Technical Memorandum 6-2

Riparian Habitat Downstream of Englebright Dam

Attachment 6-2F

Representative Photographs

Yuba River Development Project
FERC Project No. 2246

June 2013

List of Figures

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ATTACHMENT 6-2E

REPRESENTATIVE PHOTOGRAPHS

Figure 1. Floodplains in the lower Yuba River (LYR) are dominated by various species of willows (*Salix* spp.) and Freemont's cottonwood (*Populus fremontii*) (cottonwood) along with California brickelbush (*Brickellia californica*). This photograph overlooks Parks Bar from the south bank.

Figure 2. Various willows and cottonwoods on a lateral bar in the Parks Bar study site, with oak (*Quercus* ssp.) grasslands and grey pines (*Pinus sabiniana*) in the upland areas.

Figure 3. Large cottonwoods are present in abundance on levee walls and at the top of terreces. Photograph taken in the Hallwood reach.

Figure 4. Cottonwoods are located across the full width of the LYR valley. Two mature cottonwoods are pictured here on a lateral bar in the Parks Bar study site.

Figure 5. Small trees (recruits) tended to be intermixed with willow patches on the flood plains and in backwater areas.

Figure 6. Seedlings are present along unvegetated or sparsely vegetated banks, and were generally within about 50 feet of the wetted edge during the time of the surveys. Photograph taken in the Timbuctoo Bend study site.

Figure 7. In the Marysville reach, large, standing trees had wedges chewed from the base of the cottonwoods, although many of these had scared over and the trees appeared healthy.

Figure 8. Beaver water-trails and dammed backwater areas support young-looking (smaller trees) riparian stands. Photograph taken on the south side of the LYR at the Hallwood reach.

Figure 9. In the Timbuctoo and Englebright Dam reaches, backwater areas or mature riparian stands were prevalent, but many of the cottonwoods were beaver-chewed to stumps. This photograph was taken in the Timbuctoo Bend study site looking upstream.

Figure 10. Willows lining the channel are frequently sheared by beavers at a consistent height. Photograph was taken in the Dry Creek study site looking downstream.

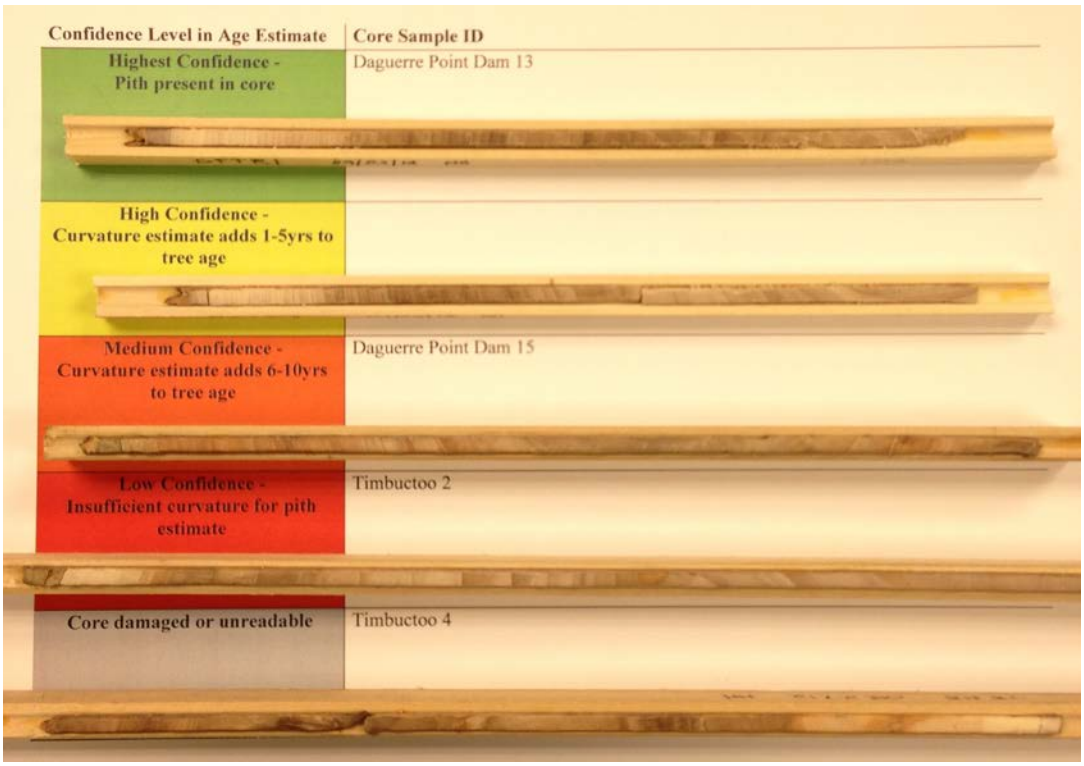

Figure 11. Example of cottonwood age-estimated cottonwood cores of various confidence levels.

Figure 12. In the Daguerre Point Dam study site, historical aerial photographs show that the density of riparian vegetation increased dramatically on over time. This area corresponds to beaver-dammed backwater ponds.

Figure 13. Bands of willow shrubs on the flood plains act as a capture point for large woody material (LWM), creating tall piles of small woody debris and LWM against the upstream side of the vegetation or around the base of the shrubs.

Figure 14. On the open cobbles of the bars in the alluvial reaches, LWM and smaller woody debris was deposited at a high flow line; this distribution comprised the smallest number of LWM pieces. This photograph was taken at the Timbuctoo Bend study site, looking downstream on the south side of the river.

Figure 15. Large woody material accumulated against the lower portion of the training walls that line the north side of the river in Dry Creek study site at flood flow levels.

Figure 16. A great deal of LWM was located at flood heights far from the wetted channel in stands of riparian forests. This photograph was taken at the Daguerre Point Dam study site on the south side of the river.

Figure 17. This photograph shows LWM and smaller woody debris accumulated on rip-rap at flood flow heights at the Parks Bar study site.

Figure 18. Many LWM pieces were found to be upland trees that fell downslope into the riparian are, as pictured above in the Englebright Dam study site.

Figure 19. Some key pieces of LWM were in the active channel; these pieces frequently showed signs of beaver activity. This photograph was taken in the Dry Creek study site.

Figure 20. Most pieces of LWM were found to be mobile (not stabilized to resist high flows) and few pieces were observed to have an impact on the geomorphology (greater than one square meter) or capture woody debris. This photograph was taken at a mid-channel bar looking downstream at the Hallwood study site.

Figure 21. The cobble-dominated banks support dense bands of willows occurring in lines following various flow heights along the banks at or near the wetted channel. This photograph was taken on the south side of the river looking downstream in the Timbuctoo Bend study site.

Figure 22. Scarps are steeply sloping banks or cliffs formed by slumping banks, characterized by exposed, soil-faced cliffs generally ranging in height from 15 to 30 ft, often with fallen, rooted trees lying against the banks. This photograph was taken in the Marysville study site looking toward the north bank.

Figure 23. Levee banks have slightly gentler slopes than scarps (around 45 degrees) and support simple vegetation communities, characterized by either grassy banks or Himalayan blackberry thickets and mature cottonwood trees. This photograph was taken on the south side of the river looking upstream in the Marysville study site.

Figure 24. The Narrows reach has very large, car-sized boulders stacked against the steep canyon walls. This photograph was taken just downstream of the "Ground-chuck" rapid on the north side of the river looking downstream.

Figure 25. The Englebright Dam reach is slightly less narrow than the Narrows reach, with moderately sized boulders. This photograph was taken on the north side of the river looking downstream.

Figure 26. In the Narrows and Englebright Dam reaches, the cottonwoods are more prevalent near the scour-line, with the mature trees primarily populating the upper-most areas of the riparian zone, although smaller, scattered trees are present throughout. This photograph was taken looking upstream in the Narrows study site.

Figure 27. The vegetation on the terrace of the north side of the river in the Hallwood study site is primarily upland, but supports a virtual "orchard" of cottonwood trees. In this photograph, most of the cottonwoods have not yet leafed-out; they stand out among the coyote brush and poison oak.

Figure 28. At the downstream end of the Parks Bar study site on the north side of the river, gravel from the adjacent property continues to bury a mature cottonwood stand; this stand can be seen in photographs as early as 1937.

Figure 29. Small remnant lateral bars in the upstream portion of the Narrows reach support vigorous cottonwoods, willows, and sedges.

Technical Memorandum 6-2

Riparian Habitat Downstream of Englebright Dam

Attachment 6-2G

Cottonwood Inventory and Modeled Discharge Flow Levels

Yuba River Development Project
FERC Project No. 2246

June 2013

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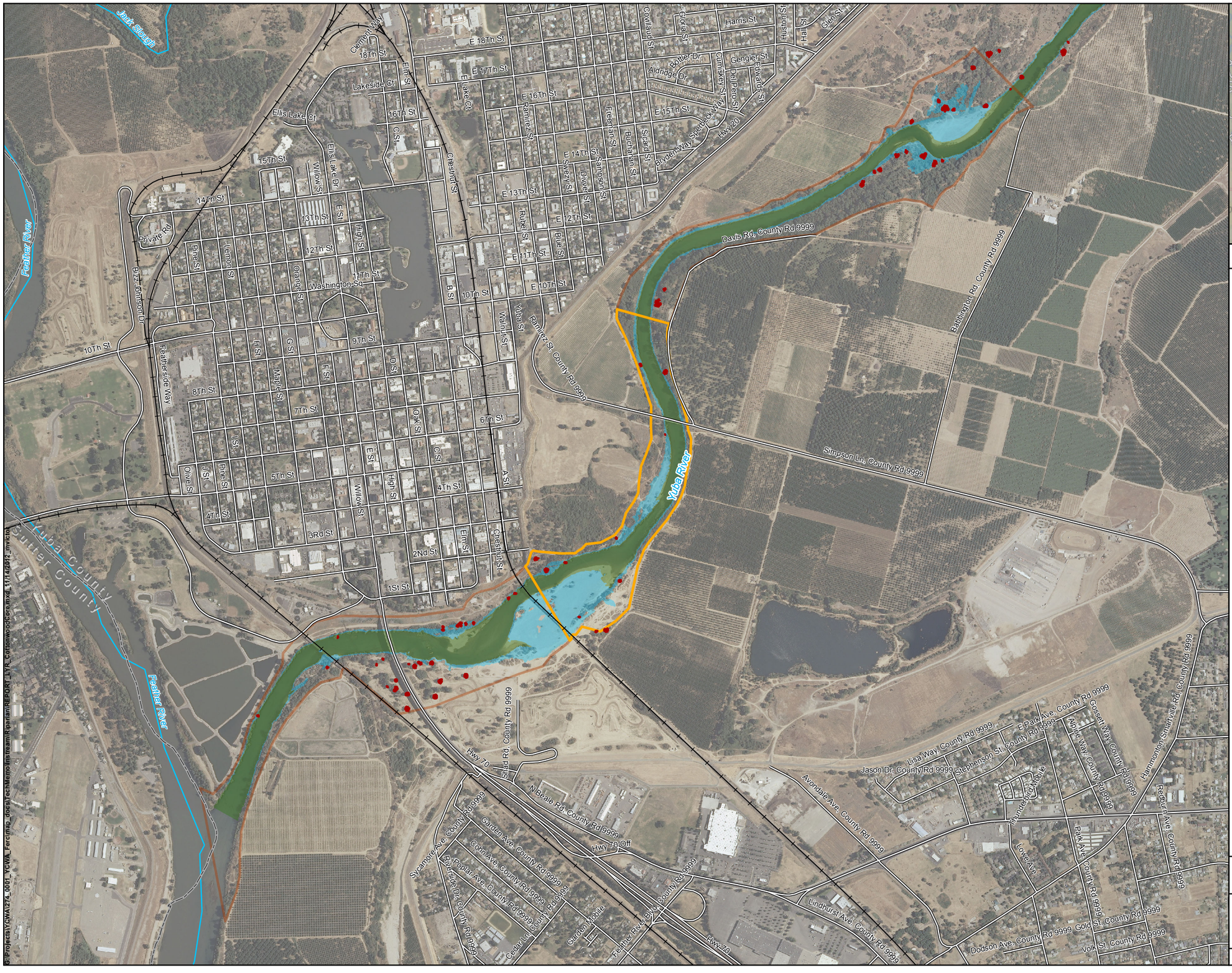
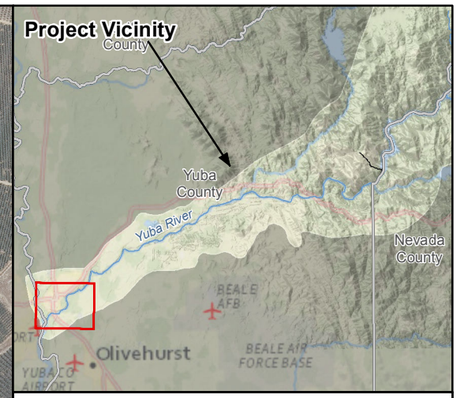




