# A Rapid Assessment System for Riparian and Stream Corridors for California: A Discussion on How Can We Improve a Rapid Assessment System for Streams?

## Executive Summary

The purpose of the following document is to begin a constructive discussion on the proposed application of the California Rapid Assessment Methodology to riparian environments. This discussion has been prepared by staff at the San Francisco Bay Regional Water Quality Control Board who are involved in the protection of streams through Water Board regulatory programs and who are concerned about potential unintended consequences of the CRAM should it remain in its current form. This discussion document is not intended to be an agency position paper. The discussion paper describes the assessment methodology and stated objectives for the CRAM's proposed use of measuring conditions of the landscape over time and evaluating watershed, stream management, and restoration priorities and projects. The discussion then identifies the criteria against which to evaluate an assessment method, including: 1) the use of a sound scientific framework; 2) results that are public policy neutral to the extent possible and therefore do not create unintended biases or outcomes, 3) does no harm to regulatory or protection programs; and 4) responds to the needs of those who need to use rapid watershed assessments.

A key discussion point presented is that a better scientific framework for an assessment system for riverine systems is a *functions-based* system as opposed to the *conditions- based* assessment used by the CRAM. The current conditions-based assessment produces biases against certain types of naturally occurring and urban landscapes. We then outline the basics of what a functions-based rapid assessment can be. The final part of the discussion uses specific examples to illustrate how the numerical ratings in the CRAM assessment, as it is currently construed, can produce results that: a) do not take into account the different valuable functions contributed by different stream types; b) are biased against mature, climax riparian woodlands and areas with the most dynamic environments, such as high functioning fish habitats; and c) are not relevant to distinguishing the differences among stream reaches in an urban environment. The discussion concludes that we must be cognizant that the CRAM numerical rating system can easily be misused by permit applicants in a manner which conflicts with the Clean Water Act regulatory objectives for projects and actions to avoid impacts to existing, naturally occurring wetlands. The CRAM ratings would have to change substantially to meet the objectives of policy makers to identify and protect rare environments, compare the relative values of restoration projects against each other in order to set funding priorities, and provide a scientific assessment of the health of a watershed over time.

# I. Introduction to CRAM and Need for Evaluation

Recently a consortium of non-profits and agencies developed the California Rapid Assessment Method (CRAM) for wetlands to include a rapid assessment methodology for stream-related wetland environments (version 4.2.3, October 2006). The CRAM is a project of the San Francisco Estuary Institute, the Southern California Coastal Water Research Project, the Central Coast California Coastal Commission, and Moss Landing Marine Lab, and is largely funded by the U.S. Environmental Protection Agency. The stated purpose of the CRAM is to provide a consistent and replicable, scientifically defensible, and relatively rapid assessment method to evaluate our State's investments in environmental management and restoration projects. The intended applications include (1) providing a preliminary assessment of the entire State's wetland conditions and stressors, and (2) providing a method to evaluate restoration project performance.

It is proposed that this method could be adopted by all relevant State resource agencies in order to standardize multiple agencies' use of rapid assessment methodologies across diverse California landscapes. While the CRAM covers both wetlands and riverine systems, this staff disucssion paper focuses only on the method as applied to assessing the conditions of California riverine systems. While the need for a rapid assessment methodology has been widely vetted, it is our understanding that the CRAM methodology for riverine environments is still in its early stages. The sampling design and its scientific underpinnings, to our knowledge, have not yet been subject to a formalized peer review specific to its application in California. The intent of this discussion document is to help guide questions for such a scientific peer review and/or for subsequent versions of the assessment methodology.

The CRAM methodology is presented as filling resource agency needs to develop "performance measures" for site-specific, watershed and programmatic activities. We believe it is appropriate for the Water Board, as potential user of the CRAM to revisit:

1. The inherent opportunities and limitations of different assessment methodologies with respect to identifying those that are most appropriate to meet specific programmatic objectives,
2. The scientific principles being applied to establish the framework for the assessment methodology, and
3. The assessments or combination of assessments needed for stream corridors in order to best serve the priority decision-making and management needs of the Water Boards and other resource agencies.

Because science guides policy decisions at the Water Board, and because any performance measure metric can be misapplied out of context, we strongly believe that a review of the CRAM needs to assess both the technical framework, and policy implications of the assessment methodology.

## A. Potential Strategies for Improvement

The CRAM has been a concept supported by the Water Boards, and it can have a constructive role in our programs. We genuinely appreciate the effort that has gone into creating a response to the requests for rapid assessments. Water Board staff hope to use this staff discussion paper to initiate a discussion of the parameters to be evaluated so that any rapid assessment methods we develop will be appropriately applied and will not be assigned policy-making functions for which the assessment is not a good match. The type of assessment proposed by the CRAM is a very narrow and limited assessment. It is not well matched, for example, with the need to evaluate land management or restoration priorities or alternatives, or to evaluate the results of these activities. To accomplish this, the CRAM will have to be supplemented with a different type of rapid or more intensive assessment. Our hope is that the discussion stimulated by this paper will be applied towards improving the CRAM so that it can be more widely, as well as appropriately, applied. The discussion paper makes the basic case that rapid scientific assessments should be well calibrated to their settings and circumstances.

