

**Figure 3-24. Orthophosphate-P and TP at all stations in the database where contemporaneous measurements were available.**

Trends along the main stem of the two major rivers were examined through box plots. Figures 3-25 to 3-27 show the  $\text{NO}_3+\text{NO}_2\text{-N}$ , TKN, and TP concentrations, respectively, by station moving upstream to downstream for the Sacramento and San Joaquin Rivers. An interesting and contrasting pattern emerges. Sacramento River (Figures 3-25a, 3-26a, and 3-27a) concentrations for all three species increase with flow downstream, though the pattern is less dominant for TKN. TP is notable for its very low concentrations at the upstream stations that become much higher downstream due to the influences of agriculture, urban runoff, and wastewater sources. San Joaquin River concentrations for  $\text{NO}_3+\text{NO}_2\text{-N}$  (Figure 3-25b) first increase then decrease downstream of Crows Landing. Immediately downstream of Sack Dam, the river is dominated by agricultural drainage which is diluted by flows from other sources with lower concentrations as the river flows downstream, principally the tributaries on the east side of the valley. For TKN and TP (Figures 3-26b and 3-27b), trends are not pronounced in the main stem of the San Joaquin River but dilution is evident in the Delta itself. The upstream concentrations start out high compared to the Sacramento upstream stations due to the influence of agriculture. As previously shown, these figures also illustrate that nutrient species concentrations are generally higher in the San Joaquin River Basin than in the Sacramento River Basin.

