

Figure 4-38. Distribution of nitrogen watershed loads by source, and loads flowing out of stream locations are compared with the loads originating from their watersheds for dry years.

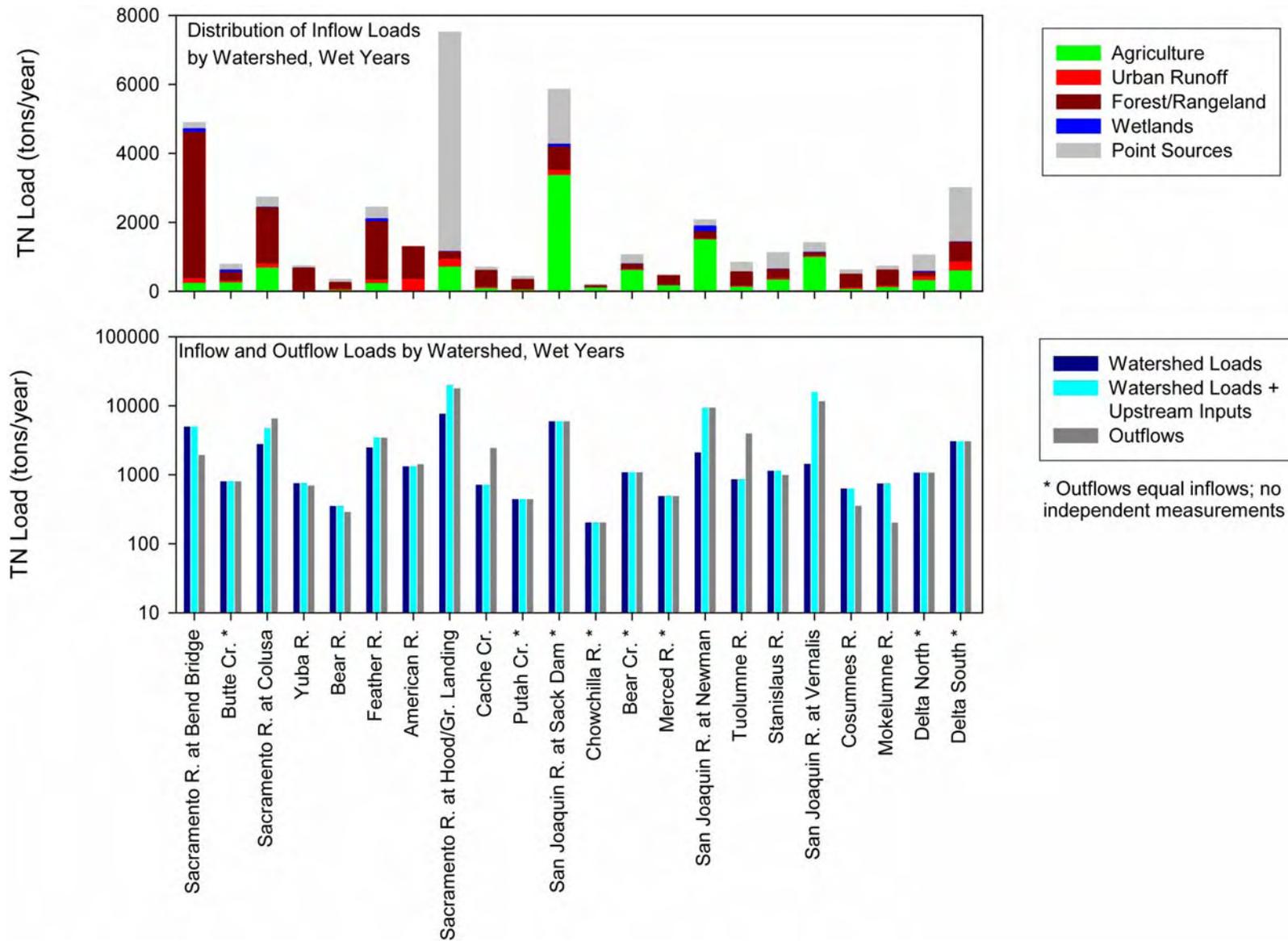


Figure 4-39. Distribution of nitrogen watershed loads by source, and loads flowing out of stream locations are compared with the loads originating from their watersheds for wet years.