The staff discussion paper does not recommend specific changes to the CRAM, but there are some possible strategies we would like to propose to improve its application so that it can be more widely accepted and used. One strategy is to integrate more numerical or letter descriptors into the landscape conditions rating scores so that the scores can recognize critical functions such as providing good fish habitat or improving water quality. A second strategy may be to add a decision-tree structure to the numerical assessments so that the CRAM can better represent, for example, the conditions found in steep stream types or urban landscapes. A third strategy could be to combine the CRAM with complementary rapid assessments that can enable the methodology to address a common and pressing need to evaluate multi-objective programs and projects. A quality control system can be designed to ensure that the assessments performed by untrained users meet certain standards, and guidance can be provided to potential users to explain inappropriate applications.

**B. Assessment Needs**

We agree with the first paragraph statement of need in the CRAM Manual: “The State needs to track the extent and condition of these [wetland] habitats to evaluate the investments in them now and in the future.” We agree with CRAM’s authors that the following basic policy questions drive efforts to inventory and assess our wetland resources:

- How do we produce a record of the State’s wetland resources,
- Can we record a snap shot of the resource’s current condition,
- Can we measure whether these resources are improving in condition over time, and
- Will our past and future investments in management, protection, and restoration positively influence an improved condition of these resources?

Any assessment system needs to have a high level of acceptance by its potential users of the underlying scientific assumptions, the type and method of data collected, and their application. For a public resource agency, this also means that the public policy aspect of assessments (potential applications) needs to help guide the types of assessments we develop and/or apply. This necessary framework guiding the development of environmental assessments does not imply that assessments should compromise sound science for the convenience of policy makers. Rather, in order for science to successfully influence public policy, research on environmental assessments identifies three factors which need to be considered in the design of assessments so that the science they represent successfully influences public policy. (Farrell and Jager 2005). According to this research, assessments need to address the factors of *salience*, *legitimacy* and *credibility*.

An assessment is *salient* if policy makers are both aware of it and deem the assessment relevant to current policy issues and the decision-making responsibilities before them. One way of making an assessment salient is ensuring stakeholder involvement in the selection of key questions they want the assessments to address. (In this case, the stakeholders include a wide range of scientists, planners, regulators, restoration practitioners, and organizations involved in the protection and restoration of the California landscape). *Legitimacy* is a measure of the perceived fairness of an assessment to a user. Inherently, assessments have limitations on their applications and focus and are difficult to develop without promoting certain priorities, goals and values over others. For this reason, an assessment needs to be evaluated in the context of how it will affect, and potentially benefit or disadvantage different stakeholders engaged in environmental management. *Credibility* is the final important measuring criteria for evaluating assessments and refers to the method's technical acceptance and the application of quality science and the judicious use of peer review (Farrell and Jager 2005). This staff discussion paper will close with a summary evaluation of the CRAM for riverine environments using these three criteria.

## II. A Conceptual Framework for Riverine Assessment

### A. Summary of the CRAM Methodology

The introduction to the method explains that the context for the CRAM is to focus on the visible biological structure of wetlands. The assessment assumption is that it favors structurally complex and larger size wetlands because these environments are associated with a diversity of "ecological services." The CRAM assesses conditions of the structural components of the landscape to indicate the degree to which they are in a degraded or impacted state. The CRAM develops a numerical scoring for reaches based on the existing condition at a field visit with the score representing the condition of the site relative to a best possible condition. The site is scored "relative to a conceptual model of what the ideal site would look like."

The introduction also describes three desired levels of data collection and assessment for a statewide assessment program. The first level consists of inventories of resources such as those contained in GIS systems. The second level calls for a value-based rapid assessment of these resources. The third level calls for intensive quantitative data to validate level one and two information and "to explain mechanisms that account for observed conditions." Presumably this highest level of assessment could approach recording landscape processes as part of the rating system.

The CRAM produces numerical conditions ratings for riverine environments based on four major landscape attributes. The first attribute is "buffer and landscape context", which is measured by rating the areal extents and connectivity of the riparian wetlands and buffers next to them. The second attribute is "hydrology", which identifies the sources of water for the riverine areas and the stability of stream channels rated by observing indicators of erosion and deposition, and entrenchment. The third attribute is physical structure, which is measured by noting the "patchiness" or "edge effects" of different topographic and vegetative changes in the reach observed. The fourth attribute is "biotic structure", which assigns ratings on the basis of the amount of organic duff layers, leaf piles and plant debris, the number of plant layers, the numbers of dominant native plants species in the layers, the interspersion of different plant zones and the presence of non-native plants. The CRAM website publishes numerical ratings for different streams based on this assessment system for immediate use and encourages non-profits, consultants and the general public to use the CRAM and/or apply the data. A CRAM Manual is provided for downloading.

