Attachment 3.10A
Habitat Mapping Report

Attachment 3.10A
To Study 3.10 Instream Flow
Upstream of USACE's Englebright Reservoir Study

Habitat Mapping Report

Summary

The Yuba County Water Agency (YCWA or Licensee) mapped habitat types and channel features along a total distance of 25.55 miles for the combined reaches of: 1) the North Yuba River downstream of New Bullards Bar Dam; 2) Middle Yuba River downstream of Our House Diversion Dam; 4) Oregon Creek, a tributary to the Middle Yuba River, downstream of Log Cabin Diversion Dam; and 4) the Yuba River from the North and Middle Yuba river confluence to the United States Army Corps of Engineer's (USACE) Englebright Reservoir (collectively referred to as the reaches).

Except for Oregon Creek, accessibility by foot to most sections of the reaches is limited. Therefore, except for Oregon Creek, the reaches were mapped using a low-altitude aerial video of the reaches, with ground-based ground-truth mapping conducted at five accessible locations. Oregon Creek was mapped entirely by ground-based mapping because it was accessible by foot and was not visible using the aerial video due to overhanging vegetation.

With the exception of Oregon Creek, the reaches are generally confined by bedrock and boulder slopes, with bedrock and boulders limiting vertical and lateral movement. Sediment transport capability generally exceeds sediment supply and there are few alluvial reaches (e.g., reaches that are composed of mobile and deformable substrate). Pocketwater and mid-channel pools are the dominant habitats, both in length and frequency. Freemans Crossing and Emory Island on the Middle Yuba River are notable exceptions and represent long-term sediment depositional sections. Large woody debris and spawning-sized gravel are uncommon, bank erosion is low, channel lateral and vertical stability is high, and there are numerous barriers to foot access. The lower mid-section of Oregon Creek is dominated by bedrock falls and steeper habitat types, but low gradient riffles and mid-channel pools within a more deformable substrate are common in the middle to upper section of Oregon Creek.

1.0 Introduction

YCWA intends to apply to the Federal Energy Regulatory Commission (FERC or Commission) for a new license for the Yuba River Development Project (Project) by April 30, 2014. At the current time, YCWA intends to relicense the Project using FERC's Integrated Licensing Process (ILP), which requires YCWA file with FERC a Pre-Application Document (PAD), which would include existing, relevant and reasonably available information regarding resources that could potentially be affected by continued operation of the Project. YCWA will file the PAD with its Notice of Intent (NOI) to File an Application for a New License between five and five and one-half years before the existing license expires on April 30, 2016.

The purpose of this habitat mapping effort was to develop specific, comprehensive, and detailed information on aquatic habitat and channel morphology characteristics of all stream reaches affected by the Project upstream of the normal maximum water surface elevation of USACE's Englebright Reservoir. The report includes a brief description of habitat mapping and channel characterization objectives, the study area, methods, and results. Prior to this effort, there has been no previous coordinated approach to habitat map the reaches, though some habitat mapping occurred in sections of some reaches. Therefore, there are significant gaps in existing data for the purposes of assessing habitat quantity, quality, and distribution in the Project-affected reaches. An initial "desktop" channel characterization effort was done using gradient, confinement, geology and the aerial video, with no ground-truth effort. The initial classification results are presented in YCWA's Preliminary Information Package (YCWA 2009a).

Habitat mapping and channel characterization was conducted prior to filing the NOI and PAD because development of aquatic study plans depends on a common understanding among federal, state and local agencies, tribes, non-governmental organizations, interested businesses, unaffiliated members of the public (collectively referred to as Relicensing Participants) and Licensee of the general physical and biological character of the streams affected by the Project.

1.1 Existing Information

Licensee found sources of existing information related to habitat mapping and fish passage barriers.

Two sources of habitat mapping information were found, each of which were incorporated into the Licensee's habitat mapping described in this document. The first source was mapping in the Middle and North Yuba River conducted in 2003 as part of the Upper Yuba River Studies Program (SWS 2006). Both ground-truth data collection and video mapping were done. Licensee reviewed these 2003 data during the development of the habitat mapping results described in this document. However, in general, License considered the 2009 data collection more reliable because 7 years had passed since the 2003 data were collected and some changes may have occurred. For instance, the Middle Yuba River area was ground-truthed below Oregon Creek within Freemans Crossing. This section of stream is within a depositional area where gravel and cobble bars are common and heavy recreation and mining use occurs. So, the potential for change over 7 years is high. However, based on the comparison of the 2009 aerial video to the 2003 ground data, the results of the two mapping efforts are very similar. North Yuba was video mapped but the quality of the video was insufficient for accurate habitat assessment and the 2009 video and 2009 ground-truth data were used exclusively.

The second source of mapping information was in the area of Our House Diversion Dam. YCWA plans to consult with agencies to gain approval to pass gravel, cobble, and sediment through Our House Diversion Dam. If approved, the sediment pass-through (SPT) events would occur during storm events anticipated to produce sufficient flows to transport material through Our House Diversion Dam impoundment and distribute the material downstream of the dam, thereby eliminating the need for dredging, decreasing potential negative environmental effects, and reducing operation costs. To prepare for agency consultation regarding SPT and select potential assessment sites, an evaluation of habitat conditions downstream of Our House Diversion Dam was done in November 2009. These data were collected using a very similar protocol to the habitat mapping done in summer 2009. Data collected during the November 2009 SPT habitat mapping were incorporated into the overall habitat mapping effort described in this document.

With regards to fish passage barriers in the main stems of the Yuba River and Middle Yuba River from USACE's Englebright Reservoir to Our House Diversion Dam, two sources of information occur. Both sources focused on barriers to upstream passage by Chinook salmon and steelhead, neither of which occur upstream of USACE's Englebright Dam. The first source is Vogel (2006) and titled *Assessment of Adult Anadromous Salmonid Migration Barriers and Holding Habitats in the Upper Yuba River – Appendix C.* In general, Vogel applied the physical parameters of Powers and Orsborn (1985) to determine how each potential barrier may affect upstream steelhead and salmon passage for spawning in spring (Vogel 2006.). In 2002, Vogel surveyed from a helicopter the mainstems of the Yuba River and Middle Yuba River above USACE's Englebright Reservoir to identify potential natural barriers to upstream steelhead and salmon passage for spawning in spring.[1] In August 2003 and 2005, he conducted field assessments of the potential barriers identified from the helicopter. Vogel identified high and low flow barriers and considered break the between the two to be flows of about 100 to 200 cfs.

The second source is Gast et al. (2005) and titled *Middle and South Yuba Rainbow Trout (Oncorhynchus mykiss) Distribution and Abundance Dive Counts August 2004 – Appendix.* The authors conducted mainstem fish distribution surveys in 2004 on the Middle Yuba River. All barriers encountered were photographed and qualitatively described, with estimated vertical heights and GPS positions recorded for each barrier.

Based on these studies[1] two potential natural barriers in the mainstem of the Middle Yuba River below Our House Diversion Dam were identified. No barriers were identified within the section of the Yuba River between USACE's Englebright Reservoir and the Middle Yuba River. The potential barriers identified by Vogel and Gast et al. are described in Table 1.1-1.

Table 1.1-1. Potential barriers to upstream passage by salmon and steelhead in the mainstem of the Middle Yuba River below Our House Diversion Dam as identified by Vogel (2006) and Gast et al. (2005).

Location (River Mile)	Feature	Comments
0.2	Low-Flow Barrier	Site visit, estimated 5 feet high, would only be low-flow barrier to upstream migration of small fish.
0.4	Low-Flow Barrier	site visit, 2 falls in series, lower falls 9 feet, upper falls 6 feet, shallow (<3 feet) plunge

[1] While Vogel and Gast, et al. focused on potential barriers to the upstream migration of larger salmon and steelhead, the barriers identified by Vogel and Gast, et al. would likely also impede or prevent upstream passage of resident fish, including hardhead and trout.

2.0 Methods

Habitat mapping generally followed standard methods similar to those applied in other recent relicensings in California, including the Yuba-Bear/Drum-Spaulding Project on the Middle and South Yuba rivers. Habitat was mapped using a combination of ground-based surveys and a low-altitude helicopter aerial video (YCWA 2009b). The video provided a cost effective means of habitat mapping the largely inaccessible reaches of the reaches. A portion of all Project-affected reaches mapped via the aerial video were also ground-truthed with ground-based mapping data to assure overall accuracy of the habitat mapping results.

Channel characterization of the reaches was performed as an initial effort, using available topographic,[2] geologic,[3] and ESRI/NAIP one-meter pixel color aerial imagery ortho-photos from 2005.[4] The effort approximated a Level 1 Rosgen classification (Rosgen 1996), but was not considered as such because there was no field checking because the initial effort used only remote-sensing data. Resulting data were provided in the Section 7.1 of the Preliminary Information Package (YCWA 2009a).

To prepare for the ground-based habitat mapping, Licensee reviewed the initial classification, longitudinal profile and geologic types of the reaches. Stream longitudinal profiles were measured using maps available from Terrain Navigator Pro© (V. 7) software. Distance between contour lines was measured and a longitudinal profile was created. Map-based gradient, while an estimate, is often a good indicator of stream energy and process. Geology was determined using the geologic map of the United States Geological Survey (USGS) Chico quadrangle. Geologic parent material is often important in sediment supply, substrate type, and channel form control.

Field data were collected under summer/fall 2009 low-flow conditions to maximize access and safety during fieldwork and evaluate habitat composition during the seasonal period of greatest habitat heterogeneity. The protocol was to assess habitat at the flow at which the survey occurred. Otherwise, anticipating habitat based on differences in discharge is too subjective.

