

**FERC Project No. 2426**  
**South SWP Hydropower**  
***Pyramid Reach Benthic Macroinvertebrates Study***

**FIELD RESULTS AND DATA SUMMARY**

*March 25, 2019*

Consistent with Section 5.0 of the South SWP Hydropower Revised Study Plan and as approved in the Federal Energy Regulatory Commission (FERC) Study Plan Determinations dated June 14, 2017 and September 7, 2018, the California Department of Water Resources and Los Angeles Department of Water and Power (Licensees) provide the following Field Results and Data Summary for Study 4.1.21, *Pyramid Reach Benthic Macroinvertebrates Study* (Study), which includes work completed to date, key findings, associated data files, variances, and remaining work. The Licensees consider these data to be public.

***Completed Work to Date:***

The Study is complete. As required by the FERC-approved Study Plan, the Licensees completed all three steps of the Study: Steps 1 and 2 (Identify Sampling Segment Locations and Collect SWAMP Data), and Step 3 (Laboratory Processing). The Licensees selected three benthic macroinvertebrate (BMI) sampling sites: BMI Sampling Site 1 is located in the 2-mile-long section of Pyramid reach between Pyramid Dam and the concrete structure upstream of Frenchman's Flat; BMI Sampling Site 2 is located within a mile downstream of Frenchman's Flat, in the stream segment from the concrete structure upstream of Frenchman's Flat to the confluence of Fish Creek; and BMI Sampling Site 3 is located upstream of the confluence with Agua Blanca Creek within the stream segment from Fish Creek to the normal maximum water surface elevation of Lake Piru (refer to Table 1). Sites were selected in collaboration with Resource Agencies<sup>1</sup>, including a site visit on May 17, 2018. After receiving feedback from the agencies, the Licensees agreed to relocate two of the preliminary sampling sites (Site 1 and Site 3) from their original location. The Licensees filed a letter with FERC on August 1, 2018,<sup>2</sup> describing these changes and the rationale for the new locations. FERC agreed with the selection of BMI Sampling Sites 1, 2, and 3 in the Study Plan Determination dated September 7, 2018.

**Table 1. Pyramid Reach Benthic Macroinvertebrate Sampling Locations**

Site	Upstream Coordinates	Downstream Coordinates	Site Description
BMI Sampling Site 1 (DS of Pyramid Dam)	34.635371° N, -118.75689° W	34.63489° N, -118.75497° W	Site 1 begins from River Mile (RM) 0.94 to RM 1.04 and extends 150 meters (m) long
BMI Sampling Site 2 (DS of Frenchman's Flat)	34.61117° N, -118.74920° W	34.61032° N, -118.75035° W	Site begins from RM 3.3 to RM 3.4 and extends 150 m long
BMI Sampling Site 3 (US of Agua Blanca Creek)	34.54669° N, -118.77316° W	34.54669° N, -118.77160° W	Site begins from RM 16.01 to RM 16.10 and extends 150 m long

*Key:*  
*DS = downstream*  
*m = meters*  
*US = upstream*

<sup>1</sup> Resource Agencies present on May 17, 2018 included California Department of Fish and Wildlife, National Marine Fisheries Service, State Water Resources Control Board, and US Forest Service.

<sup>2</sup> FERC Accession Number 20180803-5090

BMI and habitat data were collected from June 25 to June 27, 2018, using the California State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) Protocol (Ode et al. 2016). Sampling followed the reach-wide benthos methods for documenting and describing BMI assemblages and physical habitat. All sampling sites were 150 m in length with 11 "main" transects (A-K) interspersed with 10 "inter-transects," all of which were arranged perpendicularly to the primary direction of stream flow. Basic water quality parameters were collected, and physical habitat were characterized at each site. Data were collected at each transect pertaining to channel characteristics, substrate composition, riparian vegetation, instream habitat complexity, human influence, channel habitats, bank stability, and canopy cover.

BMI samples were collected at the 11 "main" transects by rubbing cobble and boulder substrates, and disturbing finer substrate upstream of a D-frame kicknet fitted with a 0.02-inch (in) diameter mesh net. Samples were preserved in 95 percent ethanol and were labeled to form a single composite sample for each sampling site. A replicate sample was collected at BMI Sampling Site 1 for quality assurance/quality control procedures per the SWAMP protocol.