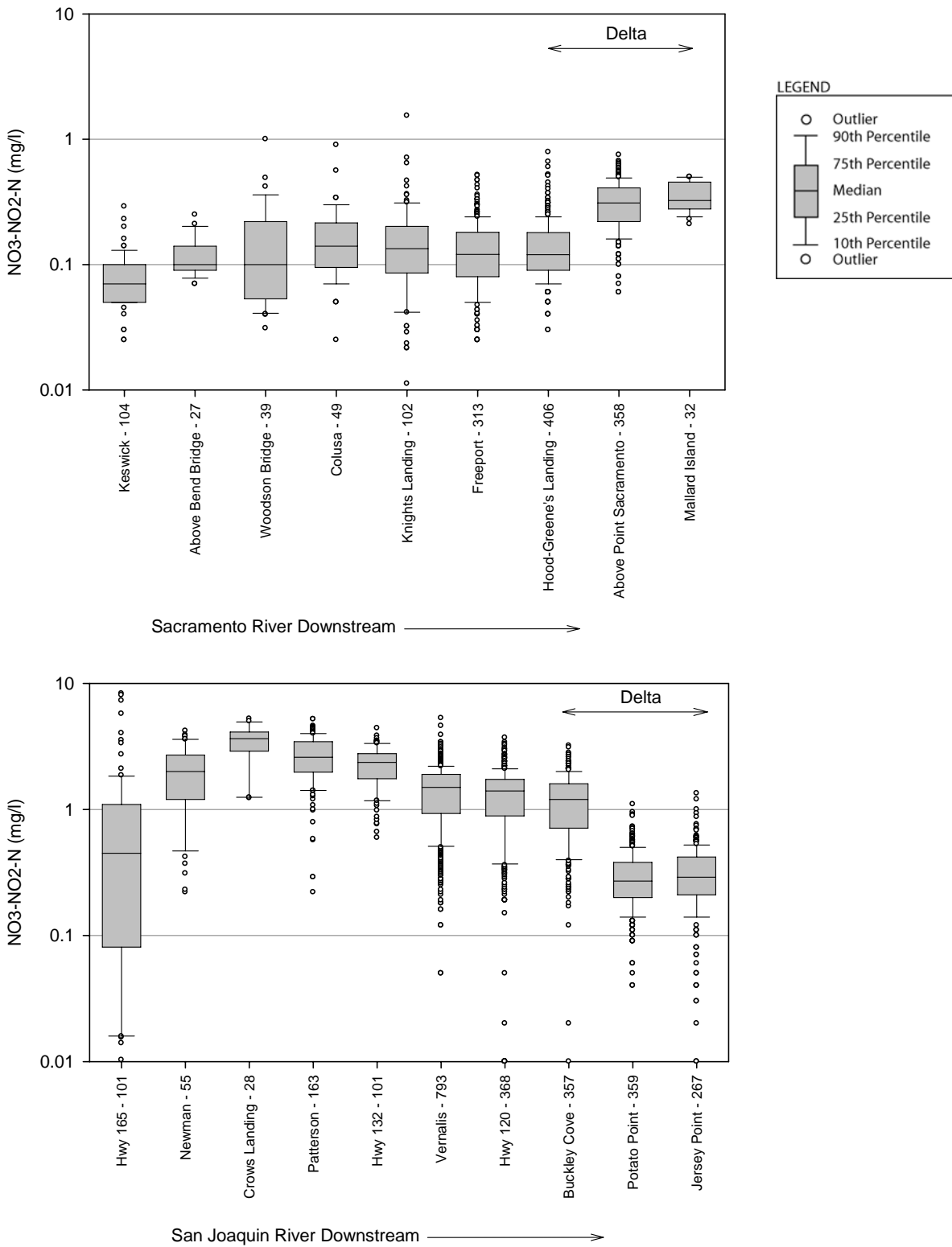


Figure 3-25. NO<sub>3</sub> + NO<sub>2</sub>-N at various locations in the Sacramento and San Joaquin Rivers. The number of data points is shown after each station name.