2.1 Study Area

Habitat mapping occurred in the following reaches:

- Middle Yuba River – Oregon Creek and Our House Diversion Dam Reaches: 12.0 miles from the confluence with the North Yuba River to Our House Diversion Dam
- Oregon Creek Reach – Log Cabin Diversion Dam Reach: 4.1 miles from the confluence with the Middle Yuba River to the Log Cabin Diversion Dam

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[2] Derived from Terrain Navigator Pro V.7 available from Maptech, Inc. ©
[3] Geologic Map of the Chico Quadrangle. 1992. California Department of Conservation, Division of Mines and Geology. Compiled by G.J. Saucedo and D.L. Wagner.
[4] http://casil.ucdavis.edu/casil/imageryBaseMapsLandCover/imagery/naip_2005/county_mosaics/

- North Yuba River – New Bullards Bar Dam Reach: 2.3 miles from the confluence with the Middle Yuba River to the New Bullards Bar Dam
- Yuba River – New Colgate Powerhouse and Middle/North Yuba River Reaches: 7.5 miles. Normal maximum water surface elevation of USACE's Englebright Reservoir (RM 32.2) to Middle Yuba/North Yuba river confluence at RM 39.7

2.2. Meso-Habitat and Channel Classification

A three-tiered habitat mapping classification system developed by Hawkins et al. (1993) was used to assist in the identification of individual habitat units in the field. Level III categories are generally modified/adopted from McCain et al. (1990). Figure 2.2-1 shows the relationship among the three levels. At the broadest level, Level I categorizes habitats as "fast water" and "slow water." In Level II, fast water is subdivided into two categories: turbulent and non-turbulent; slow water is also subdivided into two categories: scour pool and dammed pool.

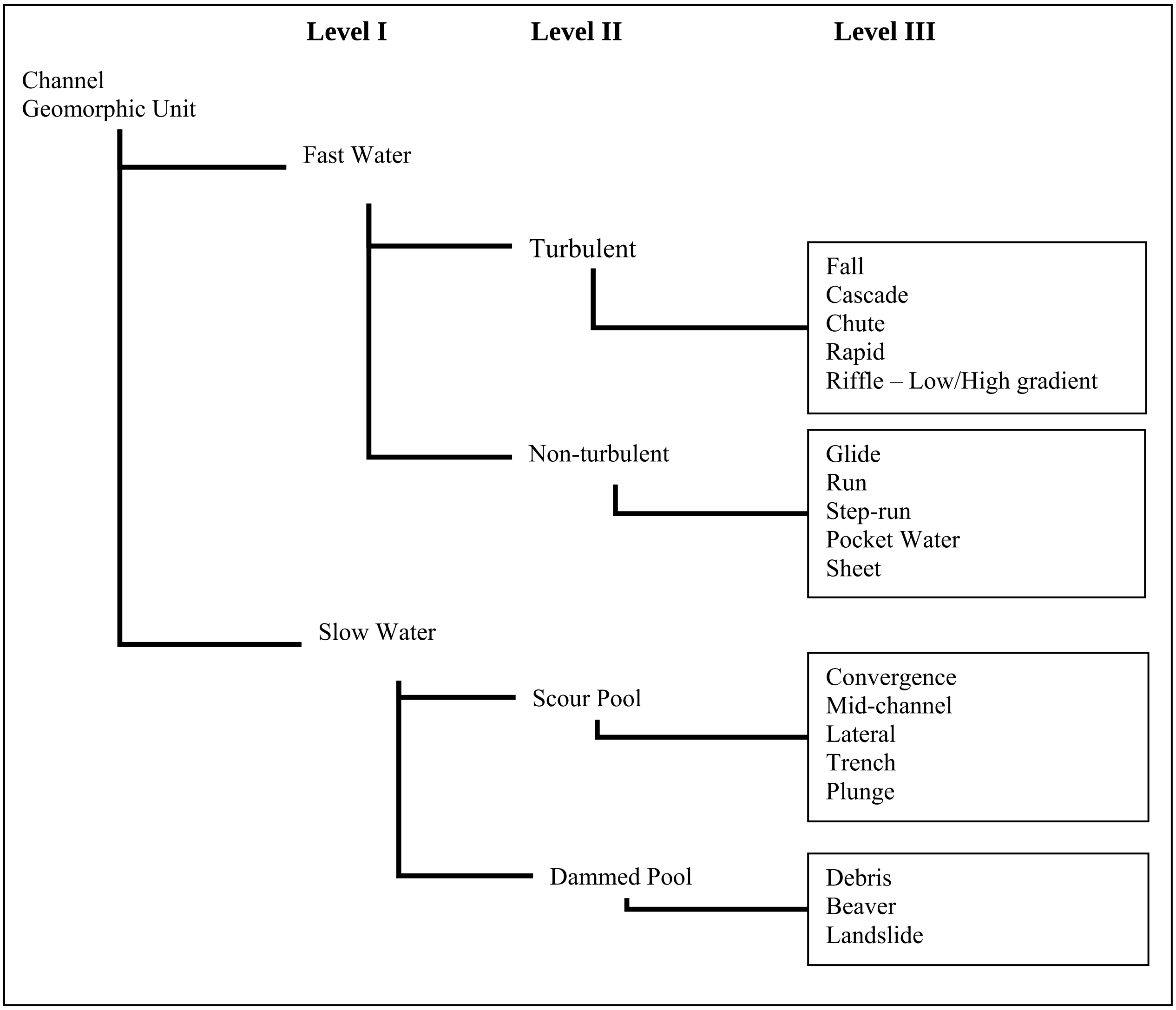

Figure 2.2-1. Key to habitat types used in Yuba County Water Agency Project streams.

Habitat mapping used methods developed by Hawkins et al. (1993), McCain et al. (1990) and Flosi and Reynolds (1994). Each distinct habitat unit was numbered consecutively in an upstream direction, beginning at the downstream end of a designated reach. Habitat type descriptions are listed in Table 2.2-1. Channel and habitat characteristics shown in Figure 2.2-1 and Table 2.2-1 were assessed in all ground surveys, and the aerial video was used to assess channel and habitat types when streams were clearly visible in the aerial video. Dammed pools were infrequent to non-existent and pools that were dammed by large woody debris or other strong downstream control were so noted with an asterisk and a description was added in the comments (e.g., there was not another pool type for dammed mid-channel pools in the data summary).

Table 2.2-1. Habitat types to be used in mapping for the Yuba County Water Agency Project (Adapted from McCain et al. 1990, Armantrout 1998, Payne 1992, McMahon et al. 1996, and Hawkins et al. 1993).

Habitat Type	Description
I. Fast Water:	Riffles, rapid, shallow stream sections with steep water surface gradient.
A. Turbulent:	Channel units having swift current, high channel roughness (large substrate), steep gradient, and non-laminar flow and characterized by surface turbulence.
1. Fall:	Steep vertical drop in water surface elevation. Generally not modelable.
2. Cascade:	Series of alternating small falls and shallow pools; substrate usually bedrock and boulders. Gradient high (more than 4%). Generally not modelable.
3. Chute:	Narrow, confined channel with rapid, relatively unobstructed flow and bedrock substrate.
4. Rapid:	Deeper stream section with considerable surface agitation and swift current; large boulder and standing waves often present. Generally not modelable.
5. Riffles:	Shallow, lower-gradient channel units with moderate current velocity and some partially exposed substrate (usually cobble). • Low gradient — Shallow with swift flowing, turbulent water. Partially exposed substrate dominated by cobble. Gradient moderate (less than 4%). • High gradient — moderately deep with swift flowing, turbulent water. Partially exposed substrate dominated by boulder. Gradient steep (greater than 4%). Generally not modelable.
B. Non-turbulent:	Channel units having low channel roughness, moderate gradient, laminar flow, and lack of surface turbulence.
1. Sheet:	Shallow water flowing over smooth bedrock.
2. Run / Glide:	Shallow (glide) to deep (run) water flowing over a variety of different substrates.
3. Step Run	A sequence of runs separated by short riffle steps. Substrates are usually cobble and boulder dominated.
4. Pocket Water:	Swift flowing water with large boulder or bedrock obstructions creating eddies, small backwater, or scour holes. Gradient low to moderate.
II. Slow Water:	Pools; slow, deep stream sections with nearly flat water surface gradient.
A. Scour Pool:	Formed by scouring action of current.
1. Trench:	Formed by scouring of bedrock.
2. Mid-channel:	Formed by channel constriction or downstream hydraulic control.
3. Convergence	Formed where two stream channels meet.
4. Lateral:	Formed where flow is deflected by a partial channel obstruction (streambank, rootwad, log, or boulder).
5. Plunge:	Formed by water dropping vertically over channel obstruction.
B. Dammed Pool:	Water impounded by channel blockage.
1. Debris:	Formed by rootwads and logs.
2. Beaver:	Formed by beaver dam.
3. Landslide:	Formed by large boulders.
4. Backwater:	Formed by obstructions along banks (Recorded as a comment or note to mapping).
5. Abandoned Channel:	Formed along main channel, usually associated with gravel bars (Not part of the main active channel - Recorded as a comment or note to mapping).

2.3 Ground-Based Habitat Mapping

The extent of the ground-based habitat mapping surveys was determined based on the visibility of the stream from the aerial video, the length of the sub-reach within which the ground survey was to be done, and whether the reach was accessible. Ground-based mapping was conducted in those stream segments where habitat characteristics were not adequately discernible in the aerial video. Poor visibility in the video was usually due to thick overhead vegetation, steep topographic relief, or small channel size. Ground-based mapping was also conducted in stream segments that were conducive to mapping using aerial video. Ground-based mapping in streams visible in the video was used to "calibrate the eye" by physically measuring and typing specific habitat units observed in the video, thereby "ground truthing." Meso-habitat units assessed on the ground were then "typed" in the remainder of the stream sub-reach using the video. The physical parameters (e.g., bankfull width, pool depth, substrate) measured for each meso-habitat unit during ground-based mapping are expected to be similar for those same meso-habitat units throughout the remainder of the sub-reach.

Except for Oregon Creek, the reaches were mapped using a combination of ground-based mapping and aerial video. Field measurements were necessarily limited because safe foot access was very limited (Table 2.3-1). There were only limited locations where the larger channels could be accessed, but Oregon Creek was fully accessible along the entire length.

Table 2.3-1. Access for YCWA's Project Reaches upstream of Englebright Reservoir.

