EFFECTIVENESS MONITORING COMMITTEE PROJECT CONCEPT PROPOSAL

Proposed Project: Conceptual Design and Implementation Planning for Evaluation of Effectiveness of FPR's for Unstable Areas

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Background and Justification: Considerable effort is invested in THP development to avoid erosion and sedimentation impacts to water quality, fish habitat and stream channel condition that could result from forest practice activities in "unstable areas" that could contribute to triggering landslides. Road design, WLPZ design, and specific hillslope silvicultural prescriptions are intended in part to prevent disturbance to unstable areas that would have a high likelihood of delivering sediment to streams should a landslide occur. Additional mitigation and/or avoidance measures affecting forest practices on or near unstable areas are developed by consulting geologists or California Geological Survey geologist. Some aspects of WLPZ design and specific hillslope silvicultural prescriptions encourage retention of trees associated with unstable areas as a source of LWD recruitment. The effectiveness of these THP regulations and design objectives is not easily tested, largely because mass wasting events (landslides of various types) are relatively rare. Triggering events for episodes of mass wasting are typically large magnitude, low frequency rainfall (or rain-on-snow) events that deliver large volumes of water to the landscape over short periods of time that stress hillslopes by causing high levels of water to accumulate in soil materials. Events such as wildfires and earthquakes can add to stress conditions that test hillslope stability. When stressing events cause a significant number of individual landslides to occur, the affected area may be relatively large, encompassing many watersheds and a wide range of "treatments" on the landscape related to forest practices. These events may cause substantial resource damage, but they also provide an opportunity to investigate the conditions under which individual landslides occur and their relationship to historic forest management practices and current FPR's. Examples of such studies are noted in section 4.2.2 of the EMC Strategic Plan. A substantial number of landslide inventories have been conducted on commercial timberlands in California for Habitat Conservation Plans. Furthermore, Habitat Conservation Plans (HCP's) cover some areas in the north coast of California typically include additional measures designed to prevent management-caused landslides. Additionally, similar studies have been conducted in the western United States (e.g. US Forest Service Klamath Forest report following storms in 1996-97; Oregon Department of Forestry's reports following both the 1996-97 and 2007 storms; Washington's report following the 2007 storms).

With this background in mind, this proposed project would develop a conceptual study plan to prepare for an investigation of FPR effectiveness immediately following a future episode of mass wasting in forested watersheds in the North Coast, Klamath or northern Sierra Nevada region, or elsewhere in California.

Relationship to Strategic Plan Themes and Critical Questions: This proposal is most directly related to EMC Strategic Plan Theme 4-Mass Wasting Sediment (directly quoted below):

> To limit mass wasting sediment from anthropogenic sources, the FPRs require that timber operations be planned and conducted to provide mitigation measures to minimize sediment delivery from unstable geologic features (14 CCR § 923 [943, 953]). While considerable past

monitoring efforts have addressed implementation and short-term effectiveness of FPRs designed to limit sediment entry related to surface erosion processes, less documentation has occurred on a statewide basis for success of the FPRs in preventing accelerated rates of management-related mass wasting features. This is particularly important in the California Coast Ranges and Klamath Mountains, where landslide features can be the primary sediment delivery mechanism. Achieving this goal is consistent with the goals of FGCom and/or FGCom and Board (Joint) policies, including the Endangered and Threatened Species, Salmon, Water, and Joint Pacific Salmon and Anadromous Trout Policies. In addition, these FPRs may also contribute toward meeting Basin Plan objectives. The critical questions for this theme address specific mass wasting-related topics to determine if the current rules and regulations are effective in avoiding and reducing management-induced mass wasting.

Critical Questions: Are the FPRs and associated regulations effective in minimizing sediment delivery from…

(a) existing chronic unstable geologic features to maintain water quality?

(b) mass wasting during episodic rare events and/or large storms to maintain water quality (see Section 4.2.2)?