Marysville Reach

Base Map
- Streams
- Railway
- County Line

Project Features
- Project Powerhouse
- Penstock
- FERC Boundary (No. 2246)

Label Color Key
Yuba County Water Agency
Yuba River Development Project (FERC Project No. 2246)
Non-Project Facility

Non-project Features
- Powerhouse
- Dam

- Reach
- Study Site

Cored Cottonwood Trees
- Medium (30 - 50ft)
- Tall (> 50ft)

Cottonwood Inventory
- > 90% Confidence

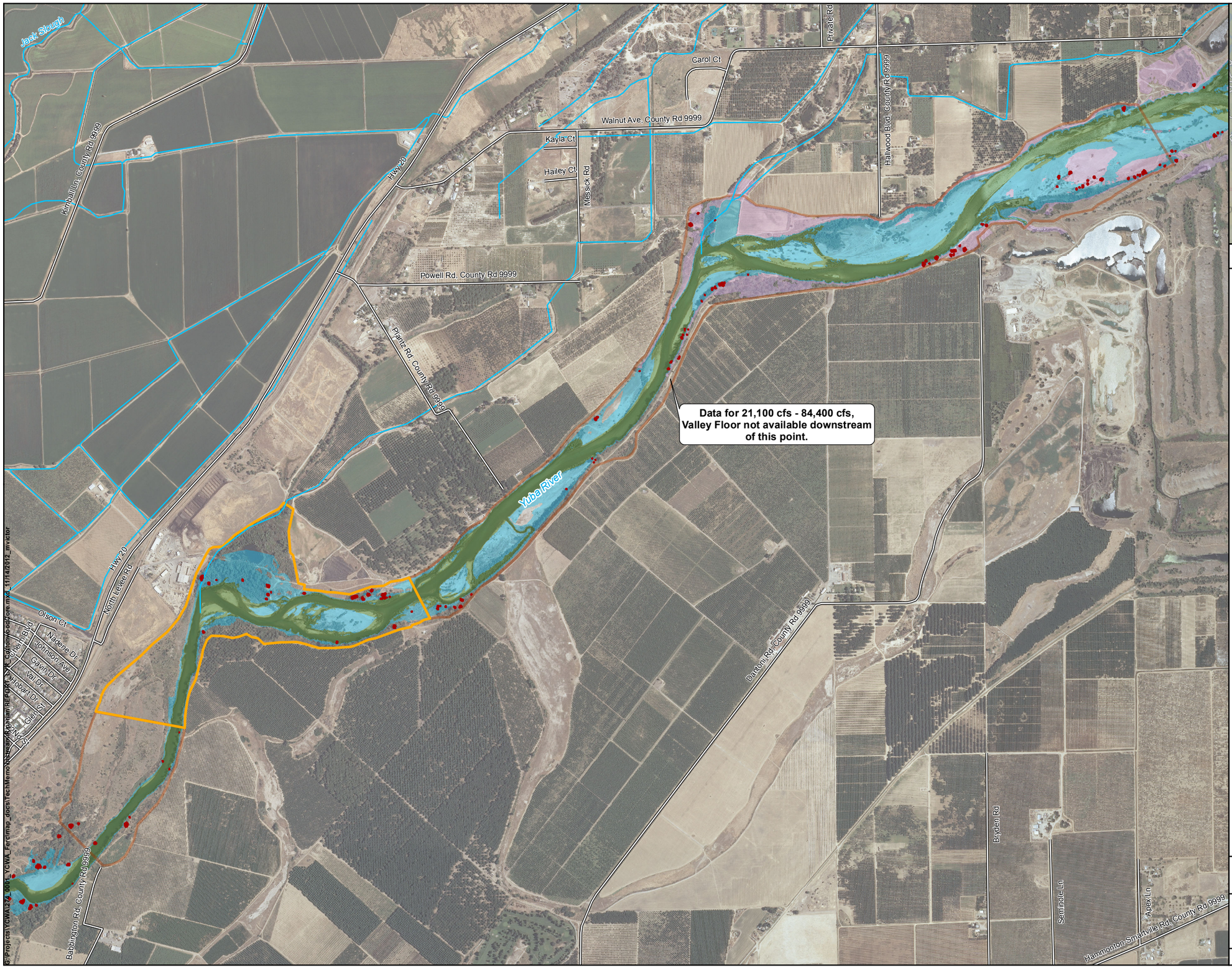
Channel Region
- < 5,000 cfs (Bankfull)
- 5,000 cfs - 21,100 cfs (Floodway)
- 21,100 cfs - 84,400 cfs (Valley Floor)

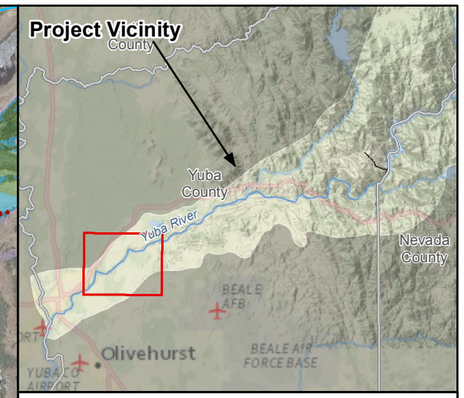
N

0	550	1,100	2,200	Feet
0	165	330	660	Meters

Yuba River Development Project
FERC Project No. 2246

Data Sources: Aerial - NAIP; FERC Boundary, Project and Non-Project features-Yuba County GIS; Base Map-USGS, CASIL, HDR; Cottonwood and Vegetation - WSI and HDR. Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.





Hallwood Reach

Base Map
- Streams
- Railway
- County Line

Project Features
- Project Powerhouse
- Penstock
- FERC Boundary (No. 2246)

Label Color Key
Yuba County Water Agency
Yuba River Development Project (FERC Project No. 2246)
Non-Project Facility

Non-project Features
- Powerhouse
- Dam

- Reach
- Study Site

Cored Cottonwood Trees
- Medium (30 - 50ft)
- Tall (> 50ft)

Cottonwood Inventory
- > 90% Confidence

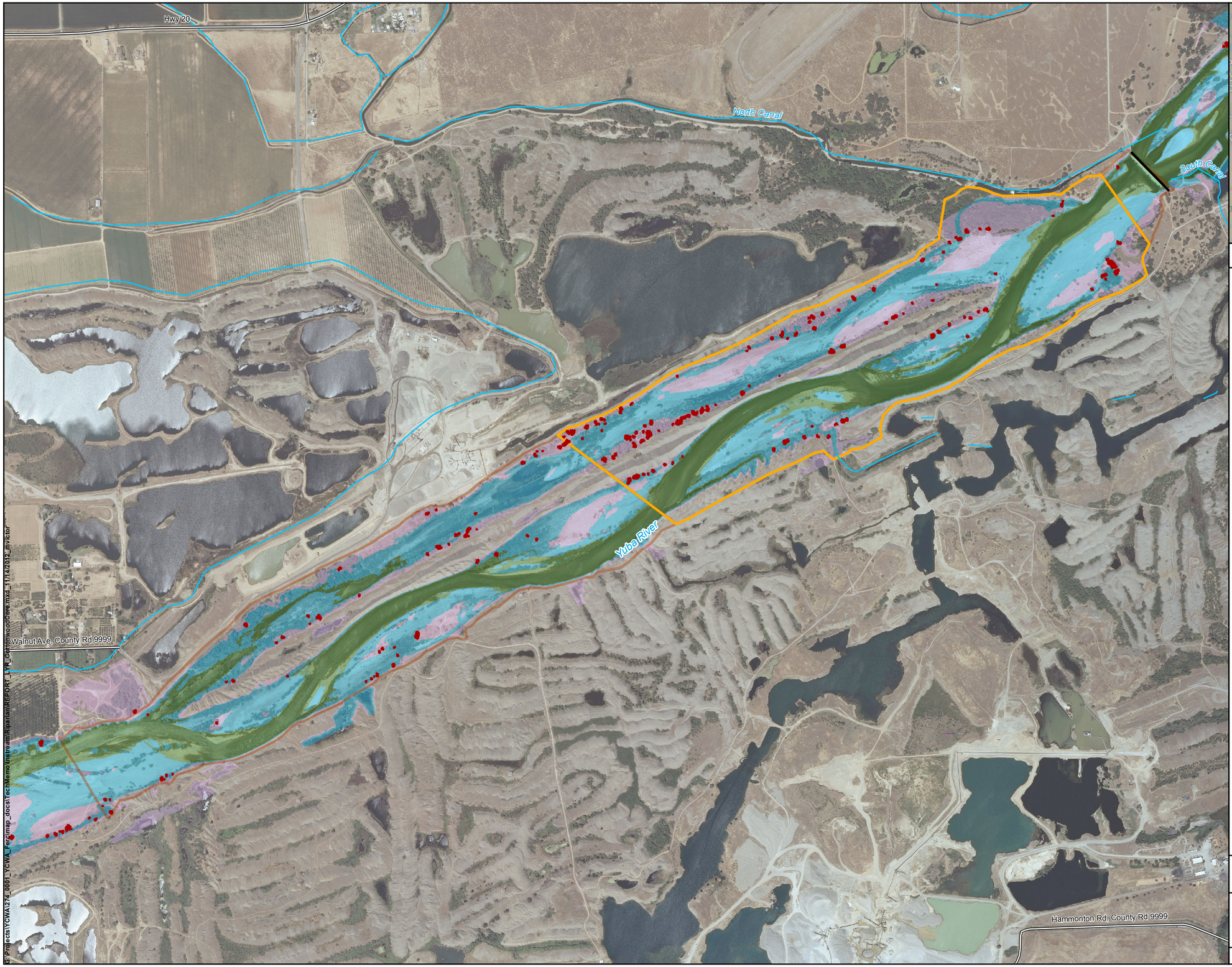
Channel Region
- < 5,000 cfs (Bankfull)
- 5,000 cfs - 21,100 cfs (Floodway)
- 21,100 cfs - 84,400 cfs (Valley Floor)

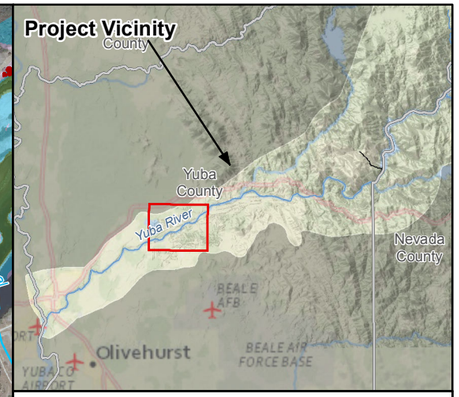
N

0 700 1,400 2,800 Feet
0 220 440 880 Meters

Yuba River Development Project
FERC Project No. 2246

Data Sources: Aerial - NAIP; FERC Boundary, Project and Non-Project features-Yuba County GIS; Base Map-USGS, CASIL, HDR; Cottonwood and Vegetation - WSI and HDR. Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.





Daguerre Point Dam Reach

Base Map
- Streams
- Railway
- County Line

Project Features
- Project Powerhouse
- Penstock
- FERC Boundary (No. 2246)

Label Color Key
Yuba County Water Agency
Yuba River Development Project
(FERC Project No. 2246)
Non-Project Facility

Non-project Features
- Powerhouse
- Dam

- Reach
- Study Site

Cored Cottonwood Trees
- Medium (30 - 50ft)
- Tall (> 50ft)