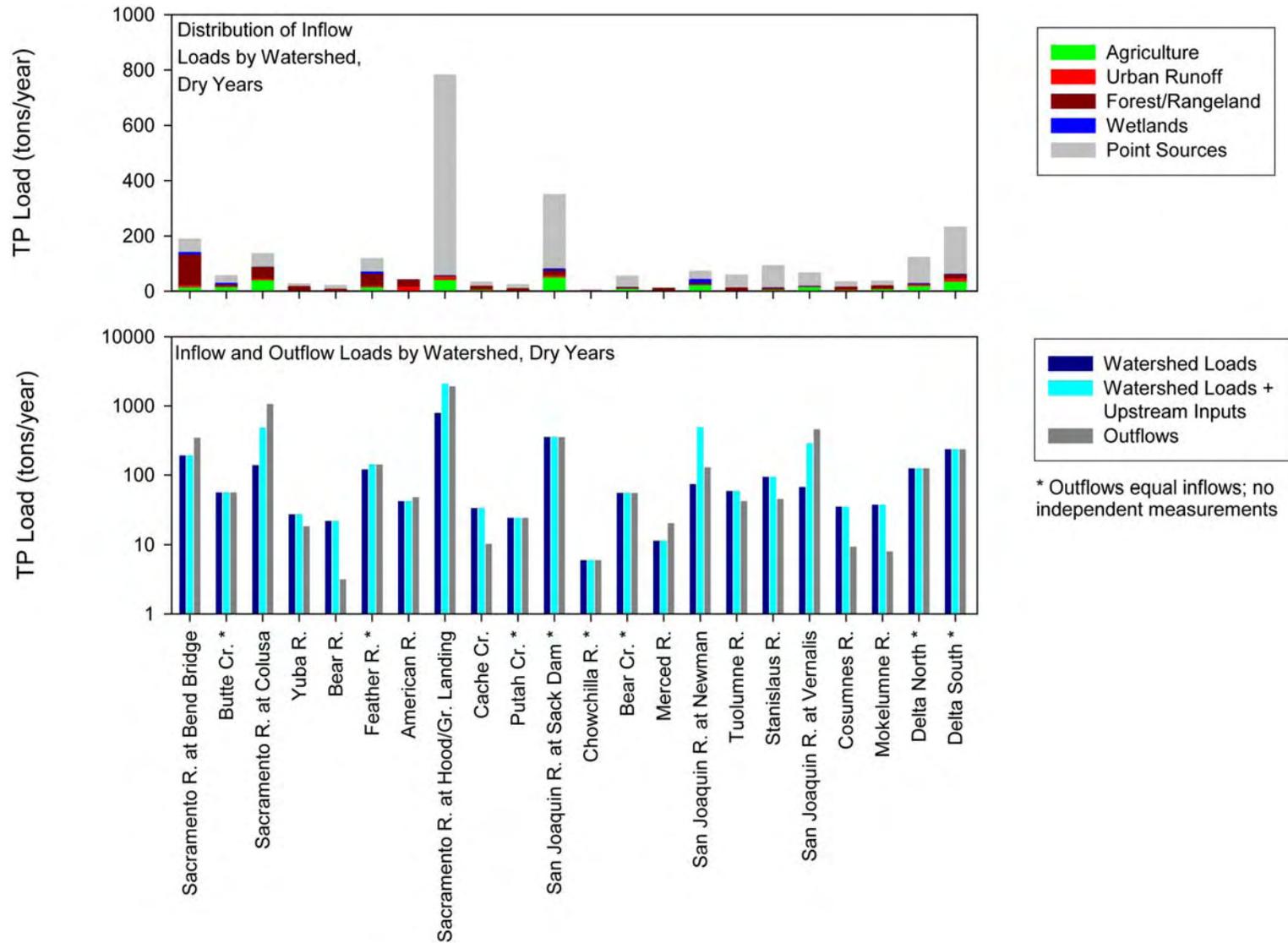


Figure 4-40. Distribution of phosphorus watershed loads by source, and loads flowing out of stream locations are compared with the loads originating from their watersheds for dry years.

