BIO-4 BENTHIC MACROINVERTEBRATE TECHNICAL MEMORANDUM

KERN RIVER NO. 3 HYDROELECTRIC PROJECT
FERC PROJECT NO. 2290

PREPARED FOR:

SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead®

KERNVILLE, CALIFORNIA

July 2024

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
%	percent
% sat.	percent saturation
µS/cm	microsiemens per centimeter
BIO-4 Study	BIO-4 Benthic Macroinvertebrate Study
BMI	benthic macroinvertebrate
CSCI	California Stream Condition Index
cfs	cubic feet per second
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FERC	Federal Energy Regulatory Commission
KR3	Kern River No. 3
m	meter
mg/L	milligram per liter
MMI	multi-metric index
NFKR	North Fork Kern River
O/E	observed-to-expected
Project	Kern River No. 3 Hydroelectric Project (FERC Project No. 2290)
RM	river mile
SAFIT	Southwestern Association of Freshwater Invertebrate Taxonomists
SCE	Southern California Edison
s.u.	standard unit
SWAMP	Surface Water Ambient Monitoring Program

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1.0 INTRODUCTION

This Technical Memorandum provides the results of the BIO-4 Benthic Macroinvertebrate Study (BIO-4 Study) conducted in support of Southern California Edison's (SCE) Kern River No. 3 (KR3) Hydroelectric Project (Project) relicensing, Federal Energy Regulatory Commission (FERC) Project No. 2290. The *BIO-4 Benthic Macroinvertebrate Study Plan* was included in SCE's Revised Study Plan submitted on July 1, 2022 (SCE, 2022). In the October 12, 2022, Study Plan Determination (FERC, 2022), FERC approved the BIO-4 Study with modifications. Specifically, FERC recommended that SCE include an additional sampling site.

The benthic macroinvertebrate field surveys were conducted in October 2023. All field sampling efforts and data analyses are complete and summarized below.

2.0 STUDY GOALS AND OBJECTIVES

The objective of the study, as outlined in the *BIO-4 Benthic Macroinvertebrate Study Plan* (SCE, 2022), is to conduct an inventory and assessment of benthic macroinvertebrate (BMI) diversity and abundance in the Fairview Dam Bypass Reach[1] using an aquatic ecosystem health index.

3.0 STUDY AREA AND STUDY SITES

The study area includes regulated and unregulated reaches of the North Fork Kern River (NFKR) as described below:

- Downstream of KR3 Powerhouse (Site KR-1)
- Immediately upstream of KR3 Powerhouse (Site KR-2)
- Downstream of Gold Ledge Campground (Site KR-3)
- Upstream of Fairview Dam (control site) (Site KR-4)

Additional detail regarding the BMI study sites is provided in Table 3-1 and locations are shown in Figure 3-1.

[1] The Fairview Dam Bypass Reach is defined as the approximately 16-mile bypass reach of the North Fork Kern River (NFKR) between Fairview Dam and the KR3 Powerhouse tailrace.

Table 3-1. Benthic Macroinvertebrate Sites Sampled in 2023 for the Kern River No. 3 Hydroelectric Project

Site Code	Location Description	Location Coordinates (decimal degrees)		Sample Date (2023)	Elevation (meter)	Reach Length (meter)
		Latitude	Longitude			
KR-1	Downstream of KR3 Powerhouse	35.772203	-118.434222	10/24	818	100
KR-2	Upstream of KR3 Powerhouse	35.777042	-118.437793	10/24	823	100
KR-3	Downstream of Gold Ledge Campground	35.835710	-118.452380	10/25	912	100
KR-4	Upstream of Fairview Dam (control site)	35.955413	-118.482610	10/25	1,114	100

KR3 = Kern River No. 3

Figure 3-1. Benthic Macroinvertebrate Study Area.

4.0 METHODS

Study implementation followed the methods described in SCE's Revised Study Plan Package (SCE, 2022), as amended by FERC in its Study Plan Determination (FERC, 2022).