Cottonwood Inventory
- > 90% Confidence

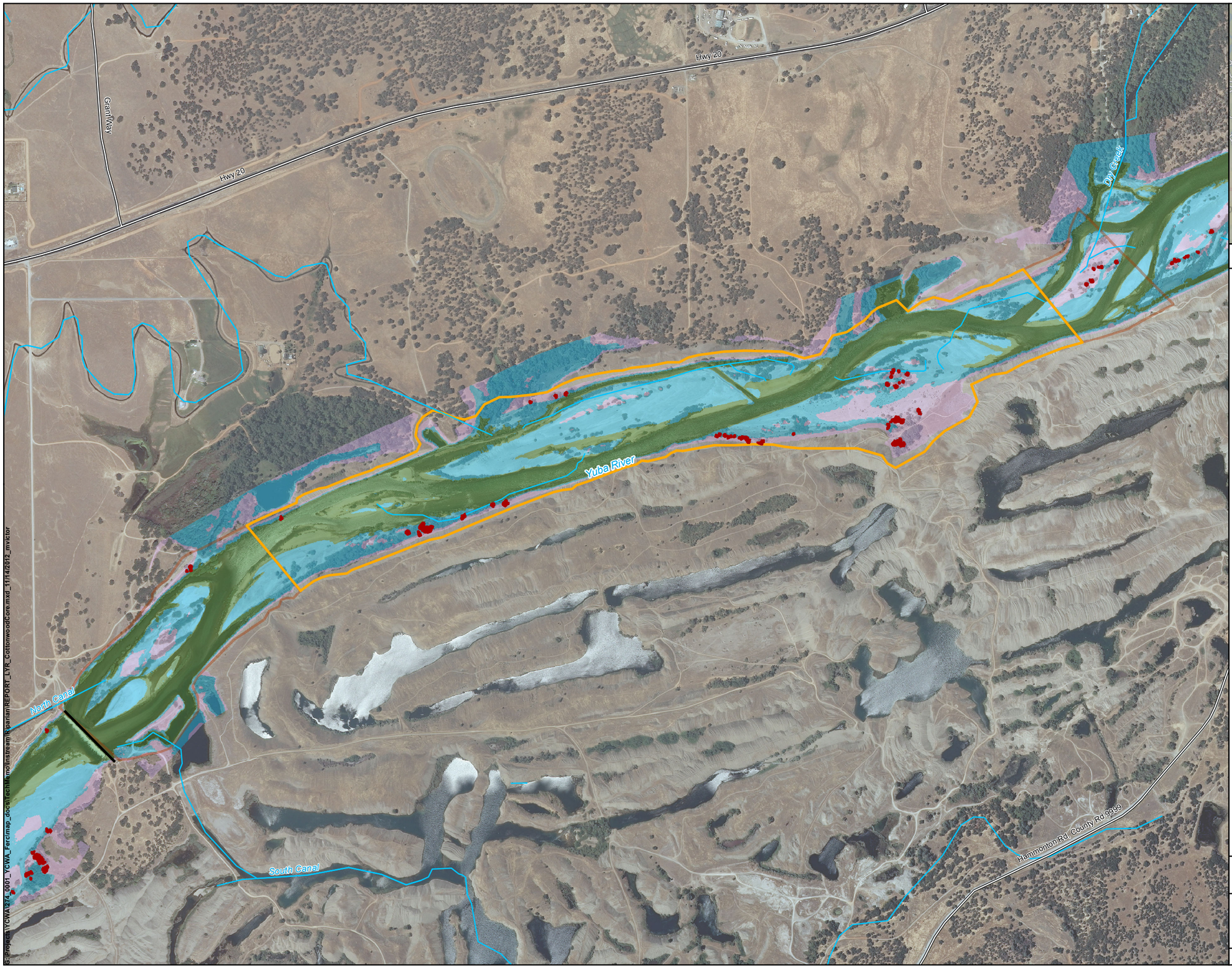
Channel Region
- < 5,000 cfs (Bankfull)
- 5,000 cfs - 21,100 cfs (Floodway)
- 21,100 cfs - 84,400 cfs (Valley Floor)

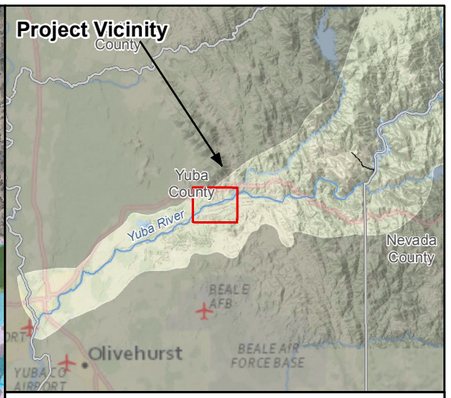
N

0 550 1,100 2,200 Feet
0 165 330 660 Meters

Yuba River Development Project
FERC Project No. 2246

Data Sources: Aerial - NAIP; FERC Boundary, Project and Non-Project features-Yuba County GIS; Base Map-USGS, CASIL, HDR; Cottonwood and Vegetation - WSI and HDR. Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.





Dry Creek Reach

Base Map
- Streams
- Railway
- County Line

Project Features
- Project Powerhouse
- Penstock
- FERC Boundary (No. 2246)

Label Color Key
Yuba County Water Agency
Yuba River Development Project (FERC Project No. 2246)
Non-Project Facility

Non-project Features
- Powerhouse
- Dam

- Reach
- Study Site

Cored Cottonwood Trees
- Medium (30 - 50ft)
- Tall (> 50ft)

Cottonwood Inventory
- > 90% Confidence

Channel Region
- < 5,000 cfs (Bankfull)
- 5,000 cfs - 21,100 cfs (Floodway)
- 21,100 cfs - 84,400 cfs (Valley Floor)

N

0 420 840 1,680 Feet
0 125 250 500 Meters

Yuba River Development Project
FERC Project No. 2246

Data Sources: Aerial - NAIP; FERC Boundary, Project and Non-Project features-Yuba County GIS; Base Map-USGS, CASIL, HDR; Cottonwood and Vegetation - WSI and HDR. Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

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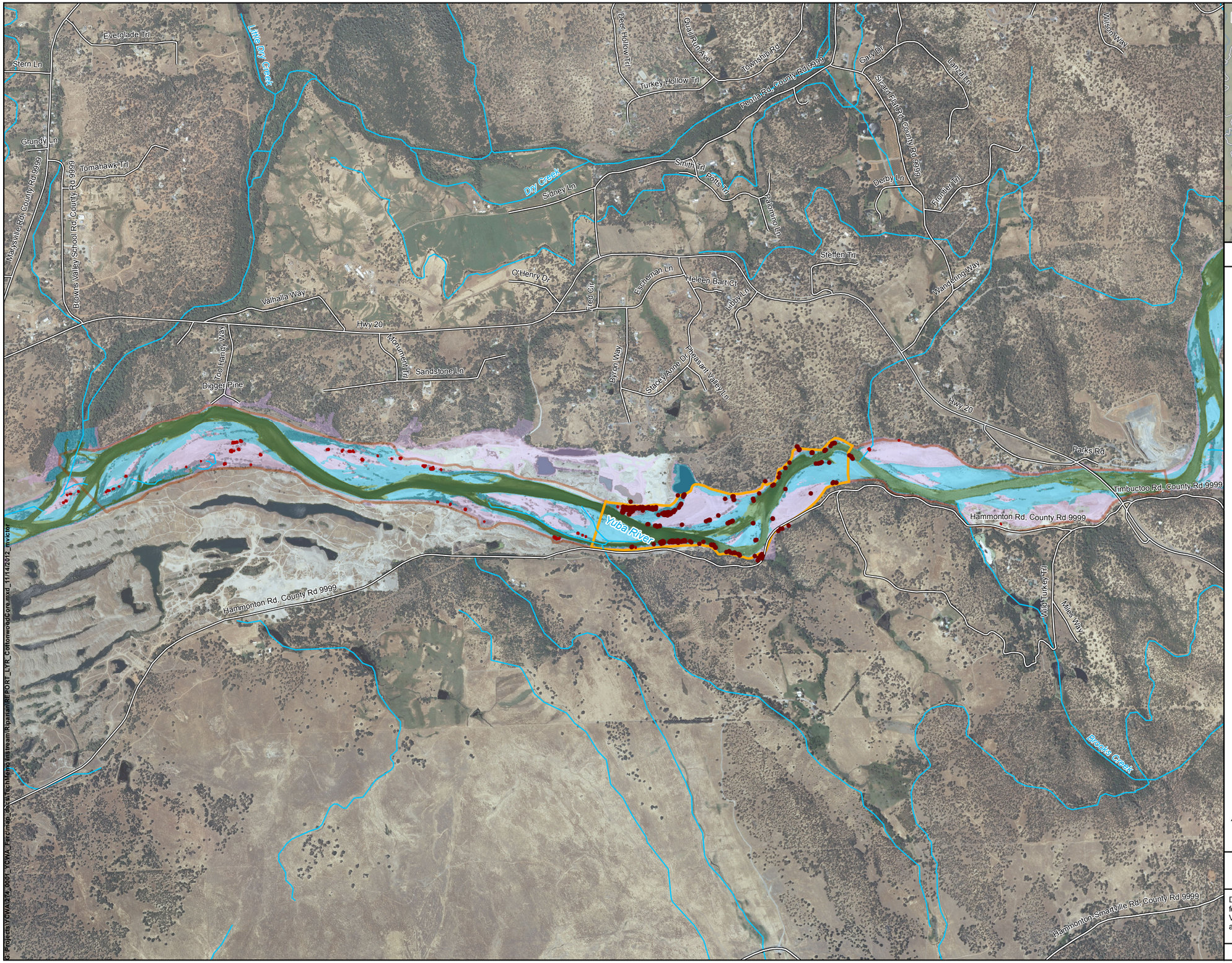

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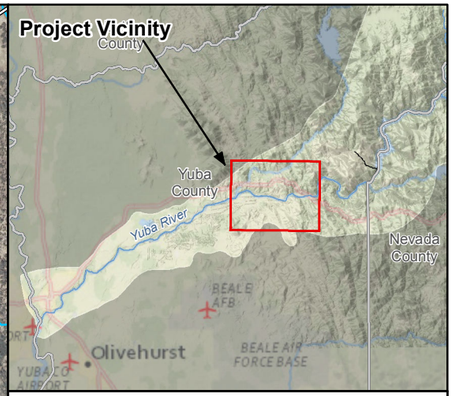


Parks Bar Reach

Base Map
- Streams
- Railway
- County Line

Project Features
- Project Powerhouse
- Penstock
- FERC Boundary (No. 2246)

Label Color Key
Yuba County Water Agency
Yuba River Development Project
(FERC Project No. 2246)
Non-Project Facility

Non-project Features
- Powerhouse
- Dam

- Reach
- Study Site

Cored Cottonwood Trees
- Medium (30 - 50ft)
- Tall (> 50ft)

Cottonwood Inventory
- > 90% Confidence

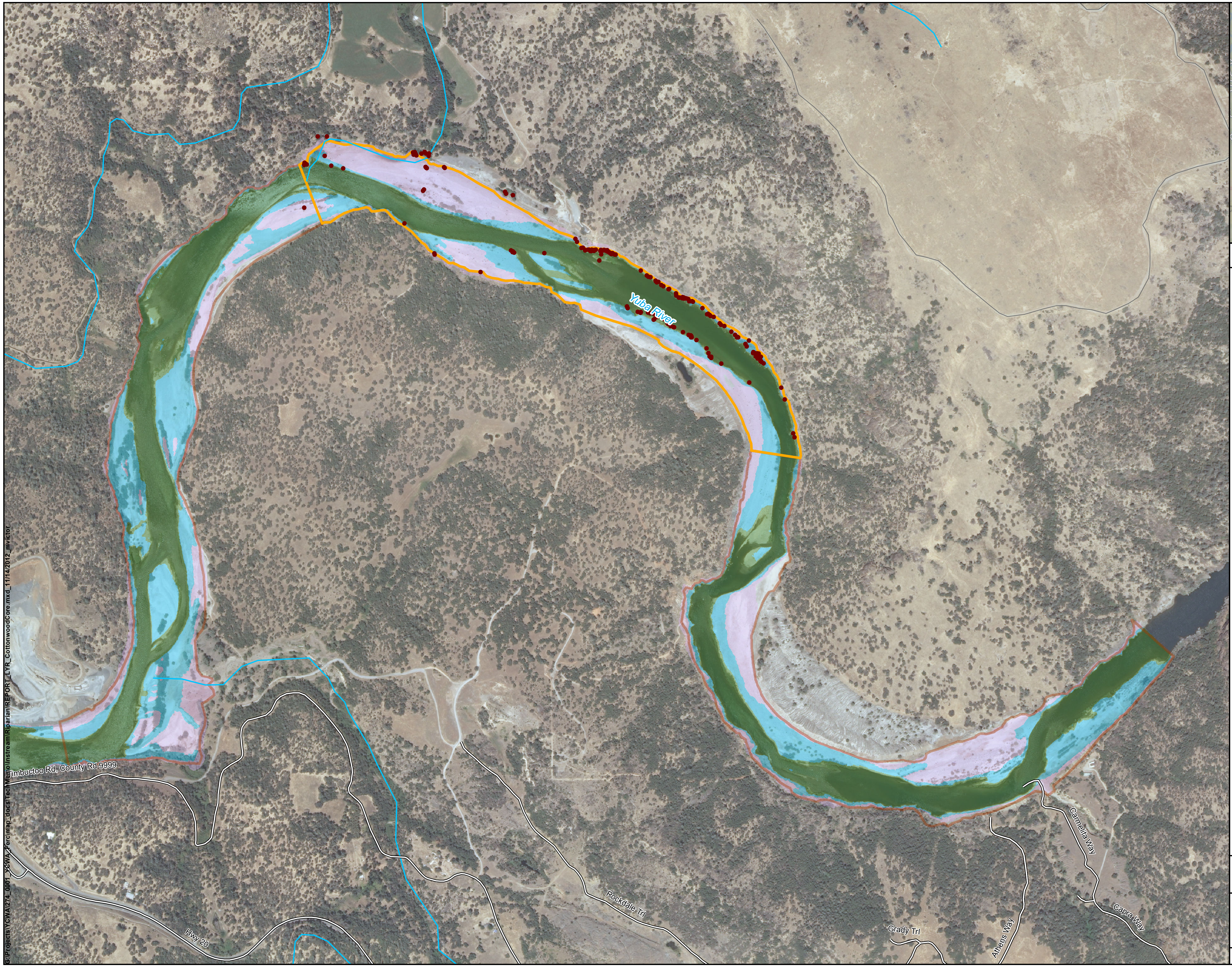
Channel Region
- < 5,000 cfs (Bankfull)
- 5,000 cfs - 21,100 cfs (Floodway)
- 21,100 cfs - 84,400 cfs (Valley Floor)

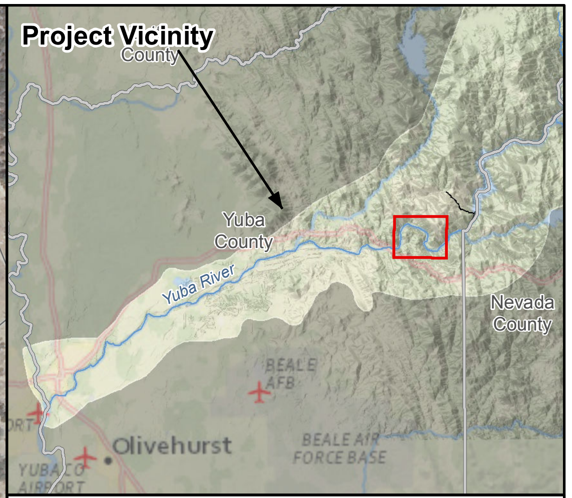
N

0 800 1,600 3,200 Feet
0 250 500 1,000 Meters

Yuba River Development Project
FERC Project No. 2246

Data Sources: Aerial - NAIP; FERC Boundary, Project and Non-Project features-Yuba County GIS; Base Map-USGS, CASIL, HDR; Cottonwood and Vegetation - WSI and HDR. Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.