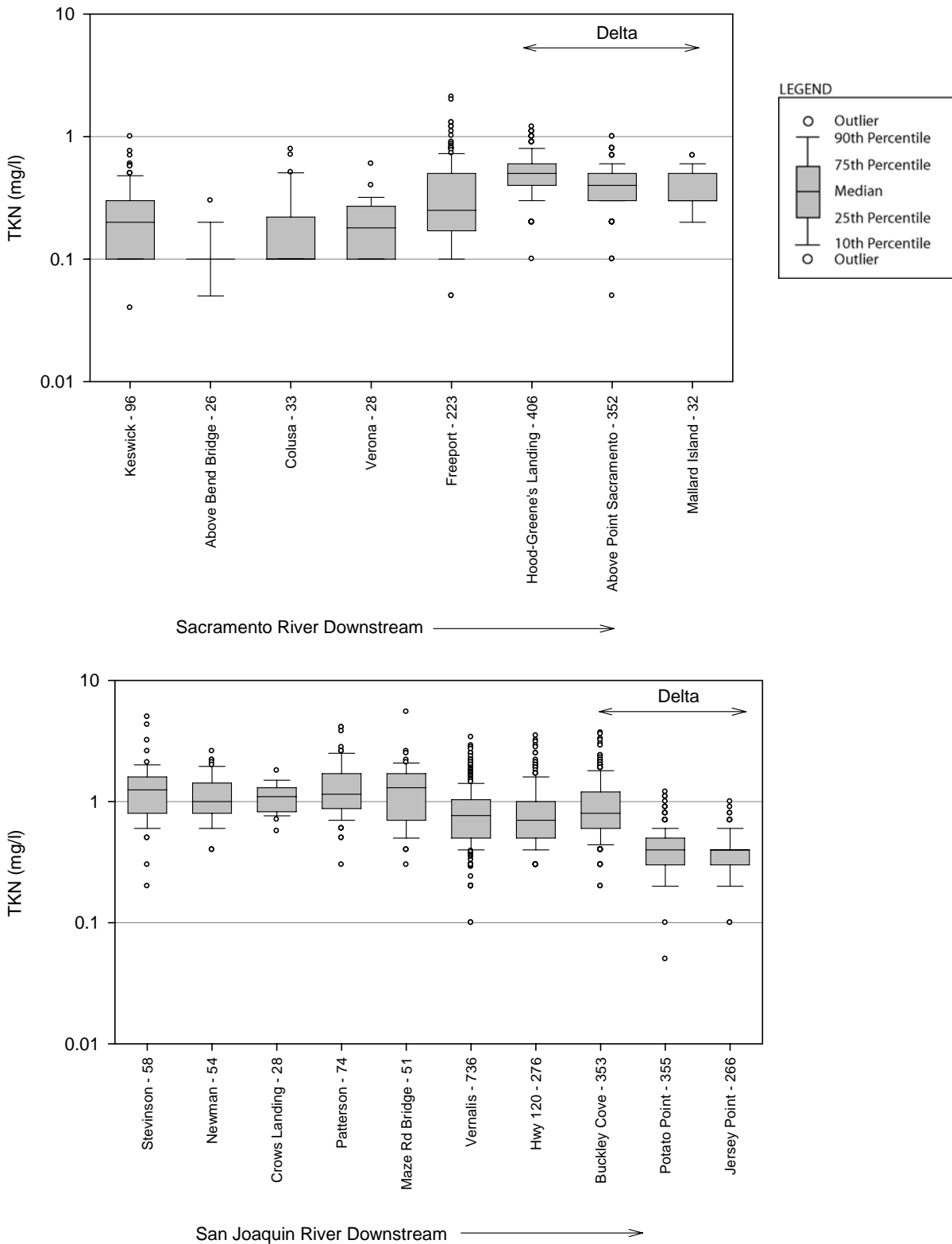


Figure 3-26. TKN at various locations in the Sacramento and San Joaquin Rivers. The number of data points is shown after each station name.