**B. Identification of Issues Regarding the CRAM Framework**

This paper identifies three major concerns about the landscape conditions based assessment and the numerical ratings they produce. The first concern is that the landscape conditions assessment does not capture the scientifically important concept that the functions of the different riverine ecosystems and changes in them over time can be better measurements of landscape health, particularly for riverine landscapes, which are disturbance-based ecosystems. The second concern is that the assessment rating system selects out a few "ideal" landscape types when in fact there is a diversity of naturally occurring healthy riverine landscapes that have valuable functions and would score high in a functions-based assessment but score low in the CRAM. The third concern is that the CRAM is supposed to be able to provide one system for assessing all landscapes in the State, but the rating system selected isn't relevant for distinguishing the different conditions of functioning riverine systems found in urban areas.

The discussion presented by this paper first focuses on the issue that it is difficult to apply rapid wetland assessment methods to riverine wetland types because streams and rivers are the creatures of disturbance regimes and must continue over time in dynamic states in order to be "healthy." Thus, the CRAM measurements of degradation may describe a degraded system but the numerical ratings may also be indicators of a healthy dynamic riverine system, thereby rendering the numeric score of little scientific assessment value. Likewise, river scientists expect that stream environments will evolve into different types of landscapes and ecological communities over time and that no one of these natural landscape types should be considered inherently more valuable than another type. A well-accepted objective is to try to manage a variety of landscape regimes so that they will retain or improve their resiliency in recovering a balance in reaction to land use changes and impacts caused by human use. We can manage a stream ecosystem in order to increase its equilibrium at one point in time so that it can continue to evolve in a dynamic equilibrium as it is affected by naturally occurring changes created by storms, floods, landslides, evolution of plant communities, etc.

This means that in order for any assessment of riverine environments (rapid or intensive) to have scientific credibility and utility, it needs to be process-based and not based on ecosystem community structure. From our perspectives, land managers will be best assisted with assessments that help them understand what processes are acting on the riverine environments and the **causes of instabilities.** Our experience is that many local land managers know where problem reaches of streams and rivers are located, but they need help developing an understanding of how to address the causes of these problems.

Our assessments in these dynamic riverine environments need to first recognize that conditions caused by geology, parent soils or topography, size of the watershed, precipitation, climatic changes, and naturally occurring disturbances such as floods need to be approached using a value-neutral recording of this natural variability. The perspective that needs to be integrated into any assessment system is that each reach of stream has a different set of variables that can constrain or enhance its evolution into a different, more complex ecosystem. For example, a more entrenched bedrock stream will not have as much inherent ability to produce the ecologically diverse landscape associated with a gravel, mobile bed stream system, but it does provide different, highly valued (though fewer) variable functions. A bedrock channel in a tectonically active setting, for example, meters and drives landscape evolution through a series of complex feedback loops between the channel, hillslopes and sediment supply. A more appropriate basis for a rapid assessment system for California riverine environments may be based not on measuring and recording the diversity of environmental features at any one reach, but rather on identifying the rarity or uniqueness of different environments and/or functional attributes that support ecosystem "services" such as critical anadromous fish migration, endangered species habitat, or rare old growth riparian groves.

Assessments for streams in urban areas also need to take into account inherent limitations on future potential conditions as well. If this factor of natural or man-caused limitations on stream functions is not recognized in an assessment method, certain environments, no matter what enhancements or protections are attempted for them, will inherently score low in assessments. This will result in biasing policy decisions towards the creation, protection or enhancement of a certain idealized landscape type that may occur only rarely in the San Francisco Bay Area or other urban regions of the State. The policy makers for an urban area must have an assessment tool that is relevant and realistic to the types of decisions that must be made to improve the conditions of urban watersheds. This cannot be accomplished with an assessment tool that builds in a standardized, numeric metrics biased against urban streams so that the relative values of different urban stream environments remain unmeasured.

## III. What Is Important Information for Regulators from a Rapid Assessment Method?

We asked ourselves how we could get a snapshot of the Bay Area to record existing or baseline conditions, and then we asked what assessments methods are simple, well accepted and in use, and are capable of recording the processes of dynamic systems that are characterized by change through time. A landscape inventory to create this snapshot of a "baseline" condition for a large geographic area should be feasible by collecting existing reports and documents, including satellite imagery and aerial photography Landscape assessments focused on recording process-oriented information as opposed to assessments primarily focused on physical attributes should also be feasible with a modest effort. The inventory and assessments can focus on applying the following scientific information for recording the conditions of stream-related wetlands over time. **(This is not intended to be an exhaustive list, but is proposed for discussion purposes.)**

### A. Inventory

- Records on the historic landscape geomorphic features (including discontinuous channels, side channels, multiple channels, channel meander lengths and sinuosity, alluvial fans, floodplains, riparian corridors, grass channels and other freshwater wetlands)
- Historic and current known native fish habitat
- Locations of channels subject to flood control projects or ditching and channelization
- Location of hydraulic constrictions
- Fish barriers
- Major controls on stream gradients
- Stream channels that are above and underground in manmade conduits
- Stream channels that are largely vegetated and those with riparian corridors
- Existing stormwater retention projects and "green" stormwater source controls
- Existing hydrograph data based on the required hydromodification plans from cities and counties

