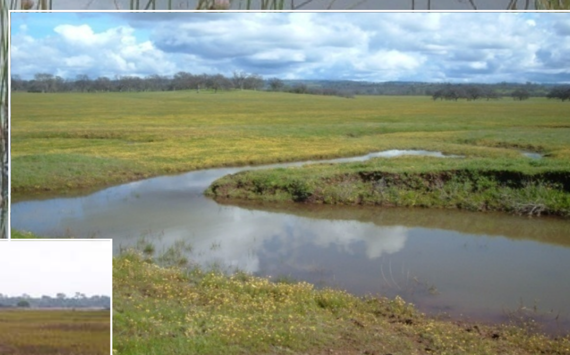
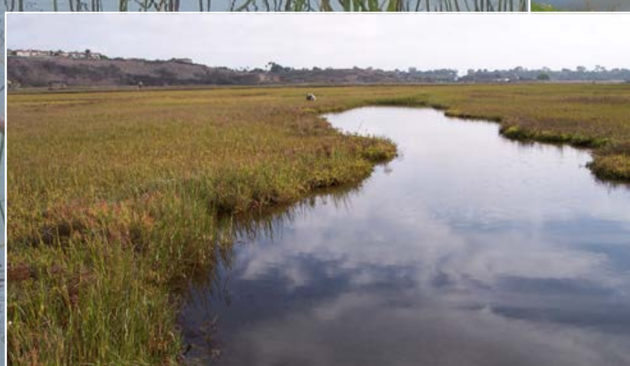
California Wetland Monitoring Workgroup Tenets of a State Wetland and Riparian Monitoring Program (WRAMP)





April 2010

California Wetland Monitoring Workgroup

Executive Summary

Millions of dollars are spent annually in California by Federal, State, and local agencies to restore and protect wetlands and riparian resources; however, the State is unable to report on the health of wetlands and riparian areas because ambient conditions are not routinely or systematically assessed, projects are monitored in disparate ways, there is little assurance of data quality, and the existing data are not readily available.

The main challenge in coordinated wetland management is that the responsibility for assessing wetlands and managing data on extent and condition currently resides with at least half a dozen different agencies. Compilation of these data is hindered by the following technical factors and by the fact that *California lacks a central agency or group with the responsibility and authority to compile and manage data across wetland programs*.

- California lacks a coherent wetland definition and classification framework.
- There is no mechanism for design and coordination of consistent wetland monitoring.
- There is no consistent database or central data management system.
- Data management across programs and agencies is uneven and inconsistent.
- There are no standard agreed upon data protocols.
- Quality assurance processes are absent, unclear, or inconsistent.
- Data are often not geo-referenced.

Some wetland data can currently be found on several web sites, including BIOS, CERES, and CAL-ATLAS. However, none of these systems serves to compile wetland data across all agencies, not all data are available to the public, and the sites are not well integrated. In addition, there is a wealth of data that resides with non-governmental agencies and joint ventures that is difficult to access. There is currently no means or incentive for these organizations to share or disseminate their data. As a result, *wetland data are not readily available within and between agencies/organizations, are not of known quality or sufficiently comparable to permit regional or statewide assessments, and are often difficult to access by the public.*

The California Wetland Monitoring Workgroup (CWMW) was established in 2009 as a subcommittee of the California Water Quality Monitoring Council. A primary goal of the CWMW is to effectively function as the forum for statewide coordination of wetland and riparian monitoring and assessment and to provide a mechanism for cooperation among state and federal agencies, non-governmental organizations, and research institutions.

To achieve its primary goal of coordinated wetland monitoring, assessment, and reporting, the CWMW recommends that a Wetland and Riparian Area Monitoring Program (WRAMP) be developed to serve all State agencies and support the State's new Wetland and Riparian Area Protection Policy. The goal of the WRAMP is to produce regular reports on trends in wetland extent and condition and to relate these trends to management actions, climate change, and other natural and anthropogenic factors in way that informs future decisions.

The WRAMP should be based on the following tenets:

- Focus on public answers to basic questions: where are the wetlands and riparian areas; what is their health status; and are the policies, programs, and projects to restore and protect wetlands and riparian areas working?
- Minimize new program costs by leveraging existing programs and projects through their use of standardized core methodologies for mapping, assessment, quality assurance, data management, and reporting.
- Use the peer review process of the SWRCB to help assure the scientific credibility of core methodologies used in ambient assessment and project assessment.
- Implement the WRAMP through regional programs served by the Regional Data Centers of the SWRCB and delimited by the boundaries of its Regional Water Boards.
- Allow regions to augment the core methodologies to meet special local and regional information needs.
- Be coordinated statewide through the CWMW on an ongoing basis.

To date, substantial progress has been made to develop the WRAMP. Key accomplishments include:

- The CWMW developed a charter and effectively functions as the forum for statewide coordination of wetland and riparian monitoring and assessment.
- The CWMW serves as the primary inter-agency clearinghouse for technical memoranda produced by the Technical Advisory Team (TAT) for the Wetland and Riparian Area Protection Policy. The memoranda to date cover wetland and riparian definitions and wetland delineation.
- The CWMW produced an interagency technical bulletin on implementation of the California Rapid Assessment Method (CRAM) for projects.
- A Committee of the CWMW was formed to develop standardized mapping protocols and a classification system for wetland and riparian areas.
- A Committee of the CWMW was formed to coordinate further development and implementation of CRAM and other rapid assessment methods.
- Wetland and riparian area mapping protocols have been developed and piloted.
- Initial statewide ambient assessments were completed for riverine wetlands (in coordination with the SWAMP program) and estuarine wetlands using CRAM.
- The first iteration of the California Wetland Web Portal has been developed and launched.

Much additional work needs to be completed. The CWMW recognizes that wetlands and riparian areas vary significantly in natural form and function among the regions of the State, that each region has a community of experts best suited to account for this variability through data interpretation. Furthermore, some monitoring of wetlands and riparian areas is already happening, although these efforts are not standardized or well coordinated at this time. Based on these considerations, the CWMW recommends the following.

- The WRAMP should consist of a network of regional and local programs coordinated by the CWMW through their use of standard methods for mapping, data collection, data management, data analysis, and public reporting.

- To account for the natural regional variations in wetlands and riparian areas, the core assessment methodologies of the WRAMP should be calibrated to reference conditions in the Level 3 Ecoregions of CDFG.

Achieving the goals of the WRAMP will require a detailed strategy that includes elements for each major category of activity that has the potential to affect wetland area or condition - permitting programs, unauthorized activities, agricultural restoration, conservation programs, and grant or bond funded conservation and restoration activities. ***The Water Quality Monitoring Council should instruct the CWMW to develop a strategy that suggests the roles and responsibilities of local and State agencies, the associated costs per region and statewide, and alternative ways to meet the funding requirements.*** Implementation of the WRAMP strategy should be coordinated by a technical team (that is a subcommittee of the CWMW) that includes representatives from Federal and State agencies, Joint Ventures and other agencies (e.g. SCCWRP, SFEI, MLML) involved in regulating or managing wetlands. This technical team should oversee implementation of the following recommendations related to the major components of the WRAMP:

Wetland Definition, Mapping, Classification, and Delineation

- Adopt a common approach for wetland and riparian classification in California.
- Adopt a common approach for wetland and riparian mapping in California.
- Develop an analytical approach and data standards for reporting on wetland changes.

Wetland Monitoring and Assessment

- Conduct ambient assessments for all major wetland classes in all ecoregions.
- Develop consistent procedures for assessing the effect of projects.
- Facilitate the adoption of rapid assessment methods as a core tool.
- Develop a strategy for prioritization of research and use of intensive assessment methods.

Data Quality Assurance and Quality Control

- Develop a coordinated quality assurance/quality control (QAQC) plan.
- Develop consistent quality control and metadata requirements.

Data Management, Outreach and Information Sharing

- Establish a coordinated and integrated data management program.
- Establish a wetland data portal as a repository of all wetland data.

This document provides detailed recommendations for development and implementation of the WRAMP, including preliminary cost estimates. The WRAMP is the first step of a long-term strategy for ongoing coordination among wetland programs in California. Implementation of the WRAMP will allow for a public accounting of results of the investment in the restoration and protection of wetlands and riparian areas in California.

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Issue

Millions of dollars are spent annually in California by Federal, State, and local agencies to restore and protect wetlands and riparian resources through longstanding public policies and programs, yet it is difficult to account for the effects of this investment. The State cannot report on the health of wetlands and riparian areas because ambient conditions are not routinely or systematically assessed, projects are monitored in disparate ways, there is little assurance of data quality, and the few existing data are not readily available.

The ability to track changes in wetland extent, distribution, and condition over time is fundamental to all wetland monitoring and assessment programs in the State. It provides the basic ability to report on status and trends and allows for the evaluation of the effectiveness of regulatory and management programs, including the Porter-Cologne Water Quality Control Act (Porter-Cologne), California Coastal Act, California Environmental Quality Act §15386 and §15381, McAteer-Petris Act, Public Resources Code §6000, Fish and Game Code §1600, US Clean Water Act §401 and 404, the California Wetlands Conservation Policy, and the Wetland and Riparian Area Protection Policy that is being developed by the State Water Resources Control Board (SWRCB). It also provides a foundation for monitoring the effects of climate change and other natural disturbances (e.g. fires and floods).

Development of a coordinated wetland and riparian monitoring and assessment programs is a key recommendation in the Natural Resource Agency's 2009 *State of the State's Wetlands Report (draft)* and is crucial for accurately assessing the Governor's "no net loss" policy, and is consistent with the central mandate of Senate Bill 1070. The ability to meet these goals and mandates will require both technical and administrative changes to the way wetland data are collected and managed.

Challenges

Responsibility for assessing wetlands and managing data on extent and condition currently resides with at least half a dozen different agencies. Compilation of these data is hindered by the following technical factors and by the fact that *California lacks a central agency or group with the responsibility and authority to compile and manage data across wetland programs*.

1. <u>California lacks a coherent wetland definition and classification framework</u>. Different state and federal agencies use one (or more) of several wetland definitions and classification systems, which impedes or prevents the collection, storage, assessment, and presentation of wetland data in a consistent framework.
2. <u>There is no mechanism for design and coordination of consistent wetland monitoring</u>. Each agency uses individual tools and monitoring approaches that may or may not be consistent or compatible with other agency programs.
3. <u>Lack of a consistent database or central data management system</u>. This makes it difficult to compile and share data across programs. Similarly, data compatibility between state and federal agencies is inconsistent.
4. <u>Uneven data management across programs and agencies</u>. The comprehensiveness and approach to data management are highly variable across agencies, varying from little to no organized data management to highly complex databases.
5. <u>No standard data protocols</u>. Each program is free to establish its own protocols, which are not consistent among programs. This makes data compilation and comparison across programs nearly impossible. Furthermore, when data protocols exist they are not readily available or clearly documented and metadata is typically absent.

6. Quality assurance processes are absent, unclear, or inconsistent. Agencies readily admit that there is uncertainty in their data, and the lack of common QA protocols makes it difficult to document the level of uncertainty in the data.
7. Data are often not geo-referenced. Information on wetland gains and losses is often not tied to a specific location. Therefore, it is difficult to determine if there is double counting over time within a given agency or over space and time between agencies.

Some wetland data can currently be found on several web sites, including BIOS, CERES, and CAL-ATLAS. However, none of these systems serves to compile wetland data across all agencies, not all data are available to the public, and the sites are not well integrated. In addition, there is a wealth of data that resides with non-governmental agencies and joint ventures that is difficult to access. There is currently no means or incentive for these organizations to share or disseminate their data. As a result, *wetland data are not readily available within and between agencies/organizations, are not of known quality nor sufficiently comparable to permit regional or statewide assessments, and are often difficult to access by the public.*

Institutional Foundations for Success

Much work has occurred over the past ten years that provides a strong foundation for addressing the above challenges, but there is still a lot that needs to occur. In 2002, a consortium of scientists and managers from around the state began developing a monitoring and assessment program modeled after USEPA's Level 1-2-3 framework for monitoring and assessment of wetland resources. The fundamental elements of this framework are as follows:

- Level 1: consists of wetland and riparian inventories and answers questions about wetland extent and distribution.

- Level 2: consists of rapid assessment, which uses cost-effective field-based diagnostic tools to assess the condition of wetland and riparian areas. Level 2 assessments answer questions about general wetland health.

- Level 3: consists of intensive assessment to provide data to validate rapid methods, characterize reference condition, and diagnose the causes of wetland condition observed in Levels 1 and 2. Level 3 assessments can be used to test hypothesis and provide insight into functions and processes.

Between 2002 and 2007 much progress was made in developing tools and partnerships to implement the Level 1-2-3 approach. Most notably the California Rapid Assessment Method for wetlands (CRAM) was developed, tested, and validated. Regional wetland monitoring and assessment methods were developed based on this framework. An example is the Integrated Wetland Regional Assessment Program (IWRAP) developed by the Southern California Wetlands Recovery Project (WRP). The IWRAP program was vetted and endorsed by the WRP member agencies, which represent the 17 main Federal and State agencies responsible for wetland regulation, restoration, and management in California.

In 2006, the Resources Agency was awarded a USEPA Wetlands Demonstration Pilot (WDP) grant to begin a phased implementation of a *statewide* wetlands monitoring program, modeled after the USEPA Level 1-2-3 approach. This program built on regional efforts and demonstrated implementation of the wetland and riparian assessment toolkit in various state agency (regulatory and non-regulatory) programs in the coastal regions of California. The WDP project also produced the first-ever assessment and report on the health of California's estuaries.

In 2008, the California Wetland Monitoring Workgroup (CWMW) was endorsed as a subcommittee of the California Water Quality Monitoring Council (see Appendix A: CWMW Charter). The CWMW evolved from the

WDP steering committee and includes both Federal and State agencies with responsibility for wetland management (see Appendix B: current Workgroup membership). The intent of the CWMW is to effectively function as the forum for statewide coordination of wetland and riparian monitoring and assessment. It provides the mechanism for cooperation among state and federal agencies, research institutions, and data center management organizations involved in tool development and implementation. The products of the CWMW are designed to implement the Water Quality Monitoring Council's vision for a coordinated methods and data management approach to water quality monitoring. Ongoing coordination of activities occurs through the various subcommittees of the CWMW operating under the Monitoring Council's overall guidance and approval.

Moving Towards a State Wetland and Riparian Area Monitoring Program (WRAMP)

The CWMW recommends that a Wetland and Riparian Area Monitoring Program (WRAMP) be developed to serve all State agencies and support the Wetland and Riparian Area Protection Policy (Policy). The objective of this Policy is to protect the beneficial uses of California's wetlands and riparian areas (http://www.swrcb.ca.gov/water_issues/programs/cwa401/wrapp.shtml). The WRAMP is based on the following tenets:

- Focus on public answers to basic questions: where are the wetlands and riparian areas, what is their health status, and are the policies, programs, and projects to restore and protect wetlands and riparian areas working?
- Minimize new program costs by leveraging existing programs and projects through their use of standardized core methodologies for mapping, assessment, quality assurance, data management, and reporting.
- Use the peer-review process of the SWRCB to help assure the scientific credibility of core methodologies used in ambient assessment and project assessment.
- Implement WRAMP through regional programs served by the Regional Data Centers of the SWRCB and delimited by the boundaries of its Regional Water Boards.
- Allow regions to augment the core methodologies to meet special local and regional information needs.
- Remain coordinated statewide through the CWMW on an ongoing basis.

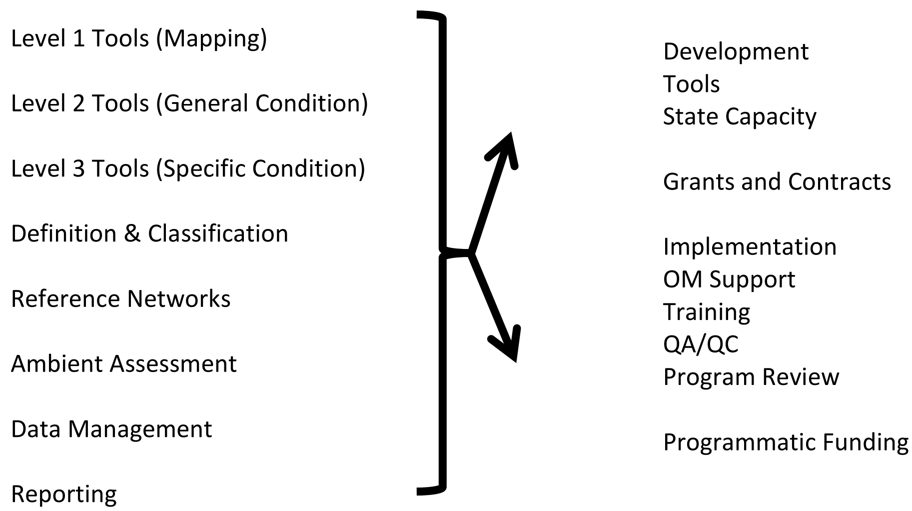
The WRAMP consists of coordinated, comparable regional and statewide efforts that use standardized methods to monitor the effects of natural processes, climate change, and government policies, programs, and projects on the distribution, abundance, and condition of wetlands and riparian areas. The standardized methods will include (Figure 1):

- definitions for wetlands and riparian areas
- a statewide classification system
- mapping and delineation protocols
- condition assessment protocols
- data transfer protocols and data quality control procedures
- analytical and reporting methods

The WRAMP will make wetland and riparian data available to the public through public information management systems. The WRAMP will be used to assess the individual and cumulative effects of local management actions, such as wetland and riparian mitigation, enhancement, restoration, and creation, on ambient conditions for a variety of spatial scales, such as watersheds, regions, and statewide.

The primary strategy for achieving this vision is to apply the standard methods through existing State programs and projects, rather than develop a new stand-alone program. The Wetland and Riparian Area Protection Policy therefore directs the Regional Water Boards to collaborate with other State agencies and regional and local interests to develop the standardized practices and methods of the WRAMP.