Timbuctoo Bend Reach

Base Map
- Streams
- Railway
- County Line

Project Features
- Project Powerhouse
- Penstock
- FERC Boundary (No. 2246)

Label Color Key
Yuba County Water Agency
Yuba River Development Project
(FERC Project No. 2246)
Non-Project Facility

Non-project Features
- Powerhouse
- Dam

- Reach
- Study Site

Cored Cottonwood Trees
- Medium (30 - 50ft)
- Tall (> 50ft)

Cottonwood Inventory
- > 90% Confidence

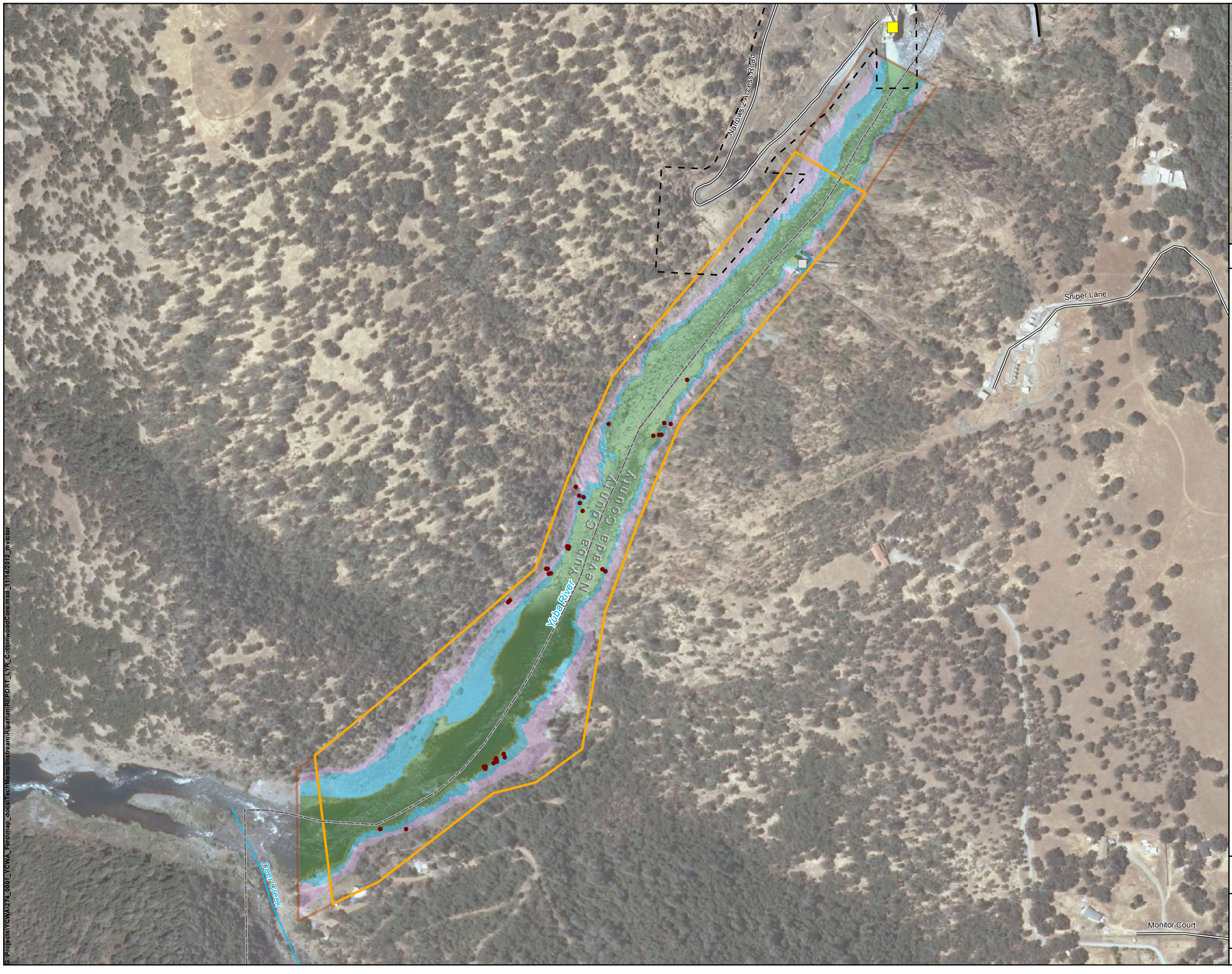
Channel Region
- < 5,000 cfs (Bankfull)
- 5,000 cfs - 21,100 cfs (Floodway)
- 21,100 cfs - 84,400 cfs (Valley Floor)

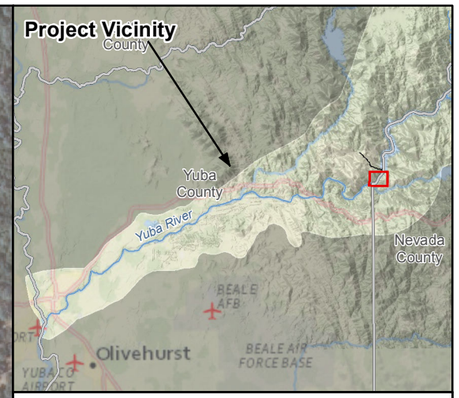
N

0 395 790 1,580 Feet
0 115 230 460 Meters

Yuba River Development Project
FERC Project No. 2246

Data Sources: Aerial - NAIP; FERC Boundary, Project and Non-Project features-Yuba County GIS; Base Map-USGS, CASIL, HDR; Cottonwood and Vegetation - WSI and HDR. Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.





Englebright Dam Reach

Base Map
- Streams
- Railway
- County Line

Project Features
- Project Powerhouse
- Penstock
- FERC Boundary (No. 2246)

Label Color Key
Yuba County Water Agency
Yuba River Development Project (FERC Project No. 2246)
Non-Project Facility

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Cored Cottonwood Trees
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- Tall (> 50ft)

Cottonwood Inventory
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Channel Region
- < 5,000 cfs (Bankfull)
- 5,000 cfs - 21,100 cfs (Floodway)
- 21,100 cfs - 84,400 cfs (Valley Floor)

N

0 165 330 660 Feet
0 50 100 200 Meters

Yuba River Development Project
FERC Project No. 2246

Data Sources: Aerial - NAIP; FERC Boundary, Project and Non-Project features-Yuba County GIS; Base Map-USGS, CASIL, HDR; Cottonwood and Vegetation - WSI and HDR. Map information was compiled from the best available sources. No warranty is made for its accuracy or completeness.

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Technical Memorandum 6-2

Riparian Habitat Downstream of Englebright Dam

Attachment 6-2H

Cottonwood Statistical Growth Models

Yuba River Development Project
FERC Project No. 2246

June 2013

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1.0 Model 1 Regression

Dependent Est_Age

Run Summary Section

Parameter	Value	Parameter	Value
Dependent Variable	Est_Age	Rows Processed	97
Number Ind. Variables	1	Rows Filtered Out	0
Weight Variable	None	Rows with X's Missing	10
R2	0.8168	Rows with Weight Missing	0
Adj R2	0.8168	Rows with Y Missing	1
Coefficient of Variation	0.4593	Rows Used in Estimation	86
Mean Square Error	341.7133	Sum of Weights	81.993
Square Root of MSE	18.48549	Completion Status	Normal Completion
Ave Abs Pct Error	49.849		

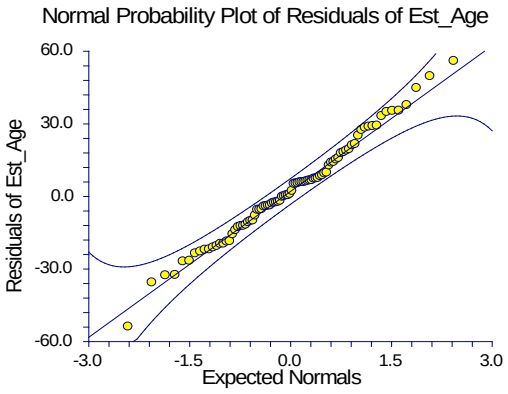
Regression Equation Section

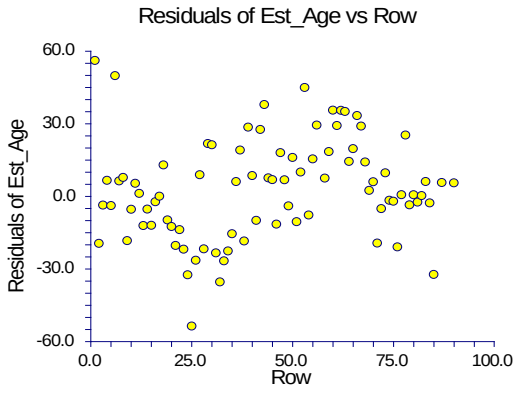
Independent Variable	Regression Coefficient b(i)	Standard Error Sb(i)	T-Value to test H0:B(i)=0	Prob Level	Reject H0 at 5%?	Power of Test at 5%
Canopy_Height	0.7054	0.0362	19.464	0.0000	Yes	1.0000

Analysis of Variance Section

Source	DF	R2	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Model	1	0.8168	129462.5	129462.5	378.863	0.0000	1.0000
Error	85	0.1832	29045.63	341.7133			
Total	86	1.0000	158508.1	1843.118			

Plots Section





2.0 Model 2 Regression

Dependent Est_Age

Run Summary Section

Parameter	Value	Parameter	Value
Dependent Variable	Est_Age	Rows Processed	97
Number Ind. Variables	1	Rows Filtered Out	0
Weight Variable	None	Rows with X's Missing	10
R2	0.8457	Rows with Weight Missing	0
Adj R2	0.8457	Rows with Y Missing	3
Coefficient of Variation	0.4204	Rows Used in Estimation	84
Mean Square Error	275.5805	Sum of Weights	78.682
Square Root of MSE	16.60062	Completion Status	Normal Completion
Ave Abs Pct Error	39.297		

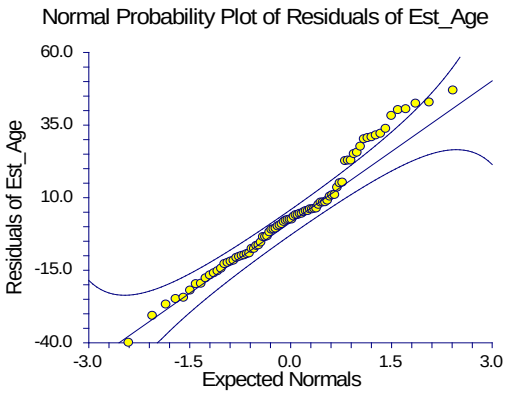
Regression Equation Section

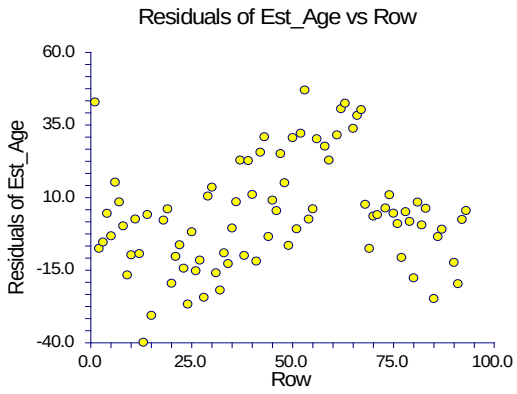
Independent Variable	Regression Coefficient b(i)	Standard Error Sb(i)	T-Value to test H0:B(i)=0	Prob Level	Reject H0 at 5%?	Power of Test at 5%
dbh	1.6162	0.0758	21.326	0.0000	Yes	1.0000