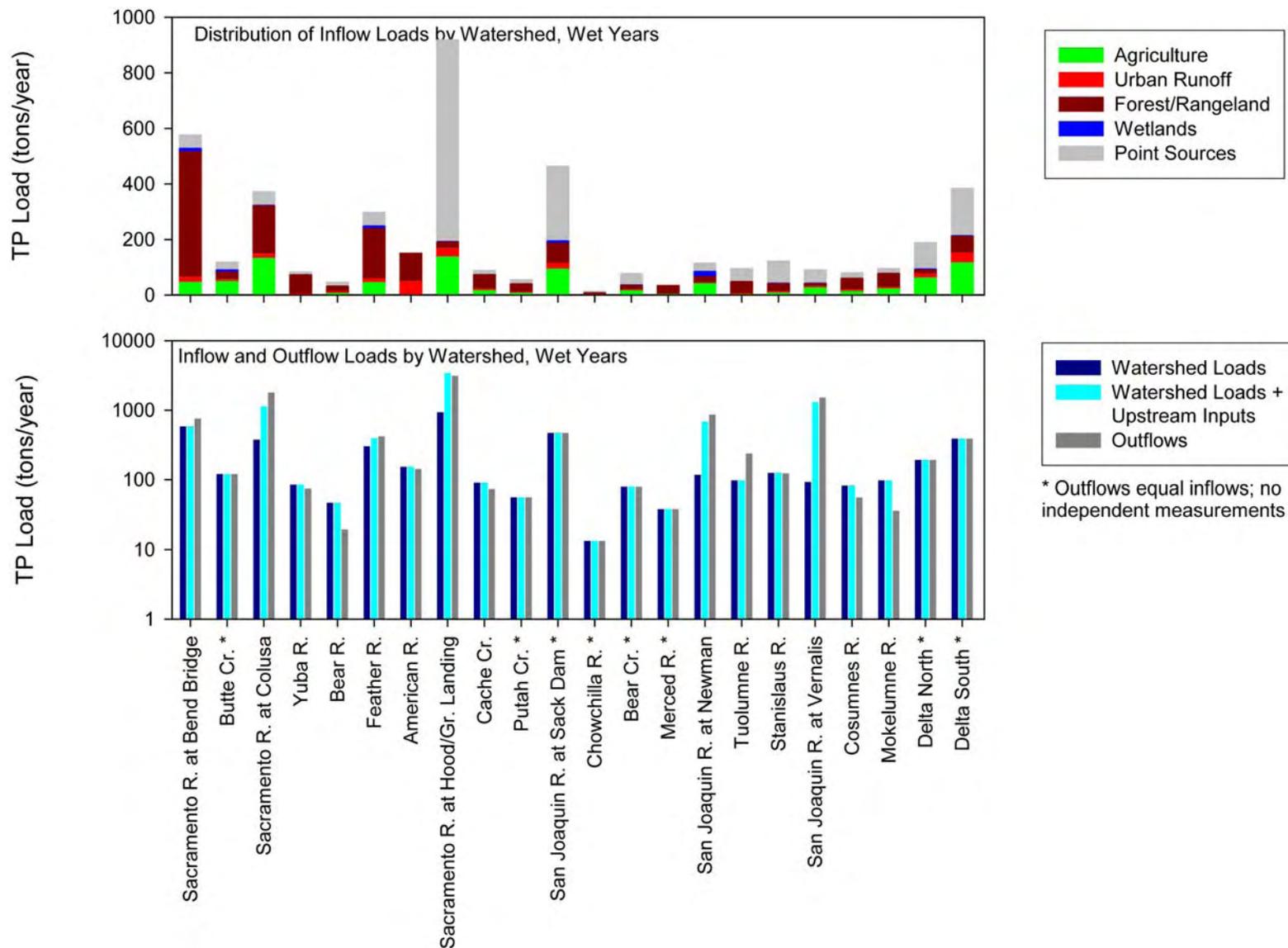


Figure 4-41. Distribution of phosphorus watershed loads by source, and loads flowing out of stream locations are compared with the loads originating from their watersheds for wet years.

Table 4-10.
Comparison of nitrogen upstream load, watershed loads, and downstream exports for dry years.

Watershed ID	Watershed Name	Load (tons/year)						Sum of Watershed Loads	Watershed Loads + Upstream Inflows	Outflows
		Agri-culture	Urban Runoff	Forest/Rangeland	Wetlands	Point Sources				
1	Sacramento River above Bend Bridge	77	58	1,023	84	165	1,408	1,408	940	
2	* Butte Creek	81	22	61	57	150	371	371	*	
3	Sacramento River at Colusa	215	49	396	7	278	945	1,885	3,323	
4	Yuba River	4	11	158	0	46	219	219	166	
5	* Feather River	75	44	408	71	318	916	1,127	*	
6	Cache Creek	29	19	118	0	77	243	243	243	
7	American River	4	154	226	0	0	383	383	442	
8	Sacramento River at Hood/Greene's Landing	224	97	53	7	6,342	6,723	11,987	11,193	
9	Cosumnes River	24	19	95	0	106	244	244	57	
10	San Joaquin River at Newman	748	9	51	133	165	1,106	5,342	1,411	
11	Stanislaus River	169	16	67	4	459	715	715	350	
12	Tuolumne River	70	11	100	0	263	444	444	759	
13	Merced River	90	2	71	0	3	165	165	528	
14	* Bear Cr/Owens Cr/Mariposa Cr/Deadmans Cr	307	11	37	11	251	618	618	*	
15	* Chowchilla River	57	1	17	0	13	88	88	*	
16	* San Joaquin River at Sack Dam	1,668	64	164	67	1,568	3,530	3,530	*	
17	Mokelumne River	40	16	114	0	93	263	263	47	
18	Bear River	14	16	47	0	73	149	149	45	
19	* Putah Creek	14	9	71	0	75	169	169	*	
20	* Delta North	103	47	32	20	460	661	661	*	
21	* Delta South	189	110	137	15	1,553	2,005	2,005	*	
22	San Joaquin River at Vernalis	495	14	24	11	268	812	3,331	4,898	

* Flow and concentration data are not available to calculate an outflow load.

Table 4-11.
Comparison of nitrogen upstream load, watershed loads, and downstream exports for wet years.

Watershed ID	Watershed Name	Load (tons/year)							Watershed Loads + Upstream Inflows	Outflows
		Agri-culture	Urban Runoff	Forest/Rangeland	Wetlands	Point Sources	Sum of Watershed Loads			
1	Sacramento River above Bend Bridge	249	134	4,243	105	165	4,896	4,896	1,913	
2	* Butte Creek	263	50	254	71	150	787	787	*	
3	Sacramento River at Colusa	693	112	1,642	9	278	2,734	4,647	6,447	
4	Yuba River	12	25	658	0	46	740	740	687	
5	Feather River	242	100	1,694	89	318	2,443	3,414	3,378	
6	Cache Creek	94	42	490	0	77	703	703	2,414	
7	American River	12	351	939	0	0	1,302	1,302	1,400	
8	Sacramento River at Hood/Greene's Landing	721	221	221	9	6,342	7,515	19,527	17,583	
9	Cosumnes River	76	44	396	0	106	622	622	350	
10	San Joaquin River at Newman	1,514	21	213	165	165	2,077	9,196	9,251	
11	Stanislaus River	342	37	280	5	459	1,122	1,122	976	
12	Tuolumne River	142	25	413	0	263	844	844	3,901	
13	* Merced River	181	4	296	0	3	484	484	*	
14	* Bear Cr/Owens Cr/Mariposa Cr/Deadmans Cr	622	26	152	14	251	1,065	1,065	*	
15	* Chowchilla River	116	3	68	0	13	200	200	*	
16	* San Joaquin River at Sack Dam	3,376	145	681	83	1,568	5,854	5,854	*	
17	Mokelumne River	129	37	473	0	93	731	731	199	
18	Bear River	45	36	193	0	73	347	347	284	
19	* Putah Creek	46	21	293	0	75	435	435	*	
20	* Delta North	332	107	133	25	460	1,056	1,056	*	
21	* Delta South	610	253	570	18	1,553	3,004	3,004	*	
22	San Joaquin River at Vernalis	1,002	32	100	14	268	1,416	15,544	11,450	

* Flow and concentration data are not available to calculate an outflow load.