(c) mass wasting from high risk geologic features?

Landslides that do occur have the potential to deliver large wood and sediment to streams, and may cause substantial change in riparian and aquatic habitat. "Rare or large events" that trigger a large number of landslides in a region or watershed provide the opportunity to observe the degree to which WLPZ designs:

- mitigate sediment delivery to streams from landslide,
- mitigate triggering of near-stream landslides,
- provide LWD for recruitment to stream channels (mass wasting is an important process that moves LWD from the terrestrial to the aquatic environment; WLPZ is a critical source area for LWD recruitment to streams, and stream disturbance associated with mass wasting episodes may cause channel shifts and overbank flow that recruits LWD to the aquatic environment).

Following are excerpts from the EMC Strategic Plan Themes that are interrelated with this proposed study; emphasis is added with ***italics***.

<u>Theme 1: WLPZ Riparian Function</u>

The FPRs have been developed to ensure that timber operations do not potentially cause significant adverse site-specific and cumulative adverse impacts to the beneficial uses of water, native aquatic and riparian-associated species, functions of riparian zones or result in an unauthorized take of listed aquatic species (14 CCR § 916 [936, 956]). The primary objective of the WLPZ FPRs is to maintain or restore riparian and aquatic functions in classified watercourses. This can occur with both passive and active management approaches that may incorporate options ranging from protection (passive no touch) to active manipulation of stand structure and include timber harvest (14 CCR § 916.9 [936.9, 956.9](v)). ***Key functions of riparian zones include large wood recruitment***, watercourse shading, ***sediment filtration***,

nutrient input, microclimate control, ***streambank/hillslope stability***, and habitat for terrestrial wildlife species.

Critical Questions: Are the FPRs and associated regulations effective in …

(c) retaining predominant conifers in WLPZs. (Implementation and Compliance) and ***large woody debris input to watercourse channels***?

(i) ***filtering sediment that reaches WLPZs***?

Theme 2: Watercourse Channel Sediment

Since the implementation of the modern FPRs in 1975, ***a primary goal of these regulations has been to limit the delivery of management-related sediment to watercourse channels in California***. ***The amount of hillslope erosion and sediment delivery that occurs following timber operations depends on*** numerous factors, including the site conditions present (e.g. slope, soil type, vegetative cover), soil disturbance, level of proper FPR implementation, ***and intensity and number of large storm events following the completion of logging***. The ***FPRs have been upgraded numerous times in the past 40 years to reduce management-related sediment delivery. Specifically, current silviculture practice regulations (14 CCR § 913 [933, 953]), harvesting practices and erosion control measures (14 CCR § 914 [934, 954]), watercourse and lake protection (14 CCR § 923 [943, 953]) and logging roads, landings and logging road watercourse crossings rules (14 CCR § 923 [943, 953]) provide measures to ensure timber operations meet the goals and intent of the FPRs by limiting sediment delivery to stream channels***. These FPRs can contribute toward meeting goals of FGCom and/or FGCom and Board (Joint) policies that address protection of water quality and fish habitat, including the Endangered and Threatened Species, Salmon, Water, and Joint Pacific Salmon and Anadromous Trout Policies. In addition, these FPRs may also contribute toward meeting Basin Plan objectives. The critical questions for Theme 2 address erosion and sediment monitoring at both the watershed (or sub-watershed) scale and Plan scale.

Critical Questions: ***Are the FPRs and associated regulations effective in minimizing management-related sediment delivery from forest management activities to watercourse channels*** …

Theme 3: Road and WLPZ Sediment

Similar to Theme 2, ***the Road and WLPZ Sediment theme has been developed to answer critical questions regarding management-related hillslope erosion and sediment delivery to watercourse channels in forested watersheds***. Theme 3 focuses on critical questions related to the effectiveness of FPR requirements included in the recently implemented Road Rules 2013 requirements (14 CCR § 923 [943, 953]). These FPRs also contribute toward meeting goals of FGCom and/or FGCom and Board (Joint) policies that address protection of water quality and fish habitat listed above. In addition, these FPRs may also contribute toward meeting Basin Plan objectives.