Analysis of Variance Section

Source	DF	R2	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Model	1	0.8457	125332.7	125332.7	454.795	0.0000	1.0000
Error	83	0.1543	22873.19	275.5805			
Total	84	1.0000	148205.9	1764.356			

Plots Section





3.0 Model 3 Regression

Dependent Est_Age

Run Summary Section

Parameter	Value	Parameter	Value
Dependent Variable	Est_Age	Rows Processed	97
Number Ind. Variables	2	Rows Filtered Out	0
Weight Variable	None	Rows with X's Missing	16
R2	0.8425	Rows with Weight Missing	0
Adj R2	0.8405	Rows with Y Missing	1
Coefficient of Variation	0.4258	Rows Used in Estimation	80
Mean Square Error	276.2761	Sum of Weights	74.474
Square Root of MSE	16.62156	Completion Status	Normal Completion
Ave Abs Pct Error	42.012		

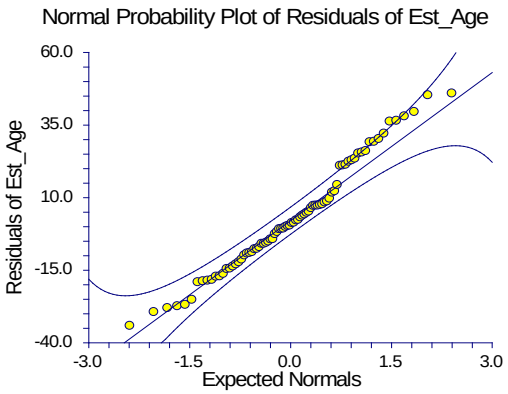
Regression Equation Section

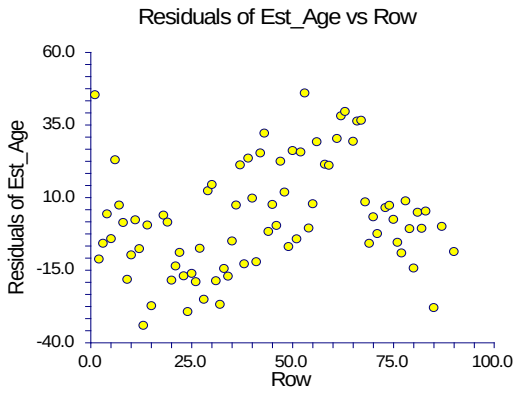
Independent Variable	Regression Coefficient b(i)	Standard Error Sb(i)	T-Value to test H0:B(i)=0	Prob Level	Reject H0 at 5%?	Power of Test at 5%
Canopy_Height	0.1889	0.1053	1.793	0.0768	No	0.4252
dbh	1.2226	0.2467	4.955	0.0000	Yes	0.9983

Analysis of Variance Section

Source	DF	R2	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Model	2	0.8425	115258.5	57629.26	208.593	0.0000	1.0000
Error	78	0.1575	21549.54	276.2761			
Total	80	1.0000	136808.1	1710.101			

Plots Section





4.0 Model 4 Regression

Dependent Est_Age

Run Summary Section

Parameter	Value	Parameter	Value
Dependent Variable	Est_Age	Rows Processed	97
Number Ind. Variables	3	Rows Filtered Out	0
Weight Variable	None	Rows with X's Missing	16
R2	0.8552	Rows with Weight Missing	0
Adj R2	0.8515	Rows with Y Missing	1
Coefficient of Variation	0.4211	Rows Used in Estimation	80
Mean Square Error	280.0227	Sum of Weights	78.204
Square Root of MSE	16.73388	Completion Status	Normal Completion
Ave Abs Pct Error	43.559		

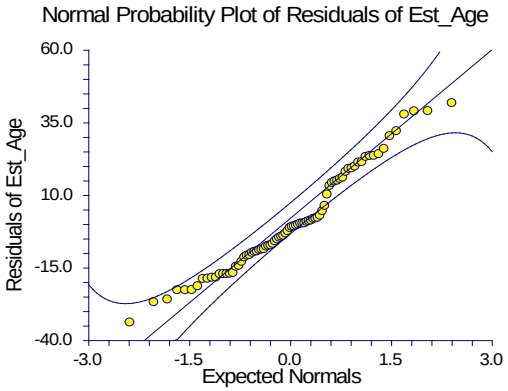
Regression Equation Section

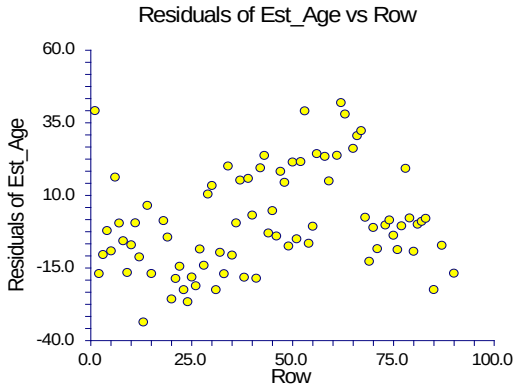
Independent Variable	Regression Coefficient b(i)	Standard Error Sb(i)	T-Value to test H0:B(i)=0	Prob Level	Reject H0 at 5%?	Power of Test at 5%
Canopy_Height	0.3223	0.1082	2.979	0.0039	Yes	0.8368
dbh	1.9939	0.3241	6.153	0.0000	Yes	1.0000
Canopy_Height*dbh	-0.0175	0.0047	-3.750	0.0003	Yes	0.9593

Analysis of Variance Section

Source	DF	R2	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Model	3	0.8552	127364.6	42454.87	151.612	0.0000	1.0000
Error	77	0.1448	21561.75	280.0227			
Total	80	1.0000	148926.4	1861.58			

Plots Section





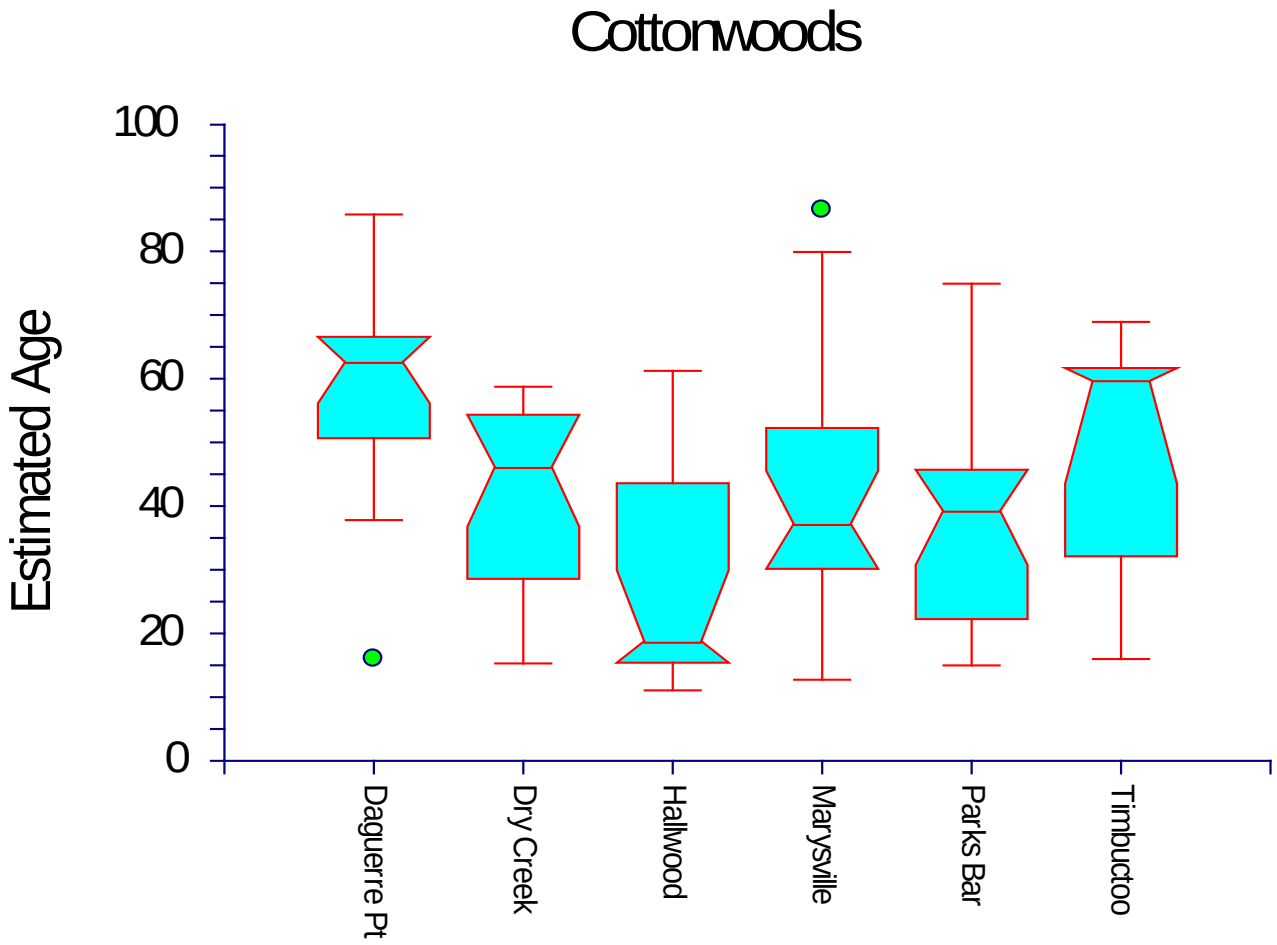


Figure 4.0-1. Box-whisker plot of estimated age based on annular counts.

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Technical Memorandum 6-2

Riparian Habitat Downstream of Englebright Dam

Attachment 6-2I

Historical Discharge Flow Data from the Smartsville and Marysville Gages

Yuba River Development Project
FERC Project No. 2246

June 2013

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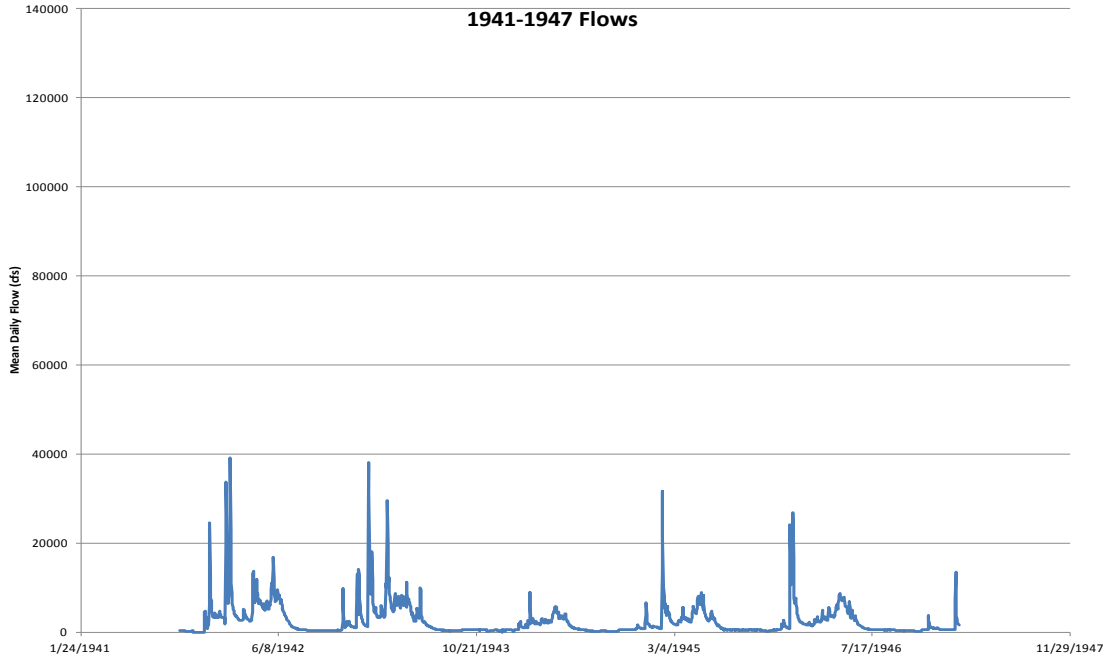


Figure 1.0-1. Daily discharge data from the Smartsville gage from the earlies available date (1941) to 1947.

