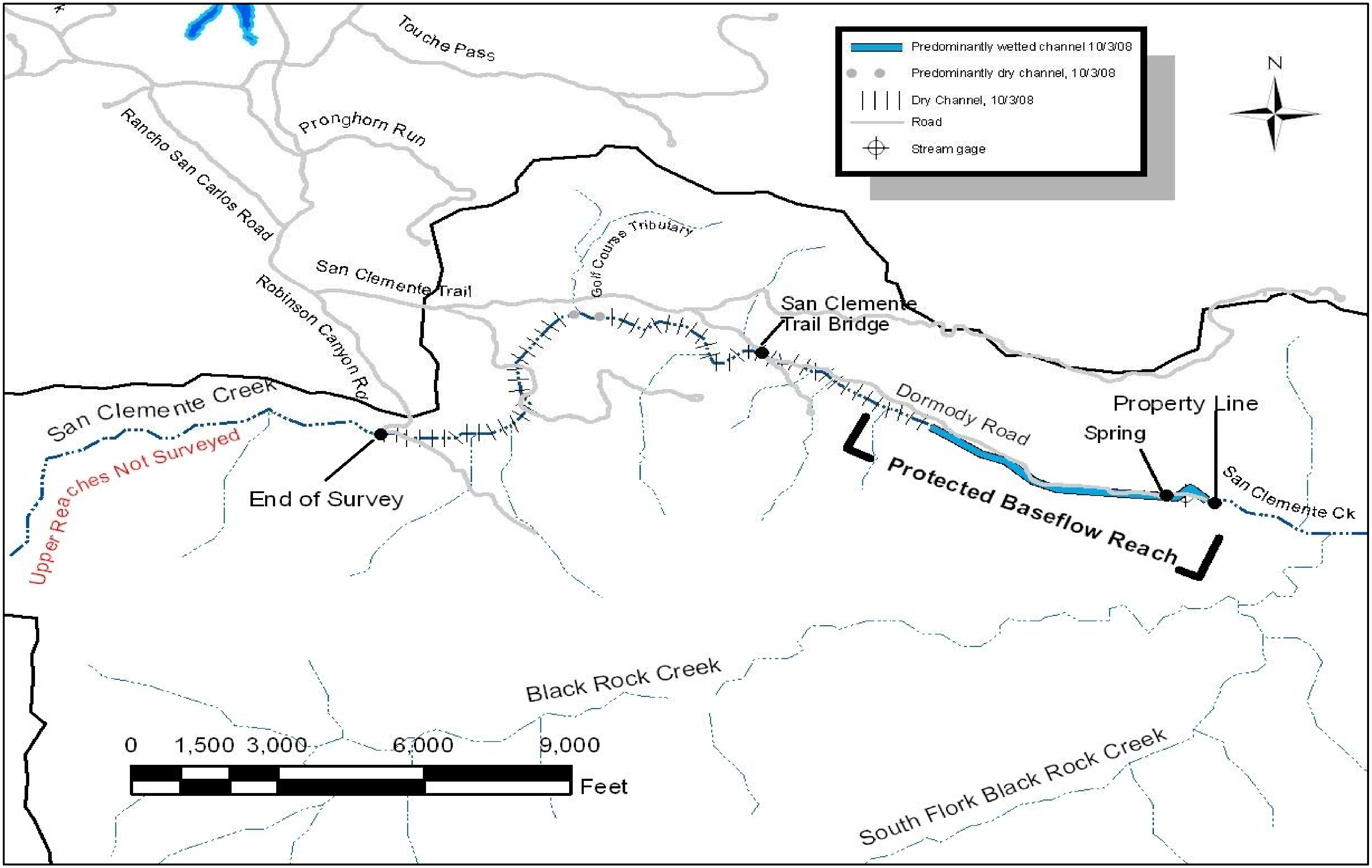


Figure 11. Map showing generalized flow conditions for San Clemente Creek on October 3, 2008.