- Water storage facilities and features and diversions
- Existing open space, stream corridor easements and public lands adjacent to waterways
- Unstable geologic areas, fault zones, and landslides
- SWAMP water quality data

**B. Process Oriented Landscape Assessment Data Will Record Changes in Values for These Parameters over Time:**

- Stream gage data from federal, state and local gages
- Rain gage data and isohyetal maps
- Stream cross sections and profiles
- Regional curves for drainage areas, discharges, and bankfull geometry and stream channel form
- Shifts in vegetative community types over time
- Changes in conditions of flood control channels and undergrounded stream corridors
- Land use changes
- Changes in stream corridor easements, rights-of-way, public lands and private lands
- Changes in hydraulic constrictions, grades, fish barriers,
- Fish habitat assessments for all life stages
- Landscape process models (adapted from the Schumm model) which identify the evolutionary stage a channel is experiencing in reaction to land use hydrology, sediment and gradient, and natural and man-caused disturbances.
- Riverine areas which contain functioning buffers for intercepting non-point source runoff
- Watershed areas with potential for stormwater treatment and catchment swales
- Watershed areas with potential for stream daylighting

What will this kind of information tell us about a large geographic area? It can help record changes in climate, tectonics, rainfall intensities and averages, and potentially equate landscape changes to both land use and climate changes. This information can record how average channel dimensions are changing over time in different sub-regions of the Bay and how individual stream reaches compare to these average values. It can record the evolution of plant community types. The conditions of the landscape can be quantitatively assessed by comparing the existing and future landscapes against historic landscape types. It can record potential recovery or loss rates for: floodplain and vegetated corridors, better functioning equilibrium channels from flood and erosion control projects, fish passage and habitat, water quality, and evolution of channels through different stages of adjustments and recovery.

It is inappropriate to apply any numerical assessment system, designed to record broad regional landscape trends, towards evaluating the public benefits achieved through a site-specific restoration project. Restoration projects need to be subject to a much higher level of scrutiny and evaluation that compares the landscape condition against the restoration objectives intended for the project. These restoration objectives, in part, must be informed by historic landscape conditions as well the site constraints and, to some extent, the social objectives. These assessment methods must also be relevant to the restoration practitioners who need feedback on the performance of the restoration designs, project implementation, and construction strategies. Because of the huge number of variables affecting restoration projects, they require “custom designed”, case-by-case assessment strategies in order for the information to successfully serve these purposes. Therefore, it is our recommendation that in general “level three” assessments (see “Summary of CRAM Methodology” section above) be customized for any site undergoing detailed evaluation.

## IV. An Evaluation of the Currently Proposed Rapid Assessment Methodology

We evaluated the current CRAM methodology (version 4.2.3, October 2006) against the assessment needs we have identified above for a methodology that intends to: (1) capture the spatial, temporal and condition trends over time, (2) accommodate an environment that is typically governed by dynamic responses to disturbance regimes, and (3) recognize the constraints of the modern urban landscape as well as naturally occurring constraints for certain natural landscapes. Our evaluation represents a Bay Area perspective based on the knowledge of our landscape as well as observations on how this rapid assessment system may not be well adapted to other California environments.

### A. Numeric Ratings for landscape Conditions Lack Context

The first step of the CRAM assessment methodology is to assemble background information on the management and history of the sites to be assessed. There is open-ended direction to collect reports on geology, soils, projects and plans. This first step intends to set the stage for someone assessing each wetland reach to become aware of the environmental and historic context for the reaches they are rating. A two page worksheet is provided in Chapter Five of the Manual to help the evaluator to think about the land use and management stressors that may be affecting the condition of the site. Guidance on the questions to ask about natural factors attributes of the site, such as geology, soils, wildlife, endangered species or rare plant communities, is not provided (excepting fire and floods). The ecological or water quality functions the sites might perform are not noted. The information from any contextual background information collected by the evaluator does not ultimately become integrated into the assessment scoring.

The first limitation of the CRAM assessment system, as it's currently designed, is that it assigns a similar quantitative numeric value to a landscape condition which may represent a stream channel that is in a substantial state of disequilibrium and has little resiliency for accommodating a new equilibrium, or conversely a channel that is essentially experiencing a natural disturbance and is exhibiting healthy and natural processes as it evolves in a resilient manner to a new form. For example, a reach along Lagunitas Creek that is "resetting" its channel dimensions and slope and experiencing tree collapse, channel widening, sediment trapping and aggradation because it is reacting to a relatively naturally occurring flood event, would likely receive the same numeric score as a reach on San Ramon Creek impacted by a recent addition of a new storm drain and downstream culvert. Both these stream reaches could have very similar or different capabilities for accomplishing a relatively resilient response to a new equilibrium condition.

