Placer County Water Agency
Middle Fork American River Project
(FERC Project No. 2079)

GEOMORPHOLOGY/RIPARIAN MONITORING PLAN

Placer County Water Agency
P.O. Box 6570
Auburn, CA 95604

February 2011

TABLE OF CONTENTS

Page

List of Tables

List of Maps

List of Attachment

List of Acronyms

CDFG	California Department of Fish and Game
Commission	Federal Energy Regulatory Commission
DBH	diameter at breast height
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information Systems
GPS	Global Positioning System
GRMP	Geomorphology and Riparian Monitoring Plan
MFP	Middle Fork American River Project
PCWA	Placer County Water Agency
Project	Middle Fork American River Project
State Water Board	State Water Resources Control Board
TSP	Technical Study Plan
TSR	Technical Study Report
USDA-FS	United States Department of Agriculture-Forest Service

1.0 INTRODUCTION

This Geomorphology/Riparian Monitoring Plan (GRMP) was developed for the Placer County Water Agency's (PCWA) Middle Fork American River Project (MFP or Project) located on the west slope of the Sierra Nevada range primarily in Placer County, California. Monitoring of sediment and channel conditions and riparian vegetation conditions has been integrated into one plan to facilitate coordination of data collection, analyses, and reporting for these two inter-related resources.

2.0 GRMP ORGANIZATON

The GRMP is organized into the following sections:

Section 3.0 GRMP Objective: This section defines the purpose of the GRMP.

Section 4.0 Monitoring Approach: This section describes the locations, schedule, and sampling and analytical methods for monitoring of channel and sediment conditions and riparian vegetation in bypass and peaking reaches over the term of the new license.

Section 5.0 Reporting and Consultation: This section describes agency consultation and reporting that would be conducted over the term of the new license.

Section 6.0 Literature Cited: This section provides a list of documents or other resources that are referenced in the GRMP.

3.0 GRMP OBJECTIVES

The objectives of the GRMP are to monitor at select sites in the bypass and peaking reaches:

- Channel and sediment conditions, including general channel shape, bank erosion, and fine sediment in pools; and

- Riparian vegetation communities, including species composition, age class structure, relative cover, vegetation community structure, position along the stream channel, and health.

4.0 MONITORING APPROACH

This section describes the approach for monitoring of sediment and channel conditions and riparian vegetation.

4.1 MONITORING LOCATIONS AND SCHEDULE

Channel and sediment conditions and riparian vegetation will be characterized at ten monitoring locations on the bypass and peaking reaches (GRMP Map 1). The types of monitoring to be conducted at each location are identified in GRMP Table 1. Geomorphology and riparian studies were previously conducted at all of these locations

during studies conducted in support of the relicensing of the MFP (AQ 9 – Geomorphology Technical Study Report [AQ 9 – TSR] and AQ 10 – Riparian Resources TSR [AQ 10 – TSR]) (PCWA 2011a and 2011b; Supporting Document [SD] B).

Geomorphology and riparian long-term monitoring will be conducted in Years 2, 3, 7, 8, 13, 14, and thereafter for two consecutive years during every 10 year period for the term of the license. This schedule is consistent with the other aquatic monitoring plans, including fish populations, water temperatures, and foothill yellow-legged frogs.

4.2 MONITORING METHODS

A combination of methods will be used to monitor trends in channel and sediment conditions and riparian vegetation, including ground-level photo documentation, channel cross-sections, V* sampling, and riparian vegetation mapping. The integration of the geomorphology and riparian vegetation data collection is shown in GRMP Table 1. Each of these methodologies and the relation to monitoring channel and sediment conditions and riparian vegetation is described below.

4.2.1 Photo-documentation

Periodic photography at the monitoring locations over the term of the license will be used to visually document any trends in conditions of the channel and riparian communities (Elzinga et al. 1998; Bureau of Land Management 1999; Burton et. al. 2007). Specifically, the photographs will be used to document changes in bank erosion; general channel shape; relative herbaceous and woody vegetation cover along the stream banks; structure of the vegetation community (e.g., multi-layered canopy, single stratum shrub, tree-shrub, shrub-herbaceous, etc.); and position of the vegetation along the channel.