4.1. STUDY PLAN VARIANCES

Monitoring scheduled for October 2022 was rescheduled due to substantial rainfall resulting in high turbidity in the river that prevented effective sampling. SCE postponed the scheduled monitoring until 2023 to allow for safe and effective monitoring conditions. The benthic macroinvertebrate field surveys were conducted in October 2023. All field sampling efforts and data analyses are complete.

4.2. BENTHIC MACROINVERTEBRATES

4.2.1. SAMPLE COLLECTION

As required by the Study Plan, BMI sampling was conducted following the standard reach-wide benthos method for documenting and describing BMI assemblages and physical habitat described by Ode et al. (2016) for the Surface Water Ambient Monitoring Program (SWAMP) protocol and included the following:

- Establishment of a 100-meter reach[2] (measured along the bank) divided into 11 equidistant main transects and 10 inter-transects arranged perpendicular to the direction of flow.
- Collection of BMI at each main transect with a D-frame kick net (0.5-millimeter-diameter mesh) with subsequent combination into a single reach-wide benthos composite sample for each site.

4.2.2. WATER QUALITY AND PHYSICAL HABITAT MEASUREMENTS

Water quality and physical habitat parameters were recorded using methods described in the SWAMP protocol (Ode et al., 2016), including geographic coordinates (i.e., latitude and longitude), total sample site length, gradient, discharge, water temperature, specific conductance, alkalinity, pH, and dissolved oxygen. Water quality measurements were taken using a YSI Pro Plus, calibrated as specified by the manufacturer. Discharge was estimated using the average daily flow recorded at the nearest gage (U.S. Army Corps of Engineers Kernville Gage for Site KR-1, SCE gage 401 at Kern River below Fairview Dam for Sites KR-2 and KR-3, and the sum of SCE gage 401 and SCE gage 402 at the KR3 Flowline for Site KR-4). Percent gradient was calculated using satellite imagery and the U.S. Geological Survey's National Elevation Dataset Digital Elevation Model.

[2] In accordance with the Study Plan (SCE, 2022), the length of the sample reach (typically based on average wetted width) was adjusted to 100 meters due to swift water, which limited the availability of contiguously wadeable and safely accessible aquatic habitat.

Additional physical habitat data were collected from main transects and/or inter-transects, including wetted width; depth (averaged from five points on each transect); bankfull width and depth (estimated); bank stability (categorized as stable, vulnerable, or eroded); percent aquatic habitat type (e.g., riffle, run); canopy cover (using the Strickler [1959] modification for a convex spherical densiometer); substrate measurements (using a modified Wolman [1954] pebble count); percent cobble embeddedness (for a minimum of 25 cobbles); and presence or absence of algae, macrophytes, and coarse particulate organic matter. Additionally, an evaluation of riparian vegetation and instream habitat complexity was conducted along the main transects.

4.2.3. Laboratory Methods

Laboratory methods followed procedures outlined in the *Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California* (Woodard et al. 2012) with approximately 600 individuals subsampled from each composite BMI sample[3] and identified using standard aquatic BMI identification keys (e.g., Merritt et al., 2008; Stewart and Stark, 2002; Thorp and Covich, 2001; Wiggins, 1996). All organisms from the subsample were identified to a minimum level 1 taxonomic effort as specified by the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT; Richards and Rogers, 2011). An independent laboratory was contracted to conduct an external quality control review of the BMI identification for one of the samples.

4.2.4. Data Analysis

In accordance with current SWAMP practices for BMI sample evaluation, the California Stream Condition Index (CSCI; Rehn et al., 2015) was calculated for the BMI samples collected in 2023. The CSCI score is based on predictive modeling generated from a state-wide BMI database and was used as a composite biological response variable to evaluate aquatic habitat quality at sites and identify overall trends related to stream condition as reflected by the BMI community. In addition, a suite of commonly reported metrics (Karr and Chu, 1999) regarding taxonomic richness, composition (e.g., Shannon-Weaver Diversity Index), and tolerance (Richards and Rogers, 2011) was calculated using Microsoft Excel or R Studio for each sample.