Table 4-12.
Comparison of phosphorus upstream load, watershed loads, and downstream exports for dry years.

Watershed ID	Watershed Name	Load (tons/year)							Watershed Loads + Upstream Inflows	Outflows
		Agri-culture	Urban Runoff	Forest/ Rangeland	Wetlands	Point Sources	Sum of Watershed Loads			
1	Sacramento River above Bend Bridge	14	6	112	10	47	189	189	341	
2	* Butte Creek	15	2	7	7	25	56	56	*	
3	Sacramento River at Colusa	39	5	43	1	47	136	477	1,045	
4	Yuba River	1	1	17	0	8	27	27	18	
5	* Feather River	14	5	45	8	47	119	140	*	
6	Cache Creek	5	2	13	0	13	33	33	10	
7	American River	1	17	25	0	0	42	42	48	
8	Sacramento River at Hood/Greene's Landing	41	10	6	1	724	782	2,072	1,886	
9	Cosumnes River	4	2	10	0	18	35	35	9	
10	San Joaquin River at Newman	23	1	6	15	28	73	483	128	
11	Stanislaus River	5	2	7	0	78	93	93	45	
12	Tuolumne River	2	1	11	0	45	59	59	42	
13	Merced River	3	0	8	0	0	11	11	20	
14	* Bear Cr/Owens Cr/Mariposa Cr/Deadmans Cr	9	1	4	1	39	55	55	*	
15	* Chowchilla River	2	0	2	0	2	6	6	*	
16	* San Joaquin River at Sack Dam	50	7	18	8	267	350	350	*	
17	Mokelumne River	7	2	13	0	16	37	37	8	
18	Bear River	3	2	5	0	12	22	22	3	
19	* Putah Creek	3	1	8	0	13	24	24	*	
20	* Delta North	19	5	4	2	93	123	123	*	
21	* Delta South	35	12	15	2	169	232	232	*	
22	San Joaquin River at Vernalis	15	2	3	1	46	66	282	454	

* Flow and concentration data are not available to calculate an outflow load.

Table 4-13.
Comparison of phosphorus upstream load, watershed loads, and downstream exports for wet years.

Watershed ID	Watershed Name	Load (tons/year)							Watershed Loads + Upstream Inflows	Outflows
		Agri-culture	Urban Runoff	Forest/ Rangeland	Wetlands	Point Sources	Sum of Watershed Loads			
1	Sacramento River above Bend Bridge	48	19	451	12	47	577	577	746	
2	* Butte Creek	51	7	27	8	25	118	118	*	
3	Sacramento River at Colusa	134	15	175	1	47	373	1,119	1,770	
4	Yuba River	2	3	70	0	8	84	84	73	
5	Feather River	47	14	180	10	47	298	390	413	
6	Cache Creek	18	6	52	0	13	89	89	72	
7	American River	2	49	100	0	0	151	151	141	
8	Sacramento River at Hood/Greene's Landing	140	31	24	1	724	919	3,362	3,082	
9	Cosumnes River	15	6	42	0	18	81	81	55	
10	San Joaquin River at Newman	43	3	23	19	28	115	671	848	
11	Stanislaus River	10	5	30	1	78	123	123	122	
12	Tuolumne River	4	3	44	0	45	96	96	235	
13	* Merced River	5	1	32	0	0	38	38	*	
14	* Bear Cr/Owens Cr/Mariposa Cr/Deadmans Cr	18	4	16	2	39	78	78	*	
15	* Chowchilla River	3	0	7	0	2	13	13	*	
16	* San Joaquin River at Sack Dam	96	20	72	10	267	464	464	*	
17	Mokelumne River	25	5	50	0	16	96	96	36	
18	Bear River	9	5	21	0	12	47	47	19	
19	* Putah Creek	9	3	31	0	13	56	56	*	
20	* Delta North	64	15	14	3	93	189	189	*	
21	* Delta South	118	35	61	2	169	385	385	*	
22	San Joaquin River at Vernalis	28	4	11	2	46	91	1,296	1,502	

* Flow and concentration data are not available to calculate an outflow load.