The Lagunitas Creek reach may be in a protected park, have a healthy riparian cover and a wide floodplain corridor and therefore have a good capacity for recovery. However, this reach may be near a road with a high landsliding potential and will be subject to on going disturbance from a fault system no one notices. San Ramon Creek may return to an equilibrium condition quickly because the stormwater system redirects its flows and the culvert is removed or redesigned. The creek may alternatively be subject to vegetation removal every ten years by a flood control agency. In each of these cases a numerical rating of a "low condition" doesn't record the context for the scores, which are recording the widened channels, aggradation and downed trees; therefore the ratings do not have much inherent value. An assessment system that focused specifically on recovery potentials could provide much more valuable information in characterizing landscape condition.

Meaningful quantitative, numerical assessment methods for stream wetlands need to carefully include the **context** for any given reach assessment system. Any rapid assessment needs to occur within a context that acknowledges that a reach which exhibits evidence of instability and lack of equilibrium may not be representing an “unhealthy” condition or low-ranking functioning ecosystem, but it may display a disturbance such as undercut banks that is essential to habitat diversity. The reach may be in the middle of a process of adjusting to disturbances and therefore necessarily have fallen trees, eroding banks and sediment bars. Do we assess this natural phenomenon as a low rating landscape in a quantitative assessment or as a high ranking landscape because of its unusually good habitat features? This problem informs us that meaningful rapid assessment methods for stream wetlands need to carefully include the **context** for any given reach assessment.

A geomorphic based example illustrating this context issue for assessment is the headwater streams of coastal San Mateo, which are fed by debris flows and landslides. Many of the first order channels are discontinuous, with slumping banks, disturbed riparian corridors, or excessive fine sediment loads. An assessment of habitat condition might depend on (a) timing of evaluation and (b) frequency of the evaluation. Stochastic debris flow events that occur at or near a background level in terms of frequency and magnitude are critical components contributing large woody debris and gravels to downstream reaches. Of course too much of a good process can have threshold effects leading to difficult recovery to an equilibrium state.  For example, does the disturbance happen every rain year or every ten years on the average? Habitat condition might depend on how many nearby tributaries still provide for similar aquatic beneficial uses, so that episodic habitat disturbances are not confined to100 percent of the remaining local habitat.

A plant community biology example of this context issue for assessment is particularly relevant for missing the values of the rare, old growth redwood and oak woodland riverine ecosystems. These climax plant communities may only have two layers of vegetative canopy, very little landscape “patchiness”, and only one or two dominant native tree species.  However, these communities may represent a more or less very stable climax condition characterized by a mature old growth oak or redwood forest with a sword fern ground level canopy. These habitats represent stable but lower complexity structural environments and won’t have a chance to evolve into something of greater structural complexity until there is a fire, flood or some other major disturbance. Does it make sense to provide a potential low scoring for this climax condition if our objective is to record the improvement of functioning over time?

Unfortunately, context development is the easiest factor to leave out of a quantitatively derived reach assessment and can be the hardest factor to accurately record from existing maps, documents and/or field visits.

### B. Biases against Naturally Occurring Landscapes

The CRAM guidance states that the CRAM develops an assessment rating to produce “a site scored relative to a conceptual model of what the ideal site would look like.” Reviewers of this assessment methodology should first ask to know the nature of this idealized environment against which we are ranking stream reaches.  By using the scoring system we can identify what landscapes will add up to the highest scores and therefore create a description of what this idealized landscape looks like. The assessment compares confined riverine environments to each other in one wetland category and unconfined riverine environments to each other in another category. The riverine environments receiving the highest scores within each category are those channels with the highest entrenchment ratios (i.e., with wider floodplains), channels with gravels rather than bedrock, environments with greater topographic diversity, and more diversity of native plant species. Areas receiving stormwater or non point runoff, areas with recreational use, or areas with land uses that may be impacting the environment receive lower scores.

The most probable conceptual ideal site within the confined riverine category, therefore, is a gravel stream with quite a lot of channel sinuosity and variability and floodplain, with patchy landscape plant diversity usually characteristic of earlier to mid-succession riparian communities with willows, alders, dogwood, and maples (Rosgen C channel type). The more confined, steeper gradient streams that do not have pools every 5-7 channel widths, but represent a step-pool system, with excellent undercut bank fish refugia, with a mature redwood or oak woodland mature forest (a low diversity native plant community) is a low scoring landscape using the CRAM (Rosgen A and B channel types).

A healthy river reach with high confining terraces such as occurs naturally along the San Joaquin River in the Fresno area (a natural Rosgen F channel) would also be a natural landscape that would receive a negative bias in the CRAM rating. These stream environments could be highly functioning ecosystems but do not meet the physical conditions of the idealized landscape that the CRAM rating system favors numerically. If these (Rosgen A and B, G, or F channel types) riverine systems are serving the function of infiltrating runoff, catching sediment or processing nutrients, they may be scored even lower by the CRAM.