Figure 1. WRAMP Strategic Elements



Organization

The CWMW recognizes that wetlands and riparian areas vary significantly in natural form and function among the regions of the State, that each region has a community of experts best suited to account for this variability through data interpretation, and that implementing the WRAMP for all regions of the State at the same time is not practical or necessary to achieve Policy goals. The CWMW also recognizes that some monitoring of wetlands and riparian areas is already happening, although these efforts are not standardized or well coordinated at this time. Much of the existing efforts are related to permits issued under Fish and Game Code §1600, US Clean Water Act §401 and 404, and Waste Discharge Requirements and conditional waivers issued pursuant to the Porter-Cologne Water Quality Control Act (Porter-Cologne). Based on these considerations, the CWMW recommends the following.

- The WRAMP should consist of a network of regional and local programs coordinated by the CWMW through their use of standard methods for mapping, data collection, data management, data analysis, and public reporting.
- To account for the natural regional variations in wetlands and riparian areas, the core assessment methodologies of the WRAMP should be calibrated to reference conditions in the Level 3 Ecoregions of DFG.

Achieving the goals of the WRAMP will require a detailed strategy that includes elements for each major category of activity that has the potential to affect wetland area or condition - permitting programs, unauthorized activities, agricultural restoration, conservation programs, and grant or bond funded conservation and restoration activities. *The Water Quality Monitoring Council should instruct the CWMW to develop a strategy that suggests the roles and responsibilities of local and State agencies, the associated costs per region and statewide, and alternative ways to meet the funding requirements* (see Appendix C).

Implementation of the WRAMP strategy should be coordinated by a technical team (that is a subcommittee of the CWMW) that includes representatives from the Natural Resources Agency and Cal/EPA, relevant Federal agencies, appropriate Joint Ventures, the Southern California Coastal Water Research Project (SCCWRP), the San Francisco Estuary Institute (SFEI), and the Moss Landing Marine Lab (MLML). The technical team should be overseen and report to the Monitoring Council. In addition, the products of this workgroup should be vetted through the California Water Quality Monitoring Council. Ongoing coordination will occur through the CWMW its various committees. Potential participating agencies are listed in Appendix D.

Specific Recommendations of the CWMW

Work has begun on the main elements of the WRAMP, and is summarized below. To facilitate implementation of the WRAMP, the following activities should be undertaken:

Wetland Definition, Mapping, Classification, and Delineation

1. Adopt a common approach for wetland and riparian mapping in California. To the extent possible, State agencies should use a common set of definitions and protocols to identify and map wetlands and riparian areas in California. This is essential for leveraging various mapping efforts to assess the regional and statewide distribution and abundance of these resources and to assess compliance with California's "no net loss" directive. The CWMW should be responsible for the definitions and mapping protocols, and DFG should be responsible for maintaining and updating wetland and riparian maps as guided by the CWMW. With input from the CWMW, the Technical Advisory Team

(TAT) advising the State Water Board on the development of the Policy has developed a proposed wetland definition for regulatory purposes which was circulated for vetting by other agencies and public review in June 2009. The Council should direct the CWMW to create a Mapping Committee to coordinate the development and implementation of mapping methods. The Mapping Committee should coordinate with other state mapping efforts, especially the vegetation mapping program of DFG, and the watershed mapping program of the California Interagency Watershed Mapping Committee.

The Department of Fish and Game should be responsible for maintaining and updating wetland and riparian maps, based on the advice and review of the CWMW, with input from the basemap user communities, and making them readily available to the public. *The ultimate goal should be the production of a statewide standard basemap of* aquatic habitats *(topography, lakes, rivers and creeks, wetlands, nearshore marine areas).*

Current activities:

- A technical memorandum on a wetland and riparian definition for regulatory purposes (Appendix E) has been produced by the Technical Advisory Team (TAT) for the Wetland and Riparian Area Protection Policy. (http://www.waterboards.ca.gov/board_info/agendas/2009/oct/100609_6%20att_wetlanddefinition_final3_.pdf)
- A Committee of the CWMW was formed to develop standardized mapping protocols and a classification system for wetland and riparian areas (Appendix F: Draft California Wetland Classification).
- Wetland and riparian area mapping protocols have been developed and piloted (Collins et al.)

2. Adopt a common approach for wetland and riparian classification in California. There should be one standardized basemap of wetlands and riparian areas. However, the wetlands and riparian areas shown on the map can be classified in different ways, depending on the purpose of the classification. For example, wetlands might be classified differently with regard to wildlife support and flood control. To support the Wetland and Riparian Area Protection Policy, the CWMW should develop a classification system that helps identify the beneficial uses of wetlands and riparian areas. This does not preclude developing other classification systems for other purposes. The Council should instruct the CWMW and its Mapping Committee to develop a classification system that supports the Wetland and Riparian Area Protection Policy, and to develop guidelines for developing other classification systems based on the standardized definitions and protocols for identifying and mapping wetlands and riparian areas. The goals is for every effort to map wetlands and riparian areas in California to classify them using the system developed for the Wetland and Riparian Area Protection Policy, although additional classification systems can also be used.

   Current activities:

   - Wetland and riparian maps have been developed for portions of California using an enhanced protocol based on the National Wetlands Inventory
   - A draft procedure to select or develop a classification system for California wetlands has been developed.

3. Develop an analytical approach and data standards for reporting on wetland changes. The data standards should be based on a standard wetland classification system and define how features such as open water or riparian ecosystem elements are identified and reported. These standards should be used across all wetland programs to allow for compilation and sharing of data across

programs. In additional the efficacy of survey-based vs. probability based methods should be compared, with a goal of recommending an approach for future adoption by the CWMW.

Current activities:

- No work has begun on this yet, but initial efforts will begin in 2010 under a new project funded by USEPA.

Wetland Monitoring and Assessment

1. Conduct ambient assessments for all major wetland classes in all ecoregions. The ambient condition of wetlands and riparian areas should be regularly assessed throughout the State. The Council should direct the CWMW to develop a technical plan of ambient assessment that can be incorporated into the Surface Water Ambient Monitoring Program (SWAMP) of the SWRCB. The SWRCB should be responsible for assessing the ambient condition of wetlands and riparian areas, with interagency coordination provided by the CWMW. The goal should be regular public reports on the health status and trends of wetlands and riparian areas to help assess and forecast the ecological effects of climate change and to assess the performance of the State's policies and programs to protect these natural resources.

   Current Activities:

   - Initial statewide ambient assessments have been completed for riverine wetlands (in coordination with the SWAMP program) and estuarine wetlands using CRAM.
   - Several regional programs have been developed with proposed ambient assessment procedures, e.g. IWRAP in southern California.
   - An ambient assessment for one subclass of depressional wetlands will be conducted for one California ecoregion during 2011 under a new project funded by the Natural Resources Agency.

2. Develop consistent procedures for assessing the effect of wetland projects. Every human action on the ground that changes the extent or condition of a wetland or riparian area should be tracked through a public information system. Activities should include permitted wetland fills, agricultural activities, restoration and conservation actions, and unauthorized activities (to the extent that agencies are aware). The Council should direct the CWMW to develop and guide a technical plan for using standard habitat definitions, mapping methods, assessment methods, reporting methods, and the California Wetland Portal (www.californiawetlands.net) to track such projects from their planning stages through their completion. It is essential that the wetland and riparian areas of the projects be mapped and assessed using the core methodologies developed by the CWMW. The plan should enable the State to compare projects to each other and over time, and to assess their cumulative effects on ambient condition. The goal is to understand the individual and cumulative benefits of wetland and riparian projects at a variety of scales from watersheds to regions and statewide.

   Current Activities:

   - The CWMW produced an interagency technical bulletin on implementation of the California Rapid Assessment Method (CRAM) for projects (Appendix G).

3. Use rapid assessment methods as a core tool. The high cost of monitoring and assessment has been their main deterrent. Comprehensive monitoring of the functions and services of wetlands and riparian areas has never been accomplished for any region of the State and would require more

people and money than have ever been available for such purposes. Nevertheless, the State needs to monitor and assess its wetlands and riparian areas. The CWMW recommends using cost-effective rapid assessment methods (RAMs) to assess ambient condition, and to combine rapid assessment with more intensive measures when they are needed to design projects or assess particular aspects of condition or project performance. The CWMW has developed a California Rapid Assessment Method (CRAM) (www.cramwetlands.org) is currently being used by some California Districts of the US Army Corps of Engineers and other organizations[1]. The Council should direct the CWMW to create a RAM Committee to coordinate RAM development and implementation for all state agencies. The goal is to consistently assess the effects of policies, programs, projects, and climate change on the general health of wetlands and riparian areas at a variety of scales from watersheds to regions and statewide.

Current Activities:

- A Committee of the CWMW was formed to coordinate further development and implementation of CRAM and other rapid assessment methods.

4. <u>Develop a strategy for prioritization of research and use of intensive assessment methods.</u> In technical terms, intensive assessment (IA) is the quantification of selected processes or health aspects of wetlands or riparian areas. IA is essential to answer questions about particular plant and animal species, water quality parameters, or other health aspects that are not individually assessed using RAMs. There are many more aspects of wetland and riparian health that might be assessed using IA than time and money allow. The Council should instruct the CWMW to develop and guide an approach to prioritize and develop IA methods. The goal is to provide standard methods of intensive assessment for key aspects of wetland and riparian health that RAMs do not adequately assess.

   Successful monitoring and assessment programs are supported by research to develop methods of data collection, management, analysis, interpretation, and reporting. Past research has brought the State to the threshold of a cost-effective program for monitoring and assessing wetlands and riparian areas; the program will need a research component to maintain scientific excellence. The Council should instruct the CWMW to develop and guide a plan to identify and prioritize immediate and medium range future research needs. The goal is to create a research component of the WRAMP that directly targets the highest priority needs for new or revised technical methodologies.

   All scientific measurement methods will need to be revised and updated periodically. Lack of provision for this ongoing maintenance has contributed to problems identified with previously developed RAMs and IBIs. The Council should direct the CWMW to conduct ongoing testing, review and refinement of core assessment methods, including identification and maintenance of a statewide reference wetland area network capable of supporting calibration of methods and validation of assessment data.

   Current activities: none thus far

[1] CRAM is proposed for use in regulatory decisions by the State Water Board, pending peer review and approval of the State Wetland and Riparian Protection Policy.

Data Quality Assurance and Quality Control

1. Develop a coordinated quality assurance/quality control (QAQC) plan. Having adequate assurances and control on data quality (QAQC) means the program generates reliable data that meet the needs of wetland and riparian regulators and managers in terms of representativeness, accuracy, and precision. The QAQC should include these five aspects:

   a. *Peer Review.* The Council should instruct the CWMW to develop and guide a peer review plan to help assure the propriety and scientific credibility of the core methodologies for wetland and riparian mapping and assessment. The CWMW should also develop guidelines for establishing technical committees that incorporate informal peer review into their work, and to define the role of scientific publication of monitoring methods and results in peer review. The goal is to assure that data generated by the Policy are "consistent with scientific knowledge, methods and practice" to inform management and regulation of wetlands and riparian areas, and to assess the performance of policies, programs, and projects designed to restore and protect these natural resources.

   b. *Training.* The Council should instruct the CWMW to develop and guide a plan for training agency staff and practitioners in the proper use of the core methodologies for mapping, data collection, data management, data analysis, data interpretation, and reporting. Training may occur via a variety of venues, but curricula and instructors should be coordinated to ensure consistent training throughout the user communities. The goal is to develop trainers and curricula that can be implemented through a large variety of educational programs. Training based on this model is already being offered on the use of CRAM (www.cramwetlands.org/training).

   c. *Auditing.* The Council should instruct the CWMW to develop and guide a plan of third-party audits of selected monitoring data and reports. The audits would focus on the use of core methodologies for mapping, data collection, and data analysis. The goal is to maintain the scientific integrity of WRAMP by identifying and correcting misuse and misapplication of its core methodologies, especially in the context of project design and regulatory decisions.

   Current activities:

   - Approximately half dozen CRAM 3-day practitioner trainings and well over a dozen 1-day agency trainings have been completed. The CRAM development team has developed a relationship with UC Extension for future implementation of training.
   - The State Water Board has initiated an external peer review of CRAM. A prior peer review was completed by the Corps of Engineers Engineering Research and Development Center.
   - A plan has been developed for regional audit teams in association with the Regional Data Centers; several proposals are in consideration for full funding of the audit teams.

2. Develop consistent quality control and metadata requirements. Wetland data should be accompanied by information on the source and quality of the data, estimates of confidence in the accuracy of the data, and any notations or explanatory information from the source agency. This will aid in data interpretation and compilation and allow for appropriate qualification of the data sufficient to be able to determine whether data from multiple sources can be combined in broader assessment efforts.

   Current activities: none thus far

3. Require that all wetland data be geo-referenced or associated with a map. Multiple agencies or programs often collect data on a given project. Requiring spatial attribution will allow mapping of wetland projects. This will reduce the potential for double counting of gains or losses, will aid in the assessment of cumulative effects, and will help support regional planning and assessment programs.

   Current activities: none thus far

Data Management, Outreach and Information Sharing

1. Establish a coordinated and integrated data management program. Data management is not only a main aspect of QAQC, it is fundamental to data sharing and integration across projects, programs, and regions of the State. The Council should direct the CWMW to create a Data Management Committee (as a subcommittee of the CWMW) to include representatives from the Natural Resources Agency and Cal/EPA, the Southern California Coastal Water Research Project (SCCWRP), the San Francisco Estuary Institute (SFEI), and the Moss Landing Marine Lab (MLML). The Data Management Committee will report to the CWMW and coordinate the development and implementation of a plan that assures WRAMP data meet minimum requirements of data quality and completeness to include:

   Current activities: none thus far

2. Establish a wetland data portal as a repository of all wetland data. A main goal of the WRAMP (and the Wetlands Monitoring Workgroup) is to make all data and information about wetlands and riparian areas readily available to agencies, the private sector, and the public. The primary mechanism for this communication should be the California Wetland Portal and its Regional Data Centers. The data centers will perform initial quality control and make the data available through the statewide data network. Ultimately, these data will be accessible to the public through the statewide wetland data portal. The workgroup should identify the most logical relationships between the California Wetland Portal and existing online data libraries, such as BIOS and CERES.

   The Monitoring Council should require that all data be submitted to the Regional Data Centers. Furthermore, the Monitoring Council should instruct the CWMW to develop and guide an outreach and training plan to encourage Portal use, and for gaining insight from the user community about how the Portal might be improved. The Goal is to maximize the value of the California Wetland Portal. Information on wetland change associated with the major activities that affect wetland area (permitting programs, unauthorized activities, agricultural restoration, conservation programs, and grant or bond funded conservation and restoration activities) should be tracked through the wetland portal[2]

Current activities:

- The first iteration of the California Wetland Portal was developed and launched (www.CaliforniaWetlands.net).
- Several Regional Data Centers have been established by the State Water Board (as part of the California Environmental Data Exchange Network or CEDEN) to allow for regional compilation of water quality data from multiple programs.

[2] Functionality of Wetland Tracker has not be integrated into the Wetland Portal

- Regional Board 2 (San Francisco) is requiring data from priority Section 401 certifications to be tracked through the wetland portal. Other regional boards are considering adopting this requirement as well.

Reporting

The goal of the WRAMP is to produce regular reports on trends in wetland extent and condition and to relate these trends to management actions in way that informs future decisions. This goal will be facilitated by the large amounts of data that would ultimately be generated on an ongoing basis by many partners throughout the State. Limited syntheses of core data could be automated through the Wetland Portal for a variety of scales from watersheds to regions and statewide. However, there should also be periodic reports authored by the CWMW or its member agencies that more broadly synthesize monitoring and assessment results. For example, the WRAMP should support regular reporting to USEPA pursuant to §305(b) and 303(d) of the US Clean Water Act. The program should also generate reports on net change in wetland and riparian extent and health pursuant to the California Wetlands Conservation Policy and the SWRCB Wetland and Riparian Area Protection Policy. Production of these kinds of reports will require dedicated analyses of monitoring results and much coordination among the responsible agencies. The recent report from CWMW on estuarine wetland condition is a successful example. The Council should instruct the CWMW to develop a plan indicating what periodic reports should be developed from the WRAMP, what the reporting interval should be, and how the reports will be accomplished. The goal is to publicly account for the public investment in the restoration and protection of wetlands and riparian areas.

Next Steps

Next steps in WRAMP development have been identified in Appendix H. These steps will yield further validation studies of CRAM, protocols for regional and statewide ambient assessment including phasing of implementation, online mapping tools for local data stewards, and pilot implementation of the Wetland and Riparian Area Protection Policy at the watershed scale.

A long-term strategy should ultimately be developed for ongoing coordination among wetland programs in California. *Ultimately, there should be a single group or agency with the authority to coordinate wetland monitoring activities and to compile, manage and report on wetland data in California*. An implementation work plan will need to be developed that includes funding strategies for the recommended actions. A list of implementation priorities for the WRAMP is included in Appendix H.

Cost Implications

Ultimately, the recommended changes to wetland data management would be integrated into existing agency programs, and therefore be included in their budgets. Successful implementation of the WRAMP would improve efficiency across programs and could ultimately lead to lower overall costs by eliminating duplicative monitoring and assessment efforts and consolidating data management through the Regional Data Centers (as is recommended by the Monitoring Council).

Funding will be required to support the initial efforts of the technical team to implement the recommendations. Additional ongoing funding will be required by the CWMW and the Monitoring Council to oversee and enhance monitoring, assessment and reporting coordination efforts and by the Regional Data Centers for data management, quality control, training, reporting, and periodic updates/upgrades. *It is recommended that the equivalent of one full-time position be funded at one of the State member agencies of the CWMW for ongoing coordination and management of the State's* *wetland data systems*. In addition, the estimated initial and recurring *statewide* costs to implement each recommendation are summarized in Table 1. Detailed cost estimates are provided in Appendix I.