Project Reach	Access / Difficulty	Description
Middle Yuba River (Our House Diversion Dam to Confluence with North Yuba River)	Fair/Moderately Easy	Five access locations: • Access to lower section of reach from junction with North Yuba River down YCWA access road. Follow Middle Yuba River upstream for about 1 mile through boulders and falls until vertical cliffs limit further access at higher flows. • Access to reach downstream of Hwy 49 via stream-adjacent road (Moonshine Road), but must cross or be adjacent to private property. Good access, low difficulty. • Access to reach upstream of Hwy 49/Oregon Creek through slightly difficult walk along Middle Yuba River Trail for a short distance. No limit to upstream access within at least the first 1-2 mi upstream of Oregon Creek. • Access to reach via private road. Unknown difficulty. We were not able to gain permission to cross this private land. • Access to reach downstream of Our House Diversion Dam. Moderate difficulty walking downstream/numerous crossings of boulder-dominated runs or cobble-dominated pool tails. Vertical cliffs limit further downstream access from this location within about 1 mile of dam.
Oregon Creek (Log Cabin Diversion Dam to Confluence with Middle Yuba River)	Good/Easy/Moderately Difficult	Most of the creek is accessible though blackberry vines, private property and some vertical walls limit access to certain locations (which can be avoided by going upstream or downstream). Most difficult is between the upper end of Celestial Valley, which is near the middle of the reach, and Log Cabin Diversion Dam – private property, no stream-adjacent road like in the remainder of creek, must walk downstream from Log House Dam or upstream via end of old log yard. Next difficult section is upstream of junction with Middle Yuba to gage site where creek is steepest and falls must be traversed (moderately difficult but nothing to stop one from walking entire stream).

Table 2.3-1. (continued)

Project Reach	Access / Difficulty	Description
North Yuba River New Bullards Bar Dam to Middle Yuba River) (continued)	Poor/Difficult/Limited Distances Accessible (continued)	Two access locations: • Access to lower reach at junction with Middle Yuba River only down YCWA access road, cross North Yuba River below junction and walk upstream through house-sized boulders and past deep pools. Access beyond 1-mi upstream from junction long and difficult walk • Access to upper reach below New Bullards Bar Dam from road below dam. Crossable stream, moderate difficulty for about .75 mi where vertical cliffs limit further access downstream.
Yuba River (Confluence of Middle and north Yuba Rivers to USACE's Englebright Reservoir)	Good/Moderately Easy Though Limited Distance	Access is at Colgate PH and Rices Crossing: • Access upstream of New Colgate Powerhouse – relatively easy walking along stream for about 1 mile but further access limited by vertical cliffs. • Access downstream of New Colgate Powerhouse – relatively easy walking along stream; difficult to cross at time of survey. If flows drop, crossing at riffles and pool tailouts possible. • Rices Crossing – did not visit this section but video suggests possible access though this location is coincident with backwater effects from USACE's Englebright Reservoir and may not be dominated by riverine processes nor passable when flows high. • Limited access from Middle and North Yuba river confluence. Good access below junction for about 500 ft (high gradient riffle, cascades, and some step runs) then vertical cliffs.

For ground-based mapping in support of the video mapping, a minimum of 30 channel widths were assessed in each mapping segment, and generally at least four replicates of the major meso-habitat types were assessed. The aerial video was of excellent quality and provided the necessary coverage between ground-mapped sections for the reaches except for Oregon Creek, which was entirely ground-mapped.

Ground habitat mapping was conducted on foot by teams of two individuals. Habitat units were designated using the habitat types described in Table 2.2-1. Habitat units were separately identified where the unit length was at least equal to the active channel width (McCain et al. 1990, Flosi and Reynolds 1994), or if the unit is otherwise distinctive. Figure 2.3-1 is a copy of the field form used during ground-based habitat mapping. Teams recorded the length and width of each habitat type unit using a laser range finder. Mapping was contiguous (i.e., each habitat unit abuts the next unit, except for split channels, which had the length measured but individual habitat units within each split were not mapped). The beginning and ending of the mapped section, and every fifth mapped unit, and every tenth characterized habitat unit, had a Global Positioning System (GPS) reading recorded in UTM NAD83 datum.

STREAM HABITAT TYPING SURVEY DATA (YCWA - Yuba River Development Project)

Data Sheet # ______________

Stream/Reach/Subreach:____ Page __________ of _________

Team: ____ Date ________________________

UTM: ____NAD 83 (Habitat unit No_______) PM ___________________________________ Map Gradient:__________

Habitat Unit #																				
Habitat Type [1]	FALL	CAS	CHU	RAP	FALL	CAS	CHU	RAP	FALL	CAS	CHU	RAP	FALL	CAS	CHU	RAP	FALL	CAS	CHU	RAP
	HGR	LGR	GLI	RUN	HGR	LGR	GLI	RUN	HGR	LGR	GLI	RUN	HGR	LGR	GLI	RUN	HGR	LGR	GLI	RUN
	STEP	POW	SHT	COP	STEP	POW	SHT	COP	STEP	POW	SHT	COP	STEP	POW	SHT	COP	STEP	POW	SHT	COP
*note if dammed pool	MCP	LAP	TRP	PLP	MCP	LAP	TRP	PLP	MCP	LAP	TRP	PLP	MCP	LAP	TRP	PLP	MCP	LAP	TRP	PLP
Length (ft)																				
Est. Avg. Width (ft)																				
Est. Avg. Pool Depth (ft)																				
Max. Pool Depth (ft)																				
Pooltail Embedded %																				
Significant Cover?[2]	INSIGNIF		BLDR		INSIGNIF		BLDR		INSIGNIF		BLDR		INSIGNIF		BLDR		INSIGNIF		BLDR	
	VEG		WOOD		VEG		WOOD		VEG		WOOD		VEG		WOOD		VEG		WOOD	
SUBSTRATE COMPOSITION																				
Dominant Substrate	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB
	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT
Subdominant Substrate	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB
	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT
Dominant Bank Substrate	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB	BED	BLD		COB
	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT	GRV	SND		SLT
Length of LB and RB Exposed Banks (feet)																				
Confinement[4]																				
Unit Flagged/ Labeled? (Y/N)																				
Tributary Inflow in cfs																				
Landmarks or photos																				
Large Woody Debris[5] within bankful width	#	Diameter class		Length class	#	Diameter class		Length class	#	Diameter class		Length class	#	Diameter class		Length class	#	Diameter class		Length class
No. of LWD Pieces within wetted width																				
Fish Migration Barrier [6] (y/n)?																				
Spawnable Gravel Area (sqft) Est.[7] (1/4" - 2.5")																				
Maximum Spawning Gravel Patch Size (sq-ft) Est.																				
Comments / Observations:																				
Fish? Wildlife? Amphibs? Backwater or side chan. amphib habitat? Riparian? Landmarks, Photo #s, Etc.																				

[1] **FALL** = Falls, **CAS** = Cascade, **CHU** = Chute, **RAP** = Rapid, **GLI** = Glide, **RUN** = Run, **STEP** = Step Run, **HGR** = High Gradient Riffle (>4%), **LGR** = Low Gradient Riffle, **POW** = Pocket Water, **SHT** = Sheetflow ;
Pools: COP = Convergence, **MCP** = mid-channel pool, **LAP** = Lateral, **TRP** = Trench, **PLP** = Plunge
The minimum unit length should be 1x active channel width, unless there is something notable or unique about it.

[2] Note if cover is a significant or dominant feature of the unit:
(e.g., logs in stream, lots of boulders, >25% surface area has instream or low overhanging vegetation, etc.)

Q/C initials: __________

[4] Channel Confinement: **1**=Confined Shallow; **2**=Confined Deep; **3**=Moderate Confined (<2x wetted channel width); **4**=Unconfined (>= 2 wetted channel widths)

[5] Criteria for LWD is:any downed wood within bankfull width of channel =or> than 1/2 bankfull width.
Size classes: 6**-12",** 12**-24",** 24**-36",or** 36**"+ x** 3**-10',** 10**-25',** 25**-50',** 50**-75',** 75**'+** (ie. 6 | 25 = 6-12", 25-50')

[6] Waterfalls, high velocity chutes or cascades at approx bankful flows. NOTE VERTICAL DROP and IF CONDITIONAL or PERMANENT

[7] Spawning Sized gravel submersed in an area of adequate depth and velocity within one unit

Notes regarding access points (road condition, bridge crossings, trails, etc.)	

Figure 2.3-1. Field form used for ground-based habitat mapping.

Table 2.3.-1. Description of data collected during ground-based habitat mapping.