Critical Questions: Are the FPRs and associated regulations effective in …

(a) ***reducing or minimizing management-related generation of sediment and delivery to watercourse channels?***

(b) ***reducing generation and sediment delivery to watercourse channels when timber operations implement the Road Rules 2013 measures***?

(c) ***reducing the effects of large storms on landslides as related to roads, watercourse crossings and landings***?

(d) maintaining or improving fish passage through watercourse crossing structures? (see Section 4.2 for discussion of appropriate scale(s))

Theme 5: Fish Habitat

Numerous FPR regulations relate to the protection of fish habitat features in forested watersheds, particularly those found in the WLPZ rule section [14 CCR § 916 (936, 956)]. Specifically, these FPRs require that ***timber operations shall be planned and conducted to provide protection for*** water temperature control, ***streambed and flow modifications by large woody debris, filtration of organic and inorganic material, upslope stability, bank and channel stabilization***, and spawning and rearing habitat for salmonids [14 CCR § 916.4 (936.4, 956.4) (b)]. As stated above for the other themes, these rule requirements contribute toward meeting the goals of Fish and Game Commission and/or Fish and Game Commission and Board (Joint) policies, including: Endangered and Threatened Species Policy, Salmon Policy, Water Policy, and Joint Pacific Salmon and Anadromous Trout Policy. In addition, these FPRs may also contribute toward meeting Basin Plan objectives. The critical questions included under this theme relate to maintaining and/or restoring the quality and connectivity of foraging, rearing, and spawning habitat.

Critical Questions: Are FPRs and associated regulations effective in …

(b) ***maintaining and restoring the distribution of foraging, rearing and spawning habitat for anadromous salmonids***? (Note: Monitoring may also be appropriate for the AB1492 Working Groups).

As demonstrated by the emphasized elements of Themes 1, 2, 3 and 5, this proposed project would be expected to contribute substantially to evaluation of FPR effectiveness in terms of those themes and their critical questions.

Finally, this proposed project could contribute to understanding of the potential long-range effects of climate change, drought, forest health and increased wildfire severity by including these factors as potential stressors that could contribute to accelerated mass wasting. In particular, the effects of declining forest health expressed by tree mortality or reduced vigor in response to drought, disease and insect infestation would be expected to reduce slope stability through a reduction in root reinforcement and reduced evapotranspiration that tends to elevate soil moisture and increases the likelihood of a triggering event. Similarly, wildfire is expected to increase the potential for landslides, and landscape response to wildfire would also provide an opportunity to observe the behavior of WLPZs and other measures in specific THP's intended to promote slope stability, reduce sediment delivery to channels, and promote LWD delivery to channels.

Scope of Study Plan Development

Development of the study plan will draw on the considerable expertise of EMC members and cooperating agencies. Outside assistance (i.e. contractors) will be needed to provide expertise in study design and statistical analysis, in determining the required data and data collection protocol with respect to geomorphology of mass wasting and watershed features, as well as THP features, and in developing the approach to preparing for an opportunistic field investigation in a study area determined by a mass

wasting triggering event. It is anticipated that a contractor would work closely with an EMC working group (e.g. the co-PI's), and periodically with the full EMC, in developing the study plan details. Developing the study plan is expected to require about 12 months. Additional time (about 6 months) and resources would be needed to organize for implementation, including training of field geologists and other personnel regarding data collection protocols and other aspects of project implementation.

Prior landslide survey and inventory methods and CGS methods will provide the basis for data collection pertaining to landslides. These would generally provide for consistent observation and interpretation to describe the size and type of landslide events and to collect observations that may help determine the factors contributing to landslide initiation. Additional emphasis may be needed to describe the origin and fate of material mobilized by landslides, i.e., where sediment and large wood was mobilized from and where it is deposited in relation to WLPZs and other THP features such as roads, landings and identified unstable areas. The data collection may be considered to be an intensive mapping project. The availability of LiDAR-derived digital elevation data, aerial imagery and topographic maps, obtained prior to or following a triggering event would greatly improve the quality of data that could be collected.