Permanent photo point locations will be selected at each monitoring location (GRMP Table 1) in consultation with the United States Department of Agriculture-Forest Service (USDA-FS), State Water Resources Control Board (State Water Board), and California Department of Fish and Game (CDFG). Photo point locations used in support of the relicensing studies will be reviewed and considered when selecting permanent photo point locations (PCWA 2007a). Each photo point will be marked with capped rebar or other permanent marker at the photographer's location and the location will be recorded with a Trimble® GeoXT Global Positioning System (GPS) unit, or similar (sub-meter accuracy).

Photographs from previous years will be taken into the field each year to assist in relocating the photo point locations and with orienting the camera. The photographs will be taken at approximately the same time of year (season) and time of day during the monitoring surveys. The photo point procedures, including protocols for documenting the photo point locations and repeat photography, are outlined in Attachment A.

4.2.2 Channel Cross-sections

Channel cross-section surveys will be used to monitor the shape of the channel and position of riparian vegetation adjacent to the channel over the term of the license. At least three cross-sections will be surveyed at each geomorphology and riparian monitoring location (GRMP Table 1). The cross-sections will correspond to those surveyed during the relicensing studies, if the headpins can be relocated (PCWA 2007a; PCWA 2011b). If headpins for any cross-section cannot be located, photographs taken during the relicensing studies of the cross-section will be reviewed to locate its approximate location. The endpoints of the cross-sections will be marked with headpins, such as capped rebar or other semi-permanent marker, and documented with a Trimble® GeoXT GPS unit, or similar (sub-meter accuracy).

Each cross-section survey will include the channel and will extend across the riparian zone to the hillslope including any bars, if present. Elevations will be surveyed in sufficient detail to detect changes in channel shape and topography, which may occur within the channel, on the channel bars, and within the riparian corridor over the term of the license. In addition, the surveyors will document the location of the water surface elevation and the location(s) of the established woody vegetation closest to the channel along each surveyed cross-section.

4.2.3 Residual Fine Sediment in Pools

Residual fine sediment in pools will be monitored using visual V* estimates (Hilton and Lisle 1993), which is consistent with the survey method used for studies completed during the relicensing of the MFP (AQ 9 – Technical Study Plan [TSP]; PCWA 2007b; and AQ 9 - TSR; PCWA 2011a). V* is a ratio of the volume of residual fine sediment deposited in a pool divided by the total residual pool volume. "Residual" refers to the pool dimensions at the point of zero flow.

The visual V* estimates will be conducted in ten pools at each of the monitoring locations in the bypass reaches and in five[1] pools at the monitoring locations in the peaking reach (GRMP Table 1). The pool locations will be the same as those surveyed for the relicensing studies, if they can be relocated (PCWA 2007a; PCWA 2011a). Field notes, maps, and photographs from the relicensing studies will be used to assist in re-locating the pools, as necessary. The locations will be documented with a Trimble® GeoXT GPS unit, or similar (sub-meter accuracy), and mapped for use in locating pools during subsequent sampling efforts.

Visual estimates of fine sediment at each pool will be made by a team swimming the entire length of the pool with a snorkel and mask following a grid pattern. Divers will be used, if necessary. The visual surveys will be supported by a combination of

[1] Due to their very large size and depth (often over 0.5-mile long and exceed 10-feet deep); pools in the Middle Fork American River below Ralston Afterbay will require significantly greater effort to monitor. Therefore, a total of five pools, instead of ten, will be visually surveyed at each of the monitoring locations, which is consistent with the number sampled for the studies completed during the relicensing of the MFP (AQ 9 – TSP and TSR; PCWA 2007b and 2011a).

photographic documentation of pool bottom sediments and sketch maps, and measurements of surface area and depth of any fine sediment patches observed. Photographs and sketch maps will be scanned and compared following each monitoring survey.