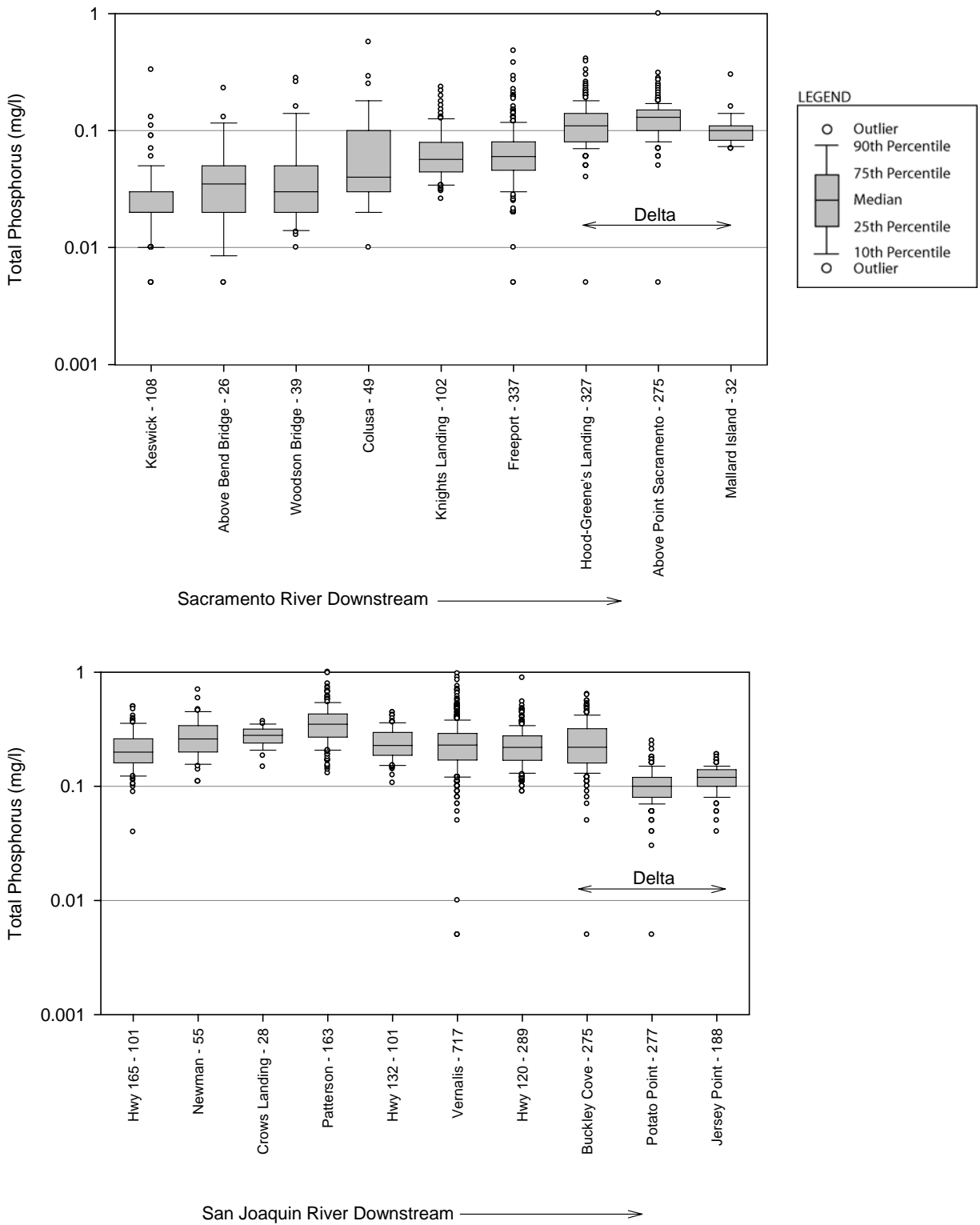
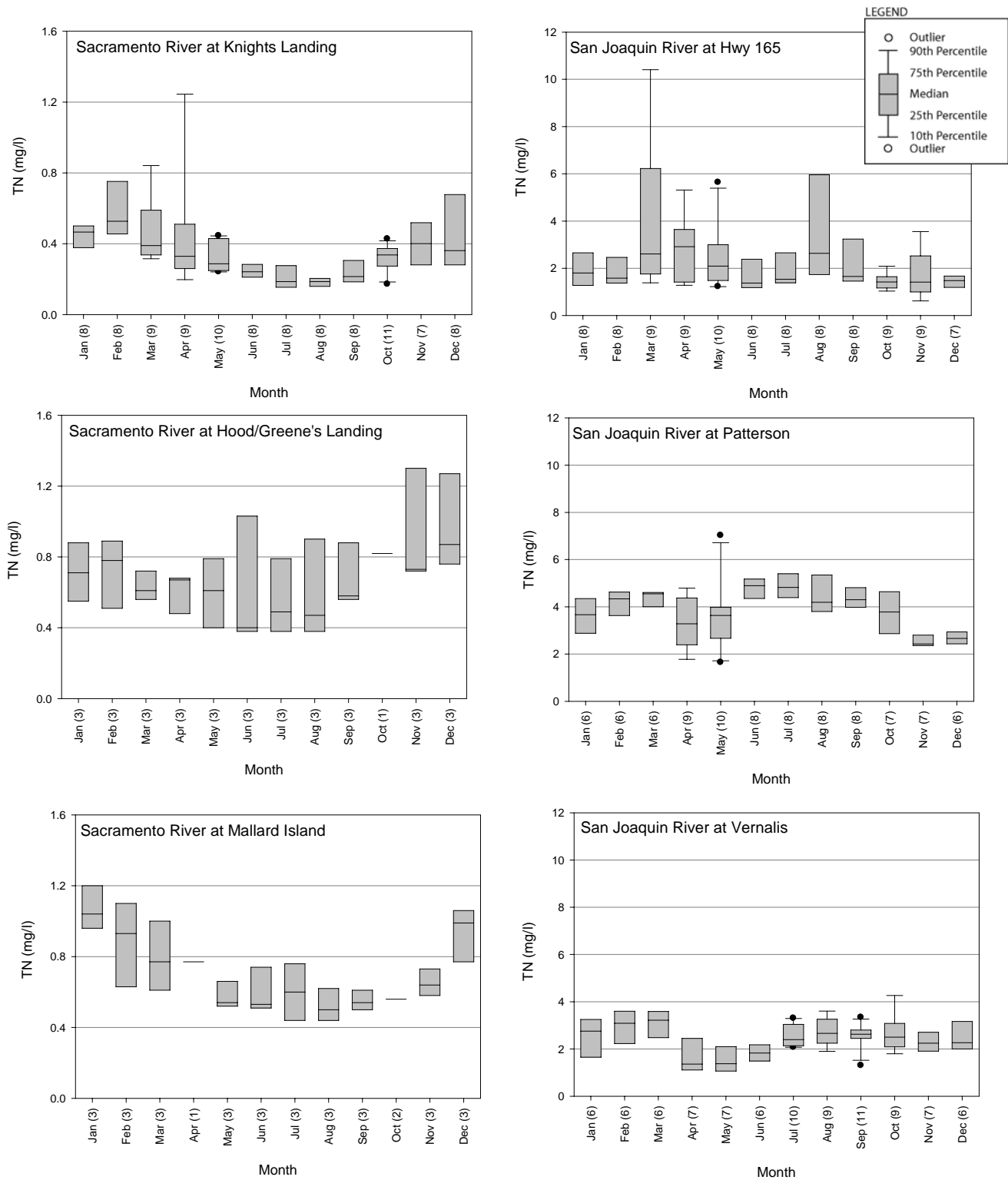