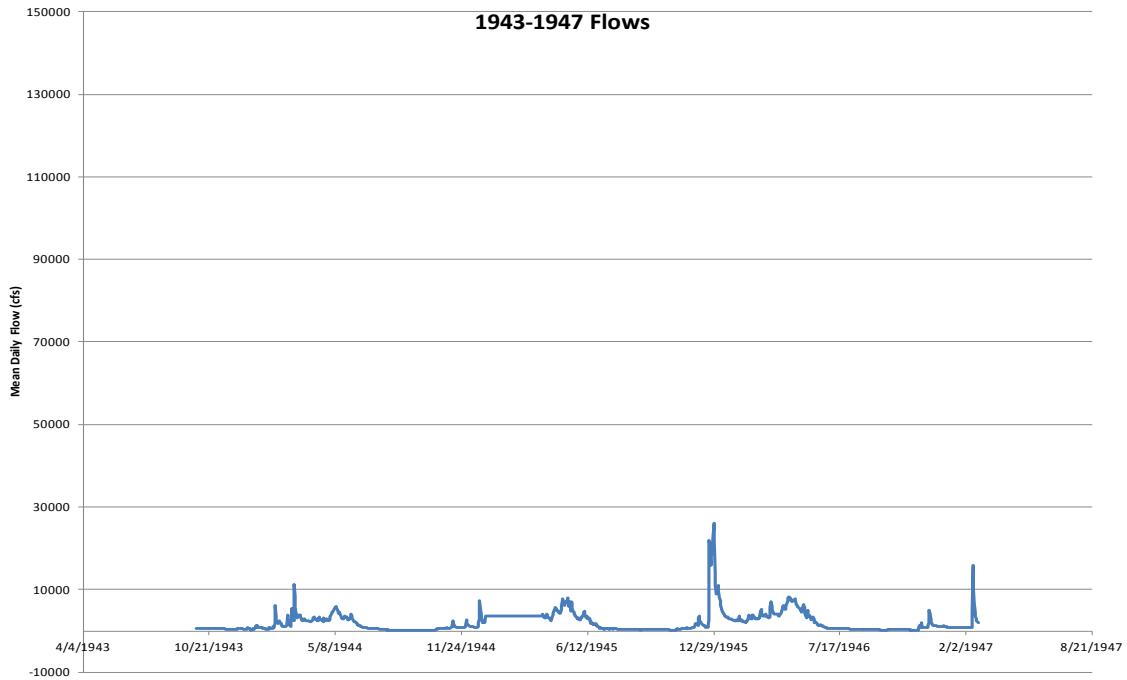


Figure 1.0-2. Daily discharge data from the Marysville gage from the earlies available date (1943) to 1947.

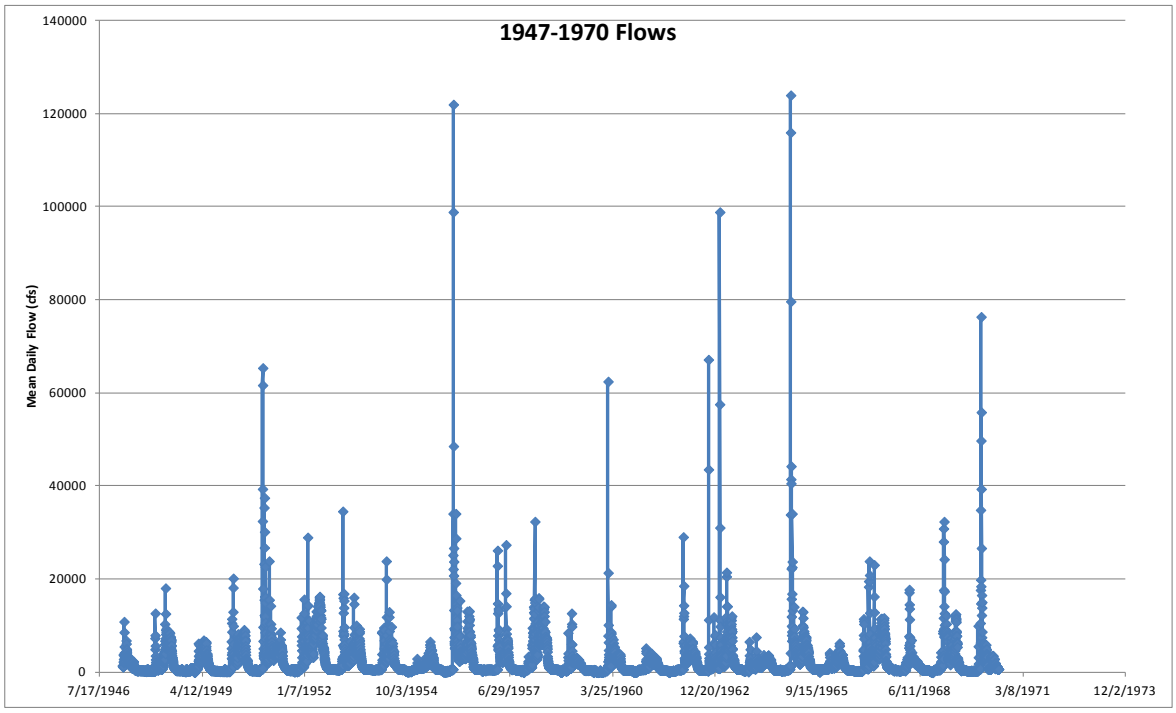


Figure 1.0-3. Daily discharge data from the Smartsville gage from the 1947 to 1970.

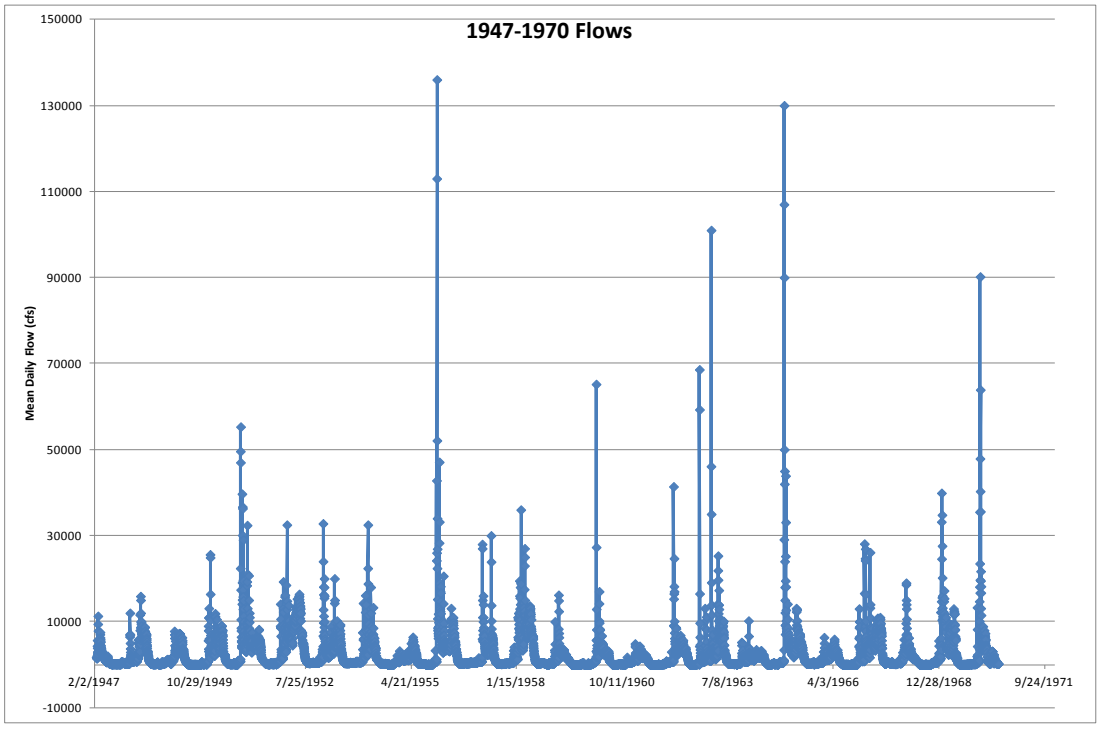


Figure 1.0-4. Daily discharge data from the Marysville gage from the 1947 to 1970.

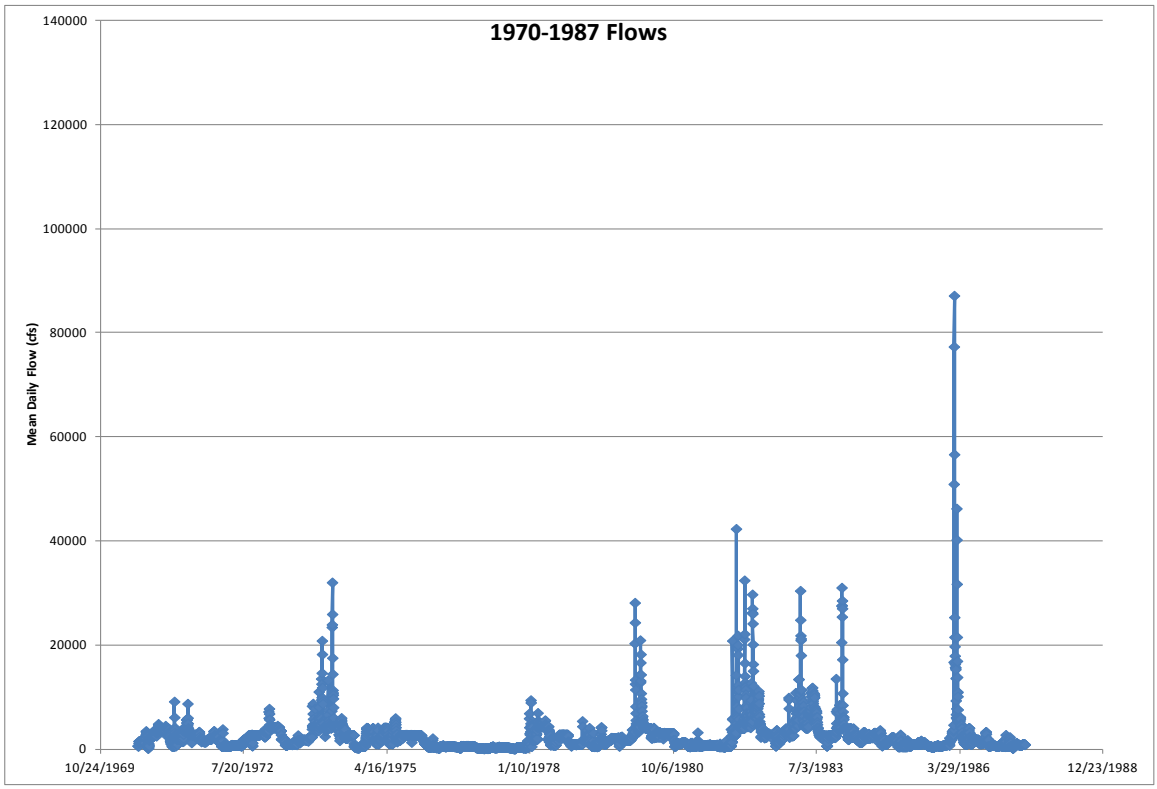


Figure 1.0-5. Daily discharge data from the Smartsville gage from the 1970 to 1987.

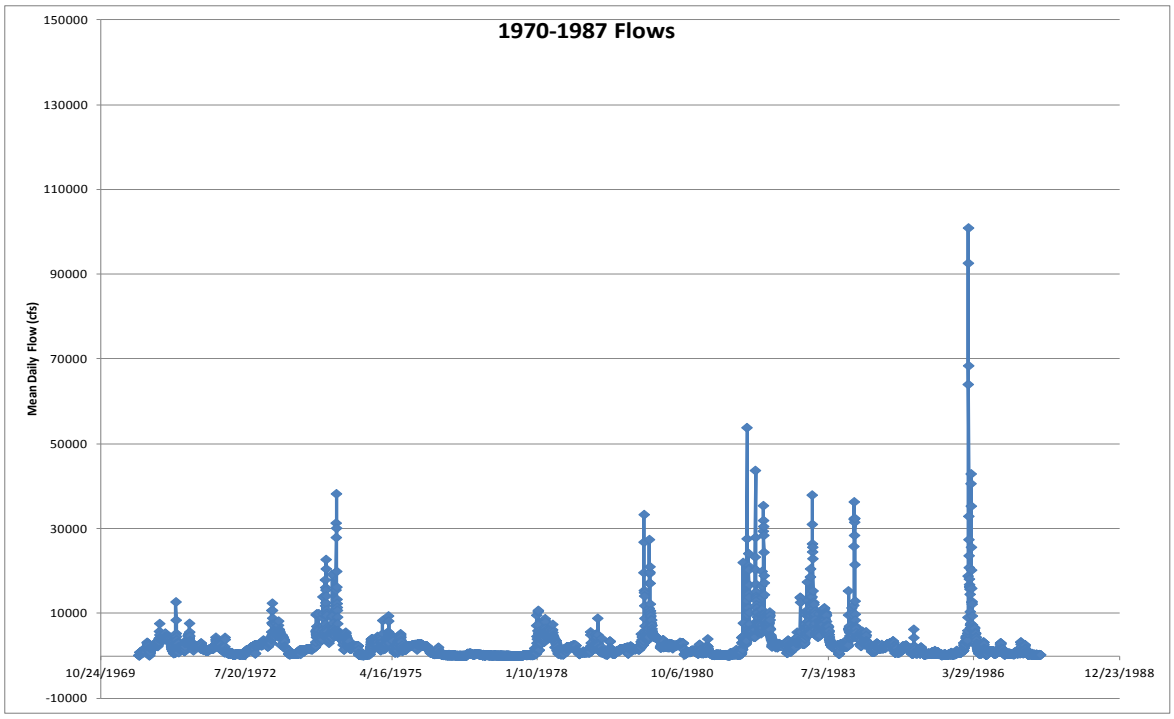


Figure 1.0-6. Daily discharge data from the Maryssville gage from the 1970 to 1987.