Laboratory processing of BMI samples was conducted by EcoAnalysts, a qualified taxonomy laboratory, which complies with requirements outlined in the SWAMP protocol. The California Stream Condition Index (CSCI) scores were calculated using the BMI data. The California Department of Fish and Wildlife Aquatic Bioassessment Laboratory (ABL) conducted an external quality control review of sample identification completed by EcoAnalysts.

The CSCI, developed by the State Water Resources Control Board, is California's new statewide assessment tool that translates BMI data into a numerical measurement of stream health. The CSCI uses a large set of representative data to better account for a wider range of ecological variability (Rehn et al. 2015). Scores are calculated using two indices, a multi-metric index (MMI) and observed-to-expected (O/E) index. MMI scores reflect ecological structure and function and O/E scores measure taxonomic completeness (Rehn et al. 2015). The O/E index compares the observed versus expected BMI taxa and measures the biological condition of a site. Expected taxa are calculated using a statistical model. A stream's biological condition is quantified by the variance of the observed versus expected taxa. Degradation of a biological condition can be quantified by a loss of expected native taxa (Rehn et al. 2015). The MMI index combines several BMI metrics into a single measurement of biological condition. The metrics used to calculate MMI were chosen for their responsiveness to human disturbance and ability to differentiate between healthy and degraded conditions (Rehn et al. 2015).

The mean CSCI score of reference sites is 1. CSCI scores greater than 1 indicate more complex ecological functioning and taxonomic richness than predicted. As a stream's CSCI score approaches 0, it represents a stream's increased variance from reference conditions and a degradation of the stream's biological conditions (Rehn et al 2015). To ensure CSCI could be used as a statewide assessment tool, four CSCI thresholds were created (Table 2) to classify biological condition.

**Table 2. CSCI Score Interpretation**

CSCI Score	Interpretation
≥ 0.92	Likely Intact Conditions
0.91 to 0.81	Possibly Altered Conditions
0.79 to 0.63	Likely Altered
≤ 0.62	Very Likely Altered

Key:  
 ≥ = greater than or equal to  
 ≤ = less than or equal to

**Key Accomplishments/Summary of Findings to Date:**

Table 3 and Table 4 summarizes the sampling site characteristics and BMI results for BMI Sampling Sites 1, 2 and 3, respectively.

**Table 3. Pyramid Reach BMI Sampling Site Characteristics**

Category	Metric	Site 1 (Downstream of Pyramid Dam)	Site 2 (Downstream of Frenchman's Flat)	Site 3 (Upstream of Agua Blanca Creek)
Water Quality	Water Temperature (°C)	21.23	24.72	22.15
	Dissolved Oxygen (mg/L)	9.35	7.97	7.44
	Specific Conductivity (µS/cm)	555	867	1056
	pH	7.97	7.94	7.99
	Reach Length (m)	150	150	150
	Flow (cfs)	2.6	1.3	0.3
Site Characteristics	<b>Habitat Composition (% of Site)</b>			
	Cascade/Falls	6	2	0
	Rapid	0	0	0
	Riffle	14	35	0
	Run	22	24	10
	Glide	0	5	48
	Pool	58	36	43
	Dry	0	0	0
	<b>Dominant Thalweg Composition (% of Site)</b>			
	Bedrock, Smooth	1	0	0
	Bedrock, Rough	0	3	0
	Boulder, Large	16	7	0
	Boulder, Small	30	16	1
	Cobble	15	5	2
Gravel, Course	6	10	22	

	Gravel, Fine	3	6	48
	Sand	5	11	13
	Fines	24	39	14
	Wood	1	2	0
	Other	0	2	0
<b>Transect Characteristics</b>	<b>Channel Conditions</b>			
	Average Sample Plot Depth (cm)	20.3	14.6	9.9
	Average Wetted Width (m)	6.3	2.8	3.7
	Average Bankful Width (m)	10.3	7.4	9.3
	Average Bankful Height (m)	0.6	0.7	0.4
	Riparian Canopy Cover (%)	79	88	63

*Key:*

% = percent

°C = degrees Celsius

cfs = cubic feet per second

cm = centimeters

m = meter

mg/L = milligrams/liter

µS/cm = microsiemens per centimeter

The CSCI score for the uppermost reach (BMI Sampling Site 1) fell into “likely altered” status for both the original sample and replicate sample (0.75 and 0.74, respectively). The CSCI score for BMI Sampling Site 2 was 1.07, indicating a “likely intact” status. BMI Sampling Site 3 scored 0.88, indicating a “possibly altered” status.