If the fine sediment depth is determined to be only a thin coating over coarser material that cannot be accurately measured with the probe, then it will be described as "<0.1 foot" average thickness in the field notes. Because a calculated volume of fine sediment is not possible with such thin layers of sediment, the results will be described as "trace" amounts of fine sediment. Sediment depths equal to or exceeding 0.1 foot will be used with the sediment patch length and width to calculate the volume of sediment that occupies the residual pool volume.

4.2.4 Riparian Vegetation Mapping

Riparian vegetation will be mapped in the field at each of the monitoring locations (GRMP Table 1). In the large bypass and peaking reaches, riparian vegetation will be mapped along both stream banks for 0.5 mile. In the small bypass streams, riparian vegetation along each bank will be mapped for 0.25 mile. The mapping will extend across the riparian zone to the hillslope and on any bars, if present. The upstream and downstream points of the reaches will be documented with a Trimble® GeoXT GPS unit, or similar (sub-meter accuracy). An attempt will be made to survey the same reaches during subsequent surveys.

Co-dominant species will be mapped as polygons on either aerial photographs (if available) or topographic maps, with a minimum mapping size of 2,500 square feet. The boundaries of the polygons will be delineated using a Trimble® GeoXT GPS unit, or similar (sub-meter accuracy), if necessary. Percent cover of the dominant and sub-dominant species will be recorded for each polygon. This information will be used to classify the vegetation into plant associations, as defined in Potter (2005)[2]. Age class information by woody species[3] will be recorded for polygons with woody species present. Additional information will also be recorded at each polygon, including substrate size, bedrock, and large woody debris. In addition, observations of riparian health, recent scouring by high flows, or other factors that may affect the condition of the riparian vegetation will be recorded at each polygon, as appropriate.

The vegetation polygons will be digitized in Geographic Information Systems (GIS) or similar application, and maps of the vegetation composition, age classes, and substrate will be produced. An accompanying database (attribute table) will be developed that will

[2] Or subsequent classification, as agreed to by the USDA-FS, State Water Board, and CDFG.

[3] Age class structure will be based on categories of shrub stem densities per individual and tree diameters, as follows: Seedlings and sprouts (S); Young (Y): shrubs with less than 10 stems per individual or trees with diameters (diameter at breast height [DBH]) less than 3 inches; Medium-aged (M): shrubs with between 10 and 60 stems per individual or trees with DBHs between 3 and 9 inches; and Old/Mature (O): shrubs with more than 60 stems per individual or trees with DBHs greater than 9 inches.

include information on the dominant and sub-dominant species and age classes present, as well as any other observations made in the field for each polygon.

The riparian vegetation mapping will be combined with the cross-section survey data (Section 4.2.2. above) to illustrate and document trends in the distribution of riparian vegetation in relation to the stream channel and topography over the term of the license.

Species lists will also be compiled for each monitoring location, and will include common and scientific names of each taxon, whether each species is native or non-native, and any noxious weed or special-status category.

4.2.5 Hydrology

The hydrology and other environmental factors (e.g., fire) that may affect the trends in channel and riparian vegetation conditions (upward or downward) since the previous sampling period will be summarized. The frequency and magnitude of high flow events and non-spill years between monitoring periods will be summarized.

4.3 ANALYSIS METHODS

The following describes the analyses methods to be used.

4.3.1 Photo-documentation

The photographs will be compared to each preceding monitoring period. Results will be included in the Geomorphology/Riparian Monitoring Report.

4.3.2 Channel Cross-sections

The shape of each cross-section will be compared to the preceding monitoring periods and surveys completed in support of the relicensing studies (if available) (PCWA 2007a) to document potential change in channel shape or floodplain topography. In addition, the position of the vegetation adjacent to the channel along the surveyed cross-sections will also be compared to the preceding monitoring periods.