Table 1. Estimated Statewide Costs to Implement Recommendations

Program Element	***one-time initial costs***	***annual cost***	***total cost per cycle***	***yrs/cycle***
Wetland Status & Trends Mapping	$5,060,000	$315,000	$2,205,000	7
Revise Statewide Wetland Map	none	$420,000	$8,400,000	20
Wetland Condition Assessment	grant funded	$840,000	$5,880,000	7
Data Management (incl. QAQC)	$75,000	$1,212,500	$1,212,500	1
Reporting	grant funded	$20,000	$100,000	5
Total	**$5,135,000**	**$2,807,500**	**$17,797,500**	

The wetland mapping and condition assessments can also be implemented incrementally based on ecoregions and/or wetland classes. We estimate the unit cost for wetland mapping and condition assessment to be *$45,000/ecoregion/wetland class* and *$120,000/ecoregion/wetland class*, respectively. There are seven ecoregions and currently seven major wetland classes[3] recognized in California. The unit cost approach allows decision makers to implement mapping and assessment in a phased manner based on priorities. In addition, we recommend that the wetland and riparian mapping for the entire state be updated on a 20 year cycle, at cost of approximately $3,000 for each of the 2,800 USGS quadrangles in California.

Successful implementation of a coordinated wetland data management program will require sustainable funding and dedicated staff to coordinate among the key data providers and managers. The California Water Quality Monitoring Council has indicated that they will assume the lead role in developing a coordinated funding strategy for all elements of the State Water Quality Monitoring Program.

[3] The number of wetland classes may change over time as the TAT develops a recommended wetland classification system, and that system is refined over time.

ATTACHMENTS

ATTACHMENT A
California Wetland Monitoring Workgroup Charter
October 23, 2008
http://www.mywaterquality.ca.gov/monitoring_council/wetland_workgroup/docs/cwmw_charter.pdf

Mission
To improve the monitoring and assessment of wetland and riparian resources by developing a comprehensive wetland monitoring plan for California and increasing coordination and cooperation among local, state, and federal agencies, tribes, and non-governmental organizations. The workgroup will review technical and policy aspects of wetland monitoring tool development, implementation and use of data to improve wetland management in California.

Need for the CWMW
The need for comprehensive wetlands monitoring and assessment is articulated by the National Research Council's report on "Compensating for Wetland Losses under the Clean Water Act" (NRC 2001), which called for wetland managers to:

- conduct ambient monitoring and assessment;
- create adaptive and performance-based assessment tools to assist regulatory and management agencies;
- provide mechanisms to engage all regulatory programs via consistent approaches and tools;
- conduct assessment to provide a regional context for decision-making, including evaluation of cumulative impacts;
- develop a consistent approach to assess project performance; and
- provide a common framework and platform for data management and dissemination.

In California, no single agency has authority over aquatic resources. Regulation and management of wetlands and streams falls under the authority of six state and federal agencies. To add to this complexity, multiple programs within an agency may have authority or regulatory control over wetlands. A need exists to implement standardized monitoring and assessment tools and approaches within state and federal agencies in California. The resultant data can be used to better manage wetland and riparian resources, evaluate program efficacy, and facilitate improved coordination and communication within and between agencies.

Background and Description
The California Wetland Monitoring Workgroup (CWMW) evolved from a statewide steering committee formed to coordinate among agencies and advise on the development, implementation and routine use of standardized wetland and riparian monitoring tools. This assessment toolkit, standardized statewide, addresses the three tiered framework advocated by USEPA in their Elements Paper: Level 1-- habitat inventory and landscape tools, Level 2-- rapid, field-based assessments of condition, and Level 3-- intensive measures of condition. As state and federal agencies in California move toward implementation of the toolkit, improved coordination is needed to ensure smooth implementation and maximum utility of data collected.

The CWMW has been endorsed as a subcommittee of the California Water Quality Monitoring Council and will provide the mechanism for coordination and cooperation among state and federal agencies and data center management organizations involved in tool development and implementation. The CWMW will also coordinate with the State Water Boards' Surface Water Ambient Monitoring Program (SWAMP), as well as other related efforts, as necessary.

Membership and Representation
Representatives from state and federal agencies, as well as data center management organizations participate on the Workgroup. Meetings will be open, informal and consensus driven. The CWMW is lead by three chairs, one

each from a state and federal agency and one from a participating data center management organization. Local agencies can be represented through participation in regional teams.

Scope and Objectives

The CWMW will provide feedback on comprehensive, watershed-based, and cross-programmatic monitoring and associated linkages with resource and regulatory programs involving the monitoring and assessment of wetlands and riparian areas. Objectives for the CWMW are listed below:

Objectives

- Develop a comprehensive wetland monitoring program for the State of California;
- Agree upon core wetland and riparian monitoring and assessment tools and methods;
- Compile information on existing wetland monitoring programs and activities;
- Communicate wetland monitoring information to agency staff and decision makers at the federal, state, and local levels; and
- Agree among partner agencies on data sharing.

ATTACHMENT B
California Wetland Workgroup Membership*
http://www.mywaterquality.ca.gov/monitoring_council/wetland_workgroup/docs/cwmw_roles_responsibilities.pdf

Co-Chairs
- Craig Wilson, California Department of Fish and Game
- David Castanon, U.S. Army Corps of Engineers, Los Angeles District
- Eric Stein, Southern California Coastal Water Research Project

Participating State Agencies
- California Coastal Commission
- California Department of Parks and Recreation
- California Department of Fish and Game
- California Natural Resources Agency
- California Department of Water Resources
- California State Lands Commission
- Central Coast Regional Water Quality Control Board
- Central Valley Regional Water Quality Control Board
- Los Angeles Regional Water Quality Control Board
- San Diego Regional Water Quality Control Board
- San Francisco Bay Regional Water Quality Control Board
- Santa Ana Regional Water Quality Control Board
- State Water Resources Control Board

Participating Federal Agencies
- Natural Resources Conservation Service
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Other Participating Organizations
- Humboldt Bay Harbor District
- Moss Landing Marine Laboratories
- Southern California Coastal Water Research Project
- San Francisco Estuary Institute
- University of California at Merced

* as of January 2010

ATTACHMENT C
List of Potential Partner Agencies for WRAMP

Potential State Agency Participants:

California Department of Fish and Game
California State Coastal Conservancy
California Coastal Commission
Bay Conservation and Development Commission
State Lands Commission
California Department of Parks and Recreation
California Wildlife Conservation Board
California Department of Water Resources
California Department of Forestry and Fire Protection
State Water Resources Control Board
Regional Water Quality Control Boards

Potential Federal Agency Participants:

US Environmental Protection Agency
US Army Corps of Engineers
NOAA National Marine Fisheries Service
USDA Forest Service
US Fish and Wildlife Service
USDA Natural Resources Conservation Service

ATTACHMENT D
Suggested Strategy and Organizational Framework for the State WRAMP

Level 1

- Level 1 mapping of State Waters and Aquatic Resources should be linked to CDFG's Vegetation
- Classification and Mapping Program (VEGCAMP) and to the California Interagency Watershed Mapping Committee (IWMC).
- All Level 1 mapping products should be managed by CDFG.
- All Level 1 methods should be subject to State peer review with input from effected State agencies.
- The State Water Board should lead this peer review.
- Establish and maintain a Statewide subcommittee of the CWMW to guide development and use of all Level 1 tools.
- Level 1 Committee Agency lead: California Department of Fish and Game

Level 2

- Each module of CRAM should be subject to peer review as defined by the State Board.
- Eco-regional networks of CRAM reference sites should be maintained. For this purpose, eco-regions should be defined by CDFG.
- Establish and maintain a Statewide subcommittee of the CWMW to guide development and use of CRAM and other Level 2 assessment tools.
- Level 2 Committee Agency lead: State Water Resources Control Board

Level 3

- The CWMW should develop and implement a process to prioritize and guide Level 3 tool development.
- Each Level 3 tool should be subject to peer review as defined by the State Water Board.
- Maintain eco-regional networks of Level 3 reference sites. For this purpose, eco-regions should be defined by CDFG. To the extent possible, use Level 2 reference networks.
- Level 3 Committee Agency lead: to be determined

ATTACHMENT E
Technical Advisory Team
California Wetland and Riparian Area Protection Policy
Technical Memorandum No. 2: Wetland Definition
Final
25 June 2009

Disclaimer
This is not a draft or final California state wetland definition. This is the wetland definition recommended by the Technical Advisory Team to the Policy Development Team for the California Wetland and Riparian Area Protection Policy.

Purpose
The purpose of this memorandum is to recommend a scientific definition of wetlands to the Policy Team with enough explanatory text to support an analysis of this definition in the context of the Policy. Subsequent memoranda from the TAT will recommend a landscape framework for wetlands, an approach to wetland and riparian identification and delineation, a wetland and riparian classification scheme, a wetland and riparian mapping methodology, and an approach to wetland and riparian mitigation and assessment in the watershed context. A description of the TAT, including why and how it was formed, its membership, and its workplan is available in a separate memorandum titled "Technical Memorandum No. 1: Technical Advisory Team."

Methodology
Guiding Principles
The TAT began working on its recommendation for a State wetland definition by developing a set of guiding principles. These principles were created in a consensus process with detailed editing of the language of each point. In short, the TAT sought to develop a definition rooted in science and supported by previous approaches and the experience ensuing from them.

TAT's guiding principles for providing science support to the California Wetland and Riparian Protection Policy Development Team

- Recognizing the goal of wetlands protection, describe the wetland science needed to support the policy.
- To the extent possible, adopt a wetland definition that relies on existing approaches to wetland delineation, mapping, classification, and monitoring.
- To the extent possible, develop recommendations based on science rather than regulatory, economic, or political concerns.

Overview of Wetland Definitions

The history of the term *wetland* has been reviewed by Mitsch and Gosselink (2000), Lewis (1995), and Tiner (1999). The term has been in common usage for about a century, with formal, scientific definitions first appearing about 50 years ago. The number of definitions increased markedly in the 1960s, with more scientific and public recognition of the importance of wetlands and that they were disappearing at an alarming rate. A worldwide review of contemporary wetland definitions, with an emphasis on those from temperate parts of the globe, evokes two observations. First, only a few characteristics are commonly referenced by most of the definitions. They focus on soil saturation and its physical, chemical, and biological consequences. As such, hydric soils are one of the common and persistent physical indicators of a wetland, with hydrophytic plants as another common indicator.

There are also ecological and hydrological functions that are strongly associated with wetlands (Greeson et al., 1979, USEPA 1995). These include flood water storage, groundwater recharge, shoreline stabilization, water filtration, and support of native biological diversity. It has been estimated that in the United States roughly 150 species of birds and more than 200 species of fish depend on wetlands for their survival (Flynn 1996). As of 1988, almost 30% of all plants and about 50% of all animals that are listed as endangered or threatened in the US depend on wetlands (Niering 1988). The value of wetlands to threatened and endangered species has probably increased since then. Of all the regions in the country, the Pacific Coast region contains the largest number of at-risk species that depend on vulnerable wetlands (e.g., headwater streams and hydrologically isolated wetlands that may not be fully protected by existing federal policies). California has by far the largest number of at-risk plant species occurring within vulnerable wetlands (Comer et al. 2005). The second observation is that definitions are surprisingly variable, in spite of well-recognized physical attributes and functions. This may be a consequence of definitions attempting to address regulatory concerns specific to the agency or country that develops them rather than adhering to science-based approaches. Wetland definitions also differ due to natural variability in wetland structure, form, and landscape position. Wetlands vary in size, shape, soil properties, plant community composition, and an array of hydrologic properties, such as duration of wetness, frequency of being wet, and depth of flooding. (Mitsch and Gosselink 2000). Tiner (1999) lists 26 common wetland types in North America. According to the wetland classification system used by the USFWS (Cowardin et al. 1979), there are thousands of variations in these wetland types. The number of wetland types can be further increased by combining the Cowardin system, which is focused on the biological and physical attributes of wetlands, with other systems that also focus on water sources and landscape position (Brinson et al. 1993, Tiner 1995, 2003).

Some definitions describe wetlands as transitional areas between uplands and deepwater aquatic areas. For example the USFWS states that "Wetlands are lands transitional between terrestrial and aquatic systems…" Indeed, some types of wetlands, such as those forming lakeshores, always exist between uplands and deepwater areas. However, many wetlands are surrounded by uplands. For example, vernal pools occur in large numbers over large landscapes, yet are almost never bordered by deepwater areas. With regard to wetlands, the term *transitional* does not necessarily denote geographic location; it means that etlands are neither completely terrestrial nor completely aquatic. In a general sense, wetlands are distinct habitat types (Daubenmire 1976), land units (Zonneveld 1989), or landscape patches (Forman 1995) having terrestrial and aquatic attributes.

Comparison of Candidate Definitions

After the TAT was formed and had drafted its guiding principles for defining wetlands, its next task was to draft criteria for selecting or developing a successful definition. Based on these criteria, and after reviewing definitions currently in use by governmental agencies and scientific organizations in California, other states, other nations, or worldwide, the TAT selected nineteen candidate definitions that contained enough information to support their evaluation (Appendix A). The candidate wetland definitions were ranked by each TAT member based on the draft selection criteria. The criteria had equal value; they were not weighted. The degree to which each candidate definition met each criterion was evaluated on a simple numerical scale of 1 to 5. The degree to which each definition met all the criteria was evaluated as the sum of its scores.

Criteria for Selecting or Developing a California Wetland Definition

Defines unique features of landscapes that are neither terrestrial nor aquatic in terms of physical attributes, chemistry, ecology, and social values.

Encompasses the full range of all conditions of all wetlands of all types commonly recognized in California by regional, state, and national communities of wetland managers and scientists.

Can be translated into a standard approach to mapping and field-based delineation of wetland boundaries without unnecessarily limiting the scope or breadth of the maps or delineations.

Is the same as, or very similar to, an existing definition that has been proven appropriate through broad application by US States, Tribes, or federal agencies.

Refers to natural processes that account for the particular characteristics, functions, beneficial uses, or ecological services of California wetlands.

The TAT met to discuss the findings of each member. This provided ample opportunity to dissect the candidate definitions with regard to the selection criteria. During this initial analysis, some of the criteria were revised. The candidate definitions were then re-ranked by the TAT members working together. The final criteria are listed above.

In addition to the numerical ranking analysis of the candidate definitions, the TAT also engaged in a virtual "ground-truthing" session to determine how well the top candidates fared across a variety of California wetlands. TAT members contributed photo sets of different wetlands from across the State, focusing on conditions that illustrated the selection criteria or challenged the candidate definitions (Appendix B). Through this exercise, the TAT quickly realized which kinds of areas it was comfortable identifying as wetlands, which it definitely could identify as not being wetlands, and which had some wetland characteristics but were probably not wetlands. This discussion considered the likely formative processes of the areas and their likely ecological or physical beneficial uses and ecological services, as well as their visible characteristics.

Results

The TAT has found that a new wetland definition is needed because none of the existing, candidate definitions fully represents all the various forms or kinds of landscape areas in California that are very likely to provide wetland functions, beneficial uses, or ecological services. Some of the candidate definitions were better than others, but none met all the criteria or passed the virtual ground-truthing test (Appendix B). Of special concern was that no candidate definition adequately reflected the range in vegetation condition that is commonly expressed by any wetland type at any given time across the State, and none of the candidates adequately reflected the range in wetland condition that can be expressed by many wetland types over time. The better candidates were either too general to unambiguously cover all the wetlands types, or they were clearly too restrictive in their coverage. The TAT therefore moved forward to develop a new wetland definition based on what it had learned while comparing the candidates.

In its effort to develop a new wetland definition for California, the TAT reviewed the processes that most directly account for wetland conditions, and how these processes vary throughout the State due to climate, geology, and land use.

California landscapes are diverse and variable. The ecology of the State's deserts, mountains, and fertile valleys varies greatly with altitude, latitude, and distance inland. Each landscape in every part of the State experiences seasonal and annual variations in rainfall, and is occasionally subject to drought and deluge. And, each has clearly identifiable areas that function as wetlands. The extent and condition of these areas can be affected by rainfall, emerging groundwater (i.e., seeps and springs), normal runoff, or floods. These areas might persist all year every year for decades or longer. Or, they might occur seasonally every year or only when water is abundantly available. The TAT concluded that the California wetland definition should reflect the natural spatial and temporal variability in wetland extent and condition.

Some areas in California function as wetlands despite lacking abundant wetland vegetation. For example, non-vegetated playas, tidal flats, river bars, and ephemeral or intermittent washes provide a variety of wetland functions, including water filtration, groundwater recharge, and the support of wetland wildlife. None of these areas would necessarily be defined as wetlands according to the candidate definitions. The TAT concluded that the California wetland definition should clearly include these non-vegetated areas that mainly provide wetland functions.

The TAT recognizes that the State would benefit from having a wetland definition consistent with that used by the US Army Corps of Engineers (USACE). The benefit would be derived from the ability of the State to use the identification and delineation procedures established by the USACE, specifically the USACE's 1987 wetland manual (Environmental Laboratory 1987). Wetland delineation under the 1987 manual is a complex technical procedure that has been vetted through extensive scientific testing and legal challenges. Although the TAT rejected some of the language of the definition used by the USACE, it found that it could develop an alternative definition that meets all the suitability criteria, and is supported by the USACE 1987 wetland manual. A complete explanation of the necessary revisions to the USACE method for its use with the recommended State wetland definition will be provided in the TAT technical memorandum pertaining to wetland identification and delineation.

Recommended California Wetland Definition

The TAT has developed a wetland definition for California that meets all the suitability criteria presented above. The recommended definition is:

An area is wetland if, under normal circumstances, it (1) is saturated by ground water or inundated by shallow surface water for a duration sufficient to cause anaerobic conditions within the upper substrate; (2) exhibits hydric substrate conditions indicative of such hydrology; and (3) either lacks vegetation or the vegetation is dominated by hydrophytes.