**Table 4. BMI Summary Statistics**

Metric	Site 1 (Downstream of Pyramid Dam)	Site 1 (Downstream of Pyramid Dam) Replicate	Site 2 (Downstream of Frenchman's Flat)	Site 3 (Upstream of Agua Blanca Creek)
MMI Score	0.593	0.573	0.863	0.747
Clinger Percent Taxa	31.9	34.7	51.5	30.6
Clinger Percent Taxa predicted	55.1	55.1	55.3	56.5
Coleoptera Percent Taxa	0.0	0.0	11.3	14.2
Coleoptera Percent Taxa predicted	10.9	10.9	11.1	14.0
Taxonomic Richness	21.05	18.5	33.55	25.75

Taxonomic Richness predicted	29.2	29.2	29.3	30.1
EPT Percent Taxa	41.8	43.0	36.7	34.2
EPT Percent Taxa predicted	41.6	41.6	41.4	40.6
Shredder Taxa	0	0	0	1
Shredder Taxa predicted	1.63	1.63	1.61	1.53
Intolerant Percent	5.4	1.6	2.5	1.7
Intolerant Percent predicted	14.9	14.9	14.7	13.2

Key:  
EPT = Ephemeroptera, Plecoptera, Trichoptera  
MMI = multimetric index

The ABL conducted an external quality control review of the BMI sample identification completed by EcoAnalysts. ABL calculated 11 Measurement Quality Objectives (MQO) from the BMI samples they checked. SWAMP provides standards for five selected MQOs where significant error in the MQO relates directly to errors in BMI metrics. If the designated MQO values exceed SWAMP standards, corrective action is necessary. EcoAnalyst's BMI identification data were less than SWAMP standards for MQO values for all listed variables (Table 5) (Rehn et al.2015).

**Table 5. MQO Values and SWAMP Standards**

Variable Name	Value	SWAMP Standard
Absolute Recount Error Rate	1.33 %	< 10%
Taxa ID Error Rate	6.56 %	< 10%
Individual ID Error Rate	1.33 %	< 10%
Lower Taxonomic Resolution Individual Error Rate	1.16 %	< 10%
Lower Taxonomic Resolution Count Error Rate	1.64 %	< 10%

Key:  
% = percent  
< = less than  
ID = identification

There were no incidental observations of special-status species made during this study.

**Associated Data Files** (all associated data can be found in the folder with this summary form. Note: confidential CEII/privileged information will not be posted publicly):

File Name	Data Description	File Type	File Location
Pyramid_reach_BMI_Taxonomy_Results	BMI Taxonomy Results	Microsoft Excel	Project Website
Pyramid_reach_BMI_QAQC_Taxonomy_Review	EcoAnalysts Quality Control Review Results	Microsoft Excel	Project Website

Pyramid_reach_BMI_Physical_Habitat_Data	Water chemistry and physical habitat data	PDF	Project Website
Pyramid_reach_BMI_Sampling_Site_Map	Maps with BMI and Stream Fish sites	PDF	Project Website

***Variations from Study Methods, Schedule, or Approach and Abnormalities in Expected Field Conditions:***

There were no variations in Study Methods, Schedule, or Approach from the FERC-approved Study Plan.

***Remaining Work:***

None; the Study is complete.

***References Cited:***

- Ode, P.R., A.E., Fetscher, and L.B. Busse. 2016. Standard Operating Procedures for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat. California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 004
- 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. Swamp Technical Memorandum SWAMP-TM-2015-0002.
- Rehn, A.C., J. Slusark, and M. A. Sigala. 2015. Standard Operating Procedures (SOP) for External Quality Control of Benthic Macroinvertebrate Taxonomy Data Collected for Stream Bioassessment in California. SWAMP bioassessment procedures. SWAMP-SOP-2015-0002.