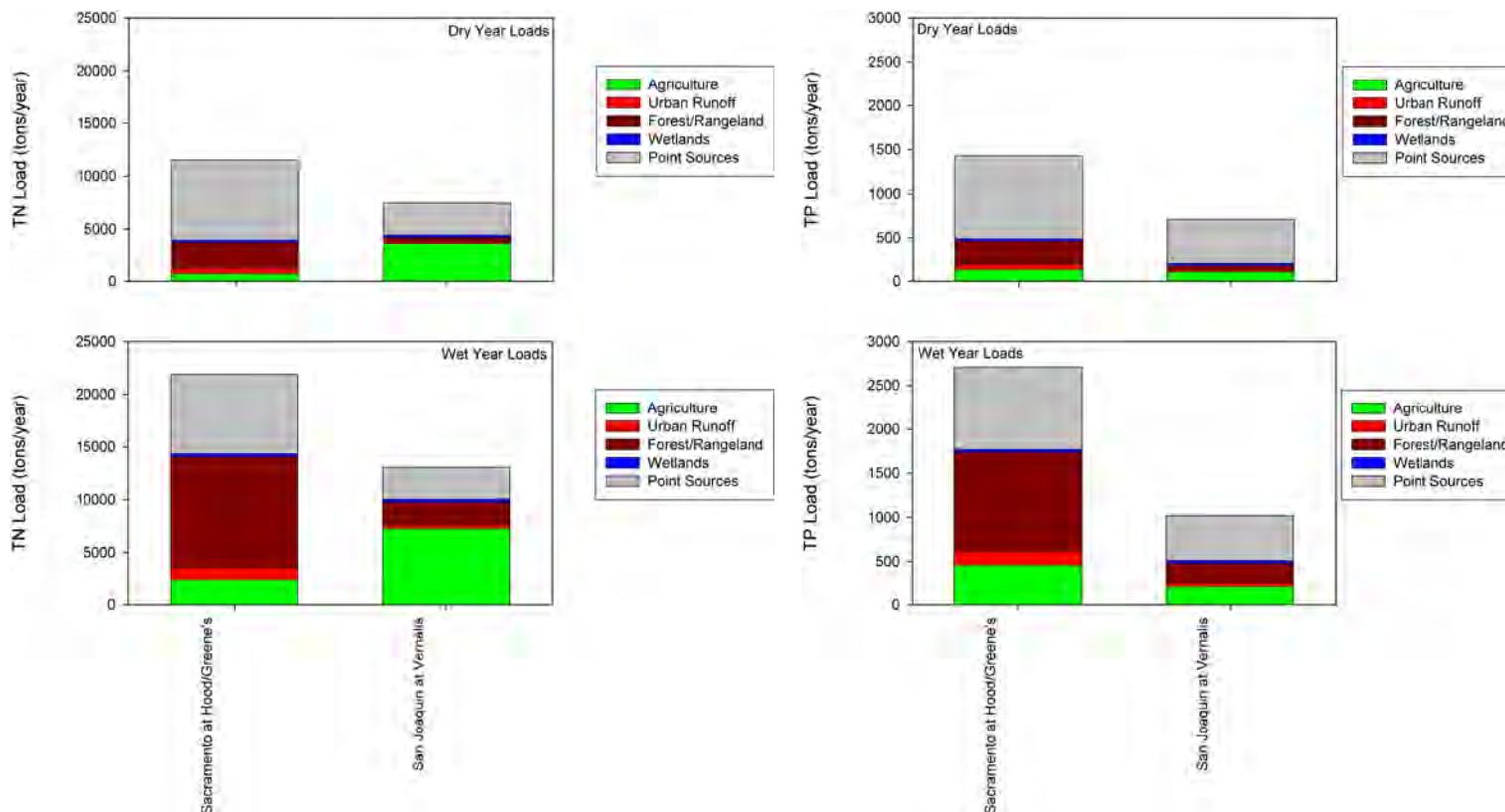


Figure 4-42. Distribution of nitrogen and phosphorus watershed loads by source for the Sacramento and San Joaquin Rivers.