Synopsis

The recommended definition meets all of the criteria developed by the TAT for a California wetland definition. Future technical recommendations from the TAT regarding wetland mapping, classification, delineation, and monitoring will be consistent with this definition.

The recommended definition reflects current scientific understanding of the formation and functioning of wetlands (Lewis et al. 1995, Mitsch and Gosselink 2000). Hydrology is the dominant factor in wetland formation because it controls the development of anaerobic chemical conditions, and thus strongly influences the abundance of plant species tolerant of such conditions (Voesenek et al. 2003) or indicative of them (Reed 1988).

The recommended State definition uses field indicators of hydrological regimen, substrate condition, and plant community composition to distinguish wetland areas from other areas of a landscape. This is commonly regarded as the "three-parameter approach"[1] to defining, identifying, and delineating wetland areas in the field (Tiner 1999). These are the same parameters incorporated into the wetland definition used by the USACE and the US Environmental Protection Agency (USEPA) for Clean Water Act purposes (see code D in Appendix A).

However, the recommended State definition recognizes that all three parameters may not be evident or present in some areas that provide wetland functions, beneficial uses, or ecological services at some times of the year or in some years (especially during prolonged dry periods), and that some of these areas lack vegetation and therefore may satisfy only two parameters (i.e., wetland hydrology and hydric substrates). The TAT determined that a modification for the vegetation parameter was necessary to address instances where the USACE definition is problematic. For example, the USACE methodology requires "positive" evidence that the vegetation cover is dominated by hydrophytes; areas that are not dominated by hydrophytes but that provide wetland beneficial uses and ecological services, such as tidal flats, playas, and nonvegetated river bars, are not necessarily identified as wetland areas according to the USACE definition and delineation methodology. Therefore, the TAT established a vegetation parameter in the recommended State definition that requires dominance by hydrophytes (the

[1] The National Academy of Science recommends that 'parameter' not be used in this context. In order to be consistent with the USACE identification/delineation method, 'parameter' herein refers to wetland hydrology, substrate, or vegetation.

condition required by the USACE definition) only when the wetland is vegetated. That is, the recommended State definition identifies non-vegetated areas that satisfy the hydrology and substrate parameters, such as some tidal flats, playas, and river bars, as wetlands. The recommended definition also includes wetland restoration and creation sites that lack vegetation.

The TAT emphasizes that the recommended definition pertains to circumstances that are not always readily observable. This may be due to normal seasonal or annual variability, or to the nature of the soils or plant species involved, to occasional natural events, or to recent human activities. The practical approaches to field-based wetland identification and delineation developed through several decades of federal agency experience will be helpful in applying the recommended definition.

The TAT recommends that anyone applying the recommended definition should objectively use all the appropriate indicators without any a-priori decisions on the outcomes, regardless of the circumstances. No area should be identified as a wetland unless it has been determined to have the wetland conditions specified in the recommended definition.

The TAT recommends that the State initially identify the USACE's 1987 wetland manual (Environmental Laboratory 1987), the supplement for arid regions (USACE 2008a), the interim supplement for western mountains, valleys, and coastal region (USACE 2008b), and any subsequent replacement USACE technical guidance as the primary sources for information and practices necessary for identifying wetland areas and delineating wetland boundaries pursuant to the recommended State definition. Based upon experience gained in applying the definition, the State may eventually elect to develop new reference materials that address more specifically the implementation of the definition. The TAT will produce a separate memorandum more fully addressing wetland identification and delineation relative to the recommended State definition.

Glossary of Operative Terms in the Wetland Definition or Relating to It

Altered Conditions – Altered conditions are hydrologic, substrate, and vegetation conditions that differ from normal circumstances because of recent human activity or natural processes. For example, an area may have wetland hydrology and hydric soils but lack wetland vegetation because of recent vegetation management; a floodplain area of a river might have hydric soils and vegetation dominated by hydrophytes but lack wetland hydrology because of a recent natural change in the river course; the shallow margins of a river delta in a lake may be devoid of vegetation because of recent delta deposits. Altered conditions that are not permanent are not likely to convert wetland areas into non-wetland areas.

Aquatic Area – This is any area having physical, chemical, and/or biological conditions resulting from the presence of surface water and/or shallow groundwater.

Aquatic Support Area – This is an area that either (1) meets the hydrology criterion for wetland, but not the substrate criterion (regardless of vegetation); or (2) meets the substrate criterion, but not the hydrology criterion (regardless of vegetation); or (3) meets neither the hydrology criterion nor the substrate criterion, but meets the vegetation criterion. Such areas often exist in close proximity to wetlands or in areas that are transitioning (temporally or spatially) to or from wetlands (TAT 2009).

Beneficial Uses – Beneficial uses define the resources, services, and qualities of wetland areas and other waters of the State of California that are the ultimate goals of protecting and achieving high water quality. Beneficial uses serve as a basis for establishing water quality objectives and discharge prohibitions to attain these goals.

Channel – A channel is a landscape feature with well-defined bed and banks that are formed by the gravity flow of water or that are purposefully constructed to convey water by gravity flow. Channels can be subterranean for short lengths but are generally surface features. For example, channels can pass under bridges or through culverts, but buried stormdrains, agricultural drains, and water pipes are not channels. Channels may be found in wetlands, and they can contain wetlands, deep water aquatic areas, and non-wetland aquatic areas.

Dominant – Dominance refers to the relative abundance of plant species as explained in the USACE Wetlands Delineation Manual (Environmental Laboratory 1987). The "50/20 rule" of the USACE is the recommended method for measuring dominance. It states that for each height stratum in the plant community, dominant species are those that (when ranked in descending order of abundance and cumulatively totaled) immediately exceed 50% of the measure for the stratum, plus any additional species that individually comprise 20% or more of the total dominance measure for the stratum (Corps-ERDC/EL TR-08-28, 2008).

Duration - Duration refers to the length of time that an area is continuously saturated or covered by water. It is the period available for the formation of anaerobic substrate conditions. It does not refer to the presence or lack of seasonal occurrences of inundation or saturation.

Ecological Service – Wetland processes and functions can have economic and cultural value as services to society (Zedler 2000). For example, the wetland process of storing flood waters can serve society by reducing flood risks, and the wetland process of recharging aquifers can serve society by helping to maintain water supplies.

Functions – A wetland function is something that a wetland does as a physical or ecological system. For example, wetlands store flood waters, recharge aquifers, protect shorelines from erosion, filter pollutants from water, and support of native biological diversity.

Growing Season – The growing season is the annual period during which hydrophytes can generate new tissue above or below ground. It generally corresponds to the portion of a year when daily minimum soil temperature at 30 centimeters (12 inches) below the soil surface is higher than biologic zero (5º C or 41º F). Much of California experiences a growing season that lasts all year. In colder or mountainous regions of the California, the growing season can be approximated as the period when daily maximum air temperature is above 28º F (-2.2º C).

Hydric conditions – These are conditions of upper substrate that form if saturation, flooding, or ponding lasts long enough to create anaerobic conditions. For the purposes of this definition, the minimum duration of saturation, flooding, or ponding required to form anaerobic conditions in the upper substrate is identified as seven consecutive days during the growing season. Although this minimum duration is known to vary with soil temperature, soil pH, and other environmental factors, scientific evidence indicates that in most California environments the chemical transformation to anaerobic conditions in the upper substrate occurs within seven days. Indicators of hydric conditions pertinent to California are provided in “Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region,” and the “Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0),” published by the U.S. Army Corps of Engineers, April 2008 and September 2008, respectively. This definition should be reviewed in the context of future
supplements and other revisions to the USACE wetland delineation manual.

Hydrophytes – Hydrophytes are plants adapted to survive saturated substrate. A list of California hydrophytes is available from USACE (Region 10; Reed 1988), which classifies hydrophytes into five groups based on the probability of their occurrence in wetland areas: Obligate Wetland (OBL = >99% frequency of occurrence in wetland areas), Facultative Wetland (FACW = 67–99%), Facultative (FAC = 34–66%), Facultative Upland (FACU = 1–33%), and Obligate Upland (UPL = <1%). Most wetland plant communities are dominated by OBL, FACW, and/or FAC species, yet some are characterized during dry seasons by FACU species or may become non-vegetated. Obligate hydrophytes nearly always occur in wetland areas, while FACW species typically are found in wetland areas, FAC species are as common in wetland areas as in uplands, and FACU species occur mostly in uplands. This definition may be reviewed in the context of future supplements and other revisions to the USACE wetland delineation manual or guidance documents.

Landscape – A landscape is a set of visible, physical geographic features, including landforms, aquatic areas, vegetation, land uses, and built structures that can be viewed together in a single scene. In the context of landscape ecology, landscape refers to a mosaic of patches that recurs over a broad region of the earth's surface (Forman 1995).

Normal Circumstances – The normal circumstances of an area are its unaltered hydrologic, substrate, and vegetation conditions. Identification of normal circumstances can involve an evaluation of the extent and relative permanence of any altered conditions. Normal circumstances include natural seasonal and inter-annual variations in hydrology, substrate, and vegetation conditions. Natural, purposeful, or inadvertent permanent conversions of conditions can afford new normal circumstances. For example, a river that builds a delta into a lake may alter wetlands along the lakeshore by burying them, but in time new wetlands may develop on areas of the delta that are saturated by the lake; the new lake shore represents new normal circumstances.

Permanent – Field conditions indicating wetland conditions or non-wetland conditions are permanent if they are not expected to change due to normal circumstances anytime in the foreseeable future. With regard to wetland hydrology, "permanent" means that the hydrological regime leading to anaerobic conditions in the upper substrate, or not leading to such conditions, is not expected to change in the foreseeable future. A regime leading to anaerobic conditions in the upper substrate could include recurrent seasonal inundation or saturation. A normal hiatus in such a regime does not indicate a lack of wetland hydrology or a lack of anaerobic substrate conditions in the upper substrate.

Riparian – Riparian areas exist between aquatic and non-aquatic areas and are distinguished by gradients in biophysical conditions, ecological processes, and biota. They are areas through which surface and subsurface hydrology interconnect aquatic areas and connect them with their adjacent non-aquatic areas. They can include wetland areas, non-wetland aquatic areas, and those portions of non-aquatic areas that significantly influence exchanges of energy and matter with aquatic areas (NRC 2002).

Saturated – A substrate is saturated when all easily drained voids (pores) between the substrate's particles are temporarily or permanently filled with water to, or near to, the substrate surface at pressures greater than atmospheric. This includes part of the capillary fringe above the water table (i.e., the tension saturated zone) in which substrate water content is approximately equal to that below the water table. Soil at field capacity is considered to be saturated. This definition may be reviewed in the context of future supplements and other revisions to the USACE wetland delineation manual (TAT 2009).

Substrate – Substrate is the solid organic or inorganic material that forms the physical surface of a landscape area, including wetlands.

Surface Water – Surface water is the freestanding or moving water above the ground surface.

Deep Surface Water – For tidal landscapes, deep surface water is any portion of the tidal prism that is below the local Mean Lower Low Water (MLLW) datum. For non-tidal landscapes, deep surface water is either deeper than 2.0 meters during the growing season; or deeper than the greatest depth from which rooted vascular vegetation grows to the water surface, whichever is deeper. Areas temporarily inundated by deep surface water can be wetlands if such inundation does not persist throughout most of the growing season. For example, wetland areas on floodplains that are temporarily deeply inundated can retain wetland conditions and subsequently function as wetlands.

Shallow Surface Water – For tidal landscapes, shallow surface water is any portion of the tidal prism that is bounded by the local Mean Lower Low Water (MLLW) datum and the local maximum high tide contour as adjusted for the current tidal epoch. For landscapes that are not tidal, shallow surface water is not deeper than 2.0 meters for most of the growing season, or not as deep as the maximum depth from which rooted vascular vegetation grows to the water surface, whichever is deeper.

Upland (aka non-aquatic area) – Upland areas lack any field-based indicators of aquatic areas.

Upper Substrate – The upper portion of substrate, which includes the root zone for vegetation and the zone within which relevant anaerobic chemical conditions develop in wetlands, extends downward from the substrate surface to a depth of 50 centimeters (20 inches).

Vegetation – Vegetation consists of rooted emergent macrophytes, including monocots, dicots, ferns, and kelp. An area is vegetated if at least 5% of it is covered by vegetation.

Wetland Indicator – A wetland indicator is a measurable characteristic of a wetland parameter. For example, for the hydrology parameter, a wetland is indicated by substrate saturated by groundwater or shallow surface water; for the substrate parameter, an indicator is hydric substrate; for the vegetation parameter, an indicator is dominance by hydrophytes.

Wetland Parameters – A wetland parameter is a category of indicators used to identify and delineate wetland areas. Hydrology, substrate, and vegetation are wetland parameters.

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ATTACHMENT F
Criteria for Selecting or Developing a Classification System for California Wetlands
DRAFT
Version 3.0 12/22/09

A. **Represents full range of CA wetland form and function**

California has extraordinarily diverse wetlands and riverine systems because of its physiographic and climatic variability. The purpose of this criterion is to assure that the classification system captures the extreme forms of wetlands and riverine systems that typify alpine, coastal, desert, and temperate rainforest conditions, and that it captures the major variations in wetland form along the continuum of conditions between the extremes, *to the extent that the variations can be discerned during wetland and steam mapping* (see "B" below).

B. Can be applied during mapping

Some classification systems are based entirely on indicators that are evident in aerial images, satellite images, or on maps. Other systems modify such indicators based on information about management objectives or field conditions that cannot be known without site-specific reports or site visits. The purpose of this criterion is to make sure that the wetlands can be classified during wetland mapping without field visits or site reports, other than QAQC procedures, assuming that the mapping is based on 1-m pixel resolution color imagery or CIR imagery viewed at scale 1:5,000 (i.e., based on the draft State wetland mapping protocols).

C. Supports ambient assessment

The classification system will be part of the State Wetland and Riparian Area Monitoring Program (WRAMP). The wetland maps need to serve as the sample frame for both rapid and intensive assessment. The classification system must therefore be consistent with the typology that is dictated by the assessment methods. The State has no standard methods of intensive assessment of wetlands. However, the State is examining how the California Rapid Assessment Method for wetlands and wadeable streams (CRAM) might be used in regulatory and other contexts. CRAM recognizes ten wetland types. For each type, there is a unique version of CRAM.

D. Is consistent with nomenclature of CA wetland policies and programs

A primary goal of the WRAMP is to evaluate the performance of the State's policies and programs for protecting and restoring wetlands and riparian areas. This means that the classification system needs to recognize the types of wetlands that are named in the State's policies and programs. For example, since the State has an Interagency Vernal Pool Stewardship Initiative, it needs a classification system that specifically identifies vernal pools. The State is developing programs to protect montane wet meadows. It therefore needs a classification system that recognizes wet meadows. All wetland types that are targeted by State policy or programs will be identified.

E. Can be adequately cross-walked to other systems, especially NWI

For the State's effort to map wetlands to enjoy federal funding, it must be consistent with, or exempt from, the wetland mapping standards promulgated by the Federal Geographic Data Committee (FGDC). At this time, the FGDC standards require using the Cowardin system of wetland classification based on guidance from the National Wetland Inventory (NWI) of the USFWS. The Cowardin system will be provided for review. However, the FGDC standards allow NWI to accept maps that do not strictly use the Cowardin system. NWI knows that many states have their own, unique wetland mapping and classification systems that could benefit NWI through a process of data translation and transference.

F. Complements the VegCAMP

The State is implementing a statewide initiative to map vegetation (VegCAMP 2007), and has recently expressed interest in integrating vegetation mapping with wetlands mapping. VegCAMP does not map wetlands per se, but does map associations and alliances of plant species that are suggestive of wetlands. The wetland maps should help predict plant species distributions, and VegCAMP should help identify candidate wetland areas.

G. Aids identification of site-specific beneficial uses

The classification system should help wetland managers and regulators determine the kinds of beneficial uses or ecological services that any given wetland is likely to provide. This is a particular purpose of the State wetland map. It might be accomplished by annotating each mapped wetland with information about water source, geomorphic setting, position in drainage network, land use context, etc. The existing classification systems that address these kinds of factors for wetlands, such as LLWW of the USFWS (Landscape Position, Landform, Water Flow Path, Waterbody Type), will be carefully reviewed. The classification system would ideally be cross-referenced to the habitat classification system of the California Wildlife Habitat Relationships database.

H. Can be expanded or contracted without requiring new inventories or maps

State policies and programs that focus on one or a few wetlands types tend to subtypes of special interest. For example, the focus on vernal pools has revealed numerous subtypes of them relating to variations in soil chemistry, hydroperiod, characteristic flora, etc. The increasing interest in wet meadows is likely to cause more kinds of them to be recognized. The classification system should be adjustable to accommodate such changes in the scope and specific focus of wetland policies and programs.

I. Is not too elaborate or complicated

Classification can be an expensive aspect of mapping. To minimize the cost, the classification system should be no more complicated or involved than needed to meet the other criteria.

ATTACHMENT G

Technical Bulletin: *Using CRAM (California Rapid Assessment Method) to Assess Wetland Projects as an Element of Regulatory and Management Programs*. Produced by the California Wetlands Monitoring Workgroup

October 13, 2009

Many individuals representing numerous State and Federal agencies contributed to the preparation of this document. The principle contributors are listed below, although many other people provided technical review and comment.

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1. Introduction and Goals

In 2003, a consortium of Federal, State, and local scientists and managers began working to develop a framework and consistent set of tools to support wetland and riparian monitoring and assessment across a variety of agency programs. The overall goal of this effort is to provide tools to inform decisions regarding wetland and riparian resource protection and management and to improve coordination and efficiency of various State and Federal wetland programs. The conceptual approach and collection of existing wetland and riparian assessment tools is modeled after United States Environmental Protection Agency (USEPA) Level 1-2-3 framework for monitoring and assessment of wetland resources. The fundamental elements of this framework are:

Level 1: consists of map-based inventories of wetlands and related habitats, including rivers, streams, and riparian areas, plus related projects that have a direct effect on the distribution and abundance of wetlands and related habitats. Level 1 maps can serve as the basis for landscape and watershed profiles of wetland systems, and as sample frames for surveys of wetland condition based on Level 2 and Level 3 tools.