Stream/Reach	Note on every data sheet
Team	Note initials
T/R/S and UTM	Get UTM every 5th unit (NAD 83) - note if at top or bottom or unit
PM & Map Gradient	Note parent material in assessed reach from geologic map; measure gradient from Terrain Nav Pro (office, before or after).
Habitat Unit #	Numbered sequentially, usually from downstream to upstream. Note if this is not the case
Habitat Type	Circle one of the choices, or write something else in if necessary (e.g., "marsh")
Length (ft)	Measured in feet, with hip chain. Clean up your string periodically
Estimated Average Width (ft)	Average width of entire unit, estimated by eye, periodically checking your estimates with a stadia rod or tape
Estimated Average Pool Depth (ft)	Where practical, take some measurements across the channel to help develop your estimate. Particularly interested in whether most of the pool is greater than 3 ft deep or not.
Estimated Maximum Pool Depth (ft)	Measure where practical. Estimate otherwise
Pooltail Embedded	Degree to which gravel or larger substrates are vertically embedded in sand or smaller substrates.
Significant Cover?	Is cover a dominant feature of the unit? Or is it just a bit of veg overhang on the edges, and some boulder substrate?
Dominant Substrate	Dominant particle size, by area. Silt, Sand (<2mm or 1/8"), Gravel (2-64mm or 1/8-2.5"), Cobble (64-256mm or 2.5-10"), Boulder (>10"), Bedrock
Subdominant Substrate	Next most dominant particle size, by area
Dominant Bank Substrate	Dominant particle size, by area. Silt, Sand (<2mm or 1/8"), Gravel (2-64mm or 1/8-2.5"), Cobble (64-256mm or 2.5-10"), Boulder (>10"), Bedrock - for the bank.
Bank Erosion (ft)	If stream banks are exposed and actively eroding and provided sediment to the active stream channel, quantify the total length on both the right and left banks (cumulative distance) as you are walking along and total in this column.
Confinement	Channel Confinement: 1=Confined Shallow (<4'); 2=Confined Deep (>4'); 3=Moderate Confined (<2x wetted channel width); 4=Unconfined (≥2 wetted channel widths)
Tributary Inflow in cfs	Estimate trib inflow, and get water temperature of the trib and mainstem upstream of it. GPS the location.
Unit Flagged/Labeled (Y/N)	Flag units frequently, near a unit boundary, indicating up and downstream unit numbers. Label with metal tags a little less frequently. Frequency depends on length of units. Think about a year from now, how far would you like to hike up and downstream with a group of stakeholders, looking for positive identification of which habitat unit you were in? Generally marking every 5 units is a good idea, but it really depends on how long the units are.
Landmarks	Note if landmarks are near unit, to help relocate it. e.g., trib confluences, roads, bridges, trails, unique rock formations or bedrock outcrops, large trees of an atypical species, man-made structures or quasi permanent debris, campgrounds, waterfalls, old car bodies, etc. "Big rock" or "tall tree" are not very helpful. GPS whenever possible and convenient, particularly if it has been awhile since you were at a good landmark. River Left or River Right is looking downstream.
Large Woody Debris (in bankfull)	Note all of it along the way, by habitat unit number. "All pieces of wood lying within the bankfull width of the channel that measure 1/2 bankfull width or longer. Wood must be both downed, and with a portion lying within the bankfull channel, and dead or dying to be considered LWD. Divide into average size classes, and tally the total number of LWD pieces in each size class." Size classes we will use are maximum diameters of 6-12 inches, 12-24, 24-36, or >36 inches. Lengths are <3 feet, 3-10, 10-25, 25-75, >75 feet. These are total lengths, not just length in the channel. Note: LWD has to measure 1/2 bankfull width or longer or longer to be counted, so which length classes you might use are dependent on stream width (e.g., a 30ft wide stream would only use classes from 10-25ft on up, because the log would have to be at least 15ft to be counted).
Large Woody Debris (in wetted width)	Separate category: the number of pieces found within the wetted width
Fish Migration Barrier?	Note significant waterfalls or high velocity chutes, or any weirs or other man-made obstacles. Note any feature with a vertical drop exceeding 2.5 ft. Be sure to GPS it.
Spawnable Gravel Area (sq. ft.)	Estimate area of spawnable gravel (1/4 inch to 2.5 inch) patches within the wetted channel. Note any significant deposits along stream margins or on floodplain. One purpose is to determine if spawnable gravel sites could be a possible limiting factor for trout populations.
Comments/Observations	
Fish? Wildlife? Amphibians? Backwater or side channel amphibian habitat? Riparian? Etc.	Did you see some adult or juvenile fish? Idea of species? Any wildlife, such as deer, otters, amphibians, etc. that the wildlife biologists would be interested in? Are there wet backwater or side channel areas, especially with nearby or overhanging cover, that provide good habitat for amphibians, that the amphibian biologists might want to consider for TES species surveys? If you find good amphibian habitat, GPS it. Is the riparian vegetation notably lush, or wide, or are you in a marsh area?
QA/QC	Non-notetaker check all columns and boxes after sheet is full to make sure everything is filled out.

The habitat attributes defined in Table 2.3-1 were quantified and recorded for each unit mapped. Two levels of ground-based mapping occurred:

- "Fully mapped" units which included quantified variables such as bankfull width, pool depth, substrate, large woody debris (LWD), substrate and bank material, etc. (Figure 2.3-1, Table 2.3-1)
- "Characterized" units which only noted the meso-habitat type, length, maximum pool depth, and some with photographs and/or comments of notable details such as the existence of frogs, access and mining activity.

Where field access allowed, crews identified potential barriers to upstream fish movement using professional judgment and used handheld GPS units to record the locations. Significant tributary junctions and potential fish passage barriers were noted within the habitat unit in which they occurred.[5]

Photographs were taken of each fully mapped and at many characterized habitat units, generally from the bank looking upstream. Occasionally, photos were taken from the banks or from the top of the unit looking downstream, but these differences were noted. Photographs were labeled by the original habitat unit number, and placed in folders by mapped section and/or sub-reach.

Photographs and summaries of the field data have been organized electronically within separate folders: Middle Yuba Data, North Yuba Data, Mainstem Yuba Data, and Oregon Creek Data. Due to the file size of the photographs, this information is available on DVD from YCWA upon request.

2.3.1 Aerial Video Mapping

Video mapping was used to quantify the frequency of meso habitats within entire reaches where visible. In combination, video mapping and ground mapping covers 100 percent of the reach length. The mapping data may be used to develop a habitat unit frequency analysis for potential instream flow (PHABSIM) studies. This cumulative frequency sampling approach is an extremely efficient way to inventory meso habitats over long distances (Bovee 1997).

The video was not used to measure channel dimensions. Habitat for an entire reach was assessed at a set interval of 3 seconds. The video was stopped at every interval and the habitat type that was directly across the channel at the middle of the computer screen was defined and documented. A line drawn across the video screen determined the dominant habitat at that "point." Ground-truth data from the habitat mapping data were used to "calibrate the eye" so that features seen in the video had a ground-based reference. Some reaches used both video and ground-based habitat mapping data to calculate meso-habitat frequency for the entire reach. Charts and tables were created exhibiting habitat distribution and frequency.

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[5] Identification of potential natural upstream fish passage barriers was very general; criteria were vertical height exceeding 2.5', waterfalls, or high-velocity chutes. There may be additional barriers upstream and downstream of the mapped section, but the number of barriers within the mapped section is used as an indicator of the relative restrictions to upstream movement. The analysis was performed for resident rainbow trout.

Habitat frequency in reaches that use video mapping was based on the number of units that occur in a reach and was calculated as a percentage of the total number of units counted. Because canopy, topography, and size of stream can interfere with visibility, the sections that were not visible were analyzed the same as actual habitat and labeled “out of view.” Both fully-mapped and characterization data were used to established habitat frequency. Streams segments that were split by vegetated islands or had distinctly different habitats separated by a medial bar were noted as “split channel.” The habitat on each side of the stream was not classified separately, with the exception of Emory Island in the Middle Yuba River. The main channel along the left bank ascending was classified but it was a long and complex split channel.

Habitat frequency in Oregon Creek was developed using 100 percent ground-based mapping and is based on the total length of each habitat type as a percentage of the entire length mapped.

3.0 Results and Discussion

The type and location of mapping was determined largely by accessibility. Except for Oregon Creek, the reaches have very few locations where ground crews can access the channel. Access was limited to the following locations: above and below the New Colgate Powerhouse for the Yuba River; at the confluence of the Middle and North Yuba rivers, above and below Highway 49, and below Our House Diversion Dam for the Middle Yuba River; and at the confluence of the Middle and North Yuba rivers and below New Bullards Bar Dam for the North Yuba River. Oregon Creek was accessible along its entire length, and the reach was completely invisible from the aerial video, so this reach was 100 percent ground-mapped. Figure 3.0-1 shows a map of the reaches and river miles.

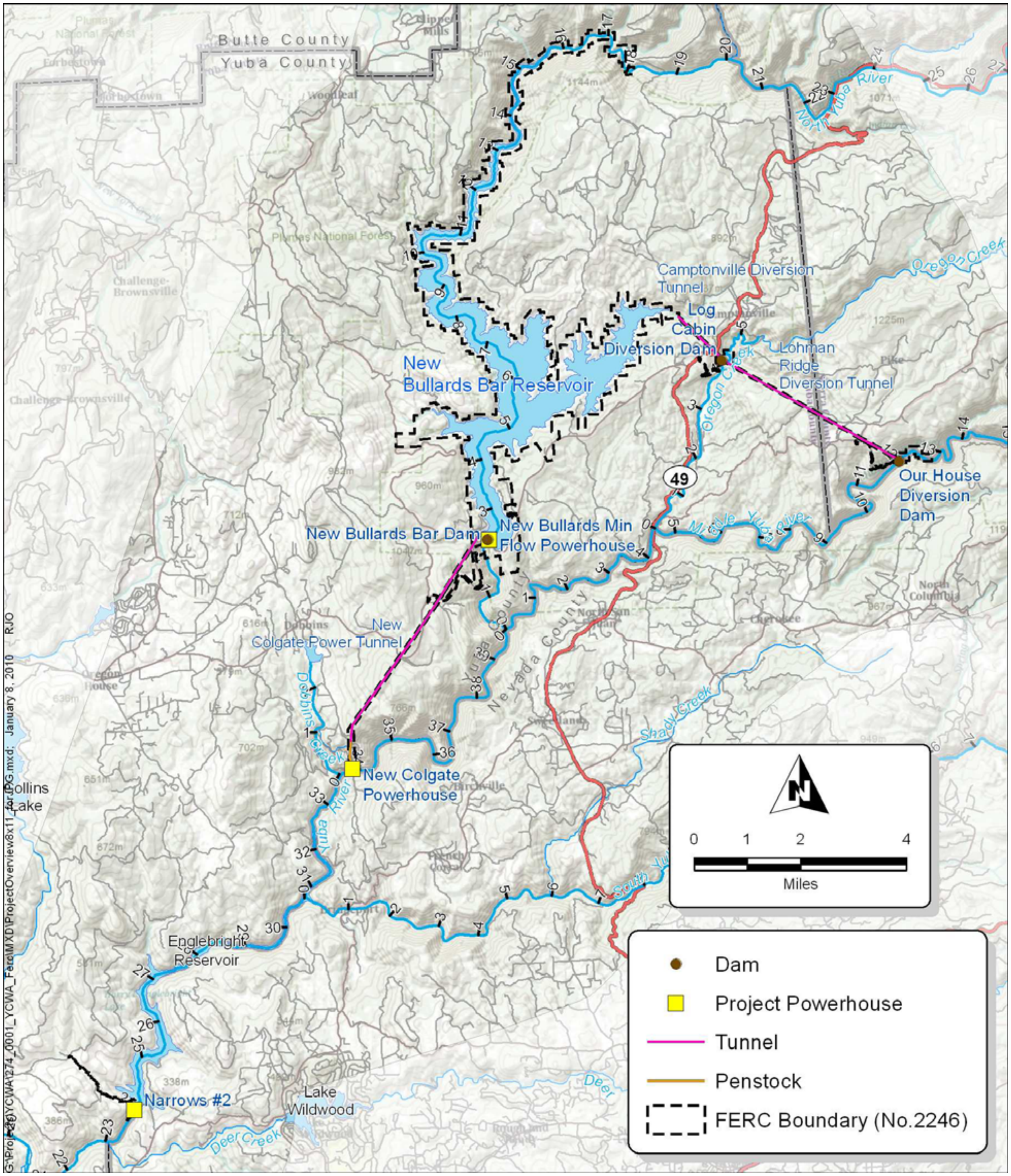

Figure 3.0-1. Map of reaches and river miles.