September 28, 1990: San Clemente Creek Generalized Wetted and Dry Conditions

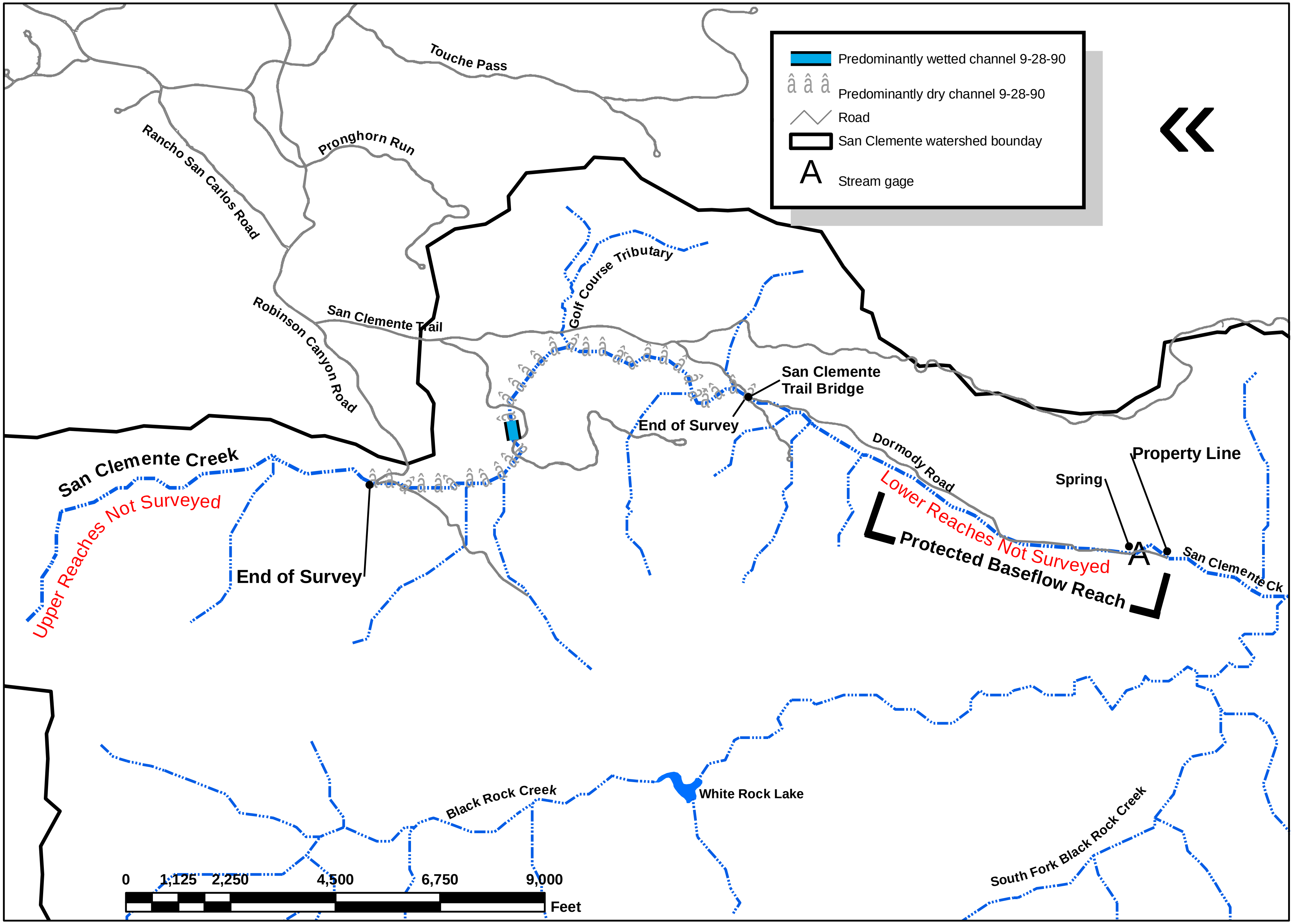


Figure 12. Generalized flow conditions on San Clemente Creek on September 28, 1990.