4.3.3 Residual Fine Sediment in Pools

V* will be calculated for each pool using the method described in Hilton and Lisle (1993). The residual pool measurements, average volume of fine sediment stored within each pool, and the calculated V* index will be summarized in tabular format. The weighted average, V*w of the calculated individual V*s, will be determined using all of the sampled pools at a monitoring location and compared to previous measurements.

4.3.4 Riparian Vegetation Mapping

The riparian community composition and age class maps will be compared to each preceding monitoring period, and to comparable data collected during the relicensing studies, as appropriate (PCWA 2007a; PCWA 2011b). The comparison will include a discussion of the recent hydrology, as it relates to any changes in riparian cover,

composition, and age classes present at each monitoring location. Observations of riparian health, scouring by high flows, or other factors that may have affected the conditions of the riparian vegetation will also be summarized. Species lists and any occurrences of special status plants or noxious weed species within each site will be documented in tabular format.

4.3.5 Hydrology

Daily flows and peak flows, measured at the gage located nearest each monitoring location, will be summarized since the preceding monitoring period in graphical format.

4.3.6 Electronic Database

All photo point data will be stored electronically with supporting photograph information. Channel cross-section and sediment V* data will be entered and stored in an electronic database (Excel spreadsheet or similar program). Riparian mapping data will be stored electronically (GIS or similar format), with supporting metadata and attribute information. Attribute data will also be stored in Excel or other compatible program. The databases will be provided to resources agencies upon request.

5.0 REPORTING AND CONSULTATION

A Geomorphology/Riparian Monitoring Report summarizing the photo points, channel cross-sections, and V* and riparian vegetation data will be prepared by PCWA and distributed to the USDA-FS, State Water Board, and CDFG for review and comment within 120 days following the completion of each monitoring period. A 60-day review period will be provided to the agencies. Based on the results of the monitoring and/or comments received during the review process, PCWA and the agencies may call a meeting to discuss the results or modify the monitoring program. Within 60 days of receipt of comments, or 60 days following any meeting, comments will be addressed and the final report will be filed by PCWA with the agencies (USDA-FS, State Water Board, and CDFG) and the Federal Energy Regulatory Commission (FERC or Commission).

6.0 LITERATURE CITED

Bureau of Land Management. 1999. Sampling vegetation attributes interagency technical reference. Denver, Colorado.

Burton, T.A., E.R. Cowley, and S.J. Smith. 2007. Monitoring streambanks and riparian vegetation – multiple indicators. Idaho Technical Bulletin No. 2007-01. April. United States Department of Interior, Bureau of Land Management, 50 pp.

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. Measuring and monitoring plant populations. Bureau of Land Management, BLM Technical Reference 1730-1. Denver, Colorado.

Hilton, S, and T.E. Lisle. 1993. Measuring the fraction of pool volume filled with fine sediment. Res. Note PSW-RN-414. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Placer County Water Agency (PCWA). 2007a. Middle Fork American River Project (FERC Project No. 2079). 2006 Physical Habitat Characterization Study Report – Supporting Document G.

____. 2007b. Middle Fork American River Project (FERC Project No. 2079), Pre-Application Document (PAD), Submitted to FERC on December 13, 2007.

____. 2011a. AQ 9 – Geomorphology Technical Study Report (2008). Available in PCWA's Application for New License – Supporting Document B.

____. 2011b. AQ 10 – Riparian Resources Technical Study Report (2010). Available in PCWA's Application for New License – Supporting Document B.

____. 2011c. Instream Flow Technical Study Report. Available in PCWA's Application for New License – Supporting Document B.

Potter, D.A. 2005. Riparian Plant Community Classification. West Slope, Central, and Southern Sierra Nevada, California. United States Forest Service Pacific Southwest Region. R5-TP-022. December.

TABLES

GRMP Table 1. Geomorphology and Riparian Vegetation Monitoring Locations.