3.1 Middle Yuba River – Oregon Creek and Our Diversion Dam Reaches

The 12.0 mile Middle Yuba River Reach flows through a variety of parent materials, most notably resistant granitic rocks, and is bisected by the Big Bend-Wolf Creek fault within 1 mile of the junction with the North Yuba River. The overall gradient is 1.2 percent, with one break at the Big Bend/Wolf Fault (2.5% below the fault, and 1.1% above). There are numerous lower gradient sections, many of which are upstream of sharp bends that form "knickpoints." A knickpoint is a term used to describe a location in a river or channel where there is a sharp change, resulting from differential rates of erosion above and below the knickpoint. However, in any of these lower gradient sections where it appears that there is floodplain and side-channel development, sinuosity never exceeds 1.1 (i.e., valley length and channel length through the valley are approximately equal). There is a hydrologic break at Oregon Creek, separating the reach into Our House Diversion Dam Reach (Middle Yuba River upstream of Oregon Creek) and the Oregon Creek Reach (Middle Yuba River downstream of Oregon Creek).

This is a confined channel, with extensive sections of bedrock forming the channel; specifically, RM 9-10.2, and RM 11.4-11.7 where the channel is almost exclusively bedrock. Trench pools (Figure 3.1-1) are indicative of the bedrock-dominated sections, though shallow, mid-channel pools also form in the bedrock sections. Cobble or boulder bars and resistant bedrock and boulder banks resist lateral and vertical movement of the channel.

Freemans Crossing is within a valley that has an overall gradient of about 1 percent (Figure 3.1-1). Heavy recreation, rural housing, and mining have modified the channel and riparian zone in this area. Through this low gradient section, the channel is very wide and shallow, and has substantial amounts of finer material (e.g., gravel in the channel and sand on the banks). A multi-thread channel splits around an area known as "Emory Island" (~RM 6.5), though sinuosity is still fairly low at 1.1, and map-based gradient is about 1 percent. The habitat was mapped within the main channel, but it is a split channel and at high flow, about 30 percent of the flow will divert to the right channel (ascending). This area has a road to the Middle Yuba Reach, but it is privately owned and access for ground-based mapping was not granted.

Ground-based habitat mapping was performed at four locations within the Middle Yuba Reach: at the junction with the North Yuba (RM 0); above and below the Oregon Creek (RM 4.5); and below Our House Diversion Dam (RM 12.2). Table 3.1-1 summarizes the habitat frequency for the reach and Table 3.1-2 provides data on various habitat parameters. The habitat frequency is based on the total number of "hits" on a habitat using the aerial video method, with the ground-based data (16% of the reach) used to interpret the habitat. Habitat is dominated by mid-channel pools, low gradient riffles, and runs (Table 3.1-1 and 3.1-2); additional habitat types that exceed 5 percent include high gradient riffles, lateral pools and trench pools. Instream cover (Table 3.1-3) is limited to boulders. Table 3.1-4 also summarizes the data for physical parameters measured in the field. There is over 2,000 square feet (sq ft) of trout spawning-sized gravel accumulations within the mapped sections. There was very limited large woody debris identified during ground-based assessments. Two potential natural barriers to upstream movement of resident trout were mapped on the ground and Vogel (2006) also identified 2 low-flow barriers in this reach. The ground-based data collected in the Middle Yuba River Reach indicate there are spawning-sized gravel accumulations. Upstream trout migration may by limited by permanent falls or other barriers, and that large woody debris is an uncommon element, and does not modify channel form or fish habitat in the active channel.

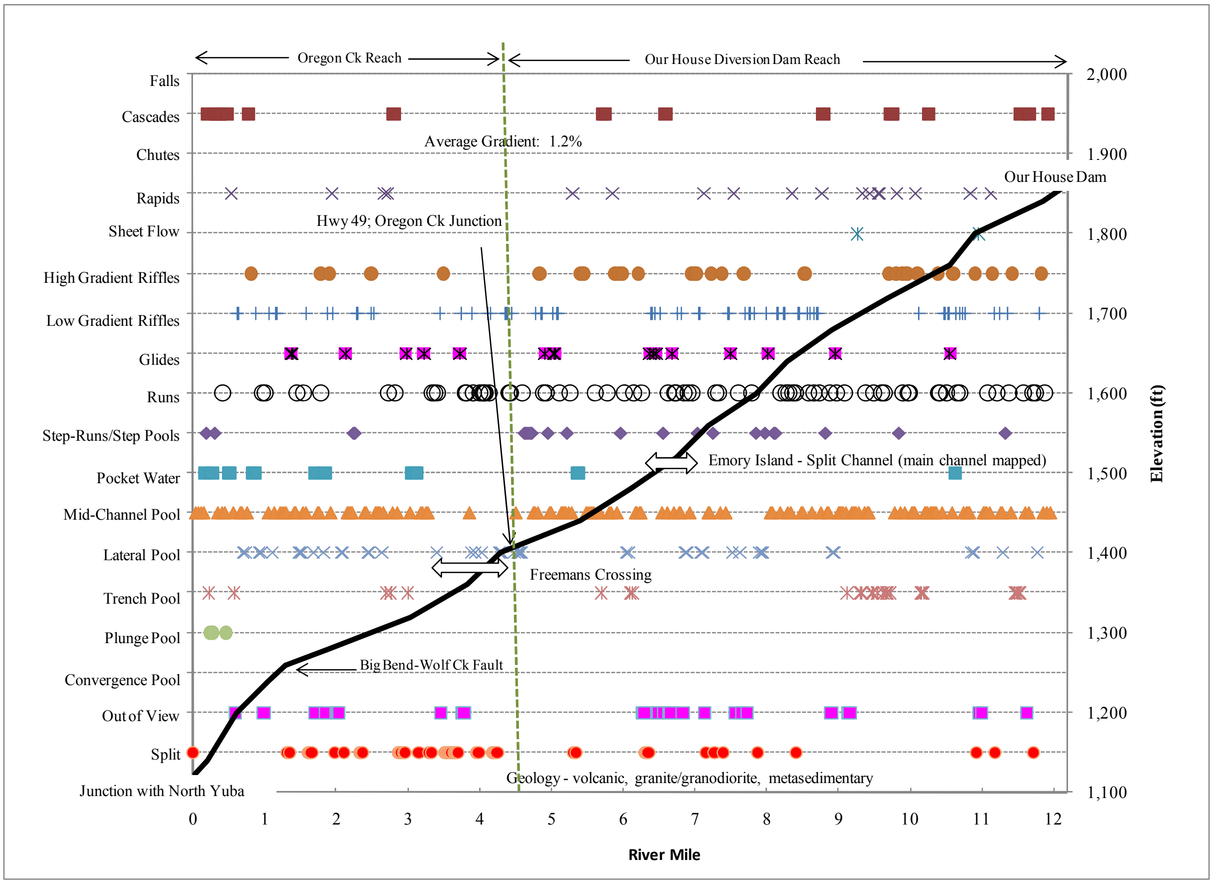

Figure 3.1-1. Longitudinal profile and habitat units (based on video-mapped data) of the Middle Yuba River – Oregon Creek and Our House Diversion Dam Reaches (between the junction with North Yuba River to Our House Diversion Dam).

Table 3.1-1. Meso-habitat frequency data based on aerial video analysis for the Middle Yuba River – Oregon Creek and Our House Diversion Dam Reaches (between the junction with North Yuba River to Our House Diversion Dam).

Meso-Habitat Type	Number	Percent Frequency
Falls	0	0%
Cascades	17	3%
Chutes	0	0%
Rapids	18	3%
High Gradient Riffles	34	6%
Low Gradient Riffles	67	12%
Glides	17	3%
Runs	71	13%
Step-Runs/Step-Pools	23	4%

Table 3.1-1. (continued)

Meso-Habitat Type	Number	Percent Frequency
Pocket Water	15	3%
Sheetflow	2	0%
Convergence Pool	0	0%
Mid-Channel Pool	135	25%
Lateral Pool	44	8%
Trench Pool	25	5%
Plunge Pool	3	1%
Out of View	28	5%
Split Channel	48	9%
Total	**547**	**100%**

Table 3.1-2. Length, frequency, width and depth of ground-mapped habitat units in the Middle Yuba River – Oregon Creek and Our House Diversion Dam Reaches (between the junction with North Yuba River to Our House Diversion Dam). The shaded cells are characteristics of pools that do not apply to non-pool habitat types.

Unit Type	Total Length (ft)	Length Rel Frequency	Number	Number of Units (frequency)	Average width (ft)	Average pool depth (ft)	Average maximum pool depth (ft)	Average pooltail embeddedness (%)
Fall								
Cascade	421	2.7%	7	6.4%	63.4			
Chute	47	0.3%	1	0.9%	22.3			
Rapid	70	0.5%	1	0.9%	26.5			
High Gradient Riffle	1014	6.5%	9	8.2%	53.1			
Low Gradient Riffle	1997.5	12.9%	17	15.5%	62.0			
Glide	531	3.4%	2	1.8%	53.8			
Run	2269	14.6%	23	20.9%	52.9			
Step Run	1225	7.9%	8	7.3%	69.2			
Pocket Water	654	4.2%	5	4.5%	55.5			
Sheet								
Convergence Pool								
Mid-Channel Pool	6182.5	39.8%	30	27.3%	56.8	3.7	6.9	7.9
Lateral Scour Pool	469	3.0%	2	1.8%	101.9	1.8	3.5	25.0
Trench Pool	216	1.4%	1	0.9%	75.3	4.0	8.0	
Plunge Pool	446	2.9%	4	3.6%	53.3	5.8	7.0	5.0
TOTAL	**15542**	**100.0%**	**110**	**100.0%**	**58.9**	**3.8**	**6.3**	**12.6**

Table 3.1-3. Instream cover identified during ground-mapping in the Middle Yuba River – Oregon Creek and Our House Diversion Dam Reaches (between the confluence with North Yuba River to Our House Diversion Dam).