The geographic area over which such a data collection effort might vary, and could conceivably be in any forested portion of California. Landslide events triggered by rare rainstorms often affect large areas tens to hundreds of square miles in size distributed over multiple watersheds. Hence, substantial human and data collection resources would likely be required.

Rapid response in terms of data collection is highly desirable, but as a practical matter is usually delayed by a period of weeks or months owing to potential access issues and safety considerations (landslide scarps are by definition unstable, and secondary failures should be expected); data collection must be completed not later than the beginning of the following winter. Consideration should be given to implementation of remote sensing data collection that might be feasible soon after the event (e.g. aerial imagery from manned or unmanned aircraft or LiDAR) that would both preserve information on conditions at the time of the event as well as provide reliable reconnaissance information that could reduce the overall cost of the field investigation.

The proposed project would lay the groundwork for implementing data collection documenting a relatively wide-spread landslide triggering event. Per guidance in section 4.2.2 of the EMC Strategic Plan, the proposed project would at a minimum develop specific methodology to accomplish the following:

> *(1) Determine that the rare event has occurred; the authority to make this determination will be the EMC.*
> *(2) Notify the appropriate response team and deploy other necessary resources, (i.e., a road failure, a landslide, or a post-fire assessment will require specific sets of skills). These will be preselected and could be available on an on-call contractual basis.*
> *(3) After review of the rare or large event, a pre-approved study plan will be reviewed and modified to best match the conditions that resulted from the rare or large event. Minor adjustments to the monitoring or research plan can be made and then executed without delay*

Most of the project effort is expected to lie in developing a detailed yet flexible study plan consistent with the scientific literature and informed by similar prior investigations. Elements of the study plan would include developing the scope of the study (specific goals and objectives), study design including

consideration of statistical analysis of data sets, development of detailed data collection protocols, implementation planning, and personnel training.

Potential Collaboration

It is anticipated that many natural resource and regulatory agencies would be potential collaborators that could contribute to project planning and implementation. It is also likely that cooperation of private landowners, particularly larger commercial timberland owners, will be necessary. The extent of State-owned timberland is insufficient to support a study of this scope. Large timberland owners may be interested in an opportunity to observe the effectiveness of various mitigation measures over and above the FPR's; older THP's could allow comparison of "standard" practices to HCP practices.

Adaptive Management

Interpretation of data from a study of this type is likely to provide conclusions with varying degrees of certainty and, probably, new questions. An objective of the study should be to make determinations regarding the efficacy of certain management practices if possible, and to propose modifications to certain practices where warranted. It is conceivable that the study would produce some conclusions with limited certainty along with an analytical framework that could facilitate limited "experiments" where specific FPR's are tested by implementation of variations in specific THP's (e.g. variation in WLPZ width or leave tree requirements) that could demonstrate effectiveness and optimize FRP applications in specified settings.

Budget Request

Principal foreseeable funding needs include contracting appropriate consulting resources for study design, particularly with respect to statistical expertise. In addition, obligation of funds necessary for inter-agency of consulting resources to be available on-call or on short-notice may be substantial. Obligation of funds for a remote-sensing data collection contractor to be available soon after an event occurs should also be considered. Once a study plan is complete, additional time and resources (about 6 months) would be needed to organize for implementation, including training of field geologists. Developing a revised detailed budget and work plan would be a high priority for initial work on this project.

Study Design/Statistical Consulting Resources	$75,000
Remote Sensing Data Collection (funds to be encumbered for use as necessary)	$150,000
Implementation Planning and Training	$50,000

Obligation of Funds for Interagency Resources (dependent on the approach developed)