The scores drop again if the streams are located in an area where recreation is occurring. If instead we were to apply a riverine functioning-based scoring systems to this category of confined riverine environments, the assessment would record whether the stream reaches functioned to provide instream fisheries habitat, including rearing habitat; transport of woody debris, cobbles and gravels to downstream reaches; temperature controls; nutrient uptake; benthic food sources; wildlife habitat; and support of increasingly rare mature or old growth habitat.

The most probable conceptual ideal site within the unconfined river category under the CRAM numerical rating system is a tidally influenced stream entering a wetland environment, such as a meadow or marsh in which there is a topographically diverse terrain with both floodplain and upland wetland areas and in which plant communities change frequently, with lots of “edge” effect. This environment contains a stream with a lot of sinuosity and floods large areas (Rosgen E channel type). This “conditions-based” rating is biased against the naturally occurring riverine environments located on steeper valley gradients in upstream reaches of creeks. These naturally occurring landscapes are characterized by less sinuosity, and smaller floodplains, but they may function as important habitat for amphibians, birds and other wildlife, as well as providing important functions related to water quality, sediment transport, and the support of less complex, mature riparian forests (Rosgen B and some Rosgen C channel types)

The CRAM assessment also clearly contains a bias against entrenched channels, because these channels can inherently have less environmental diversity and exhibit inherent instability. Entrenched channels are common throughout the world in Mediterranean climate regions including the Bay Area, where these channels often are actively down-cutting and/or widening. Entrenchment can be in response to: a) direct channel disturbances (e.g., channel straightening, ditching, levee building, etc.); b) indirect watershed disturbances (e.g., dam building, land cover changes); c) climate change or active tectonics; and/or d) some combination of the above factors. Active tectonics and/or wet periods with a high frequency of intense rainfall events will continue to be significant influences on the Bay Area landscapes and stream channel process-form dynamics. Interpreting the causes (context) is everything when attempting to envision what the channel reach was like prior to Europeans, what it is now, and what it could be.

The low scores assigned to entrenched channel reaches do not recognize the positive values of these channels in an urban context. Because they are entrenched, they provide a greater flood protection function. Entrenchment also provides an important function by creating a continuous corridor that is somewhat isolated from what are often intensive adjacent land uses throughout the Bay Area and much of the central and southern portions of the Coast Range. This asset, the inaccessible and isolated nature of an entrenched channel, is a function in and of itself. Finally, the low rating for entrenched channel reaches, when these are the result of natural process regimes, contributes to the mistaken impression that the single thread meandering bankfull channel is the reference (and desired) condition to which all of our channels (and managers) should aspire to. This low CRAM rating for entrenched landscapes works counter to the needs and concerns of resource agency regulatory staff, who are trying to create a balanced acceptance of this landscape type (which is here to stay for a long geologic time), because it often represents an equilibrium and “graded” condition that we do not want to have destabilized by well meaning, but misconstrued projects to fill channels and recreate a new landscape type that is not well matched with the riverine valley conditions.

This discussion is meant to illustrate that comparing different landscape conditions, or types, against each other omits the important distinction that the different landscape types perform different functions in a natural system and that one naturally occurring channel type, with its associated functions, should not be favored over another naturally occurring type through the use of an overly-simplified assessment scoring system. We recommend developing a more useful comparison system that would identify the different possible functions that could be present in particular landscape types, and then using such a method to compare similar landscape types against each other, based on the degree to which they contain these functions.

### C. Biases against Urban Landscapes

The CRAM rating system is also biased against most streams contained in, or influenced by, an urban environment. The bias is so severe that the CRAM system will not be capable of distinguishing between urban streams that function well as ecological systems from urban streams that have few natural functions. This bias could have unintended policy ramifications if the current proposed CRAM methodology is to be used to guide statewide priorities for the expenditure of restoration funds and, thereby, foreclose many excellent opportunities to improve our Bay Area watershed conditions. The unintended consequences can include an inability to measure significant improvements that restoration projects can create in increasing the health of urban watersheds. We believe that urban streams should not be given a special bias favoring these environments over other less urban environments, nor should they be subject to a bias that concludes that little can be done to increase the functioning value of streams located in urban settings.

The CRAM scoring requires an uninterrupted riparian corridor on both sides of a stream reach of 3000 linear feet to qualify for a high rating, or over a reach of 1500 lineal feet to achieve a medium rating. Landscapes with contiguous, uninterrupted riparian corridors are rarely found in the Bay Area. In order to receive high CRAM scores, stream channels also must be associated with buffer zones, in addition to the riparian corridor width. High CRAM scores are assigned to buffers widths of 600 feet width, while buffer widths of 150 feet are assigned a low CRAM rating. Most Bay Area streams would be assigned a low score for this metric. In addition, most Bay Area streams have flows with significant contributions from urban runoff; the presence of urban runoff in streams is another metric that receives low scores under CRAM. The CRAM assessment seems to have been developed for rural or low density population areas, and the lack of metrics relevant to urban areas makes it impossible for CRAM to distinguish the important differences in stream health among the reaches of urban streams in the Bay Area.