The CSCI integrates two measures for evaluating sample sites: (1) BMI taxonomic completeness based on an observed-to-expected (O/E) ratio and (2) ecological structure and function derived from a comparison of anticipated and empirical values for a multi-metric index (MMI). The O/E ratio is a measure of taxonomic completeness between observed (O) taxa collected at a site and expected (E) taxa generated through predictive modeling from the input of site-specific environmental variables (e.g., climate, topography, and geology) that are known to influence BMI communities (Rehn et al., 2015). The MMI component of the CSCI generates anticipated values for six metrics (Table 4.2-1) demonstrated to have a high signal-to-noise response (i.e., a clear indicator

[3] For composite samples containing greater than 600 individuals. Site KR-2 contained 425 individuals, all of which were identified.

with minimal variability) (Rehn et al., 2015). Values for each metric were calculated by comparing anticipated values based on environmental variables and taxonomic composition at reference sites built into the model with empirical values from the BMI sample collected from each site. As observed values approach those predicted by the model, scores for each measure (i.e., MMI and O/E) increase; conversely, as observed values deviate from those expected, scores decrease.

CSCI calculation integrates O/E taxonomic completeness and MMI results into a single score that typically ranges from 0.1 (great deviation from reference condition) to 1.4 (exceeding quality of reference condition). CSCI scores are further divided into three thresholds, based on the 30th, 10th, and 1st percentiles of CSCI scores at reference sites in the state-wide database. These three thresholds divide the CSCI scoring range into the following four categories of biological condition (Rehn et al., 2015):

- ≥ 0.92 = likely intact condition
- 0.91 to 0.80 = possibly altered condition
- 0.79 to 0.63 = likely altered condition
- ≤ 0.62 = very likely altered condition

Scores within the highest category (≥ 0.92) are generally indicative of healthy stream conditions.

Table 4.2-1. Component Metrics Used in the California Stream Condition Index

Metric	Description	Response to Disturbance [a]
Taxonomic richness	Total number of distinct taxa identified to a standardized taxonomic level	Decrease
Shredder taxa richness	Number of taxa within the shredder functional feeding group [b]	Decrease
Percent clinger taxa	Percentage of taxa with behavioral and morphological adaptions for attachment to surfaces in stream riffles	Decrease
Percent Coleoptera taxa	Percentage of taxa in the Coleoptera insect order	Decrease
Percent EPT taxa	Percentage of taxa in the EPT insect orders	Decrease
Percent intolerant individuals	Percentage of BMIs that are intolerant to water and/or habitat quality impairment as indicated by tolerance values[b]	Decrease

BMI = Benthic macroinvertebrate; EPT = Ephemeroptera, Plecoptera, and Trichoptera
Notes:
[a] The responses indicated are generalized and can vary with natural gradients associated with elevation, water temperature, and substrate composition, as well as impairment to the aquatic environment unrelated to project operations.
[b] The Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT; Richards and Rogers, 2011) used as source for functional feeding group and tolerance value designations.

5.0 DATA SUMMARY

A total of four samples were collected from four sites within the NFKR: one control site upstream of Fairview Dam, two within the Fairview Dam Bypass Reach, and one downstream of the Kern 3 Powerhouse (Table 3-1 and Figure 3-1).

5.1. WATER QUALITY

Water quality parameters recorded at sites during BMI collection are shown in Table 5.1-1. Water quality conditions were consistent with those that typically support aquatic life (Allan and Castillo, 2008).

Table 5.1-1. Water Quality Data by Site for Benthic Macroinvertebrate Samples Collected in 2023 for the Kern River No. 3 Hydroelectric Project

Site Code	Water Temperature (°C)	pH (s.u.)	Alkalinity (mg/L)	Dissolved Oxygen (% sat.)	Dissolved Oxygen (mg/L)	Specific Conductance (µS/cm)
KR-1	10.8	7.7	50	108	10.8	110
KR-2	12.9	7.9	80	105	10.0	105
KR-3	11.3	8.0	80	97	9.6	97
KR-4	10.2	7.8	60	101	9.9	107

°C = degrees Celsius; % sat. = percent saturation; µS/cm = microsiemens per centimeter; mg/L = milligram per liter; s.u. = standard unit