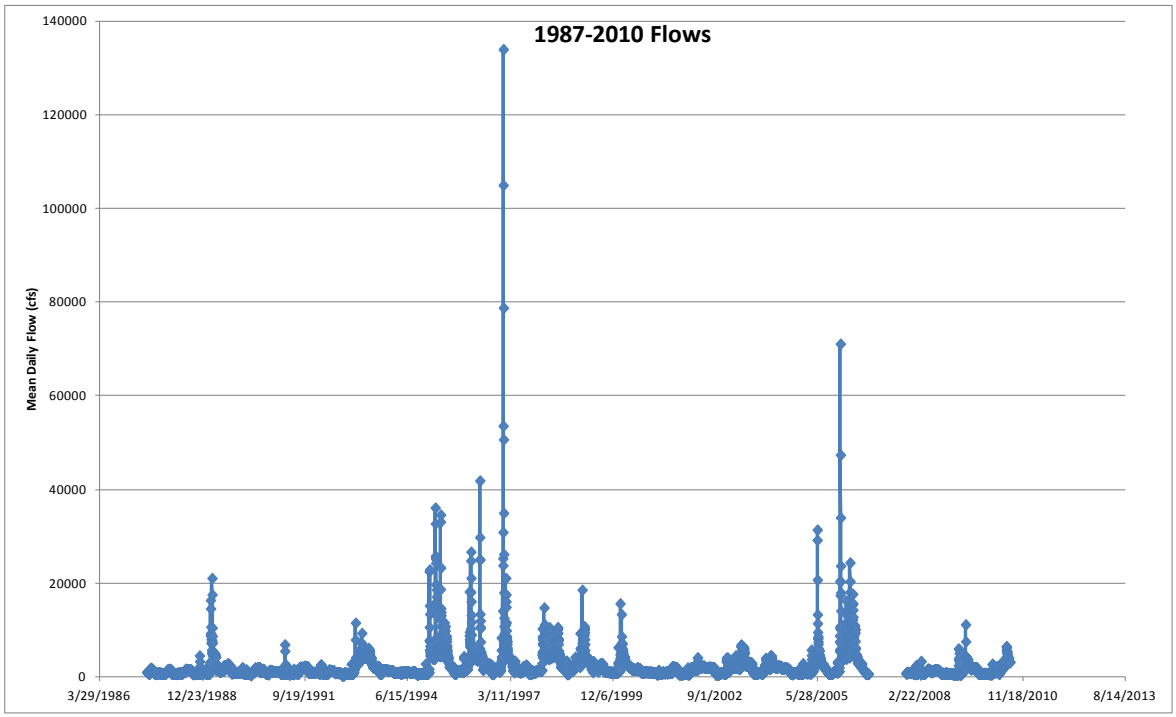


Figure 1.0-7. Daily discharge data from the Smartsville gage from the 1987 to 2010.

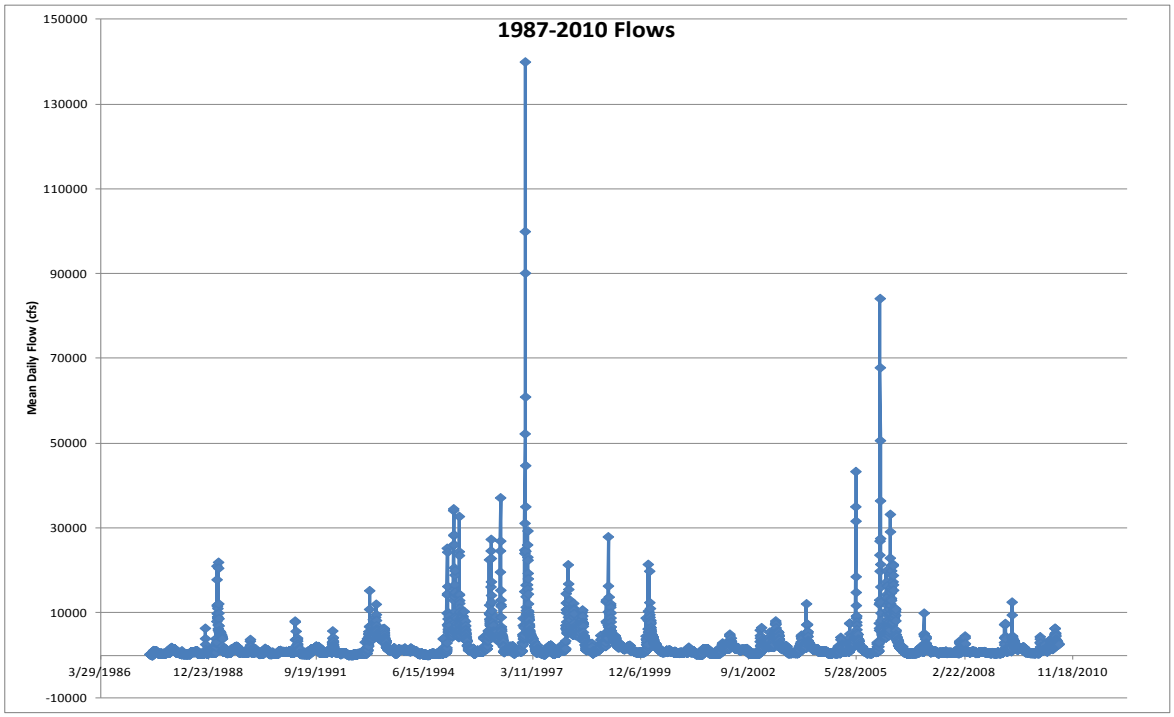


Figure 1.0-8. Daily discharge data from the Maryssville gage from the 1987 to 2010.

2.0 Peak Flow Discharge Data from the Smartsville and Marysville Gages

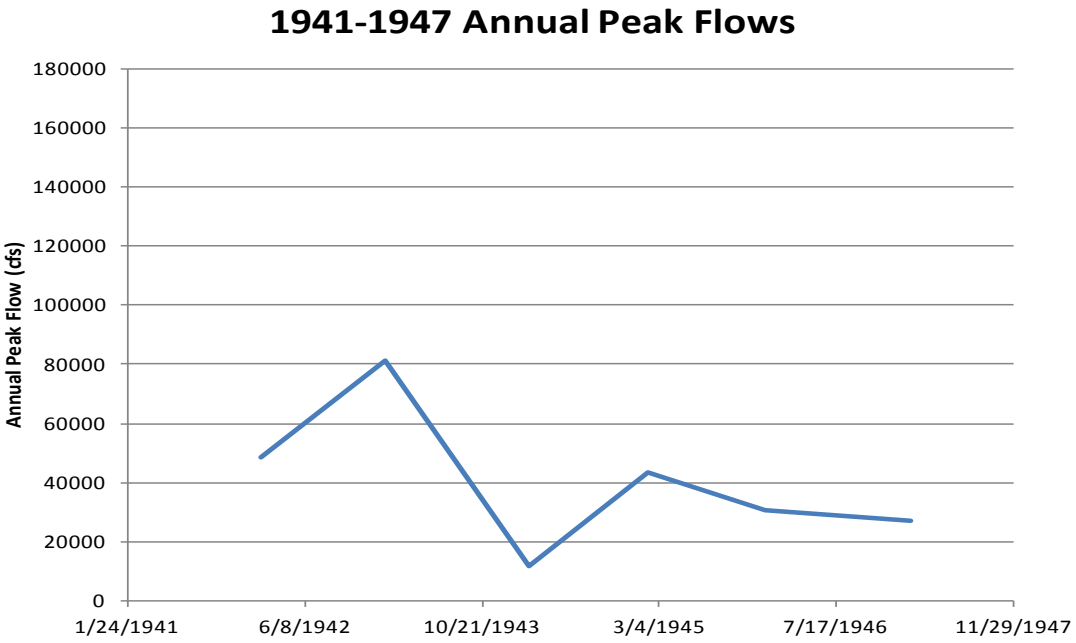


Figure 2.0-1. Peak discharge data from the Smartsville gage from the earliest available date (1941) to 1947.

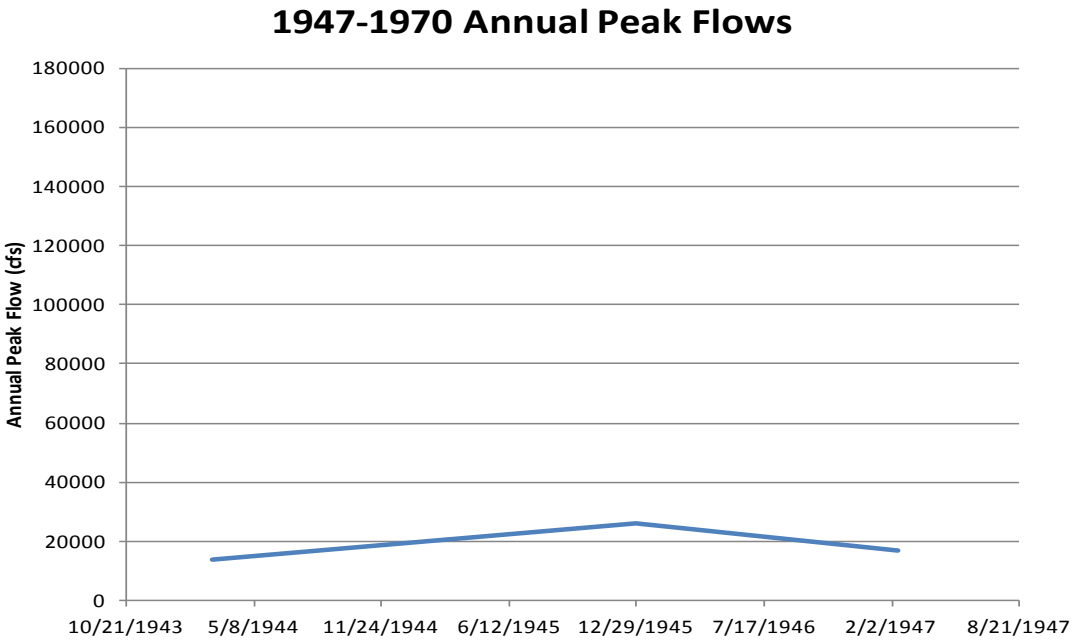


Figure 2.0-2. Peak discharge data from the Marysville gage from the earliest available date (1943) to 1947.

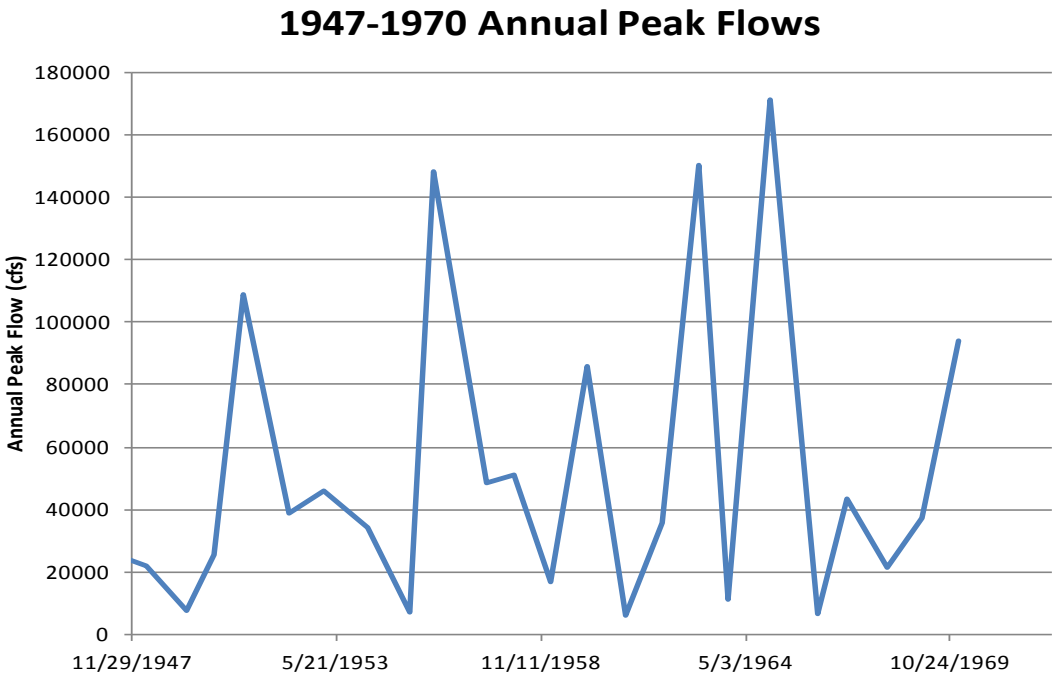


Figure 2.0-3. Peak discharge data from the Smartsville gage from 1947 to 1970.