Dominant Cover Type	Number	Relative Frequency
Insignificant	6	7%
Boulder	77	93%
Vegetation	0	--
Wood	0	--
Total	**55**	**100%**

Table 3.1-4. Reach summary of ground mapped data for the Middle Yuba River – Oregon Creek and Our House Diversion Dam Reaches (between the junction with North Yuba River to Our House Diversion Dam).

Total Reach Length:	**12.2 m**i.
Total Ground Mapped Length:	2.94 mi. (16.0%)
Average Bankfull Width:	58.9 ft.
Average Bankfull Depth:	**2.5** ft.
Average Width:Depth:	24
Total Spawnable Gravel:	2,311 ft^2 - trout
Average Largest Patch Size:	44 ft^2 - trout
LWD Density:	5/ mile (within bankfull width)
Wetted LWD Density:	4/ mile (within wetted width)
Parent Material:	Volcanic, granite/granodiorite, metasedimentary
Bank Erosion % of Reach:	0.0%
Total No. Passage Barriers:	2

3.2 Oregon Creek – Log Cabin Diversion Dam Reach

There are three gradient breaks within the 4.2 mile Oregon Creek Reach, between which fluvial processes vary (Figure 3.2-1). Oregon Creek flows mostly through resistant plutonic granitic material, though there is a short, steep section near the upstream end that is composed of competent metasedimentary material. There is a short 4.6 percent gradient section just above the confluence with the Middle Yuba River, and a 3.7 percent gradient section upstream of Celestial Valley. Celestial Valley appears to be a long-term depositional area and has an overall gradient of 1.6 percent. It is highly modified by human settlement, and channel location has been modified by roads, grazing, berms, and sub-urban development. It is also heavily vegetated with blackberry vines.

Initial classification of this stream characterized two types: the steeper 3-8 percent confined channel type near the downstream end and below Log Cabin Dam, and the lower gradient, 1-3 percent confined section through Celestial Valley. There is also a short 1-3 percent gradient confined section between the confluence with the Middle Yuba River and the steeper 3-8 percent gradient section. Following habitat mapping, these characterizations are revealed as good approximations. The stream is confined throughout between either terraces or steep valley walls. The steeper sections are dominated by cascades, falls, and plunge pools, whereas the Celestial Valley section is dominated by long planar runs and low gradient riffles, with little three-dimensional heterogeneity. Table 3.2-1 shows the occurrence of all the habitat types as a percentage of the total length. Habitat is dominated by low gradient riffles, pocketwater, and mid-channel pools (Table 3.2-1). Instream cover is dominated by boulders (Table 3.2-2). There is little trout spawning-size accumulations of gravel, and only sparse quantities of large woody debris (Table 3.2-3). Table 3.2-4 summarizes the number of large woody debris pieces within each size and diameter class of the nine pieces that were found in the reach within the bankfull channel. Seven of these nine pieces were located within the wetted channel.

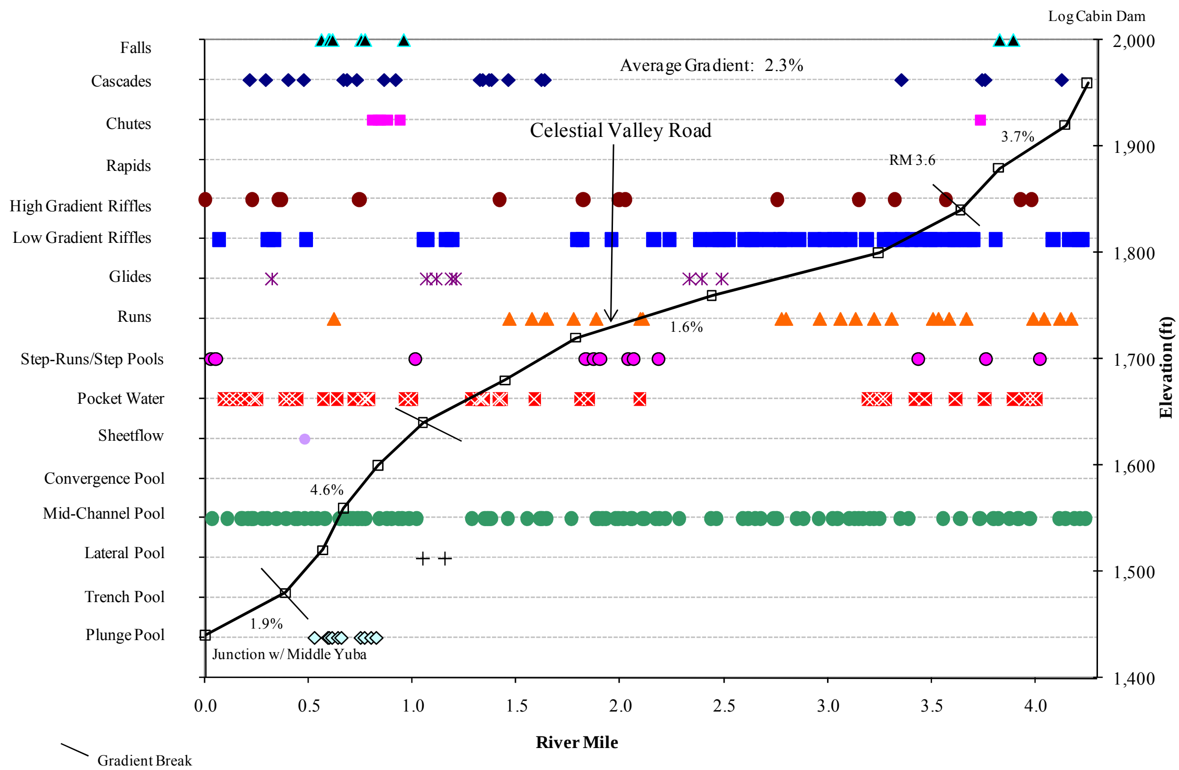

Figure 3.2-1. Longitudinal profile and habitat types (based on ground-mapped data) of Oregon Creek - Log Cabin Diversion Dam Reach.

Table 3.2-1. Total length of habitat types identified in the Oregon Creek – Log Cabin Diversion Dam Reach, and as a percentage of total reach length.

Meso-Habitat Type	Total Length (ft)	Percent of Total Reach Length
Falls	133	1%
Cascades	867	4%
Chutes	158	1%
Rapids	0	0%
High Gradient Riffles	673	3%
Low Gradient Riffles	4,170	19%
Glides	946	4%
Runs	1,245	6%
Step-Runs	808	4%
Pocket Water	2,661	12%
Sheetflow	92	0%
Convergence Pool	25	0%
Mid-Channel Pool	8,507	38%
Lateral Pool	207	1%
Trench Pool	0	0%
Plunge Pool	503	2%

Table 3.2-1. (continued)

Meso-Habitat Type	Total Length (ft)	Percent of Total Reach Length
Out-of-View	0	0%
Split Channel	1,342	6%
Total	**22,336**	**100%**

Table 3.2-2. Instream cover identified during ground-mapping in Oregon Creek – Log Cabin Diversion Dam Reach.

Dominant Cover Type	Number	Relative Frequency
Insignificant	16	14%
Boulder	93	82%
Vegetation	5	4%
Wood	0	--
Total	**114**	**100%**

Table 3.2-3. Summary of ground mapped data for Oregon Creek – Log Cabin Diversion Dam Reach.

Total Reach Length:	**4.2 m**i.
Total Ground-Mapped Length:	4 mi. (95.0%)
Average Bankfull Width:	29.4 ft.
Average Bankfull Depth:	**1.7** ft.
Average Width:Depth:	17
Total Spawnable Gravel:	255 ft^2 - trout
Avg Largest Patch Size:	12 ft^2 - trout
LWD Density:	2 / mile (within bankfull width)
Wetted LWD Density:	2 / mile (within wetted width)
Parent Material:	Granite pluton, metasedimentary
Bank Erosion % of Reach:	0.0%
Total No. Passage Barriers:	8

Table 3.2-4. Summary of large woody debris data for Oregon Creek – Log Cabin Diversion Dam Reach.

Number	Diameter Class (inches)	Length Class (feet)
1	6-12	3-10
3	6-12	10-25
3	12-24	10-25
1	6-12	25-50
1	12-24	25.50

3.3 North Yuba River – New Bullards Bar Dam Reach

While the channel of the North Yuba River - New Bullards Bar Dam Reach is dominated by gradients below 3 percent (average gradient of 2%), there is one short section where the gradient is greater than 3 percent and one short section that is above 5 percent (Figure 3.3-1). Just above the 5 percent section, the gradient flattens to less than 1 percent. The geology is composed of Mesozoic volcanic rocks of the Smartville Complex. Most of the reach is composed of bedrock and house-sized boulders that separate large mid-channel pools. There are very short and infrequent areas of cobble-size deposits, but most of the substrate is large and immobile. There is no apparent floodplain or terrace development.

This 2.3-mile reach is largely inaccessible. Two areas were ground-mapped: North Yuba upstream of the Middle Yuba River junction and just dowstream of New Bullards Bar Dam; the remainder was mapped using the aerial video. This is a very rugged stream with large boulders that often cover the channel, and large, deep pools bounded by bedrock. The middle steeper section cannot be safely accessed by foot from upstream due to a deep bedrock gorge with vertical cliff walls blocking the way. The lower section is a rugged path through very large boulders that cover pocket water and separate deep pools.