Monitoring Location Description	Monitoring Location[1]	Reach Type		Monitoring Method			
		Peaking Reach	Bypass Reach	Photo-documentation	Channel Cross-sections	V* Sampling	Vegetation Mapping
Middle Fork American River Downstream of French Meadows Dam							
French Meadows Dam to confluence with Duncan Creek	MF44.7		●	●	●	●	●
Middle Fork American River Middle Fork Interbay to Ralston Afterbay							
Upstream of Ralston Afterbay	MF26.2		●	●	●	●	●
Middle Fork American River Downstream of Ralston Afterbay							
Volcano Canyon Creek confluence to Canyon Creek confluence	MF14.1[2]	●		●	●	●	●
Canyon Creek confluence to North Fork American River confluence	MF4.8[2]	●		●	●	●	●
Rubicon River							
Hell Hole Dam to Deer Creek confluence	R25.7		●	●	●	●	●
Deer Creek confluence to Long Canyon Creek confluence	R20.9		●	●	●	●	●
Long Canyon Creek confluence to Ralston Afterbay	R3.5		●	●	●	●	●
South Fork Long Canyon Creek							
Diversion to confluence with Long Canyon Creek	SFLC2.3		●	●	●	●	●
North Fork Long Canyon Creek							
Diversion to confluence with Long Canyon Creek	NFLC1.9		●	●	●	●	●
Duncan Creek							
Diversion to confluence with Middle Fork American River	D6.3		●	●	●	●	●

[1] All the monitoring sites were surveyed for the relicensing studies (AQ 9 - TSR PCWA 2011a; and AQ 10 - TSR PCWA 2011b).

[2] Riparian vegetation composition and substrate particle size mapping was conducted at this monitoring location during the relicensing studies (AQ 10 – TSR; PCWA 2010b and AQ 1 – Instream Flow TSR [AQ 1 – TSR]; PCWA 2011c).

MAPS

ATTACHMENT A

Photo Point Procedures

PHOTO POINT PROCEDURES

Images taken at the photo points will be landscape photographs that will be taken each monitoring period from the same locations. The views in the photographs will be the same so that differences between monitoring periods can be compared.

Photo point locations will be established to document channel and riparian vegetation conditions within each monitoring location. The location(s) will be established at a location from which multiple view photographs could be taken, if possible. If necessary to document the riparian vegetation, more than one photo point location will be established. Within each view, an identifiable object, such as a large rock, will be included, if possible, to assist with scale and orientation during the monitoring periods. The photo point markers will be located in places that will likely not be eroded easily by high floods or disturbed by other activities, such as vandalism. Markers will be as inconspicuous as possible to minimize the potential for vandalism.

Photo point locations will be established from which channel conditions, including bank erosion, stream bank and bar vegetation, and vegetation within floodplains are clearly visible. If a location is established within the stream channel, a GPS point and distance(s) from the stream banks or other permanent marker will be used to document its position.

This attachment describes the procedure for documenting the photo point locations and for retaking the photographs each monitoring period. A field datasheet is provided. One datasheet will be filled out for each photo point location. For those locations where more than one view is taken from the same photo point location, all the views can be recorded on the same datasheet.

DOCUMENTING PHOTO POINT LOCATIONS

Photo point locations will be selected in consultation with the USDA-FS, State Water Board, and CDFG. A site marker, such as a stake, will be placed at the location. During the first monitoring period, the photo point locations will be established, using the following procedure:

- The photographer will stand immediately over the site marker, if possible. If this is not possible, the location of the photographer relative to the marker will be recorded on the datasheet (distance and angle from the marker).

- The time of the photograph, camera type, focus distance, height of the camera above the ground, compass bearing and vertical angle of the view will be recorded on the datasheet.