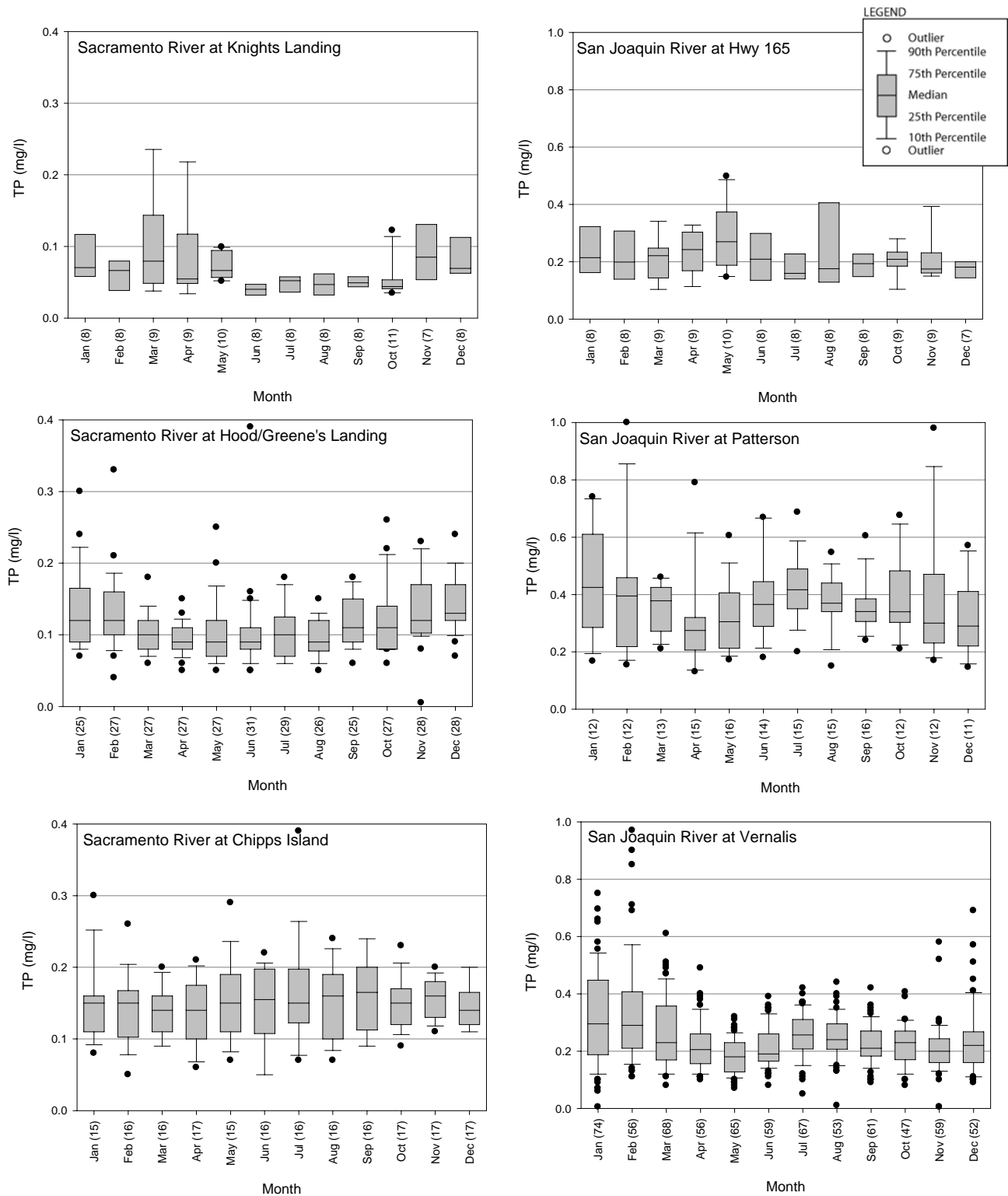