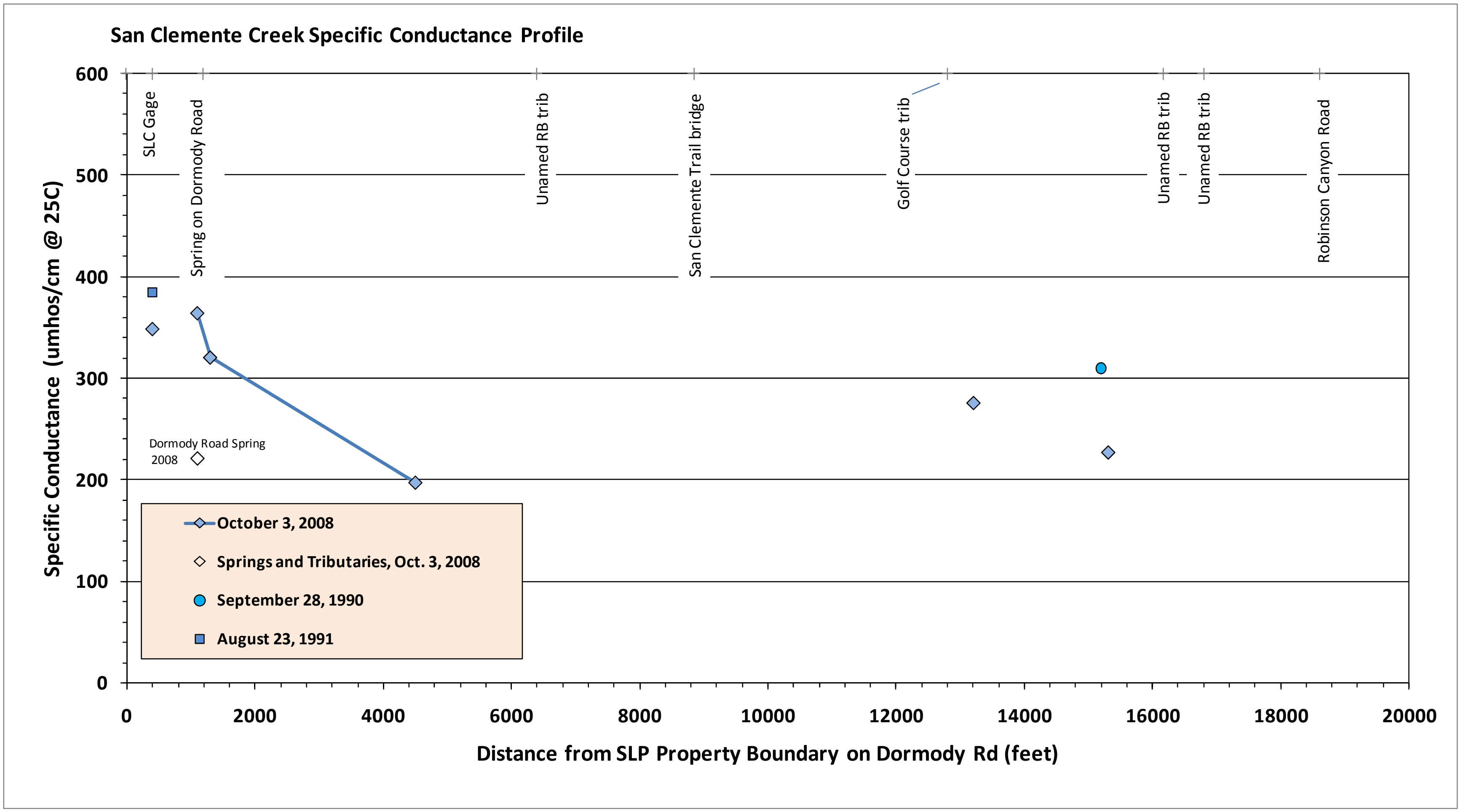


Figure 13. San Clemente creek specific conductance measurements for 1990, 1991, and 2008. For 2008 data, line breaks indicate discontinuous flow between two points. Hollow points represent springs and tributaries.