The following example is used to illustrate the bias of the CRAM assessment against urban stream restoration projects. If the CRAM is applied to assess a stream reach that was daylighted from an underground culvert five years ago in a residential neighborhood, low scores will be assigned to the restoration project. First, the numerical rating does not recognize the significance of the dramatic improvement in the functioning of a stream that has been removed from water in a pipe and placed in a functioning, above-ground ecological system. Since the urban stream's low flows are very likely to have a large contribution from urban runoff, the CRAM will assign a low score to the restored reach of creek, regardless of the water quality in the stream channel. Although the restored riparian corridor is of substantial width and length for creeks in this subregion of the Bay Area, most restoration projects have an inherent constraint on the width of the riparian corridor, because the neighborhood cannot be razed to recreate a floodplain width or a length of corridor that existed in the 1800's. Because of this the CRAM would give the restored a riparian corridor a low score that would be virtually indistinguishable from the culverted creek. This stream would also have a dense growth of native willow, alders, and dogwood, because it would be in the first stages of plant community development. This vegetation community would also give the restored reach a low CRAM assessment score.

In summary, CRAM would evaluate the restored creek in comparison to the condition of a stream in a park-like setting in order to assign the restoration a numeric score. The creek in the park setting is fed by groundwater flows, has a wider stream corridor because it is in a park and has three levels of mature vegetative canopy. Therefore, the reference reach of stream would receive a high rating, while the low CRAM score assigned to the restoration project would suggest that the project had been a failure. A policy decision maker who evaluates the value of the creek daylighting restoration project on the basis of its CRAM score is comparing this site in the neighborhood against the rating score for the stream in the park.

Therefore we are using this uniform rating system to compare sites which have inherently different land uses, as well as other unchangeable factors that will not change in our lifetimes. The policy maker is comparing sites experiencing different time and evolutionary conditions in geomorphic and biological evolution. Does this computed rating inform us of the value of our investment in the daylighting project, which is a stated objective for the role of the CRAM system? The rating system does, in fact, represent a classic case of comparing apples and oranges, because relevant context is missing from the numerical scores. What this actual CRAM assessment missed, because it is landscape "conditions-based" as opposed to "functions-based", is that the restored stream in the neighborhood is functioning as a "water treatment landscape." Water quality monitoring of such a stream would demonstrate that the stream receives nutrient loads from an upstream golf course and uptakes the nutrients into its dense riparian vegetation in the daylighted reach. The CRAM assessment would deduct points because the restored creek was receiving urban runoff. CRAM lacks a metric that would acknowledge that the restoration project is cycling nutrients that would otherwise contaminate downstream receiving waters.

## V. The Relationship between Assessments, Policy, and Decision-Making and Regulatory Needs

We would like to suggest that we evaluate the basic goals statement for the CRAM. This goal, restated is: "Large amounts of public funds and human resources are being invested in the protection, restoration, creation and enhancement of wetlands and riparian habitats in California. The State needs to be able to track the extent and **condition** of these habitats to evaluate the investments in them now and into the future".

The basic premise of this staff discussion paper is that there is great utility in changing the word "condition" in this goals statement to "functions." Our second suggestion is that we evaluate any assessment system against the objective that we do no harm by promoting its use. Finally we propose that any assessments our agencies formally recognize or adopt be measured against the performance standards of credibility, legitimacy, and salience, as described in the introduction to this paper.

### A. The Do No Harm Standard

One of the harms that the proposed CRAM assessments can pose is to compromise our current stream protection regulatory programs. A common strategy of project proponents who do not want to avoid or minimize impacts to wetlands is to propose mitigation for the loss of the wetland resources. In the cases involving proposed riparian mitigation projects, it is common for the project proponents to propose filling existing riparian environments to accommodate their site plans for housing or other land use changes. It is increasingly popular for project proponents to promote the concept that their replacement landscapes on top of the filled riparian environments will be of greater ecological value and more stable because they are filling and thereby improving entrenched channel systems. They also advance their position by stating that the existing ecosystem is "a mono-culture" of old growth trees (oaks, bays, redwoods, buckeyes) and that their landscape architects can create a new landscape stabilized through fill and diversified with a varied "native plant pallet" raised by nurseries. Using the CRAM system for evaluating landscape condition, the project proponents could easily attain a higher score for their re-created streams on fill with reduced confinement, less entrenchment, wider floodplains, greater topographic diversity and more species diversity and interspersion. If the State of California adopts a "conditions-based" landscape assessment it will compromise our ability to protect our different types of native landscapes which offer particular, and sometimes rare, functions that only these landscapes can provide.