Figure 3-27. TP at various locations in the Sacramento and San Joaquin Rivers. The number of data points is shown after each station name.

Seasonal patterns in concentration can also be explored through box plots as shown in Figures 3-28 and 3-29 for TN and TP, respectively. In each of the figures, three plots display concentrations at locations moving downstream for each of the Sacramento and San Joaquin Rivers. In general, TN displays greater inter-seasonal variation for the Sacramento and San Joaquin Rivers than TP. In the Sacramento basin, the highest concentrations for TN occur in the wet months, and are as much as twice as high during the wet months compared to the dry months (Figure 3-28). In the San Joaquin River, although TN concentrations are much higher than in the Sacramento River, there appears to be less inter-seasonal variation, with the highest concentrations being observed during the months with significant return flows from irrigation. TP concentration values show minimal trends by month for either river, with little discernible influence due to wet weather flows or to irrigation return flows (Figure 3-29).



**Figure 3-28. Temporal variation in TN concentrations at key locations in the Sacramento and San Joaquin Rivers. NO<sub>3</sub>+NO<sub>2</sub>-N and TKN are summed to obtain TN for Sacramento at Hood/Greene's and Mallard Island. Note also that the scale of the data is consistent within each river but different between the two rivers. The number of data points is shown after each month.**



**Figure 3-29. Temporal variation in TP concentrations at key locations in Sacramento and San Joaquin Rivers. Note that the scale of the data is consistent within each river but different between the two rivers. The number of data points is shown after each month.**

## 3.2 FLOW DATA USED

In addition to the concentration data in the database discussed above, flow data are used in combination with concentration data to estimate loads. The USGS has an extensive network of flow monitoring stations throughout California (Figure 3-30). Daily stream discharge data were obtained from the USGS from <http://nwis.waterdata.usgs.gov/usa/nwis/discharge> at selected locations for which loads were estimated. These locations primarily corresponded to the outflow locations of the major tributaries of the Sacramento and San Joaquin Rivers. A detailed evaluation of the flow data is presented in Appendix B. Additional flow data for the Delta region (including outflows in municipal/industrial intakes) were obtained from a computer model called DAYFLOW (supported by California Department of Water Resources, and available electronically from <http://www.iep.ca.gov/dayflow/index.html>). Load estimates using the USGS and DAYFLOW data are presented in Chapters 4 and 5.