5.2. PHYSICAL HABITAT ASSESSMENT

Physical habitat data are summarized by site in Table 5.2-1 and Table 5.2-2. Photographs of the sites are presented in Appendix A. Physical habitats among sampling sites were primarily riffle, run, glide, and rapid, and the associated substrate size classes were sand, cobble, and small boulder (Table 5.2-1). Instream habitat complexity element abundances were absent to sparse; undercut banks and artificial structures were absent at all sites (Table 5.2-2). Average canopy cover was low (1 to 7 percent) (Table 5.2-1). The upper and lower riparian canopy covers were sparse to heavy and ground cover was moderate at all sites (Table 5.2-2). Stream banks were predominantly categorized as stable and vulnerable except for two transects at Site KR-3 where erosion was noted.

No evidence of in-channel human disturbance was observed at any site. However, human influence (i.e., roads) was observed outside the channel at all sites. Highway 99 and other small roadways were present to the east of the NFKR at all sites. Additional human disturbance, including the presence of cleared lots, roads, buildings, and pipes, was noted at Site KR-1.

Table 5.2-1. Physical Habitat Data Collected by Site during Benthic Macroinvertebrate Sampling in 2023 for the Kern River No. 3 Hydroelectric Project

Site Code	Gradient (%) [a]	Discharge (cfs) [b]	Average Wetted Width (m) [c]	Average Canopy Cover (%)	Dominant Habitat (subdominant)	Dominant Substrate (subdominant)
KR-1	0.3%	532	74	1	Riffle (Run)	Cobble (Sand)
KR-2	0.8%	82	27	2	Run (Riffle)	Sand (Cobble / small boulder)
KR-3	1.2%	82	31	1	Glide (Run)	Cobble (Sand)
KR-4	1.1%	465	29	7[d]	Rapid (Run)	Small boulder (Cobble)

% = percent; cfs = cubic feet per second; m = meter

Notes:

[a] Calculated using satellite imagery and the U.S. Geological Survey National Elevation Dataset Digital Elevation Model.

[b] Estimated using the average daily flow recorded at the nearest gage.

[c] Averaged across 11 main transects.

[d] Canopy cover was not recorded at seven transects due to high flows that prevented safe access to the middle of the channel.

Table 5.2-2. Instream Habitat Complexity and Riparian Vegetation Cover Data Collected by Site during Benthic Macroinvertebrate Sampling in 2023 for the Kern River No. 3 Hydroelectric Project