The issue and controversies of gaining "value" by substituting one landscape type for another is not a new one. One recent historic example of this controversy arose from inexperienced consultants, public officials, and organizations applying the Rosgen stream classification system to restoration project design. The Rosgen system of stream classification has made an important and valuable advancement to the field of restoration by helping people understand how reference sites, and the data that can be collected from them, can inform restoration design. The Rosgen system recognizes that certain riverine landscapes are inherently "more stable" than others. The unfortunate abuse of the classification system has often resulted in well meaning, but uninformed, attempts to change a reach of stream to a new riverine landscape type to achieve a more desirable stable landscape condition. Serious problems can develop because the new landscape created does not take into account the historic and watershed context acting on the site. Because the newly constructed “restoration” landscape is not a good fit with the watershed conditions, the new landscape can create serious instabilities, in addition to impacting important existing ecological functions. Because regulators have experience with this tendency for counterproductive responses to riverine landscape conditions-based assessments, we want to advise the broader community of watershed professionals to learn from this experience. This unfortunate experience suggests that the potential benefits of an assessment system have to be carefully weighed against its probable misuse, and the benefits to harm ratio has to be large enough to proceed further with the assessment methodology.

### B. Credibility

The Water Board staff strongly supports outside peer review of the CRAM in order to enhance its credibility. The science going into the design of a rapid assessment system needs to resolve the differences among those advocating a “functions-based” assessment and “structure –conditions based assessment”. We recommend that the agencies and organizations sponsoring the CRAM solicit the assistance of an academic organization. An example of such an organization could be the National Center for Earth-surface Dynamics (NCED). (The NCED is a consortium of ten universities that is focused on the science of stream and floodplain ecology, assessment, management and restoration). The goal would be to conduct a peer review of the science being applied to the CRAM for riverine environments and request recommendations on how best to design a riverine rapid assessment system from a scientific perspective. Because it is obvious that substantial resources have already been invested in the CRAM, a good resolution for its future application is to use the collected data as a landscape inventory. Assessments that are “functions-based” can be developed by scientists to complement the CRAM. The scientists should receive management issues input from a diverse community of potential users of the assessment.

### C. Legitimacy

This staff discussion paper makes the observation that it is going to be difficult to promote the actual application of the CRAM assessments by regulatory agencies or granting agencies because it cannot, in its current form, address the basic needs for information that we need in order to assess the landscapes that we want to manage, improve and restore within an urban context. The case of the neighborhood daylighting stream project was presented to illustrate this problem. The daylighting project was scored lower for accepting urban land use created runoff. However, this site would receive higher scores in a numerical assessment system that recognized that creek daylighting represents a dramatic increase in the creek’s functioning as an ecosystem, because the creek has been removed from a pipe and is functioning as a natural water treatment area. The inability of the CRAM to distinguish among the broad range of low to high functioning levels characteristic of urban streams also compromises its legitimacy.

### D. Salience

The salience of an assessment system calls for the identification of the assessment needs of the stakeholders who need to have a way of measuring whether their decisions are contributing to well-considered priorities and effective measures for achieving greater watershed health. From our perspective, working within a regulatory agency, our most frequently asked questions for which we need assessments are the following, which the current form of the CRAM, unfortunately, does not address.

- How do we identify the rare and unique native landscapes for which we need to set regulatory and protection priorities?

- How do our grant programs compare "opportunistic" project proposals against each other? "Opportunistic" projects are those proposed by different interests to address flood damage reduction, fisheries restoration, pollution control, open space and parks acquisition, etc. These are the most frequently occurring projects for the obvious reason that they represent the efforts of organized agencies and constituencies. The Bay Area Integrated Water Management Plan (IRWMP) is a case in point, in which the Bay Area is faced with distinguishing among 116 opportunistic water and watershed management projects but has no adequate or relevant assessment system to accomplish this. Because the CRAM does not recognize the concept of landscapes serving multiple functioning values (a requirement of IRWMP and other state grant programs), this assessment system has little or no relevancy to helping us with this policy-making need.
- How do we best set restoration objectives for sites when opportunities provide for it?
- How do we design a scientifically defensible system to develop riverine protection corridors that can be applied through land use regulations and setback ordinances in the Bay Area? The State Water Resources Control Board-sponsored Hydromodification Workgroup is trying to advance the development of these landscape assessment methods. Because of the direct relationship between this landscape assessment need with potential very tangible watershed quality results, we would encourage this as a priority.
- How do we best identify opportunities for improving the health of watersheds? The information most cited to support this need are: identification of urban watershed locations with potential for landscape-based stormwater treatment systems, identification of critical headwater environments needed to protect drainage networks, and the inventory and assessment of hydraulic constrictions from roads, culverts and bridges. (The list on page 4 supplements this.)
- How do we help regulators best evaluate the impacts of reach-based project proposals with information on the watershed processes acting on these reaches?

Because the development of assessments needs to develop a constituency that will apply them, we recommend that this issue be addressed using a forum approach. We anticipate that an appropriate forum for addressing such important policy issues will be available in the near future through the California Coastal Conservancy's efforts to establish a Bay Area Watershed Forum. The State Water Board Hydromodification Workgroup is also a good forum for this kind of evaluation.

Reference cited: Farrell A., and J. Jager, 2005, Assessments of Regional and Global Environmental Risks: Designing Processes For the Effective Use of Science in Decision Making, University of California, Berkeley, Energy and Resources Group, Resources For The Future Press.

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