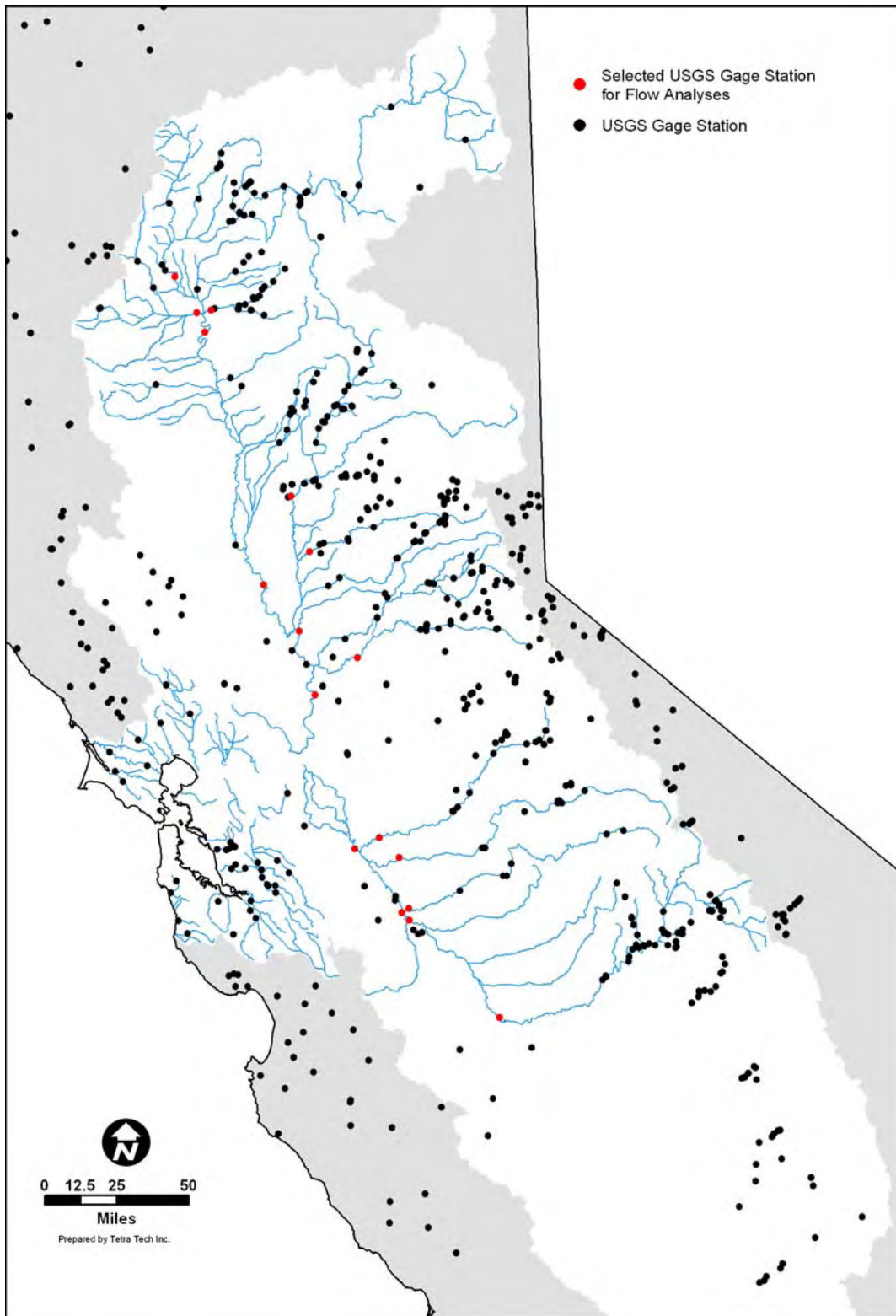


Figure 3-30. Stations with continuous flow records available through the USGS (on the internet at <http://nwis.waterdata.usgs.gov/usa/nwis/discharge>). Flow records for different stations exist over different time periods.

### 3.3 MAJOR FINDINGS

The nutrient data in the database, compiled by the Central Valley Drinking Water Policy Workgroup, consisted of measurements of NO<sub>3</sub>+NO<sub>2</sub>-N, ammonia-N, TKN, TN, orthophosphate-P and TP. Few stations reported all of these parameters. TN data were the most limited in number. Flow data were not part of the database and were obtained from other publicly available sources.

The greatest density of stations was near the Delta, with relatively limited sampling in the upper portions of the watershed. There was very little information on nutrient concentrations in reservoirs, although reservoirs and their upstream watersheds together comprise a large portion of the overall watershed area.

Box plots provided a quick summary of the available data, and showed clearly the elevated TN and TP concentrations in the San Joaquin River compared to the Sacramento River. Where nutrient species data are available, much of the nitrogen is present as NO<sub>3</sub>-N. Orthophosphate varies from a small percentage of total phosphorus to almost all of it. Data plotted by month at key locations in the Sacramento and San Joaquin Rivers show inter-seasonal variation for TN, but not for TP. The higher TN concentrations are observed during the wet months in the Sacramento River and in the dry months in the San Joaquin River.