Dry Year Total Nitrogen Loads
WATERSHED LOADS

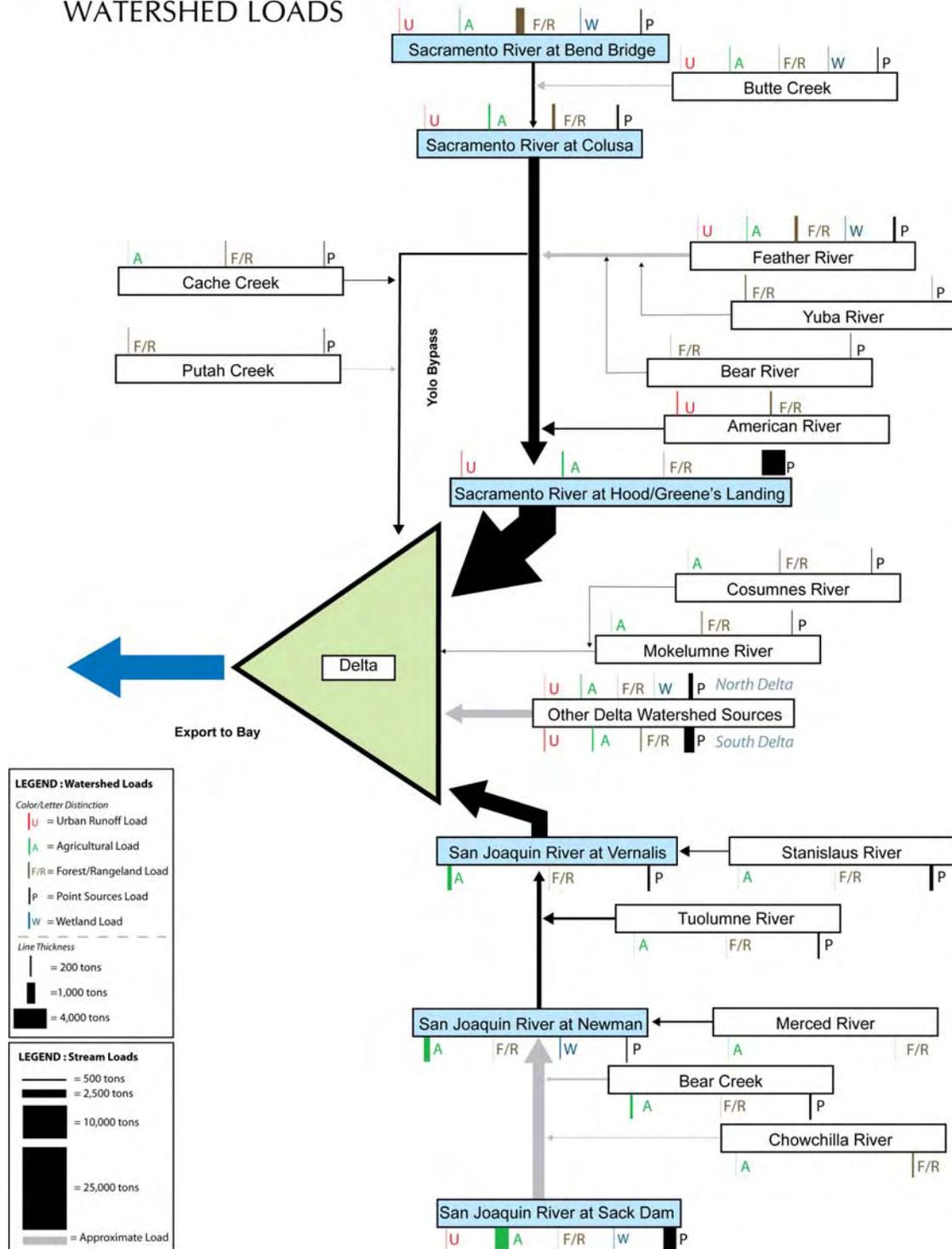


Figure 4-43. Nitrogen watershed and outflow loads for the Central Valley and Delta for average dry years. This figure and the next use the same linear scales to represent stream loads. Watershed loads are shown with a different scale to show some of the smaller load contributions.

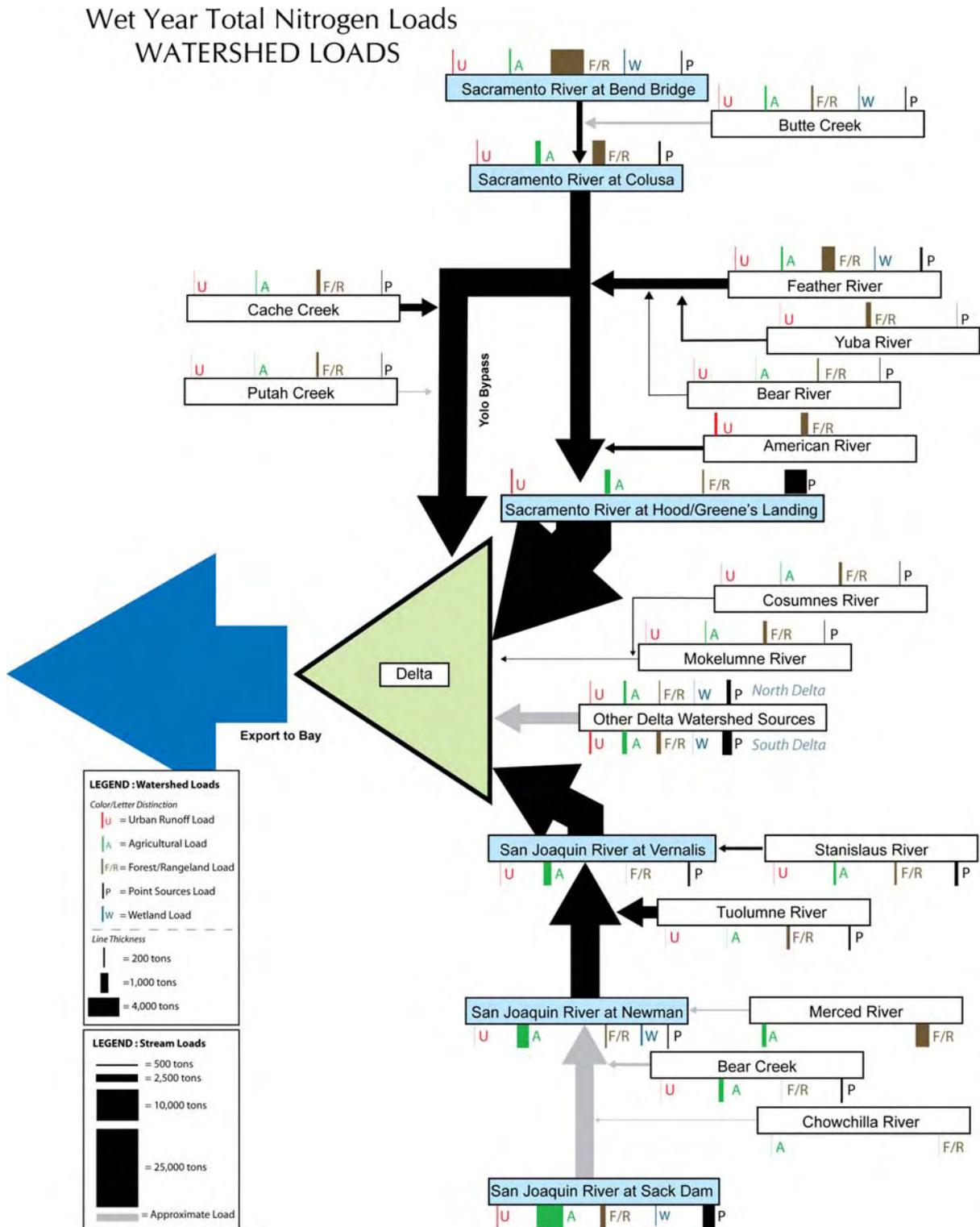


Figure 4-44. Nitrogen watershed and outflow loads for the Central Valley and Delta for average wet years. This figure and the preceding one use the same linear scales to represent stream loads. Watershed loads are shown with a different scale to show some of the smaller load contributions.