Level 2: consists of rapid, field-based assessments of the overall condition or functional capacity of wetlands and/or their likely stressors. Level 2 results can be used to cost-effectively survey the overall condition of wetlands across landscapes, watersheds, and regions.

Level 3: consists of quantitative measurement of specific wetland functions or stressors. Level 3 results can be used to calibrate and validate results from Level 2 assessments.

Existing tools that support the Level 1-2-3 framework include: Level 1 - standardized wetland, riparian, and vegetation mapping methodologies and the Wetland Tracker information system that provides Level 1 maps and Level 2 and Level 3 monitoring data to agencies and the public; Level 2 - tools to assess landscape scale stressors and the California Rapid Assessment Method (CRAM); and Level 3 – traditional assessments such as macroinvertebrate IBI for wadeable riverine ecosystems, draft periphyton IBI, standardized water chemistry and toxicity assessment methods, geomorphic or hydraulic surveys, plant surveys, or bird surveys.

The Level 1, 2, and 3 tools are intended to be used for a variety of applications including restoration planning, ambient or regional monitoring and assessment (such as: the Southern California Wetland Recovery Project's Integrated Wetlands Regional Assessment Program, the Bay Area Wetlands Regional Monitoring Program, and the State Surface Water Ambient Monitoring Program), project evaluation to inform regulatory decisions (such as, Section 401 and 404 permits), restoration or mitigation site evaluation, and general resource or watershed planning. The selection of a specific assessment tool, its precise application, quality control, and reporting needs for the wetland assessment tools may vary based on the purpose of the assessment and the desired outcome. However, each of these applications provides an important element of our overall understanding of wetland condition and should be considered when making decisions regarding wetland regulation, restoration, or management.

A common set of assessment and data management tools can help coordinate the various programmatic applications. Such coordination will allow ambient/regional assessments to provide context for project specific assessments and, conversely, will facilitate incorporation of project specific data into regional evaluations. Several resources are available to guide the use and application of the tools, including technical documents and online resources (Collins et al. 2007, Sutula et al. 2006, Stein et al. 2007, Stein et al. 2009; www.cramwetlands.org). General application is also described in the white paper "Improving Monitoring and Assessment of Wetland and Riparian Areas in California through Implementation of a Level 1, 2, 3 Framework" by Stein et al. (2007).

A. Interagency Coordination and Policy Considerations

As with any assessment method, discussion and debate on some elements of CRAM and its application is ongoing. As a result, it is expected that CRAM will continue to evolve in response to new data and changing needs of the user community. We encourage ongoing dialogue on differing viewpoints and perspectives with a goal of continuing to improve the utility of CRAM for both ambient and project assessment. To facilitate dialogue on technical aspects of CRAM and the policy implications of its use, the California Wetlands Monitoring Workgroup, under guidance from the California Water Quality Monitoring Council will form a *Level 2 Assessment Coordinating Committee*. Coordination of this committee will be provided by Water Boards staff. This committee will provide a forum for agency staff to discuss policy issues that are beyond the scope of this technical document. The committee will also interact with the CRAM principal investigators to develop priorities for future CRAM refinements, additional module development, QA/QC, ongoing testing, and validation, and reporting. This committee will also provide guidance for the training, testing and auditing of practitioners and trainers.

The purpose of this document is to address technical issues related to the use of CRAM for project assessment. The intent is to support consistent and appropriate application of CRAM for regulatory, mitigation, and restoration projects across a variety of state and federal agency programs. This document does not constitute official guidance or policy by any agency, rather it addresses a set of technical issues and considerations. This document cannot anticipate every situation or contingency that may arise in the wetland regulatory or grant-funded restoration programs. Users are encouraged to consult with agency staff on questions regarding use of CRAM in specific project circumstances.

2. Background on CRAM

CRAM is a component of a broader wetland assessment toolkit that has been developed in California based on EPA's Level 1-2-3 Framework for wetland monitoring and assessment. ***CRAM can be an effective tool for assessing the overall condition of a wetland when used as directed by trained professionals in a comprehensive program of wetlands monitoring that also includes accurate mapping of wetlands and careful quantification of essential wetland functions. CRAM is not intended to be used as a single, independent tool to meet all wetland monitoring and assessment needs***.

The USEPA has funded the development of CRAM as part of a broad effort to increase the abilities of California government agencies and Tribes to assess the status and trends in condition of wetlands and riparian areas (Collins et al. 2007). CRAM provides consistent and comparable assessments of wetland condition for all wetlands and regions in California, yet accommodates special characteristics of different regions and types of wetlands. CRAM assesses the overall condition of wetlands; the results of a condition assessment can be used to infer the ability to provide various functions or services to which a wetland is most suited.

CRAM assessments have four attributes: landscape context, hydrology, physical structure, and biotic structure. They also identify key stressors that may be affecting wetland condition. CRAM has been subject to extensive peer review and iterative refinement for all CRAM wetland types. In addition, riverine and estuarine classes have been validated against independent Level 3 measures of condition including benthic invertebrates, riparian birds, and estuarine plant richness and diversity (Stein et al. 2009). This has resulted in refinement of the metrics for these wetland types and provides for a higher level of confidence in the ecological meaning of CRAM scores. Similar validation efforts are planned for other wetland types over the next several years beginning with depressional wetlands.

CRAM metrics and attributes can be related to wetland functions, values and beneficial uses, although they are not measured directly by CRAM. For the purposes of CRAM, *condition* is defined as the state of a wetland assessment area's physical and biological structure, the hydrology, and its buffer and landscape context relative to the best achievable states for the same type of wetland. Condition is evaluated based on observations made at the time of the assessment. CRAM does not measure *functions*, which are rates of characteristic processes or services over time. CRAM condition scores are correlated with some wetland functions and hence one can infer whether certain functions are or are not likely to occur based on a CRAM condition score. The likelihood of occurrence of a specific function is sometimes referred to as *functional capacity*. An important distinction between CRAM and functional assessment methods is that the condition scores in CRAM reflect aggregations of multiple functions, as opposed to providing insight into the performance of individual rates or processes of specific functions.

The fundamental unit of evaluation for CRAM assessments is termed the Assessment Area (AA). The AA is the portion of the wetland that is assessed using CRAM. For small wetlands, the AA might include the entire wetland, but for most wetlands and streams, the AA will include a portion of the wetland (or a reach of the stream). An AA is typically defined as a portion of the wetland (or stream) that is hydrologically and geomorphically homogenous and can be assessed within four hours (see Section 5). Assessing the overall condition of larger and/or structurally diverse wetlands requires multiple AAs. The CRAM Users Manual provides procedures for defining an AA and recommended minimum and maximum AA sizes for each CRAM wetland type.

Consistent use of CRAM will facilitate comparisons of condition across projects, programs, and agencies and will promote data sharing between various wetland programs. The general procedure for using CRAM consists of eight (8) steps:

Step 1. Assemble background information about the management of the wetland.
Step 2. Classify the wetland using the manual.
Step 3. Verify the appropriate season and other timing aspects of field assessment.
Step 4. Estimate the boundary of the AA (subject to field verification).
Step 5. Conduct the office assessment of stressors and on-site conditions of the AA.
Step 6. Conduct the field assessment of stressors and on-site conditions of the AA.
Step 7. Complete CRAM assessment scores and QA/QC Procedures.
Step 8. Upload CRAM results into regional and statewide information systems.

There is a "field to PC" data management tool (eCRAM) to facilitate data quality control and availability. The eCRAM allows uploading of CRAM scores to the statewide database (www.cramwetlands.org). These data will be integrated with Level 1 maps in the Wetland Tracker to facilitate easy viewing and downloading of data on wetland extent and condition.

Like all assessment methods, CRAM will be continuously refined based on user feedback; consequently, the application of CRAM may adapt over time as more experienced is gained. The CRAM Team currently provides annual updates and revisions to the method. Information on CRAM, updates and revisions, and the CRAM statewide database can be found at www.cramwetlands.org.

3. CRAM Applications

A. Appropriate Wetland Types for CRAM Assessments

The CRAM typology recognizes six major wetland types, four of which have sub-types (Table 1). For CRAM, the term "wetland" is as defined by the U.S. Fish and Wildlife Service under the Cowardin et al. (1979) system[1]. CRAM assessments are independent of the jurisdictional boundaries of any agency (different agencies often have different jurisdictional boundaries). Consequently, CRAM Assessment Areas may include areas considered wetlands, waters of the United States, waters of the State, or uplands, depending on the specific site, type of system being assessed, location in California, and specific agency jurisdictional definition. CRAM does not delineate jurisdiction, nor are CRAM assessments constrained by jurisdictional boundaries.

[1] Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Table 1. The CRAM Wetland Typology. Table shows wetland types for which CRAM modules currently exist. Future versions of CRAM may add additional wetland classes.

CRAM Wetland Types	***CRAM Sub-types (these are recognized for some but not all metrics)***
Riverine Ecosystems	Confined Riverine Ecosystems
	Non-confined Riverine Ecosystems
Depressional Wetlands	Individual Vernal Pools
	Vernal Pool Systems
	Other Depressional Wetlands
Estuarine Wetlands	Perennial Saline Estuarine Wetlands
	Perennial Non-saline Estuarine Wetlands
	Seasonal Estuarine Wetlands
Playas	no sub-types
Slope Wetlands	Seeps and Springs
	Wet Meadows
Lacustrine Wetlands	no sub-types

For the purposes of a CRAM assessment, a riverine ecosystem consists of the riverine channel and its active floodplain, plus any portions of the adjacent riparian areas that are likely to be strongly linked to the channel or floodplain through bank stabilization and allochthanous inputs. As stated above, a riverine CRAM Assessment Area will often consist of areas considered wetland and non-wetland, depending on the location and the specific agency jurisdictional definition.

CRAM was not designed for use in the assessment of subtidal habitats and intertidal areas with less than 5% vegetated cover of emergent marsh. In addition, CRAM is also under refinement for certain subclasses of wetlands, including ephemeral streams and seasonal depressional wetlands. The CRAM biotic metrics are scaled to produce higher scores based on high structural complexity. Seasonal wetlands and headwater streams often have naturally lower complexity. Consequently, the current version of CRAM may inherently produce lower scores for these wetland types. Future refinements of CRAM are planned to address this situation and more appropriately assess these wetland types.

CRAM has undergone extensive technical and peer review. Review has occurred at several levels:

- Technical input in development of the method. A variety of individuals with different expertise and perspectives participated in the development and testing process. Literally hundreds of individuals from all levels of government, academia, and the private sector were involved in various aspects of CRAM development and testing.

- Formal technical review. To date, two peer-reviewed journal articles have been published on CRAM and the Corps of Engineers Engineering Research and Development Center (ERDC) completed an external technical review. These reviews have focused on the overall structure and technical approach of CRAM and on validation of the riverine and estuarine assessment modules. Although individuals may disagree with the results of these reviews, they are valid endorsements of the technical efficacy of the method.

- Acceptance by application. CRAM is being applied by some practitioners and agencies at staff discretion on a phased and trial basis, as recommended by this document. Increased application of CRAM may be the ultimate form of “peer” review in that it indicates a level of acceptance and confidence in the method. It is too early to judge the general acceptance of CRAM; however, we note that it has already been used in several assessments of program performance, several ambient monitoring efforts, and to support several project-specific permit evaluations (see Appendix A).

The California State Water Resources Control Board has requested an external peer review of CRAM according to the official California EPA peer review process. As of the publication of this document, this review is still in process.

The iterative evaluation process has produced metrics that have been shown to reflect the gradient of condition (and hence disturbance) for all classes listed in Table 1. A summary of external technical reviews of CRAM in terms of direct peer-review and peer-reviewed publications is provided in Appendix A.

B. Appropriate Uses of CRAM

CRAM is intended to be a diagnostic tool to provide an assessment of overall wetland condition. In many cases, CRAM will need to be used in conjunction with Level 1 and 3 methods to support the assessment of wetland condition for decision-making purposes. The particular applications of CRAM for specific projects will ultimately be at the discretion of each agency as part of its permitting or grant programs. Some appropriate uses include:

Ambient assessment of wetland condition – CRAM may be used alone or with other methods to characterize wetland condition within a landscape, watershed, or region. Such assessments are often conducted based on a probabilistic sampling design where a statistically representative sample of wetlands is assessed and used to make inferences about the overall condition of the larger population of wetlands in the geographic area of interest.

- Monitoring of ecological reserves, mitigation banks, wildlife refuges or similar management units.

- Assess capacity to deliver some Beneficial Uses

- Evaluation of pre-project conditions at potential impact sites.

- Evaluation of impacts associated with unauthorized (enforcement) actions. This may be accomplished by conducting CRAM assessments on nearby AAs in addition to the site of the unauthorized activity. This would allow generation of an assumed CRAM score based on expected, pre-disturbance conditions. Such "retrospective" CRAM scores should not be entered into eCRAM.

- Evaluation of pre-project conditions at potential mitigation or restoration sites.

- Assessment of performance or success of mitigation or restoration sites.

- Assessment of mitigation compliance – CRAM may be incorporated into the performance criteria for compensatory mitigation (along with other measures) in order
- to meet the recommendations for function/condition based assessment under the new Corps of Engineers/USEPA mitigation rule.

- Comparison of proposed alternatives for regulatory or restoration planning purposes. An anticipated CRAM score can be generated based on one or more project design alternatives. This would involve a series of assumptions about the expected structure and composition following implementation of a proposed project. Such "projected" assessments are intended to aid in the evaluation of the relative condition of several alternatives. Projected CRAM scores should not be entered into eCRAM (see below for more information).

- CRAM is not intended to be used as a "cook book" to provide a specific answer to a management question. Rather, CRAM is intended to be used to inform decisions that are made based on numerous considerations and may include other assessments in addition to CRAM.

C. Inappropriate Uses of CRAM

This list provides some examples of inappropriate uses of CRAM; however, it is not exhaustive. The appropriate agency should be consulted prior to any application of CRAM (see below).

- Jurisdictional determinations
- Focused species or threatened and endangered species monitoring
- Evaluation of specific management questions that call for Level 3 monitoring
- Evaluation of compliance with water quality objectives
- Assessment of mechanisms or processes of wetland function (diagnostic evaluation of wetland function)
- Assessment of wetland values.
- Use of CRAM metric descriptors as stand-alone project design templates

It has been well documented that wetlands provide a variety of values that are beneficial to people, such as floodflow attenuation, aesthetics, and contaminant sequestration. CRAM is designed to evaluate the ecological condition of a wetland in terms of its ability to support characteristic plants and animals. Human use values cannot be appropriately assessed using CRAM.

In addition, while the narrative descriptions of best attainable conditions for the CRAM metrics can be used as general guidelines for overall project designs, they do not account for site-specific constraints and opportunities or design objectives. Because CRAM has been calibrated against statewide conditions, it is not appropriate to design a specific project based on the descriptions contained within each metric.

D. Modifying CRAM Methodology

All CRAM attributes should be assessed and reported when conducting an assessment. ***Under no circumstances should a practitioner modify CRAM metrics or attributes.*** Doing so will invalidate the CRAM assessment. CRAM has been developed through an extensive process of testing, calibration, and validation, and has been subjected to extensive technical and peer review. *Ad hoc* modification of the method will reduce or eliminate the scientific reliability and defensibility associated with the extensive development and review process of CRAM. Additional Level 2 or 3 assessments may be used to supplement CRAM results and to help evaluate progress toward meeting specific project objectives. However, these methods should not be "hybridized" with CRAM to form a new single assessment method.

E. Multiplying CRAM Scores by Size of the Assessment or Project Area

Multiplying a CRAM score by the area or linear distance of the AA may not represent the true relationship between conditions at different scales and area/linear extents. Use of CRAM scores in deciding mitigation requirements or performance criteria should recognize this limitation. Many of the CRAM metrics are designed to account for the effect of wetland size on condition, and several metrics are explicitly scaled by size. In addition, CRAM scores do not represent functional capacity on a per acre or per unit basis. Multiplying CRAM score by any dimension of size, such as wetland area, length, or perimeter, might distort the scaling of some metrics, weight the values of other metrics in unintended ways, and thus lead to erroneous results. While combining assessments with the spatial dimensions of the areas being assessed might be desirable, there are insufficient data available at this time to evaluate such practices.

It is anticipated that the necessary data will be developed during the early phases of CRAM implementation. Future versions of these guidelines will revisit this issue as additional data become available. Use of CRAM scores in deciding mitigation requirements or project performance criteria should recognize this current limitation of CRAM. Changes in wetland area are more appropriately assessed using a Level 1 tool.

F. Summarizing Multiple CRAM Scores

CRAM is intended to provide insight into the condition of the wetland Assessment Area (AA) being assessed, where the AA is defined and delineated based on the guidance provided in the CRAM manual. When the AA is the same size as the wetland, the CRAM score pertains to the wetland as a whole. If the wetland is larger than the recommended AA and the intent is to assess the entire wetland, then multiple AAs should be independently assessed following the procedure outlined in Section 5 of this guidance document.

The assessment of a large wetland or project using multiple Assessment Areas requires an integrated summary of the results. The following suggests three ways to summarize the results from multiple assessments.

The multiple scores for each metric can be averaged, and these average metric scores can be used to calculate average attribute scores and an average overall AA score for the area being assessed. However, there are insufficient data available at this time to describe the statistical distribution of the metric scores, of their averages, or of the Attribute scores and overall AA scores calculated from the average metric scores. Therefore, no CRAM scores should be statistically analyzed using parametric procedures. Non-parametric procedures might be used, although this practice has not yet been fully investigated. Any statistical analysis of average metric scores or other scores derived from them must be fully rationalized in the report of results.