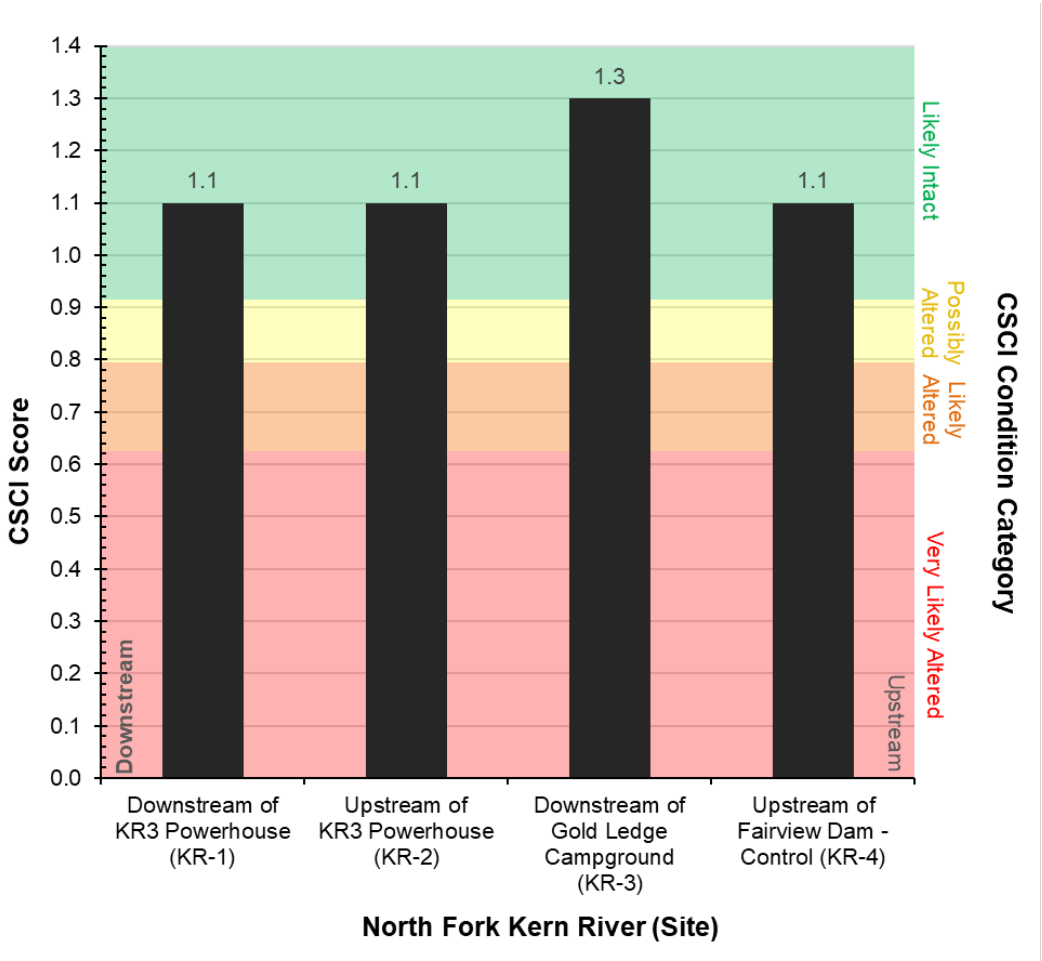
Site	Instream Habitat Complexity Elements[a]									Riparian Cover[a]		
	Filamentous Algae	Aquatic Macrophytes/ Emergent Vegetation	Boulders	Woody Debris (>0.3 meter)	Woody Debris (< 0.3 meter)	Undercut Banks	Overhang Vegetation	Live Tree Roots	Artificial Structures	Upper Canopy (>5 meter)	Lower Canopy (0.5–5 meter)	Ground Cover (<0.5 meter)
KR-1	Sparse	Sparse	Sparse	Sparse	Sparse	Absent	Sparse	Sparse	Absent	Heavy	Heavy	Moderate
KR-2	Sparse	Sparse	Sparse	Absent	Sparse	Absent	Absent	Absent	Absent	Sparse	Sparse	Moderate
KR-3	Sparse	Sparse	Sparse	Absent	Absent	Absent	Sparse	Absent	Absent	Sparse	Moderate	Moderate
KR-4	Absent	Sparse	Sparse	Sparse	Sparse	Absent	Sparse	Sparse	Absent	Moderate	Sparse	Moderate

Notes:
[a] Presence averaged across 11 main transects: Absent = 0%; Sparse = < 10%; Moderate = 10–40%; Heavy = 41–75%; Very Heavy = > 75%

5.3. BENTHIC MACROINVERTEBRATE ASSEMBLAGES

A total of 2,281 individuals representing 52 distinct taxa (identified to a minimum level 1 taxonomic effort as specified in SAFIT [Richards and Rogers, 2011]) were processed from the four samples collected from the NFKR in 2023. The BMI taxa and associated tolerance values and functional feeding groups are included in Appendix B.

The CSCI scores for the samples collected in the NFKR downstream of the KR3 Powerhouse (Site KR-1), upstream of the KR3 Powerhouse (Site KR-2), downstream of Gold Ledge Campground (Site KR-3), and the control site upstream of Fairview Dam (Site KR-4) were within the condition category described as "likely intact" with a score greater than or equal to 0.92 (Figure 5.3-1). MMI components (as described in Table 4.2-1) of the CSCI and other commonly reported metrics regarding richness, composition (e.g., Shannon-Weaver Diversity Index), and tolerance values for each sample are included in Appendix C.