Dry Year Total Phosphorus Loads WATERSHED LOADS

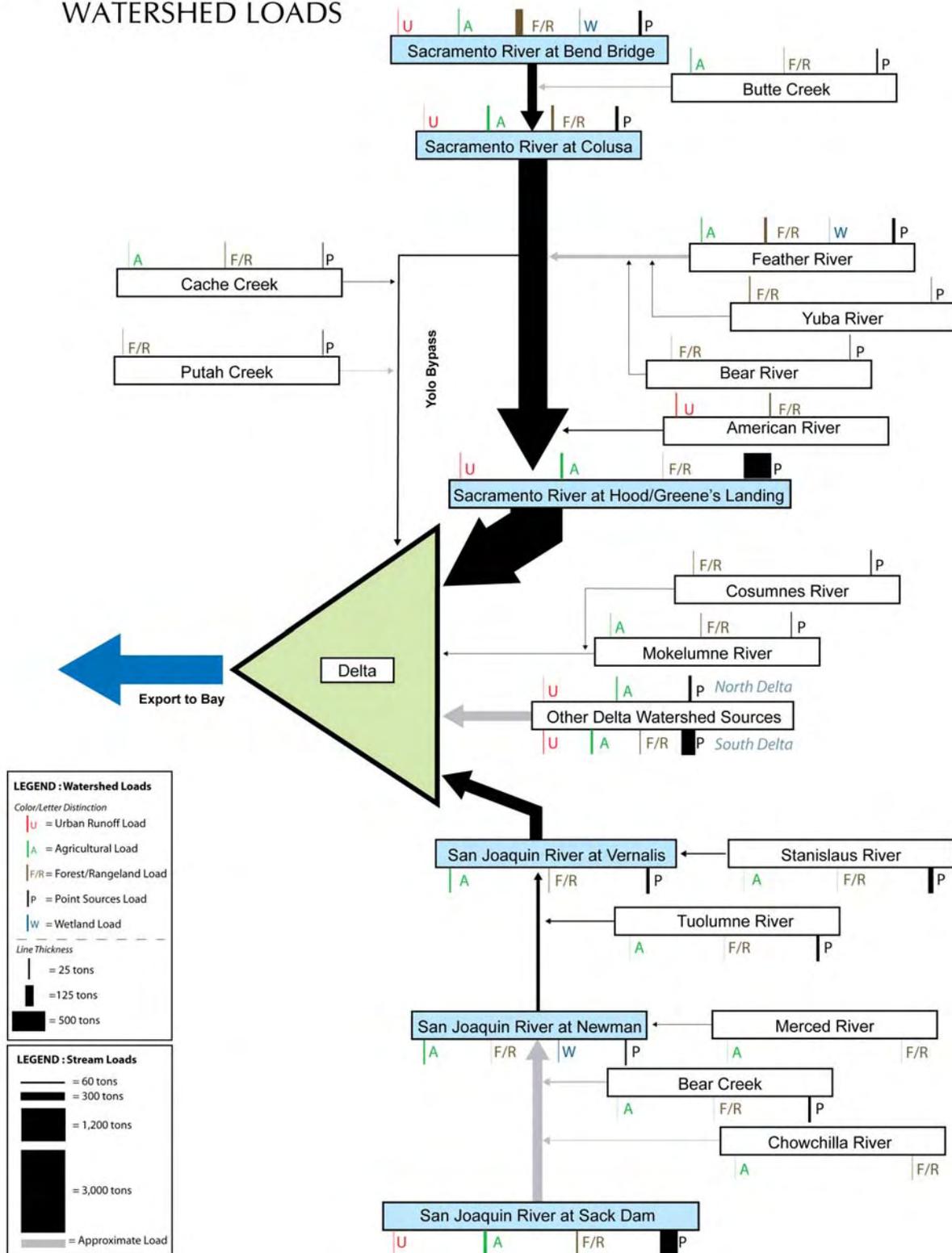


Figure 4-45. Phosphorus watershed and outflow loads for the Central Valley and Delta for average dry years. This figure and the next use the same linear scales to represent stream loads. Watershed loads are shown with a different scale to show some of the smaller load contributions.