It is very difficult, if not impossible, to interpret the meaning of average values of several attribute scores or the significance of an average CRAM score for multiple AAs. Multiple combinations of metrics scores will yield the same Attribute score, and multiple combinations of Attribute scores will yield the same overall AA score. Each Attribute score or AA score can only be explained by its particular set of contributing metric scores. When multiple scores for an Attribute are averaged, or when multiple AA scores are averaged, the link to the explanatory metric scores is blurred, if not lost entirely.

Each metric score, Attribute score, or AA score can be compared to the distribution of comparable scores from the regional or statewide Level 2 ambient survey for the type of wetland being assessed (see Figure 1). Overall condition for the wetland can therefore be assessed by comparison against a regional distribution of such scores or as the number of scores that fall into each quartile (or other percentile) of the ambient data set. This approach to summarizing multiple CRAM assessments does not involve any averaging and therefore avoids the attending difficulties in interpretation. This approach has the added benefit of linking project assessment to ambient assessment in a way that clearly illustrates their interdependence. More information on interpreting CRAM scores can be found in Section J below.

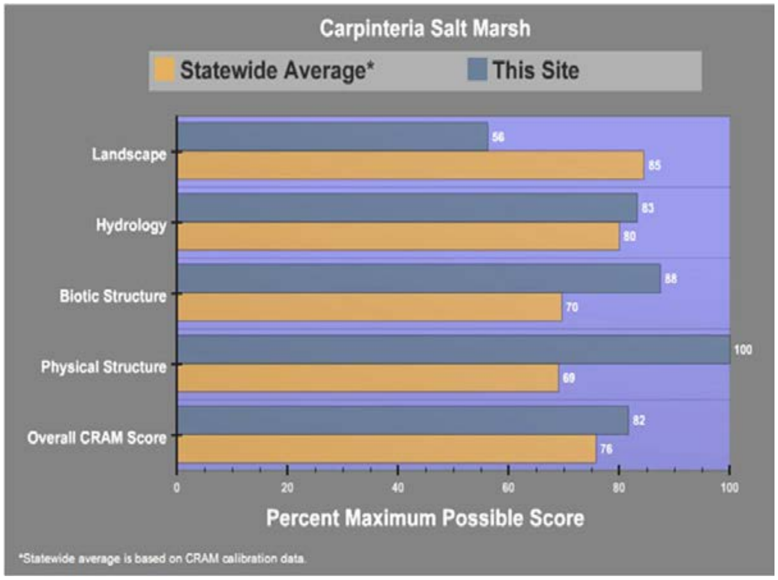


Figure 1: Example comparison of CRAM scores for a specific site to average CRAM scores for the State

G. Process to address technical issues with CRAM

Like all assessment methods, CRAM will continue to evolve and be refined with application. Comments or suggestions regarding improvement, modification, or adaptation of CRAM for specific applications can be submitted on the CRAM website (www.cramwetlands.org). All submitted comments are reviewed by the CRAM development team and used to inform annual CRAM updates and revisions. In general, suggested modification to CRAM, eCRAM, and Wetland Tracker will be compiled annually in winter, when field work is complete, and any supported modifications will be completed prior to the following field season. Technical changes to CRAM will be done by the CRAM Principal Investigators in consultation with the audit teams. Uncertainties or differences in opinion regarding application of CRAM will be addressed by the California Wetland Monitoring Council. All individuals who register on the CRAM website will receive email alerts regarding CRAM updates and opportunities to participate in occasional CRAM workshops where proposed updates are discussed.

H. Requirements for Practitioner Expertise and Training

CRAM is relatively rapid but it is not necessarily easy to apply. CRAM involves a systematic, detailed examination of wetland structure at various spatial scales. According to the CRAM manual, completion of a CRAM assessment requires expertise comparable to that necessary to conduct a wetland jurisdictional delineation. However, additional expertise in wetland botany and geomorphology is helpful in many cases.

A training program for instructors and practitioners has been developed, but the training to date has been too limited to adequately quantify how much training and practical experience is needed, or how this is affected by previous experience and background. The early indications are that people with abundant experience in some form of field-based environmental assessment learn CRAM quickly, while less experienced people take longer to achieve the same level of competence; still most people who want to use CRAM can become adequately proficient in a relative short amount of time.

All CRAM practitioners should complete at least one CRAM training course, as described above, prior to conducting a CRAM assessment. Each training course for practitioners will include an overview of CRAM and its applications plus more intensive training in one or more wetland types. The instructor training involves completing multiple classes for practitioners, supervised applications of CRAM, and instructing one or more practitioner classes. Practitioners should only conduct CRAM assessments on the wetland types for which they have been trained. A list of individuals who have successfully completed CRAM training, and the wetland types on which they were trained, is maintained on the CRAM website (www.cramwetlands.org).

CRAM assessments should generally be conducted by teams of at least two trained practitioners, preferably with complementary expertise (e.g., botany and geomorphology, hydrology and general ecology). Several CRAM metrics require interpretation of subtle differences in field condition based on indicators that cannot be mastered without supervised practice. Discussion of scoring decisions among members of an assessment team will improve the accuracy and reliability of the CRAM results by helping to bridge gaps in experience and by encouraging close examination of field conditions.

Trained practitioners will be notified via email of CRAM updates and are expected to maintain familiarity with new versions of CRAM. Periodic retraining may be necessary to ensure adequate proficiency of practitioners. When submitting a CRAM assessment, the training date(s) completed by the individuals responsible will be reported and maintained in the eCRAM/Wetland Tracker statewide database.

I. Submission of CRAM Scores

It is important that CRAM scores be submitted with a complement of supporting documentation that allows a reasonable review of the results by agency staff.

Once a CRAM assessment is completed it should be submitted online using eCRAM, which can be accessed via the Wetland Tracker (www.wetlandtracker.org) or the CRAM website (www.cramwetlands.org). Separate, additional submittals can be provided in hard copy or, preferably, as digital copies of the assessment score sheets and relevant worksheets to any agency or other interest. However, unless otherwise stipulated by the data author, anyone can view CRAM results via the CRAM website or Wetland Tracker, so separate copies should not usually be required.

When submitting a CRAM assessment it must include at least the following; space for this information is provided in eCRAM.

Fully completed CRAM data sheet. Note that all submetric, metric, and attribute scores must be provided as well as copies of the CRAM worksheets used to score metrics (where relevant).

Completed Stressor Checklist.

Photographs of the site illustrating key aspects of the wetland being assessed. Photographs should be clearly associated with specific locations on the ground and should conform to the Standard Procedures for Stream Assessment provided by the State Water Resources Control Board (www.waterboards.ca.gov/water_issues/programs/swamp/cwt_guidance.shtml) and summarized in Appendix B.

Brief rationale for assignment of each submetric and metric score (if needed).

A map of the AA that consists of the boundary of the AA on the imagery provided by eCRAM or other imagery of comparable or better resolution and vintage. Wetland Tracker (www.wetlandtracker.org) and eCRAM provide guidelines for submittal of maps with appropriate coordinates. This information has been summarized in Appendix C.

General site information, including any relevant information such as recent natural or anthropogenic disturbances, known presence of sensitive species, etc.

The timing of the assessment relative to the Assessment Window for the type of wetland being assessed.

Names and contact information for all individuals who conducted the CRAM assessment. These will be cross-referenced with the names of trainees from the CRAM training classes.

It is essential that users register on eCRAM (www.cramwetlands.org) and upload results of CRAM assessments to the statewide database using eCRAM.

J. Interpretation of CRAM scores (What do CRAM scores mean?)

One of the main values of using CRAM is the ability to compare scores from different projects, from the same project over time, or from projects and ambient surveys. This ability to make comparisons based on a common assessment tool provides context for interpretation of scores for specific projects.

Individual CRAM metric scores, attribute scores, and overall AA scores are based on an internal reference standard that represents the best achievable condition statewide for the type of wetland being assessed. Therefore, any two scores for the same type of wetland can be compared to each other because they are based on the same statewide standard. For example, an Assessment Area having an AA score of 50 can be interpreted as having lower ecological condition than another AA of the same wetland type having an AA score of 80. A similar interpretation can be made for Attribute scores.

Based upon the guidance given above, CRAM scores for a specific project can be compared to the scores for other wetlands, such as:

Pre-project condition for the project being assessed;
Other monitoring events for the project being assessed;
Similar project types within the same watershed, region, or other management unit;
Wetlands of the same type within the same watershed, region, or other management unit;
Regional population of wetlands or projects of the same type;
Ambient condition within a specific location or management unit; and
Wetlands of the same type from a regional reference network.

Such comparisons provide context for evaluating a site relative to other sites or ranges of conditions of interest, and they provide additional depth of information for evaluating project performance and making management decisions.

4. CRAM Quality Assurance

A. General Quality Assurance Requirements for CRAM Assessments

As with other assessment methods, program or project-specific quality assurance plans will need to be developed for specific CRAM applications. For example, a restoration project and a watershed assessment program would each develop a quality assurance plan specific to their goals.
In general, the following quality assurance (QA) measures will be applied to all submitted CRAM assessments. Assessments must meet the following minimum requirements or they will be rejected by the designated Quality Assurance officer(s) and returned to the author for correction:

Most recent version of CRAM was used;
All required data fields completed;
Appropriate explanations, photographs, and supporting materials provided;

Stressor checklist completed;
Acceptable map(s) provided;
At least two trained CRAM practitioners conducted the assessment;
CRAM practitioners have completed a training course (within the past 5 years) for the wetland class being assessed; and
Relationship to similar or nearby sites with similar conditions.

It is anticipated that regional audit teams will be established to assist with QA, training, and particularly difficult wetland assessments. The audit teams will consist of trained CRAM instructors, development team members, and staff of responsible agencies. The plan is to have the regional audit teams independently review approximately 10 - 15% of all submitted CRAM assessments annually for each region. Furthermore, high value, high profile, or controversial sites may be reviewed by experienced practitioners or an audit team at the request of an agency. Assessments failing to meet the basic quality standards may be rejected, additional information may be requested, or a reassessment may be requested.

B. Precision of CRAM Scores

A repeatability analysis conducted during the CRAM calibration/validation process for riverine systems and estuarine wetlands revealed that Attribute scores and overall AA scores have less than 10% error due to differences in practitioners, with the error rate being less for Attribute scores than overall AA scores. This suggests that the precision of CRAM Attribute scores and AA scores for riverine systems and estuarine wetlands is about 10%, or about 10 CRAM points for the AA score (i.e., 10% of the possible 100 points for an AA), and 3 - 5 points for the Attribute scores. Differences in AA scores of 10 CRAM points or less are within the error of the method and therefore should not be considered to represent differences in overall condition. Similarly, two scores for the same Attribute that differ by less than 3 - 5 CRAM points (depending on the Attribute) should not be regarded as representing differences in condition.

This precision only pertains to riverine systems and estuarine wetlands, and can only be expected if practitioners have been adequately trained. The precision of CRAM will be determined for additional wetland types as CRAM is calibrated and validated for them, continuing with depressional wetlands in 2009.

Precision between independent assessment teams will be improved when the teams inter-calibrate. Inter-team calibration should always be conducted among multiple teams that are pooling their independent assessments into a collective survey.

In addition to training and inter-team calibration, the precision of CRAM may be expected to improve over time with successive refinements of the manual and assessment forms to increase their clarity, and by refining the metrics so they more clearly reflect common field conditions.

C. Accuracy of CRAM Scores

One means of ensuring that practitioners are correctly practicing CRAM is to have them conduct assessments at established reference sites for which CRAM assessments have already been produced by qualified experts. The locations of these reference sites and supporting information are being established by the regional audit teams and will be made available to practitioners via the CRAM website (www.cramwetlands.org). The established reference scores will be held by the audit teams like answers to a test. The competency of practitioners can be assessed by comparing their reference site scores to the reference dataset. In general, practitioners should be expected to produce CRAM scores that are equal to the accepted reference site scores, plus or minus the precision of CRAM for the type of wetland being assessed. The precision of CRAM is determined during the calibration and validation steps in CRAM development for each wetland type (see above).

D. Seasonal Variability of CRAM Assessments

The Assessment Window is the period of time each year when assessments of wetland condition based on CRAM should be conducted. One Assessment Window exists for all attributes and metrics of each wetland type, but different types of wetlands can have different Assessment Windows. For example, the window is not the same for vernal pools and estuarine wetlands. In general, the CRAM Assessment Window falls within the growing season for the characteristic plant community of the wetland type to be assessed. For wetlands that are not subject to snowfall and that are non-tidal, the main growing season usually extends from March through September, although it may begin earlier at lower latitudes and altitudes. The growing season tends to start about a month earlier in tidal wetlands, due to the seasonal patterns of tidal inundation. For wetlands subject to snowfall, the start of the growing season is retarded by the spring thaw, which at very high elevations may not happen until late May or early June, depending on the depth of the snow pack. For wetlands that are inundated seasonally (e.g., vernal pools, playas, and some slope wetlands), the growing season will generally be March through July.

The greatest level of certainty and reliability will be achieved when CRAM assessments are conducted within the appropriate Assessment Window. However, some experts can reconstruct conditions for the Assessment Window after it closes based on forensic botany and other field techniques. Attempting assessments too early in the growing season can lead to erroneous results in some wetland types, especially vernal pools. In any case, it should be clearly noted on the CRAM data sheets if an assessment is being done outside the designated Assessment Window.

Many wetlands are subject to periodic disturbances that are a necessary part of the natural successional regime of the wetland (e.g., flood-scour in riverine systems). Such events may result in temporarily low CRAM scores associated with short-term loss of physical or biological complexity. CRAM scores should be assigned based on the conditions present at the time of the assessment. The CRAM data sheets provide a location to note if the Assessment Area was recently affected by a natural disturbance. This will allow proper interpretation of the CRAM scores. CRAM scores should not be assigned based on an assumed past or expected future condition.

E. Addressing multiple versions of CRAM

As with many assessment methods, CRAM is continually refined and updated with experience and broader applications. Modifications typically serve to clarify metrics and typically do not involve substantial revisions of the method. Revisions are conducted on an annual basis, so the frequency of updates will not occur at a frequency less than or greater than about a year. The CRAM website should be consulted before conducting a CRAM assessment to ensure that the most recent version is being used. Practitioners may also register on the CRAM website to receive email updates regarding new CRAM versions or modules. The most current versions of CRAM and the corresponding versions of eCRAM can be found at www.cramwetlands.org/install/versions.html#soft.

Over the course of a project lifetime, it is possible that different CRAM versions may be used for pre-vs. post-project assessments due to routine CRAM updates. Most often, careful documentation of the project site will allow translation of past CRAM scores into corresponding values for the most recent CRAM versions. If a different version of CRAM was used at different time points of a project, old scores should be updated using the most recent version of CRAM. These changes should be documented and reported when submitting the results of the CRAM assessment. However, the original CRAM scores on eCRAM and Project Tracker *should not* be revised based on changes in CRAM version. The original data will be archived and stamped with the version of CRAM with which they were originally collected.

5. Specific Guidance for Assessment of Projects

A. Defining a Project Area and Appropriate Assessment Area

The CRAM manual provides a process for identifying the boundaries of the Assessment Area (AA), which is the fundamental unit of analysis for CRAM assessments. Each AA should only represent one wetland of one type. Different types of wetlands can be contiguous with each other, or even nested one within the other, but each AA must only represent one type of wetland. The boundaries of the AA should be established based on clear breaks in surface hydrology, sediment supply, or geomorphology, as directed by the CRAM manual.

To the degree possible, the delineation of an AA should first be based on the hydro-geomorphic considerations presented in Tables 2 and 3, but if these considerations are not applicable, or if the resulting AA is more than about 25% larger than the recommended maximum size AA presented in Table 4, then the AA delineation should rely only on the size guidelines.

At this time, for the purposes of CRAM, a “project” is any human activity that results in a change in extent, form, structure, or condition of a wetland. Such activities often require a permit under Section 404 or 401 of the CWA, a Waste Discharge Requirement (WDR) by the State of California, a Streambed Alteration Agreement (Section 1600 of the Fish and Game Code), or a Federal or State funded or supported wetland restoration project. In the future, other activities, such as locally funded projects and agricultural operations that are not permitted under the 404 or 401/WDR programs but that effect the distribution, abundance, or condition of wetlands or riparian areas can be included in the project definition. Currently, wetland and riparian habitat acquisitions are not included in the definition.

Projects are often at least partly delimited by property lines or other administrative or legal boundaries. Wetland restoration projects, mitigation projects, mitigation banks, and wetlands that are targeted for development (i.e., impacted wetlands) are often delimited by property lines. If property restrictions do not allow a field assessment of the AA according to CRAM manual, assess just the project area and document the inability to access the recommended AA. Note that wildlife reserves, refuges and other such management units can be assessed using the same rules as a project.

***Table 2: Examples of features that** should **be used to delineate AA boundaries*.**

Flow-Through Wetlands	Non Flow-Though Wetlands	
Riverine, Estuarine and Slope Wetlands	**Lacustrine, Wet Meadows, Depressional, and Playa Wetlands**	**Vernal Pools and Vernal Pool Systems**
diversion ditches end-of-pipe large discharges grade control or water height control structures major changes in riverine entrenchment, confinement, degradation, aggradation, slope, or bed form major channel confluences water falls open water areas more than 50 m wide on average or broader than the wetland transitions between wetland types foreshores, backshores and uplands at least 5 m wide weirs, culverts, dams, levees, and other flow control structures	above-grade roads and fills berms and levees jetties and wave deflectors major point sources or outflows of water open water areas more than 50 m wide on average or broader than the wetland foreshores, backshores and uplands at least 5m wide weirs and other flow control structures	above-grade roads and fills major point sources of water inflows or outflows weirs, berms, levees and other flow control structures

*Table 3: Examples of features that should **not** be used to delineate any AAs.*

at-grade, unpaved, single-lane, infrequently used roadways or crossings bike paths and jogging trails at grade bare ground within what would otherwise be the AA boundary equestrian trails fences (unless designed to obstruct the movement of wildlife) property boundaries riffle (or rapid) – glide – pool transitions in a riverine ecosystem spatial changes in land cover or land use along the wetland border state and federal jurisdictional boundaries

Table 4: Recommended maximum and minimum AA sizes for each wetland type. Note: Wetlands smaller than the recommended AA sizes can be assessed in their entirety.