Pocketwater and mid-channel pool habitat types dominate (Table 3.3-1). Both video mapping and ground-based mapping were combined for the habitat mapping results. The video of the upper section near New Bullards Bar Dam missed most of the habitat that was ground-mapped, so the ground-mapped data (49% of the reach) was used in lieu of the video. Table 3.3-2 shows the characteristics for various habitat parameters measured during ground-based mapping. Habitat is dominated by pocketwater and mid-channel pools (Table 3.3-1 and 3.3-2). Identified cover is exclusively boulders (Table 3.3-3), but the depth of pools can also provide cover to resident trout (Table 3.3-2). Trout spawning-sized gravel accumulations were rare (511 sq ft), as was large woody debris (one log in the diameter class 12-24 inches, length class 25-50 ft, within the wetted channel), and potential natural barriers to resident trout upstream movement likely are very common in the confined, steep channel. Bank erosion was rare, given the bedrock/boulder channel margins (Table 3.3-4).

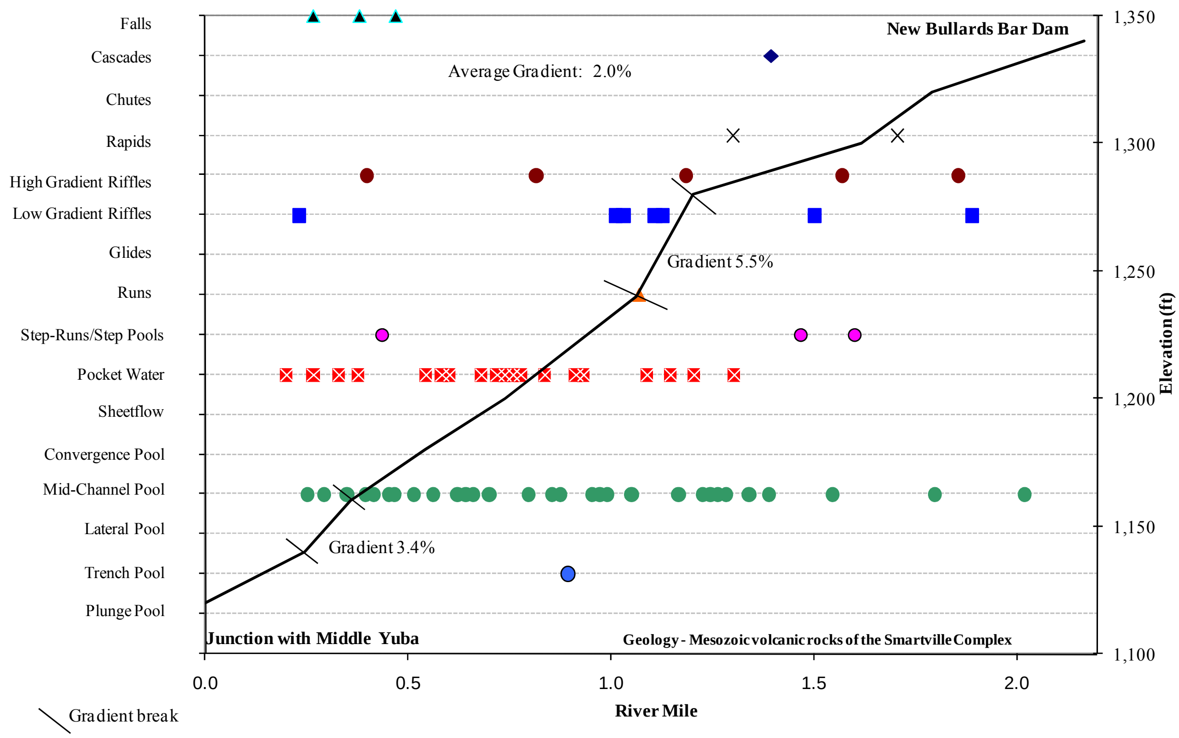

Figure 3.3-1. Longitudinal profile and habitat types (based on video and ground-mapped data) of the North Yuba River – New Bullards Bar Dam Reach (between the Middle Yuba River and New Bullards Bar Dam).

Table 3.3-1. Meso-habitat frequency using ground and aerial video data for the North Yuba River – New Bullards Bar Dam Reach (between the Middle Yuba River and New Bullards Bar Dam).

Meso-Habitat Type	Number	Percent Frequency
Falls	3	4%
Cascades	1	1%
Chutes	0	0%
Rapids	2	3%
High Gradient Riffles	5	7%
Low Gradient Riffles	7	10%
Glides	0	0%
Runs	1	1%
Step-Runs/Step-Pools	3	4%
Pocket Water	19	26%
Sheetflow	0	0%
Convergence Pool	0	0%
Mid-Channel Pool	30	42%
Lateral Pool	0	0%
Trench Pool	1	1%
Plunge Pool	0	0%

Table 3.3-1. (continued)

Meso-Habitat Type	Number	Percent Frequency
Out of View	0	0%
Split Channel	0	0%
Total	**72**	**100%**

Table 3.3-2. Length, frequency, width and depth of ground-mapped habitat units for the North Yuba River – New Bullard Bar Reach (between the junction with the Middle Yuba River and New Bullards Bar Dam). The shaded cells are characteristics of pools that do not apply to non-pool habitat types.

Unit Type	Total Length (ft)	Length (frequency)	Number	Number of Units (frequency)	Average width (ft)	Average pool depth (ft)	Average maximum pool depth (ft)	Average pooltail embeddedness (%)
Fall	63	1.1%	3	8.8%	66.0			
Cascade	22	0.4%	1	2.9%	55.0			
Chute	--	--	--	--	--			
Rapid	778	13.1%	2	5.9%	81.5			
High Gradient Riffle	455	7.7%	3	8.8%	66.2			
Low Gradient Riffle	399	6.7%	3	8.8%	59.8			
Glide	---	---	---	---	---			
Run	---	---	---	---	---			
Step Run	639	10.8%	3	8.8%	76.1			
Pocket Water	687	11.6%	5	14.7%	49.3			
Sheet	--	--	--	--	--			
Convergence Pool	--	--	--	--	--	--	--	--
Mid-Channel Pool	2894	48.7%	14	41.2%	72.7	3.8	7.3	--
Lateral Scour Pool	--	--	--	--	--	--	--	--
Trench Pool	--	--	--	--	--	--	--	--
Plunge Pool	--	--	--	--	--	--	--	--
Total	**5937**	**100.0%**	**34**	**100.0%**	**70.0**	**3.8**	**7.3**	**--**

Table 3.3-3. Instream cover identified during ground-mapping in the North Yuba River – New Bullard Bar Reach (between the junction with the Middle Yuba River and New Bullards Bar Dam).

Dominant Cover Type	Number	Relative Frequency
Insignificant	0	--
Boulder	34	100%
Vegetation	0	--
Wood	0	--
Total	**34**	**100%**

Table 3.3-4. Summary of ground mapped data for the North Yuba River – New Bullard Bar Reach (between the junction with the Middle Yuba River and New Bullards Bar Dam).

Total Reach Length:	**2.3 m**i.
Total Ground Mapped Length:	1.12 mi. (49.0%)
Average Bankfull Width:	70 ft.
Average Bankfull Depth:	**3.5** ft.
Average Width:Depth:	20
Total Spawnable Gravel:	511 ft^2 - trout
Avg Largest Patch Size:	31 ft^2 - trout
LWD Density:	1 / mile (bankfull)
Wetted LWD Density:	1 / mile (wetted width)
Parent Material:	Mesozoic rocks of the Smartville Complex
Bank Erosion % of Reach:	0.0%
Total No. Passage Barriers:	4

3.4 Mainstem Yuba River - Middle/North Yuba River Reach

The 7.1 mile channel of the Yuba River – Middle/North Yuba River and New Colgate Powerhouse Reaches - is dominantly bedrock-controlled, with only very short boulder/cobble sections. The channel is laterally and vertically stable due to dominant bedrock control. Sinuosity is very low as there are no plan and profile sections strongly influenced by alluvial deposition. Pools are large and deep, and separated by long sections of pocketwater that runs through and under very large boulders. Finer sediment (cobble and finer) is not common and sediment transport capability likely exceeds sediment availability.

This confined bedrock-dominated reach is very inaccessible. Though not very steep, according to the mapped gradient of 1.8 percent, high gradient riffles dominate the gradient "steps." The river flows through bedrock canyons, and the vertical walls inhibit ground access. The only location that was ground-mapped was the area just above and below New Colgate Powerhouse (25% of the reach). Habitat is dominated by mid-channel pools and pocket water formed between large boulders (Table 3.4-1 and 3.4-2). Boulders are the only instream cover identified (Table 3.4-3); though deep pools likely also provide cover. Large woody debris was not found and trout spawning-sized gravel accumulations were uncommon (Table 3.4-4). While there were no natural barriers to upstream resident trout movement noted during ground-based habitat mapping, in this steep, confined, bedrock-controlled reach, barriers are likely to occur. However, Vogel (2006) did not identify any barriers in this reach during aerial review of barriers.