Carmel River Basin Tributary Water Yield and Annual Rainfall

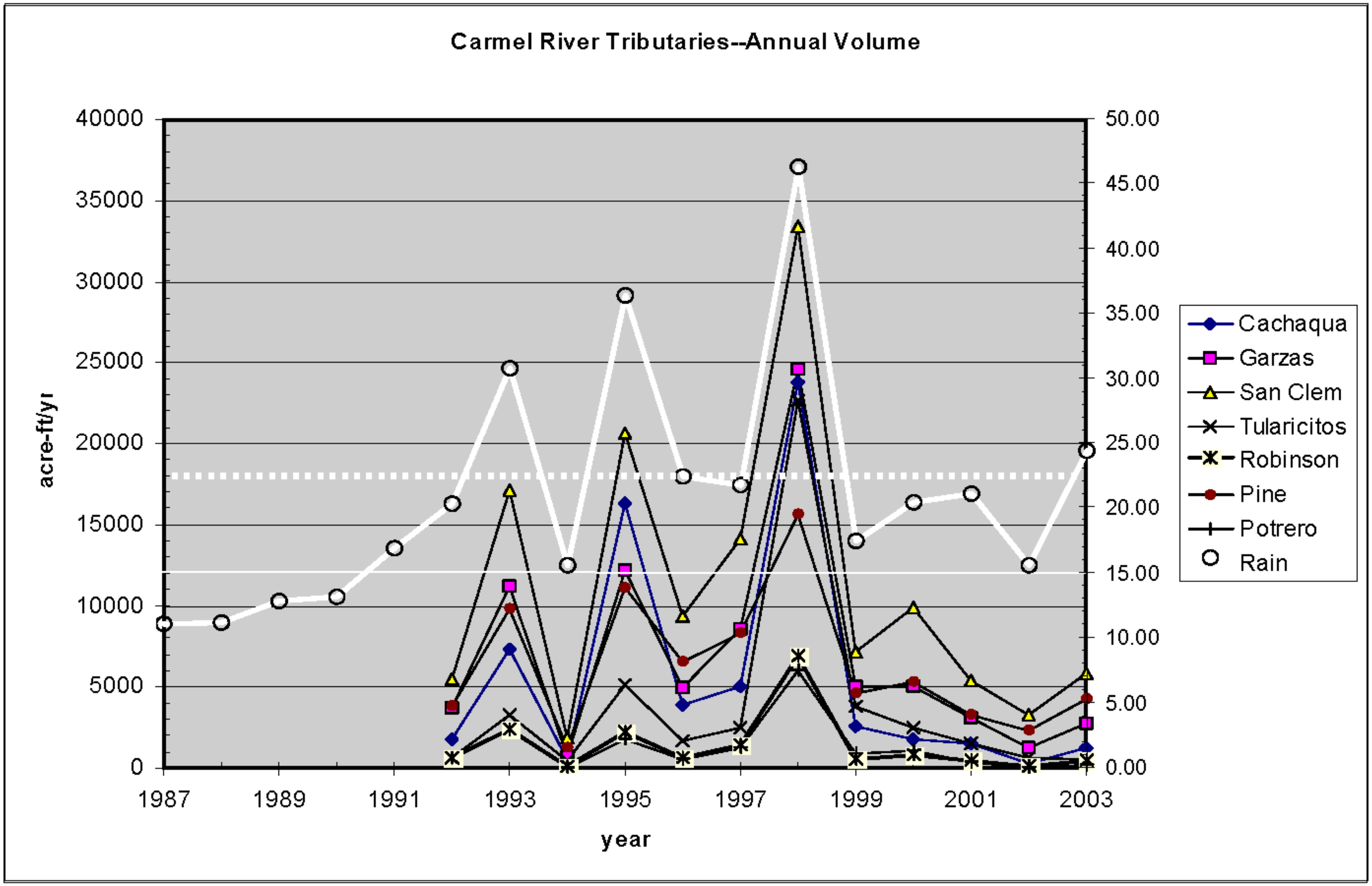


**Figure 14. Annual water yield of Carmel River tributaries, with annual rainfall.** The effect of wet years on streamflow in subsequent years can be observed: total rainfall in 2000 is nearly identical to rainfall in 2001, yet streamflow in 2000 is significantly higher than in 2001, due to the influence of a wet year in 1998 (figure from Smith et al. 2004).