CSCI = California Stream Condition Index

Figure 5.3-1. California Stream Condition Index Scores and Condition Categories for Samples Collected during Benthic Macroinvertebrate Sampling in 2023 for the Kern River No. 3 Hydroelectric Project.

5.4. INCIDENTAL OBSERVATIONS

There were no incidental observations of native freshwater mussels (western ridged mussel [*Gonidea angulata*] or western pearlshell mussel [*Margaritifera falcata*]*) or* invasive species (e.g., Asian clam [*Corbicula fluminea*]*,* American bullfrog (*Lithobates catesbeianus*), crayfish species).

6.0 STUDY-SPECIFIC CONSULTATION

No study-specific consultation is required for this study, and no consultation has been conducted to date.

7.0 OUTSTANDING STUDY PLAN ELEMENTS

All Study Plan elements have been completed as outlined in SCE's Revised Study Plan (SCE, 2022) filing and FERC's Study Plan Determination (FERC, 2022).

8.0 REFERENCES

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APPENDIX A
BENTHIC MACROINVERTEBRATE SITE PHOTOGRAPHS

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Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

Figure A-1. North Fork Kern River Downstream of Kern River No. 3 Powerhouse (Site KR-1), Kern River No. 3 Hydroelectric Project, 2023.

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

Figure A-2. North Fork Kern River Immediately Upstream of Kern River No. 3 Powerhouse (Site KR-2), Kern River No. 3 Hydroelectric Project, 2023.

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

Figure A-3. North Fork Kern River Downstream of Gold Ledge Campground (Site KR-3), Kern River No. 3 Hydroelectric Project, 2023.

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

Figure A-4. North Fork Kern River Control Site Upstream of Fairview Dam (Site KR-4), Kern River No. 3 Hydroelectric Project, 2023.

APPENDIX B
BENTHIC MACROINVERTEBRATE TAXONOMIC LIST

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Table. B-1. Benthic Macroinvertebrate Taxa Identified by Site for Benthic Macroinvertebrate Samples Collected during 2023 for the Kern River No. 3 Hydroelectric Project

Phylum	Class	Order	Family	Common Name	Final ID	TV [a]	FFG [b]	Site			
								KR-1	KR-2	KR-3	KR-4
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	Water mite	*Atractides*	8	P	2	--	1	--
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	Water mite	*Hygrobates*	8	P	--	--	2	--
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	Water mite	*Lebertia*	8	P	1	2	1	--
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	Water mite	*Sperchon*	8	P	4	4	4	2
Arthropoda	Arachnida	Trombidiformes	Torrenticolidae	Water mite	*Torrenticola*	5	P	--	2	3	1
Arthropoda	Insecta	Ephemeroptera	Ameletidae	Mayfly	*Ameletus*	0	CG	--	3	4	8
Arthropoda	Insecta	Ephemeroptera	Baetidae	Mayfly	*Acentrella insignificans*	4	CG	18	11	7	4
Arthropoda	Insecta	Ephemeroptera	Baetidae	Mayfly	*Anafroptilum* (previously *Centroptilum)*	2	CG	--	--	1	--
Arthropoda	Insecta	Ephemeroptera	Baetidae	Mayfly	*Baetis piscatoris* complex	5	CG	27	11	10	11
Arthropoda	Insecta	Ephemeroptera	Baetidae	Mayfly	*Baetis tricaudatus* complex	5	CG	199	41	37	175
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Mayfly	*Drunella grandis*	0	CG	--	--	1	--
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Mayfly	*Ephemerella*	1	CG	138	145	129	58
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Mayfly	*Serratella micheneri*	1	CG	1	--	--	--
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Mayfly	*Cinygma*	2	SC	--	1	--	--
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Mayfly	*Cinygmula*	4	SC	1	4	7	7
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Mayfly	*Ecdyonurus*	3	SC	--	--	1	--
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Mayfly	*Epeorus*	0	SC	2	7	15	1
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Mayfly	*Rhithrogena*	0	SC	65	64	90	132
Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	Mayfly	*Tricorythodes*	4	CG	--	3	--	--
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Mayfly	*Paraleptophlebia*	4	CG	1	5	12	6
Arthropoda	Insecta	Plecoptera	Capniidae	Stonefly	Capniidae	1	SH	1	1	--	15
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Stonefly	*Sweltsa*	1	P	--	1	--	--
Arthropoda	Insecta	Plecoptera	Nemouridae	Stonefly	*Zapada cinctipes*	2	SH	3	2	1	1
Arthropoda	Insecta	Plecoptera	Perlidae	Stonefly	Perlidae	2	P	--	1	--	3
Arthropoda	Insecta	Plecoptera	Perlidae	Stonefly	*Calineuria californica*	2	P	--	--	--	2
Arthropoda	Insecta	Plecoptera	Perlidae	Stonefly	*Hesperoperla pacifica*	2	P	1	--	7	6
Arthropoda	Insecta	Plecoptera	Perlodidae	Stonefly	*Cultus*	2	P	4	6	9	1
Arthropoda	Insecta	Plecoptera	Perlodidae	Stonefly	*Isoperla*	2	P	6	7	20	10
Arthropoda	Insecta	Plecoptera	Perlodidae	Stonefly	*Perlinodes aureus*	2	P	3	--	--	1
Arthropoda	Insecta	Plecoptera	Perlodidae	Stonefly	*Skwala*	2	P	5	2	4	1
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Stonefly	*Pteronarcys californica*	1	OM	1	1	3	7
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Caddisfly	*Glossosoma*	1	SC	1	2	1	--
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Caddisfly	*Cheumatopsyche*	5	CF	3	6	31	7
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Caddisfly	*Hydropsyche*	4	CF	54	35	174	84