- At least one reference point will be established for each photo point location. The reference point will be within 200 feet of the photo point location. A reference point could be a large tree outside of the flood zone or a large rock. The distance, compass bearing, and vertical angle will be measured and

recorded from the reference point to the photo point location. A marker will be placed on the reference point. The reference point will be described on the datasheet and a site sketch will be drawn showing major landmarks and the locations of the photo points and reference points. The information from the initial sketch with the reference point locations identified will be transferred to GIS for display over a high resolution aerial image and stored electronically.

- Additional photographs will be taken of the reference point and the photo point locations. The locations of each will be marked and labeled on the photographs for future use in the field. All information on the location of the photo points and reference points will be stored electronically.

- The locations of the photo and reference points will be recorded with GPS. These locations will be overlain on aerial photographs of each monitoring location to document the approximate locations of the points. The maps will be completed at a scale with sufficient detail to identify obvious landmarks and trees. These maps will be electronically stored for future use.

- Each photo point will be given an identification number, which will be used through the duration of the monitoring.

REPEAT PHOTOGRAPHY

The procedures for the photo points that will be followed during the subsequent monitoring periods are described below.

- For each photo point monitoring period, the field crew will take copies of the original photo point documentation on the locations of the photo and reference point markers, copies of the photographs, and maps. The type(s) of cameras used to take the photo points will be noted on the datasheet.

- The photographer will stand at the same place and height as that which the first photographs were taken. The camera will be aligned with the view at the same compass bearing as recorded during the initial photographs. The view will be compared with the previous photographs to ensure that it is as close as possible to the original.

- The time of the photograph, camera type, focus distance, height of the camera above the ground, compass bearing and vertical angle of the view will be recorded for this monitoring period.

- If the photo point marker cannot be located, an attempt will be made to locate a new photo point as close as possible to the original location using the reference point documentation, maps, and previous photographs. The USDA-FS, State Water Board, and CDFG will be notified and consulted if a new location is established.

- The new photographs will be catalogued with the previous photographs and stored electronically. The photographs will be compared with the previous photographs in the Geomorphology and Riparian Monitoring Report.

LITERATURE CITED

Powell, D.C. 2006. Recording the changes: field guide to establishing and maintaining permanent camera point systems. United States Department of Agriculture – Forest Service. Pacific Northwest Region. FS-14-SO-09-06. August. 21 pp.

PHOTO POINT DATASHEET

Site Name: _____ Photo Point Identification Number:_____

Date:_____ Time:_____ Weather Conditions:_____

GPS Coordinates:_____ Photographer:_____

Camera Type:_____

Subject of Photograph and Purpose of Photographs:

Photo 1	**Photo 2**	**Photo 3**
Camera Height (ft):	Camera Height (ft):	Camera Height (ft):
Camera Angle:	Camera Angle:	Camera Angle:
Azimuth:	Azimuth:	Azimuth:
Focus Distance:	Focus Distance:	Focus Distance:
Photo No.:	Photo No.:	Photo No.:
Camera No.:	Camera No.:	Camera No.:
Photo 4	**Photo 5**	**Photo 6**
Camera Height (ft):	Camera Height (ft):	Camera Height (ft):
Camera Angle:	Camera Angle:	Camera Angle:
Azimuth: °	Azimuth:	Azimuth:
Focus Distance:	Focus Distance:	Focus Distance:
Photo No.:	Photo No.:	Photo No.:
Camera No.:	Camera No.:	Camera No.:

Reference Point 1	**Sketch of Photo and Reference Point Locations:**
Description:	
Marking:	
Azimuth: Angle:	
Distance to photo point marker (ft):	
Reference Point 2	
Description:	
Marking:	
Azimuth: Angle:	
Distance to photo point marker (ft):	
Reference Point 3	
Description:	
Marking:	
Azimuth: Angle:	
Distance to photo point marker (ft):	

EQUIPMENT CHECKLIST

1. Datasheets
2. Photo point location markers
3. Sledge hammer
4. Markers for reference points
5. Tape measure (at least 100 feet)
6. Compass
7. Clinometer
8. Field Map
9. GPS unit