Wetland Type	Recommended AA Size
Slope	
Spring or Seep	Maximum size is 0.50 ha (about 75m x 75m, but shape can vary); there is no minimum size.
Wet Meadow	Maximum size is 2.25 ha (about 150m x 150m, but shape can vary); minimum size is 0.5 ha (about 75m x 75m)
Depressional	
Vernal Pool	There are no size limits (see Section 3.5.6 and Table 3.8 in CRAM manual)
Vernal Pool System	Preferred size is <10 ha (about 300m x 300m; shape can vary); there is no minimum size as long as there are at least 3 replicate large and 3 replicate small component pools.
Other Depressional	Maximum size is 1.0 ha (about 100m x 100m, but shape can vary); there is no minimum size.
Riverine	
Confined and Non-confined	Recommended length is 10x average bankfull channel width; maximum length is 200m; minimum length is 100m. AA should extend laterally (landward) from the bankfull contour to encompass all the vegetation (trees, shrubs vines, etc) that probably provide woody debris, leaves, insects, etc. to the channel and its floodplain; minimum width is 2m.
Lacustrine	Maximum size is 2.25 ha (about 150m x 150m, but shape can vary); minimum size is 0.5 ha (about 75m x 75m).
Playa	Maximum size is 2.25 ha (about 150m x 150m, but shape can vary); minimum size is 0.5 ha (about 75m x 75m).
Estuarine	
Perennial Saline	Maximum size is 1.0 ha (about 100m x 100m, but shape can vary); minimum size is 0.1 ha (about 10m x 10m).
Perennial Non-saline	Maximum size is 1.0 ha (about 100m x 100m, but shape can vary); minimum size is 0.1 ha (about 10m x 10m).
Seasonal	Maximum size is 1.0 ha (about 100m x 100m, but shape can vary); minimum size is 0.1 ha (about 10m x 10m).

There are several important considerations when using CRAM to assess projects that may require adjustment of the general rules for establishment of an AA.

• *Project wetland is larger than the AA:* Identify AAs that represent homogenous sections in terms of hydro-geomorphology within the wetland evaluation area. Use the following CRAM AA delineation language as a guide.

“Each AA must therefore encompass most if not all of the natural spatial variability in the visible form and structure of its Wetland, and the AA should also encompass most of the internal workings of the Wetland that account for its homeostasis – its tendency to maintain a certain overall condition or return to it during or after significant stress or disturbance. For an AA to have this desired level of integrity, it should be bounded by obvious physical changes in topography, hydrology, or infrastructure that significantly control the sources, volumes, rates, or general composition of sediment supplies or water supplies within the AA at the time of the field assessment. In essence, the boundaries of an AA should not extend beyond any features that represent or cause a major spatial change in water source or sediment source. “

In most cases where the project is larger than the AA, multiple CRAM assessments will need to be completed to completely characterize the project. In some cases, the entire project area may be divided up into a series of AAs, each of which is then assessed. In other cases, as statistically representative subset of AAs may be assessed using the procedures outlined in Appendix D.

Project wetland is smaller than the AA (i.e., recommended AA boundary includes areas beyond “project area”). If the wetland project area is smaller than the suggested minimum AA sizes in Table 3, conduct two CRAM assessments, one on the project area and one on an AA defined according to the rules in the CRAM manual. Both sets of scores should be reported for consideration in agency decision-making. If property restrictions do not allow a field assessment of the larger AA, assess just the project area and document the inability to access the larger AA.

A project may be restricted to one side of a wadeable riverine ecosystem, although the recommended AA will include both sides. In this circumstance, two CRAM assessments should be conducted (as described above), one for the project (including the adjoining channel) and one for the AA recommended by the CRAM manual. If property restrictions do not allow a field assessment of the larger AA, assess just the project area and document the inability to access the larger AA.

B. Selection of the Appropriate CRAM Wetland Type

A separate CRAM assessment should be done for each wetland type and each wetland should be assessed based on its current typology. If a wetland has been converted from a different wetland type (e.g. a riverine wetland impounded to create a lacustrine wetland), the CRAM module for the current wetland type should be used, regardless of the previous type.

In applying CRAM for impact assessment or restoration or mitigation planning, a wetland may undergo a type-conversion, e.g. a palustrine depressional wetland may be restored to a coastal lagoon. If CRAM is being used to help evaluate alternative designs or to provide baseline data for a restoration that anticipates changing wetland types, then the CRAM module for the anticipated future wetland class should be used, as well as the CRAM module for the current type. The CRAM module for the existing wetland type should be use for evaluation of potential impacts to the current wetland.

Use of CRAM in a predictive manner should be done with caution and all assumptions should be clearly articulated along with the submitted analysis. Projected or predicted CRAM data should not be entered into eCRAM.

The general rule provided in the CRAM guidebook is to assess a wetland based on its current class, not based on its historical condition. For example, an impounded river would be assessed as a lacustrine wetland (its current class) and not as a riverine wetland (its historic natural condition). However, if a wetland to be restored will undergo a type-conversion in the process, it is appropriate to assess the wetland with the CRAM module of its restored typology. In this circumstance, it is advisable that two assessments be conducted, one based on the pre-existing typology and one on the restored typology.

For more immediate changes in wetland type, such as those associated with an unauthorized activity, the CRAM assessment should be based on its most recent stable condition (i.e., prior to the unauthorized activity) provided that sufficient information is available on the conditions prior to the unauthorized activity, the change in wetland type is relatively recent and there have been no subsequent events that would be expected to alter condition (e.g., a large flood). If detailed information on the form and composition of the pre-existing wetland is not available, then CRAM should only be run based on the current wetland type and condition.

C. Use of CRAM to Detect Changes in Wetland Condition Over Time

CRAM may be used to help assess change in wetland condition over time. As with any assessment method, the ability of CRAM to detect change depends on the size of the change relative to the precision of CRAM. In general, based on the calibration and validation of CRAM for riverine systems and estuarine wetlands, the precision of CRAM is about 5 CRAM points for Attribute scores and about 10 CRAM points for overall AA scores. Therefore, only changes in condition that translate into differences in Attribute scores of at least 5 points or into differences in AA scores of at least 10 points will be detected using CRAM. This suggests that CRAM can be used frequently during the early stages of restoration and mitigation projects, when changes tend to be rapid and large, and less frequently later-on, when changes are more gradual. However, CRAM might prove to be useful in measuring trends or a "restoration trajectory" over the required monitoring period and comparing those results to Level-3 data (see also below). Finally, if a wetland is converted from one wetland type to another, the pre vs. post project CRAM scores will not be directly comparable because they are based on different CRAM modules.

D. Example Scenarios for CRAM Assessment of Projects

CRAM may be applied to support a variety of regulatory or grant funded applications. Typically, wetland impact analysis and compensatory mitigation or restoration planning and monitoring will require more information than CRAM will be able to provide. In some cases, appropriate Level 3 protocols already exist; in other cases additional Level 2 or 3 assessment tools may need to be developed to conduct the assessment. CRAM is intended to be used in conjunction with Level 1 and Level 3 tools, not to replace them. CRAM should not be used as the sole basis for making regulatory or project related decisions. Rather, it should be used in conjunction with other information and data to inform regulatory and project decisions. Sample applications of CRAM, with specific caveats are discussed below.

Using CRAM to assess projected project impacts and/or avoidance: CRAM may be used to evaluate existing condition and compare to expected future condition (i.e., in a forecasting mode; Table 5). Because many of the CRAM metrics require field-based assessment of site conditions, it may be difficult to accurately apply CRAM to a conceptual, future state. Therefore, users should be cautious when using CRAM to forecast expected future conditions, and should clearly document all assumptions used in generating an anticipated future CRAM condition score. Even though the minimum CRAM score is 25, it is appropriate to assign a CRAM score of zero (0) if a complete wetland fill is anticipated. As previously stated, CRAM should be only one aspect of the assessment of project impacts and mitigation, along with other factors such as area, location, and Level 3 assessments.

AA	Buffer and Lanscape Context			Hydrology			Physical Structure			Biotic Structure		
	pre	post	change	pre	post	change	pre	post	change	pre	post	change
A1	85	100	15	100	100	0	50	88	38	64	100	36
A2	85	100	15	100	100	0	50	75	25	39	100	61
B1	85	0	(85)	100	0	(100)	63	0	(63)	31	0	(31)
B2	85	0	(85)	100	0	(100)	50	0	(50)	50	0	(50)
B3	85	0	(85)	92	0	(92)	63	0	(63)	44	0	(44)
B4	85	0	(85)	100	0	(100)	75	0	(75)	64	0	(64)
B5	85	0	(85)	100	0	(100)	75	0	(75)	60	0	(60)
H2	0	59	59	0	92	92	0	63	63	0	100	100
H3	0	52	52	0	92	92	0	75	75	0	100	100
H4	83	97	14	100	83	(17)	63	88	25	53	100	47
H5	85	93	8	100	92	(8)	63	88	25	61	100	39

Figure 2: Example of CRAM evaluation to support assessment of potential impacts associated with a wetland fill (negative change) and potential gains associated with compensatory mitigation (positive change). AA (first) column represent different assessment areas in the project. Other columns show CRAM attribute scores for existing (pre) conditions and anticipated future (post-project) conditions, as well as expected change in CRAM score.

Forecasted scores should not be uploaded into the statewide CRAM database. In some cases, use of a reference site may be a more appropriate way to predict expected future CRAM scores.

Using CRAM for restoration or mitigation planning: The best achievable alternative state for each metric (i.e., the description of the "A" condition) represents the theoretical optimum condition for a specific wetland type. Consequently, this description can be used to help inform restoration/mitigation design. However, the descriptors in CRAM have been developed for use throughout California and are, therefore, not appropriate design templates for a specific mitigation/restoration project. As stated earlier, CRAM has limited value as a design template because it does not reflect site-specific constraints, opportunities, or design objectives.

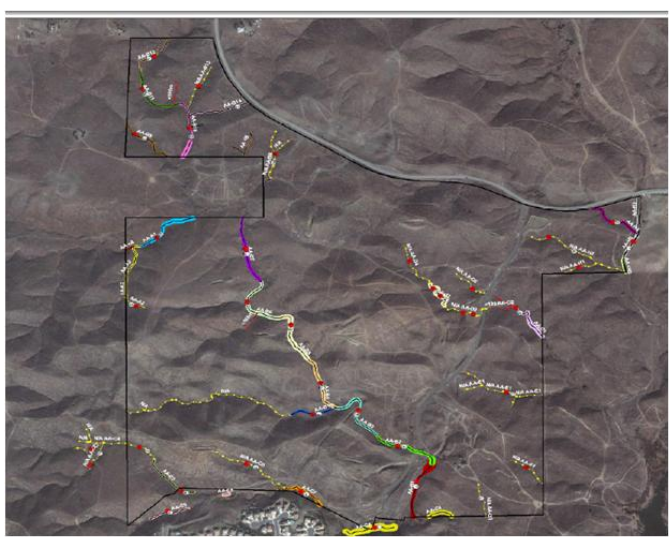


Figure 3: Example of riverine Assessment Areas color coded based on existing CRAM scores. The combination of CRAM scores and the relative position of reach Assessment Area in the landscape can be used to inform restoration priorities.

Using CRAM to assess performance of mitigation and restoration sites: CRAM may be used to evaluate the condition of compensatory mitigation sites in concert with traditional Level 3 performance monitoring measures. CRAM can be used to help address previous critiques of wetland compensatory mitigation, such as the need for condition-based management endpoints and the use of consistent evaluation tools (see Ambrose et al. 2006). CRAM may be used alone or in concert with Level 3 assessments depending on the needs of a specific project and at the discretion of each agency**.** In particular, analysis of CRAM *metrics and attribute scores* may provide more valuable insight than overall AA scores into the performance of mitigation and restoration projects and reasons for success or failure. Over time, as CRAM is used and data are compiled via eCRAM and Wetland Tracker, it may be possible to develop performance trajectories to forecast how CRAM scores or restoration or mitigation sites might change as they mature.

Attributes		Metrics	Current Score[1] (July 2008) AA 1 (downstream)	Current Score[1] (July 2008) AA2 (upstream)	Maximum Score Obtainable[1] AA 1 (downstream)	Maximum Score Obtainable[1] AA2 (upstream)
Buffer and Landscape Context		Landscape Connectivity	D	A	D	A
		Buffer Sub-metrics:				
		- Percent of Assessment Area with Buffer	A	A	A	A
		- Average Buffer Width	B	D	B	D
		- Buffer Condition	C	C	B	B
Hydrology		Water Source	C	C	C	C
		Hydroperiod or Channel Stability	B	B	A	A
		Hydrologic Connectivity	B	A	A	A
Structure	Physical	Structural Patch Richness	D	D	A	A
		Topographic Complexity	C	C	A	A
	Biotic	Plant Community Sub-metrics:				
		- Number of Plant Layers	A	C	A	A
		- Number of Co-dominant Species	B	D	A	A
		- Percent Invasion	B	A	A	A
		Horizontal Interspersion and Zonation	C	C	A	A
		Vertical Biotic Structure	D	D	A	A
		Overall AA Score[2]	52.5%	58%	86%	91%

Figure 4: Example of CRAM evaluation of a compensatory mitigation site showing scores for both current monitoring period and anticipated target scores.

Using CRAM as part of a watershed assessment: Site specific CRAM scores can be compiled for multiple sites within a watershed and analyzed for spatial patterns or trends. Use of CRAM as part of probabilistic survey can provide a profile of the range of conditions in a watershed that can be used as a frame of reference for subsequent project assessments. Although not intended to replace landscape-scale assessment methods, the spatial orientation of CRAM scores can provide insight into cumulative impacts. Furthermore, the CRAM attributes for "buffer and landscape context" and "hydrology" may be particularly affected by landscape patterns. Analysis of spatial patterns of these two attributes may help understand watershed-scale disturbances that affect numerous wetlands and/or streams.

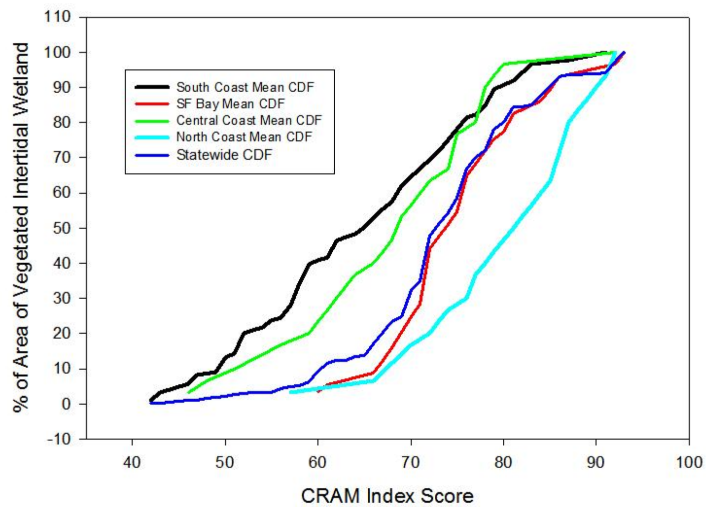


Figure 5: Cumulative distribution frequency (CDF) plots showing the ambient condition of estuaries (based on CRAM) in the State of California compared to the ambient condition in four subregions.

6. Phased Implementation of CRAM

Phased implementation of CRAM for assessing regulatory, restoration, and management projects can allow practitioners and agency staff to gain comfort and familiarity in a controlled manner. Phased implementation should be re-initiated with the introduction of new CRAM modules, or significant revisions of existing modules, although resetting to the beginning of Phase 1 may not be necessary in every case. Phased implementation would ease the transition associated with application of any new program or tool. Finally, it will allow experience and data compiled during the early phases of CRAM implementation to inform decisions regarding subsequent applications. For each module, the following sequence is recommended.

First Phase: CRAM assessments should be conducted on a limited number of priority projects in conjunction with other Level 1 or 3 assessments. Agencies may identify priority projects based on size, location, type of project, or other specific management interests. Data collected from these projects should be used to inform and educate staff about potential uses (and misuses) of CRAM, to increase the comfort level of agency staff and practitioners, and to contribute to the regional database of CRAM assessments.

Second Phase: When agency staff is comfortable, use of CRAM may be expanded to a broader set of projects and applications. In some circumstances, for small, simple, relatively less controversial projects, CRAM may be used as the primary assessment tool.

Third Phase: Full implementation of CRAM for the complete set of applications listed earlier in this document, subject to specific agency discretion. Other assessment tools should always be used when deemed necessary by the agency project manager.

Detailed information on challenges and opportunities associated with early implementation should be compiled and submitted by practitioners along with CRAM assessments and all associated Level 3 data (via Wetland Tracker). This information will be used to inform decisions regarding subsequent implementation phases.

References

Ambrose, R.F., J.C. Calloway, and S.F. Lee, 2006. An Evaluation of Compensatory Mitigation Projects Permitted Under Clean Water Act Section 401 by the California State Water Quality Control Board, 1991-2002. Report prepared for the California State Water Resources Control Board.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish & Wildlife Service, Washington, D.C. 131 pp.