Phylum	Class	Order	Family	Common Name	Final ID	TV [a]	FFG [b]	Site			
								KR-1	KR-2	KR-3	KR-4
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Caddisfly	*Leucotrichia*	6	SC	1	--	--	--
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Caddisfly	*Lepidostoma*	1	SH	--	--	3	--
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Caddisfly	*Rhyacophila coloradensis* group	2	P	--	--	--	1
Arthropoda	Insecta	Coleoptera	Dryopidae	Dryopid beetle	*Helichus*	5	SH	--	--	1	--
Arthropoda	Insecta	Coleoptera	Elmidae	Riffle beetle	*Cleptelmis addenda*	4	CG	--	--	1	--
Arthropoda	Insecta	Coleoptera	Elmidae	Riffle beetle	*Microcylloepus*	4	CG	2	--	--	--
Arthropoda	Insecta	Coleoptera	Elmidae	Riffle beetle	*Optioservus*	4	SC	2	3	5	1
Arthropoda	Insecta	Coleoptera	Elmidae	Riffle beetle	*Ordobrevia nubifera*	4	SC	--	--	1	1
Arthropoda	Insecta	Coleoptera	Elmidae	Riffle beetle	*Zaitzevia parvula*	4	SC	5	2	37	9
Arthropoda	Insecta	Diptera	Athericidae	Watersnipe fly	*Atherix*	2	P	1	1	--	1
Arthropoda	Insecta	Diptera	Chironomidae	Non-biting midge	Chironominae	6	CG	4	9	5	2
Arthropoda	Insecta	Diptera	Chironomidae	Non-biting midge	Diamesinae	2	CG	--	1	--	--
Arthropoda	Insecta	Diptera	Chironomidae	Non-biting midge	Orthocladiinae	5	CG	18	35	6	18
Arthropoda	Insecta	Diptera	Chironomidae	Non-biting midge	Tanypodinae	7	P	--	2	2	6
Arthropoda	Insecta	Diptera	Empididae	Dance fly	*Neoplasta*	6	P	--	--	1	2
Arthropoda	Insecta	Diptera	Empididae	Dance fly	*Wiedemannia*	6	P	--	--	--	1
Arthropoda	Insecta	Diptera	Simuliidae	Black fly	*Simulium*	6	CF	26	2	1	12
Annelida	Oligochaeta	--	--	Aquatic worm	Oligochaeta	5	CG	2	3	5	14