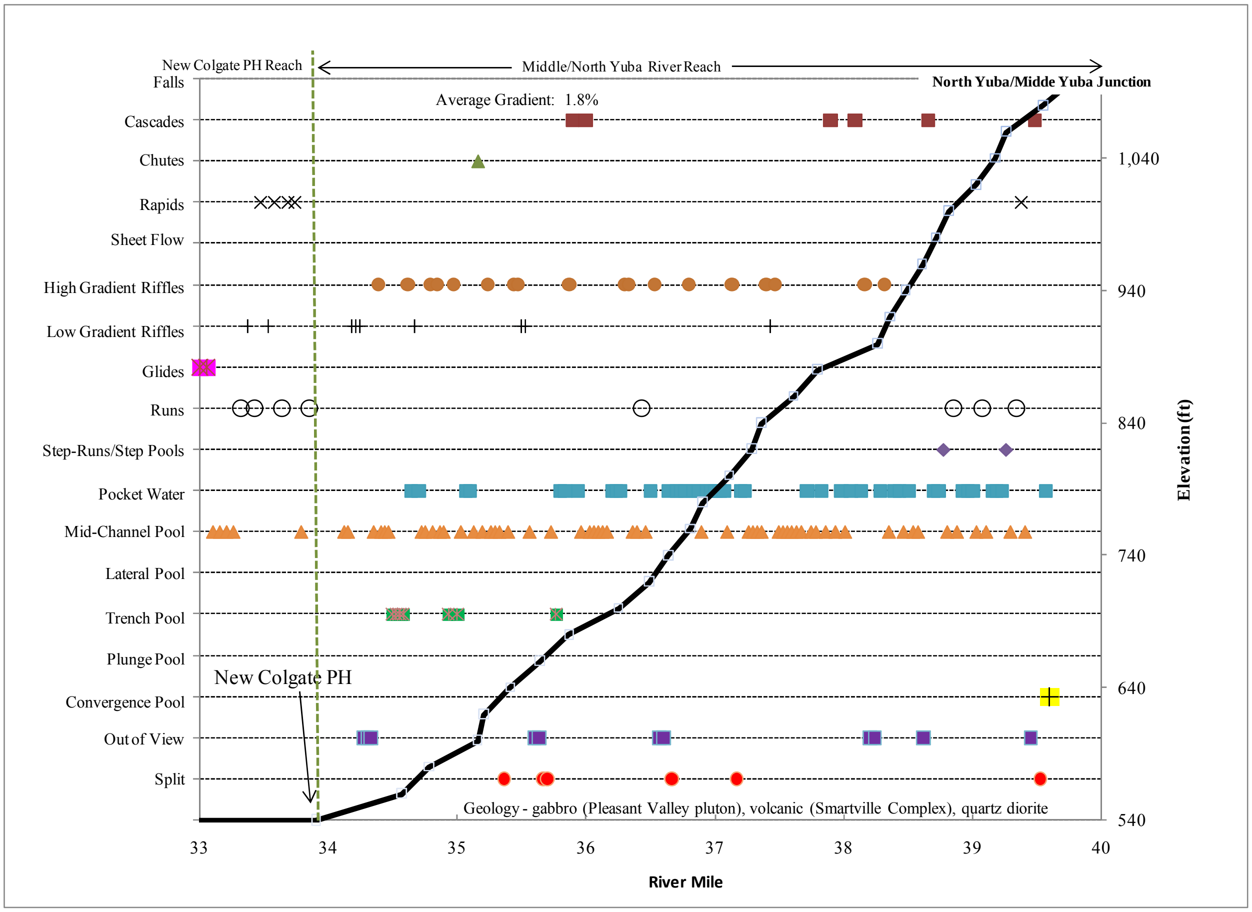

Figure 3.4-1. Longitudinal profile and habitat types (based on video-mapped data) of the Mainstem Yuba River – New Colgate Powerhouse and Middle/North Yuba River Reaches (between the New Colgate Powerhouse and the Middle/North Yuba junction).

Table 3.4-1. Meso-habitat frequency using ground and aerial video data for the Mainstem Yuba River – New Colgate Powerhouse and Middle/North Yuba River Reaches (between the New Colgate Powerhouse and the Middle/North Yuba junction) between RM 33.55 (approximate upstream end of backwater effect from Englebright Reservoir) and Middle Yuba/North Yuba junction (RM 39.6).

Meso-Habitat Type	Number	Frequency
Falls	0	0%
Cascades	6	3%
Chutes	0	0%
Rapids	9	5%
High Gradient Riffles	18	9%
Low Gradient Riffles	11	6%
Glides	4	2%
Runs	10	5%
Step-Runs/Step-Pools	2	1%
Pocket Water	42	21%
Sheetflow	0	0%
Convergence Pool	1	1%
Mid-Channel Pool	61	31%

Table 3.4-1. (continued)

Meso-Habitat Type	Number	Frequency
Lateral Pool	6	3%
Trench Pool	7	4%
Plunge Pool	0	0%
Out of View	13	7%
Split Channel	6	3%
Total	**196**	**100%**

Table 3.4-2. Length, frequency, width and depth of ground-mapped habitat units for the Mainstem Yuba River – New Colgate Powerhouse and Middle/North Yuba River Reaches (between the New Colgate Powerhouse and the Middle/North Yuba junction). The shaded cells are characteristics of pools that do not apply to non-pool habitat types.

Unit Type	Total Length (ft)	Length (frequency)	Number	Number of Units (frequency)	Average width (ft)	Average pool depth (ft)	Average maximum pool depth (ft)	Average pooltail embeddedness (%)
Fall	--	--	--	--	--			
Cascade	--	--	--	--	--			
Chute	--	--	--	--	--			
Rapid	989	10.1%	4	12.1%	117.5			
High Gradient Riffle	791	8.1%	5	15.2%	73.3			
Low Gradient Riffle	845	8.6%	6	18.2%	92.4			
Glide	235	2.4%	1	3.0%	176.5			
Run	1148	11.7%	5	15.2%	121.3			
Step Run	--	--	--	--	--			
Pocket Water	812	8.3%	3	9.1%	89.5			
Sheet	--	--	--	--	--			
Convergence Pool	--	--	--	--	--	--	--	--
Mid-Channel Pool	4978	50.8%	9	27.3%	104.7	6.6	11.1	Too deep
Lateral Scour Pool	--	--	--	--	--	--	--	--
Trench Pool	--	--	--	--	--	--	--	--
Plunge Pool	--	--	--	--	--	--	--	--
Total	**9798**	**100.0%**	**33**	**100.0%**	**104.8**	**6.6**	**11.1**	**Likely not**

Table 3.4-3. Instream cover identified during ground-mapping in the Mainstem Yuba River – New Colgate Powerhouse and Middle/North Yuba River Reaches (between the New Colgate Powerhouse and the Middle/North Yuba junction).

Dominant Cover Type	Number	Relative Frequency
Insignificant	2	6%
Boulder	31	94%
Vegetation	0	---
Wood	0	---
Total	**33**	**100%**

Table 3.4-4. Summary of ground mapped data for the Mainstem Yuba River – New Colgate Powerhouse and Middle/North Yuba River Reaches (between the New Colgate Powerhouse and the Middle/North Yuba junction).

Total Reach Length:	**7.5 m**i.
Total Ground-Mapped Length:	1.86 mi. (24.7%)
Average Bankfull Width:	104.8 ft.
Average Bankfull Depth:	**6.5** ft.
Average Width:Depth:	16
Total Spawnable Gravel:	1,405 ft^2 - trout
Average Largest Patch Size:	93 ft^2 - trout
LWD Density:	0 / mile (bankfull)
Wetted LWD Density:	0 / mile (wetted width)
Parent Material:	Volcanic (Smartville Complex), gabbro (Pleasant Valley Pluton), quartz diorite
Bank Erosion % of Reach:	0.0%
Total No. Passage Barriers:	0

4.0 Attachments

DVD can be provided upon request. DVD includes scanned field data, Excel data files, and habitat photographs. The organization of the DVD is as follows:

YCWA HM Data – Folder – 527 MB

- Mainstem Yuba HM Data – Folder – 2.3 MB
    - Mainstem Yuba below Colgate HM Photos – [1 Word document: 589 KB; 3 pages formatted to print double sided on 8 ½ by 11 paper]
    - Mainstem Yuba HM Raw Data [1 Adobe PDF file: 1.45 MB; 11 Pages formatted to print double sided on 8 ½ by 11 paper]
    - Mainstem Yuba – Habitat Mapping Data [1 Word document: 319 KB; 6 pages – Header page formatted to print on 8 ½ by 11 paper, next 4 pages formatted to print double sided on 11 by 17 paper and last page to print on 8 ½ by 11 paper.]
- Middle Yuba HM Data – Folder – 5.24 MB
    - 1 MY above North Yuba Jnctn HM Photos [1 Word document: 440 KB; 3 pages formatted to print double sided on 8 ½ by 11 paper]
    - 2 MY below HWY 49 HM Photos [1 Word document: 366 KB; 2 pages formatted to print double sided on 8 ½ by 11 paper]
    - 3 MY above Oregon Ck HM Photos[1 Word document: 1.24 MB; 5 pages formatted to print double sided on 8 ½ by 11 paper]
    - 4 MY below Our House Dam HM Photos [1 Word document: 728 KB; 3 pages formatted to print double sided on 8 ½ by 11 paper]
    - MY HM Raw Data [1 Adobe PDF file: 2.11 MB; 16 Pages formatted to print double sided on 8 ½ by 11 paper]
    - Middle Yuba - Habitat Mapping Data [1 Word document: 482 KB; ; 8 pages - Header page formatted to print on 8 ½ by 11 paper, next 6 pages formatted to print double sided on 11 by 17 paper and last page formatted to print on 8 ½ by 11 paper]

- North Yuba data – Folder – 3.23 MB
  - 1 N Yuba above M Yuba Junctn HM Photos – [1 Word document: 876 MB; 4 pages formatted to print double sided on 8 ½ by 11 paper]
  - 2 N Yuba below New Bullards Bar HM Photos – [1 Word document: 699 MB; 3 pages formatted to print double sided on 8 ½ by 11 paper]
  - NorthYuba HM Raw Data [1 Adobe PDF file: 1.46 MB; 8 Pages formatted to print double sided on 8 ½ by 11 paper]
  - North Yuba – Habitat Mapping Data [1 Word document: 266 KB; 4 pages - Header page formatted to print on 8 ½ by 11 paper, next 2 pages formatted to print double sided on 11 by 17 paper and last 2 pages formatted to print double-sided on 8 ½ by 11 paper]
- Oregon Creek HM Data – Folder – 17 MB
  - Oregon Creek HM Photos [1 Word document: 6.75 MB; 20 pages formatted to print double sided on 8 ½ by 11 paper
  - Oregon Ck HM Raw Data [1 Adobe PDF file: 10.13 MB; 42 Pages formatted to print double sided on 8 ½ by 11 paper]
  - Oregon Creek Habitat Mapping Data [1 Word document: 533 KB; 6 pages – Header page formatted to print on 8 ½ by 11 paper, next 5 pages formatted to print double sided on 11 by 17 paper and last 2 pages formatted to print double sided on 8 ½ by 11 paper.]

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