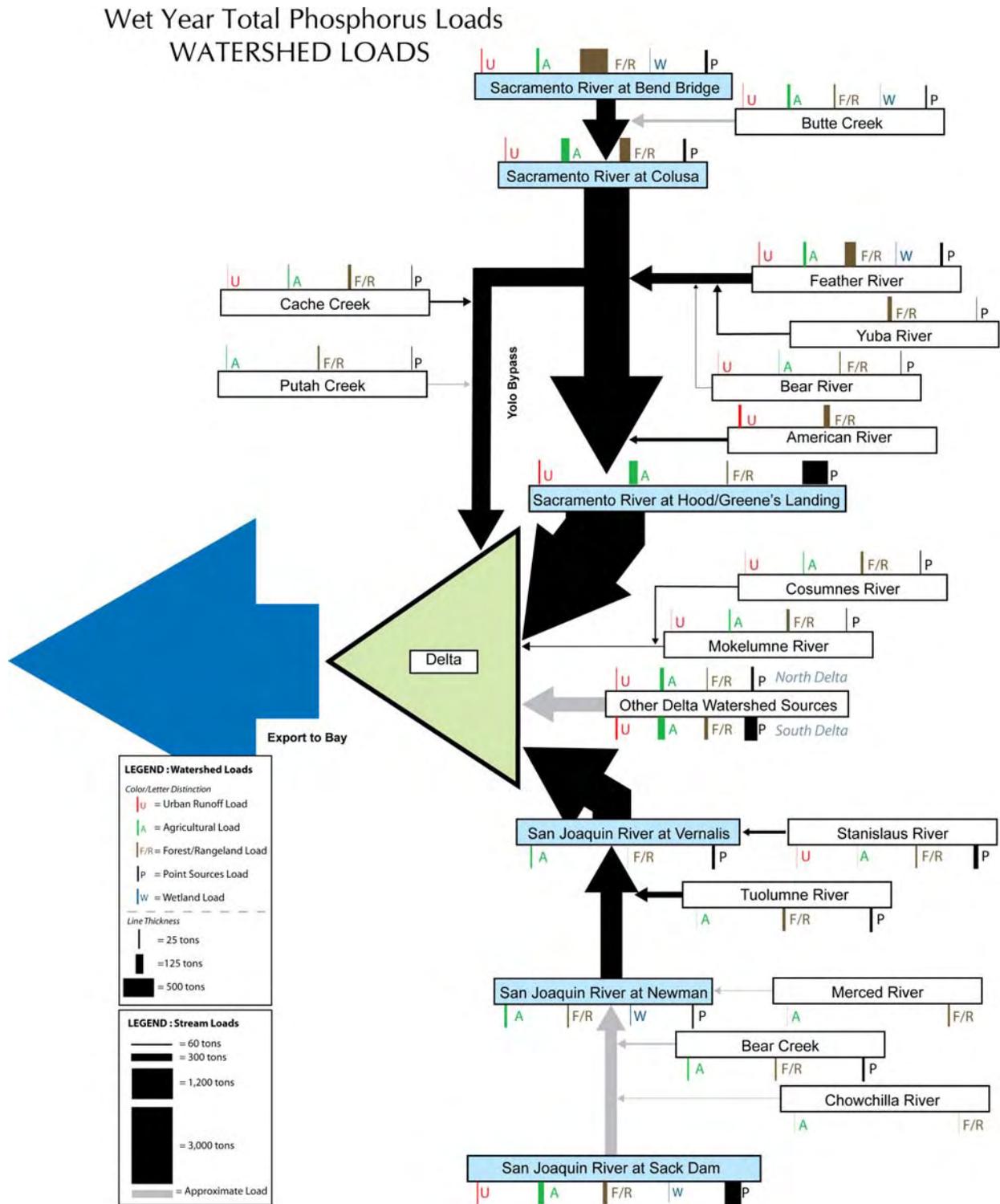


Figure 4-46. Phosphorus watershed and outflow loads for the Central Valley and Delta for average wet years. This figure and the preceding one use the same linear scales to represent stream loads. Watershed loads are shown with a different scale to show some of the smaller load contributions.

4.5 MAJOR FINDINGS

Flows in Central Valley rivers are highly variable, especially in winter months, even though they are controlled by a large number of reservoirs. At most stream sampling locations there are limited concentration data, whereas there are daily flow data. Loads are therefore estimated using monthly average concentration and flow values. At the Sacramento River at Hood/Greene's Landing and the San Joaquin River at Vernalis, stations where the greatest quantity of concentration data were available, the loads estimated by this approach were comparable to loads estimated in previous studies.

4.5.1 ESTIMATED IN-STREAM LOADS

Tributary nutrient loads are substantially greater in the wet season than in the dry season. Tributary loads were found to vary significantly between wet and dry years. Although the nutrient concentrations in the Sacramento River are lower than the concentrations in the San Joaquin River, the Sacramento River load to the Delta exceeds the San Joaquin River load by a factor of nearly two or greater for both nitrogen and phosphorus.

4.5.2 ESTIMATED WATERSHED LOADS

It was not possible to calculate export rates for each type of land use present in the Central Valley and Delta. A limited amount of nutrient data has been collected from watersheds with one particular type of land use. Most of the data available for this analysis were collected at locations that have mixed land uses. Export rates of nutrients (mass of nitrogen or phosphorus exported per unit area per year) were estimated for several land uses: urban land, agricultural land, wetlands, and background areas (including forests, shrubland, and rangeland) based on the limited data. The calculated total watershed exports are comparable to the stream loads at key locations (such as Sacramento River at Hood/Greene's Landing and San Joaquin River at Vernalis). There were considerable differences in the estimated loads derived from the two methods at locations where there were limited nutrient concentration data. Export rates, as currently approximated, could be improved through focused flow and concentration data collection in small, relatively homogenous watersheds.