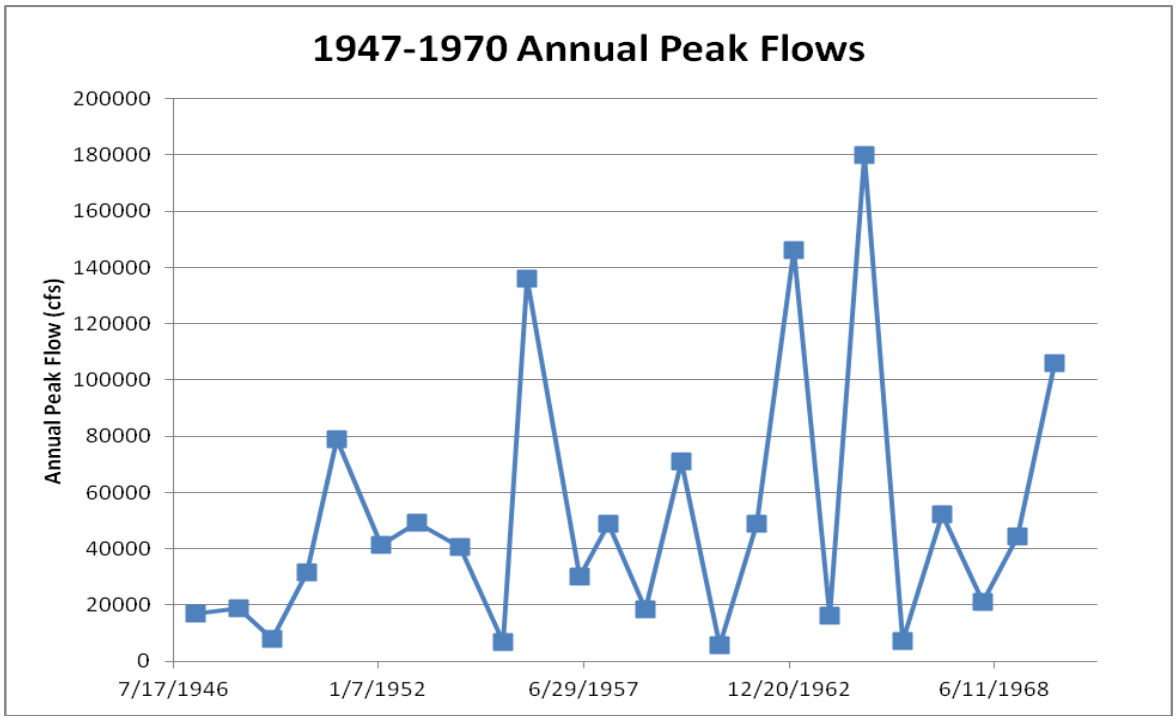


Figure 2.0-4. Peak discharge data from the Marysville gage from 1947 to 1970.

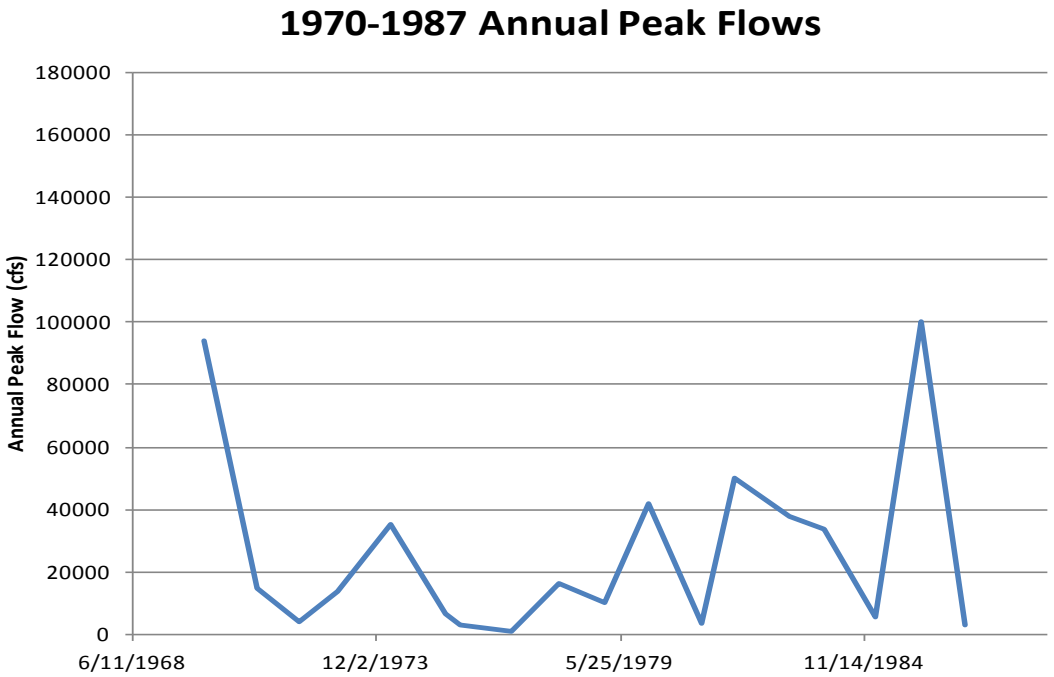


Figure 2.0-5. Peak discharge data from the Smartsville gage from 1970 to 1987.

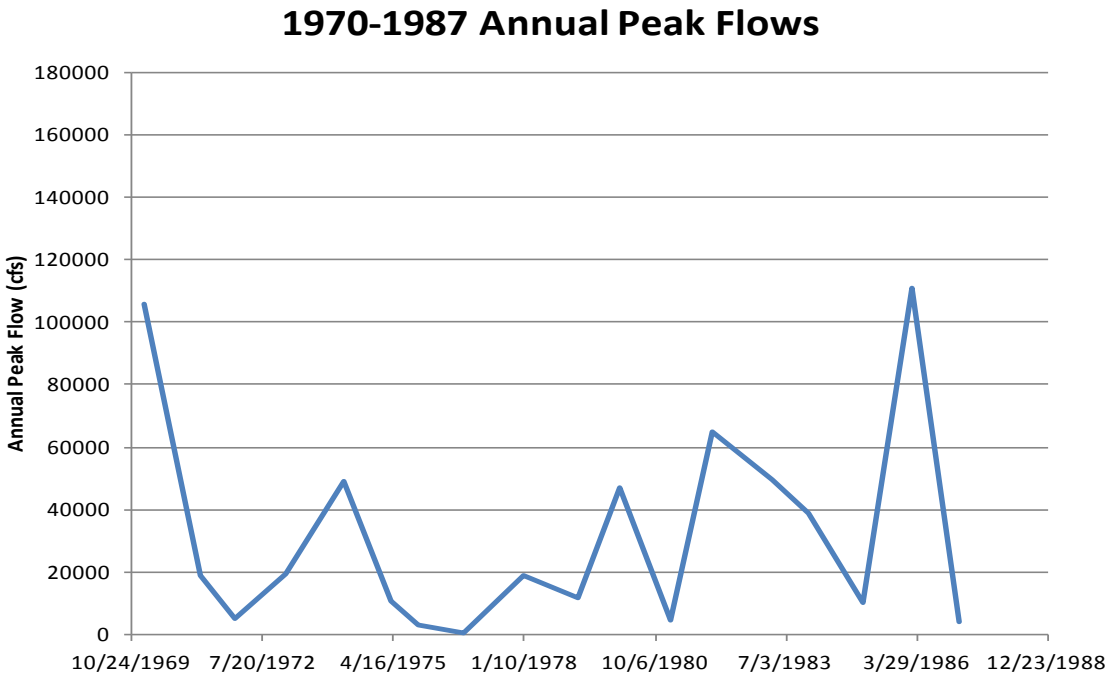
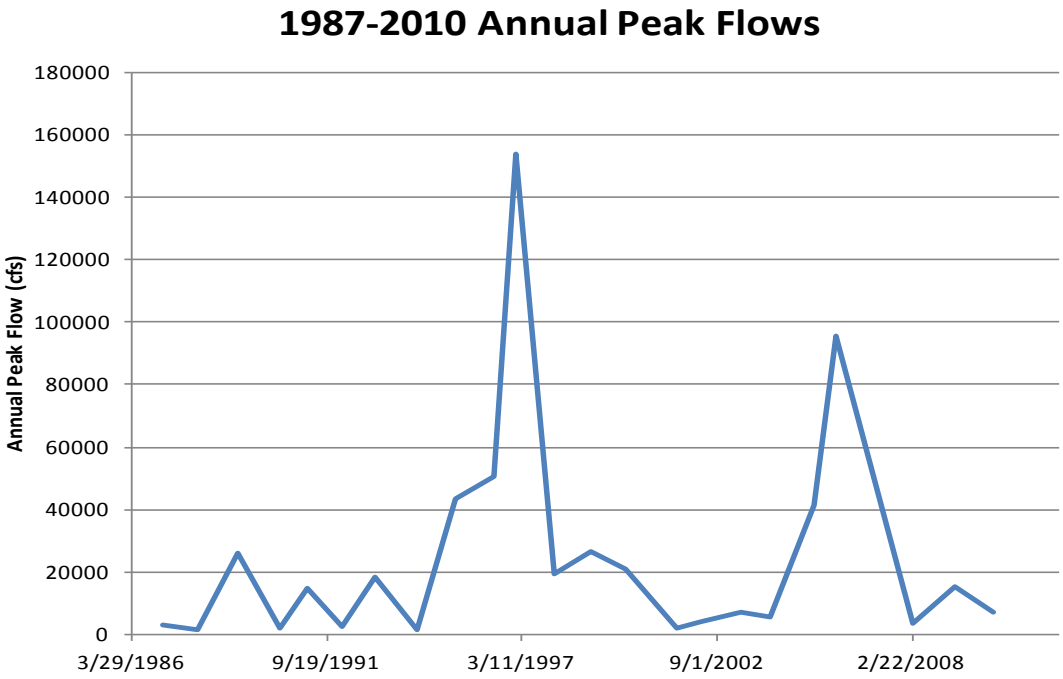


Figure 2.0-6. Peak discharge data from the Marysville gage from 1970 to 1987.



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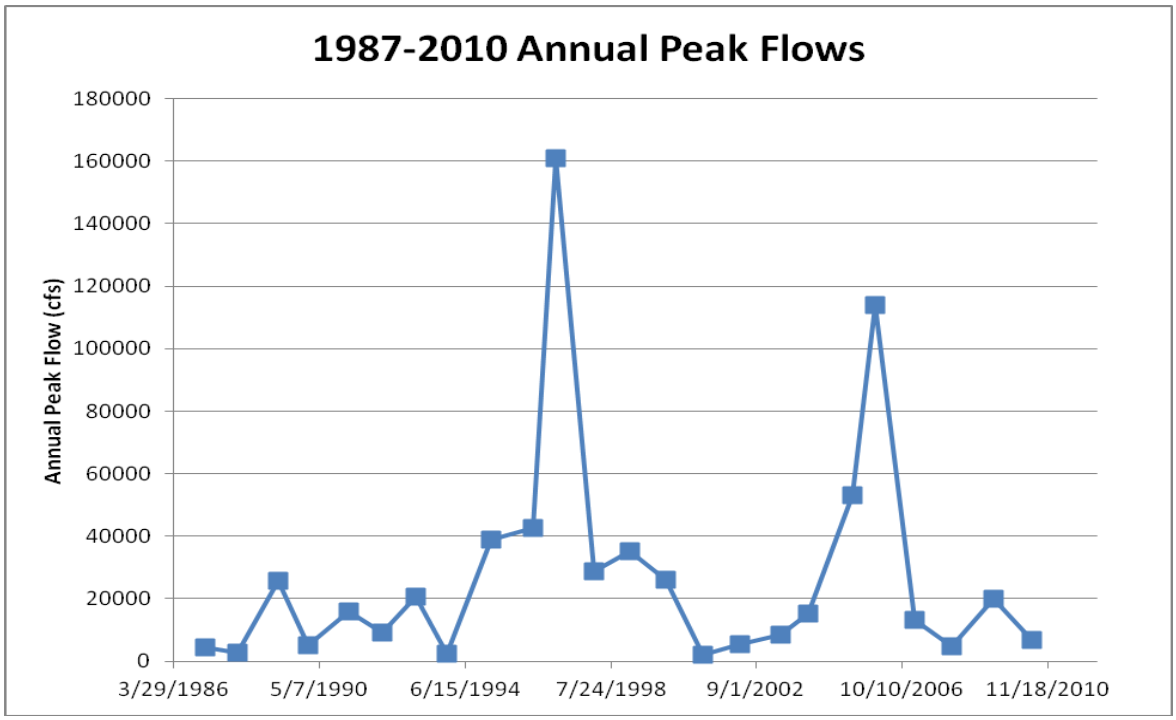

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