-- = no data
Notes:
[a] Tolerance Value (TV): Values ranging from 0–10 were assigned to each taxon and reflect the taxon's sensitivity to perturbations in water and habitat quality; as values increase, sensitivity decreases (Richards and Rogers, 2011).[1]
[b] functional feeding group (FFG): CF = collector-filterer; CG = collector-gatherer; OM = omnivore; P = predator; SC = scraper; SH = shredder

[1] Richards, A.B., and D.C. Rogers. 2011. *Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) List of Freshwater Macroinvertebrate Taxa from California and Adjacent States including Standard Taxonomic Effort Levels*. Accessed: April 2024. Retrieved from: https://safit.org/downloads/

APPENDIX C
BENTHIC MACROINVERTEBRATE METRIC VALUES

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Table C-1. California Stream Condition Index Results by Metric Component for the Benthic Macroinvertebrate Samples Collected during 2023 for the Kern River No. 3 Hydroelectric Project

Metric			Site			
			KR-1	KR-2	KR-3	KR-4
Multi-metric Index	Percent clinger taxa	Observed	73	65	64	64
		Predicted	63	60	63	68
	Percent Coleoptera taxa	Observed	10	7	14	9
		Predicted	11	10	10	9
	Taxonomic richness	Observed	28	30	33	29
		Predicted	28	28	28	29
	Percent EPT taxa	Observed	66	70	61	65
		Predicted	50	50	50	52
	Shredder taxa richness	Observed	1.9	2	2.7	1.8
		Predicted	1.0	1.0	1.0	0.8
	Percent intolerant individuals	Observed	39	57	45	41
		Predicted	16	16	17	26

EPT = Ephemeroptera, Plecoptera, and Trichoptera

Table C-2. Biological Metric Values for the Benthic Macroinvertebrate Sample Collected during 2023 for the Kern River No. 3 Hydroelectric Project

Metric		Site			
		KR-1	KR-2	KR-3	KR-4
Richness	Taxonomic richness [a]	28.1	30	32.6	29
	EPT taxa	21	22	22	22
	Ephemeroptera taxa	9	11	12	9
	Plecoptera taxa	8	8	6	10
	Trichoptera taxa	4	3	4	3
	Coleoptera taxa	3	2	5	3
	Predator taxa	9	10	11	14
	ET taxa	13	14	16	12
	Shredder taxa [a]	2	2	3	2
Composition	EPT taxa (%) [a]	66	70	61	65
	Sensitive EPT index (%)	38	57	45	40
	Shannon-Weaver Diversity Index	2.2	2.4	2.5	2.3
	Dominant taxon (%)	33	34	27	29
	Non-insect taxa (%)	13	12	16	9
	Clinger taxa (%) [a]	73	65	64	64
	Coleoptera taxa (%) [a]	10	7	14	9
	Predators (%)	4	7	8	6
	Scrapers (%)	13	20	24	25
	Shredder taxa [a]	6	6	8	6

Metric		Site			
		KR-1	**KR-2**	**KR-3**	**KR-4**
Tolerance [b]	Tolerance value	3.3	2.5	2.8	3.1
	Intolerant individuals (%) [a]	39	57	45	41
	Tolerant individuals (%)	1.0	1	1	0

EPT = Ephemeroptera, Plecoptera, and Trichoptera, ET = Ephemeroptera and Trichoptera
Notes:
a Metrics used for California Stream Condition Index (Rehn et al. 2015).[1]
b Tolerance Value: Values ranging from 0–10 were assigned to each taxon and reflect the taxon's sensitivity to perturbations in water and habitat quality; as values increase, sensitivity decreases (Richards and Rogers, 2011).[2]

[1] Rehn, A.C., R.D. Mazor, and P.R. Ode. 2015. *The California Stream Condition Index (CSCI): A New Statewide Biological Scoring Tool for Assessing the Health of Freshwater Streams.* California State Water Resources Control Board SWAMP Technical Memorandom-2015-002.
[2] Richards, A.B., and D.C. Rogers. 2011. *Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) List of Freshwater Macroinvertebrate Taxa from California and Adjacent States including Standard Taxonomic Effort Levels*. Accessed: April 2024. Retrieved from: https://safit.org/downloads/

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