Collins, J.N., E.D. Stein, M. Sutula, R. Clark, A.E. Fetscher, L. Grenier, C. Grosso, and A. Wiskind. 2007. California Rapid Assessment Method (CRAM) for Wetlands, v. 5.0. 149 pp

Stein, E.D., M. Sutula, R. Clark, A. Wiskind, and J. Collins. 2007. Improving Monitoring and Assessment of Wetland and Riparian Areas in California through Implementation of a Level 1, 2, 3 Framework. Southern California Coastal Water Research Project Technical Report #555.

Stein, E.D., A.E. Fetscher, R.P. Clark, A.Wiskind, J.L. Grenier, M. Sutula, J.N. Collins, and C. Grosso. 2009. Calibration and Validation of a Wetlands Rapid Assessment Method: Application of EPA's Level 1-2-3 Framework for Method Testing and Refinement, *Wetlands 29(2):648–665.*

Sutula, M.A., E.D. Stein, J.N. Collins, and A.E. Fetscher. 2006. Key Considerations For Developing a Wetlands Rapid Assessment Method: California's Experience. *Journal of the American Water Resources Association* 42:157-175.

Appendix A: Summary of CRAM External Reviews and Peer-reviewed Documents

Primary Publication with Scientific Peer Review	**Date**	**Description**
A practical guide for the development of a wetland assessment method: the California experience 2006. Sutula, M.A., E.D. Stein, J.N. Collins, A.E. Fetscher, R. Clark. Journal of the American Water Resources Association 42(1):157-175	2006	**CRAM Development** Choices and tradeoffs in accuracy, precision, robustness, ease of use, and cost. Literature review details, wetland classification system, conceptual models, major assumptions; attribute and metric development; method responsiveness; calibration and validation against intensive assessment;
Validation of a Wetland Rapid Assessment Method: Use of EPA's Level 1-2-3 Framework for Method Testing and Refinement Stein E.D. , A.E. Fetscher, R.P. Clark, A. Wiskind, J.L. Grenier, M. Sutula, J.N. Collins, C. Grosso. Wetlands 29(2):648-665. 2009	2009	**CRAM Validation** Case study of riverine and estuarine modules. Responsiveness of the method to ‘‘good’’ vs. ‘‘poor’’ wetland condition, ability to represent a range of conditions, internal redundancy, alternative combination rules for constituent metrics, and reproducibility of results
Integrating Probabilistic and Targeted Compliance Monitoring for Comprehensive Watershed Assessment. Stein, E.D. and B. Bernstein. Environmental Monitoring and Assessment 144:117-129 2008	2008	**CRAM Application** Demonstration of a multi-metric assessment of watershed & stream condition using CRAM, a benthic macroinvetebrate index of biotic integrity, water chemistry, and toxicity measures.
Formal Agency Review		
California State Water Resources Control Board and California Department of Fish and Game	In Progress	**SWRCB Review** Independent science review sponsored by State Water Board to determine efficacy of CRAM for meeting assessment needs of particular State Water Board programs.
US Army Corps of Engineers, C. Klimas, January 2008	2008	**USACE ERDC Review** Science review sponsored and conducted by US Army Corps to determine efficacy of CRAM for meeting assessment needs of particular Army Corps programs.

Appendix A (con't): Summary of CRAM External Reviews and Peer-reviewed Documents

Reports of Studies Advised and Reviewed by Study-specific Technical Advisory Committees		
California's Wetland Demonstration Program Pilot. A Final Project Report to the California Resources Agency Sutula, M.A. J.N. Collins, R. Clark, R.C. Roberts, E.D. Stein, C.S. Grosso, A. Wiskind, C. Solek, M. May, K. O'Connor, A.E. Fetscher, J.L. Grenier, S. Pearce, A. Robinson, C. Clark, K. Rey, S. Morrissette, A. Eicher, R. Pasquinelli, K. Ritter.	2008	**Ambient Assessment** Statewide assessment of ambient extent and condition of estuarine wetlands, plus ambient assessments of riverine wetlands for three demonstration watersheds.
An evaluation of compensatory mitigation projects permitted under Clean Water Act Section 401 by the California State Water Quality Control Board, 1991–2002. Report to the State Water Resources Control Board. University of California. Los Angeles, CA, USA. December 2004, 253 pages Ambrose, R.F., J.C. Callaway , and S.F. Lee .	2004	**Mitigation Project Review** Use of CRAM in the evaluation of mitigation projects in California
Evaluation of Federal Clean Water Act Section 401 Water Quality Certification Wetland and Stream Mitigation Sites in the Santa Margarita Watershed. A report by the California Regional Water Quality Control Board, San Diego Region, San Diego, CA, USA, January 2006, 107 pages Quigley, M., K. Ranke, D. Miller, R. Morris	2006	**Mitigation Project Review** Use of CRAM and HGM for the evaluation of mitigation projects in the Santa Margarita watershed, CA
Improving Monitoring and Assessment of Wetland and Riparian Areas in California through Implementation of a Level 1, 2, 3 Framework. Southern California Coastal Water Research Project Technical Report #555. Stein, E.D., M. Sutula, R. Clark, A. Wiskind, and J. Collins	2007	**Application of Level 1-2-3 Framework** Discussion of how to apply Level 1, 2, 3 tools (including CRAM) in an integrated manner to support both project and ambient assessment of wetlands and riparian areas

Appendix B: Standard Procedures for Photographs
(adapted from State Water Resourced Control Board Standard Operating Procedure (SOP) 4.2.1.4 - Stream Photo Documentation Procedure -
http://www.waterboards.ca.gov/water_issues/programs/swamp/cwt_guidance.shtml

General Instructions:

From the inception of any photo documentation project until it is completed, always take each photo from the same position (photo point), and at the same bearing and vertical angle at that photo point. Photo point positions should be thoroughly documented, including photographs taken of the photo point. Refer to copies of previous photos when arriving at the photo point. Try to maintain a level (horizontal) camera view unless the terrain is sloped. (If the photo can not be horizontal due to the slope, then record the angle for that photo.)

When taking photographs, try to include landscape features that are unlikely to change over several years (buildings, other structures, and landscape features such as peaks, rock outcrops, large trees, etc.) so that repeat photos will be easy to position. Lighting is, of course, a key ingredient so give consideration to the angle of light, cloud cover, background, shadows, and contrasts. Close view photographs taken from the north (i.e., facing south) will minimize shadows. Medium and long view photos are best shot with the sun at the photographer's back. Some artistic expression is encouraged as some photos may be used on websites and in slide shows (early morning and late evening shots may be useful for this purpose). Seasonal changes can be used to advantage as foliage, stream flow, cloud cover, and site access fluctuate. It is often important to include a ruler, stadia rod, person, farm animal, or automobile in photos to convey the scale of the image. Of particular concern is the angle from which the photo is taken. Oftentimes an overhead or elevated shot from a bridge, cliff, peak, tree, etc. will be instrumental in conveying the full dimensions of the project. Of most importance overall, however, is being aware of the goal(s) of the project and capturing images that clearly demonstrate progress towards achieving those goal(s).

Recording Information:

Use a systematic method of recording information about each project, photo point, and photo. The following information should be entered on the photo-log forms (blank form included in this document) or in a dedicated notebook:

Project or group name, and contract number (if applicable, e.g., for funded restoration projects)
General location (stream, beach, city, etc.), and short narrative description of project's habitat type, goals, etc.
Photographer and other team members
Photo number
Date
Time (for each photograph)
Photo point information, including:
Name or other unique identifier (abbreviated name and/or ID number)
Narrative description of location including proximity to and direction from notable landscape features like roads, fence lines, creeks, rock outcrops, large trees, buildings, previous photo points, etc. – sufficient for future photographers who have never visited the project to locate the photo point
Latitude, longitude, and altitude from map or GPS unit
Magnetic compass bearing from the photo point to the subject
Specific information about the subject of the photo
Optional additional information: a true compass bearing (corrected for declination) from photo point to subject, time of sunrise and sunset (check newspaper or almanac), and cloud cover.

Archive all photos, along with the associated photo-log information, in a protected environment.

Appendix C: Guidelines for Submitting Maps of the CRAM Assessment Area

A map of the Assessment Area (AA) should contain the following:

- The boundary of the AA on the imagery provided by eCRAM or other imagery of comparable or better resolution and vintage. For guidance on how to define the boundary of an AA, consult the CRAM User's Manual.

- Reference coordinates and datum; if possible, use NAD83 datum. The centroid coordinates and size (in hectares) of the AA polygon are automatically calculated in eCRAM.

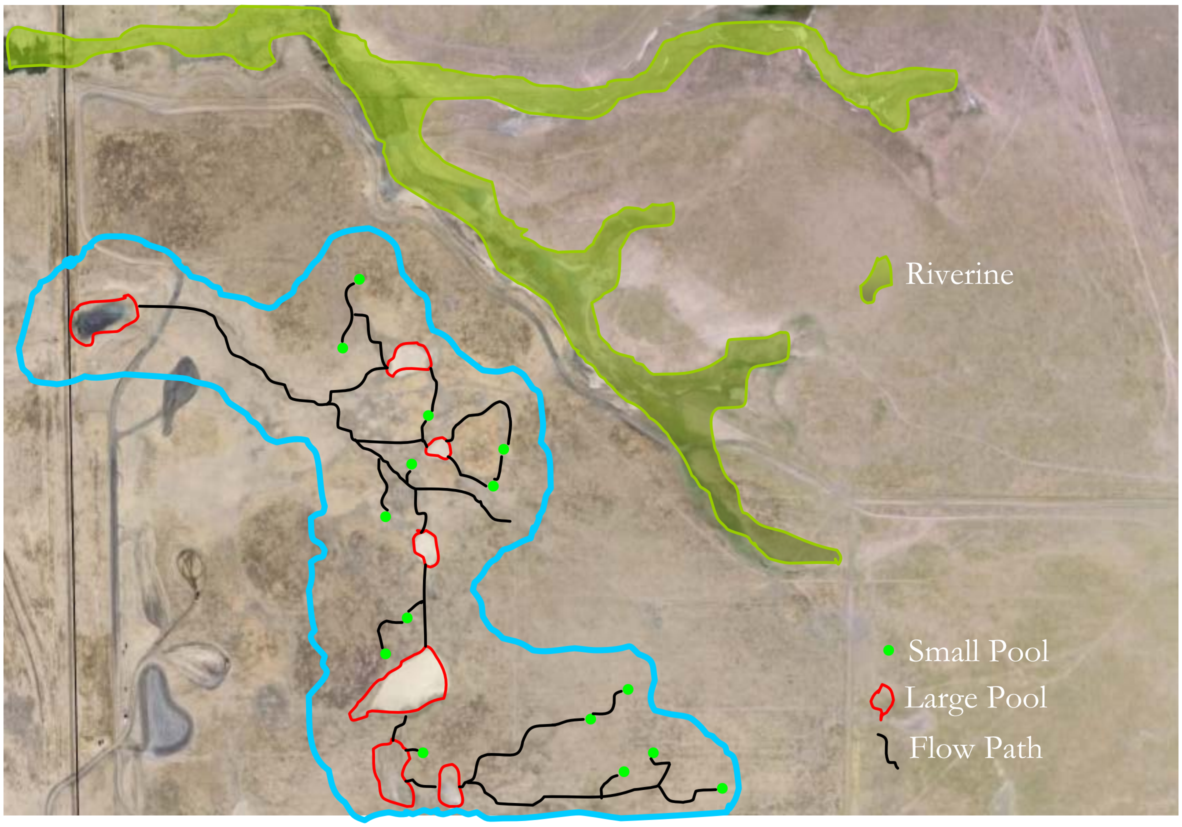
- For riverine ecosystems, provide the upstream and downstream coordinates, the approximate length of the AA, and the average bankfull width.

- For vernal pool systems, delineate the vernal pool system and its component large and small pools. There is no fixed size range for either size class. Large pools are simply those pools that are larger than most other pools in the AA.

Table C1. Steps for vernal pool system delineations.

Step	**Vernal Pool System Delineation**
1	On the site imagery, draw the boundary around the system of vernal pools that are probably interconnected by surface or subsurface flow. Do not draw the flow pathways, although they are shown in the figure below. The vernal pool system should not exceed 10 ha in size.
2	Delineate or circle and number all large pools within the pool system from Step 1.
3	Delineate or circle and number all small pools within each pool system from Step 1.
4	The pools delineated or circled in Steps 2 and 3 comprise the AA.
5	Randomly select three small pools and three large pools from the AA. These pools will be assessed individually and their scores will be averaged. If you cannot delineate three small and three large pools, then increase the AA size, even if hydrologically isolated pools have to be included.

Example map of one vernal pool system and its component elements. **The boundary around the system of vernal pools is shown as a turquoise line.**



Appendix C: Protocol for Level 2 Project Assessment V. 3.0
California State Wetlands Assessment Toolkit Development Team
April, 2008

Introduction

There are generally two kinds of CRAM applications: assessments of ambient condition and assessments of project conditions. The approach is essentially the same in each case. The critical concepts common to both are Sample Universe, Sample Frame, and Sample Draw. The Sample Universe is the population of possible CRAM Assessment Areas (AAs) for which an assessment of condition is desired. The Sample Frame is a map of the Sample Universe. The Sample Draw is the sample of AAs that are selected for assessment to represent the Sample Universe.

In the case of an ambient assessment, the Sample Universe consists of all the possible CRAM AAs of a single wetland type within a prescribed area that is larger than a project. For example, an ambient Sample Universe might encompass all of the possible AAs for fringing wetlands of lakes (i.e., lacustrine wetlands) within a watershed, administrative region of an agency, congressional district, etc. A sample of AAs is probabilistically or randomly drawn (i.e., selected) from the Sample Frame, assessed using CRAM, and the results are used to characterize conditions for the Sample Universe. No individual wetland within the universe is assessed unto itself. For more information see the CRAM manual discussion of ambient sample design.

In the case of a project assessment, the Sample Universe is all of the possible AAs for one kind of wetland within the boundaries of one project. The results are used to characterize the project.

Project Definition

For the purposes of CRAM, a "project" is any activity authorized under Section 401 and/or Section 404 of the US Clean Water Act, under the State's 401 Certification/WDR Programs, or under Section 1600 of the State's Fish and Game Code that directly changes the extent, type, or condition of at least 0.1 ha of non-riverine wetland, or at least 100m of riverine wetland length as defined in the CRAM manual.

Project Assessment Steps

Identify the Project Boundary

The project boundary is usually designated by the project sponsors and could include upland areas and other non-wetland areas (Figure 1). The project boundary has to be imported into a GIS as an overlay on 1-m pixel resolution aerial imagery or a wetland inventory of comparable resolution and of recent vintage. Whenever possible, the project should be included in the Wetland Tracker.

If a compensatory mitigation project is part of a larger wetland and is less that 80% of the recommended minimum size for a CRAM Assessment Area than conduct two assessments, one that is confined to the project and one for the larger Assessment Area that includes the project. Go to Step 2.

Identify the Sample Universe

Overlay the project boundary on the aerial imagery in the GIS and digitize the boundary of all non-riverine wetlands at least 0.1 ha in area and all riverine ecosystems at least 100m long (Figure 1). All the wetlands of one type comprise a separate Sample Universe. There will be as many Sample Universes as there are wetland types within the project that meet the minimum polygon size requirements. Go to Step 3.

For each Sample Universe, Develop the Sample Frame (Figures 2-4)

The Sample Frame will be a map of all candidate AAs within the Sample Universe. For non-riverine ecosystems, the AAs should be circles of the maximum size recommended in the CRAM Manual. For riverine ecosystems, the AAs should be polygons having the maximum recommended width and length.

There are two ways to begin creating a Sample Frame. One way is to overlay the Sample Universe with a grid having a cell size just large enough to encompass one AA. Another way is to use a GIS to generate a map of the maximum number of non-overlapping AAs. At this stage of Sample Frame development, candidate AAs can overlap the edge of the Sample Universe, although they cannot overlap each other.

Any AAs that do not meet the criteria for an AA as presented in the CRAM manual must be rejected. The following considerations are especially important.
Each AA should not cross any obvious, major physical changes in topography, hydrology, or infrastructure that significantly control the sources, volumes, rates, or general composition of sediment supplies or water supplies within the AA at the time of the field assessment.
Each AA can only include one wetland type. No AA can include any portion of more than one type of wetland, as defined by the CRAM manual.
Reject any candidate AA that is more than 50% outside the Sample Universe. The remaining AAs comprise the Sample Frame (Figure 3).
Go to Step 4a, 4b, or 4c, whichever is most applicable.

4a. If the Sample Universe is not large enough for one minimum-size AA, assess the entire Sample Universe. If possible, also assess another AA that contains the site and otherwise meets the requirements of a minimum AA. Go to Step 5: report both sets of scores, without averaging them.

4b. For each Sample Universe only large enough for 1-3 AAs, assesses all the AAs. Go to Step 5: separately report the results for each AA, plus report the average result for overall site, attribute, metric, and sub-metric based on all the AAs assessed.

4c. For each Sample Universe large enough for 4 or more mutually exclusive AAs, number the AAs in the Sample Frame and randomly select three for assessment. If at least 20% of any selected AA is outside the boundary of the Sample Universe, then re-shape the AA so that it fits entirely within the Sample Universe (Figure 4).
Calculate the average overall AA score for the first two AAs. This is done by averaging the two scores for each Attribute, and then using these average Attribute scores to calculate the average AA score.
If over the overall AA score for the third selected AA differs by more than 10 CRAM points from the average AA score for the first two selected AAs, randomly select and assess a fourth AA from the Sample Frame. Continue randomly selecting and assessing AAs so long as the overall score from last selected AA differs by more than 10 CRAM points from the average AA score for all of the previous AAs assessed, or until the Sample Frame is depleted of AAs. This means that the number of AAs used to assess a project is a function of the project's variability in condition. Go to Step 5.

5. Upload all the CRAM assessments for each AA to the CRAM website.

Figure D1: Diagrams of Project Boundary (dark green line) and Sample Universe (area shaded light green) showing a grid used to develop the Sample Frame of candidate AAs. A GIS can be used to generate the Sample Frame without using a grid.

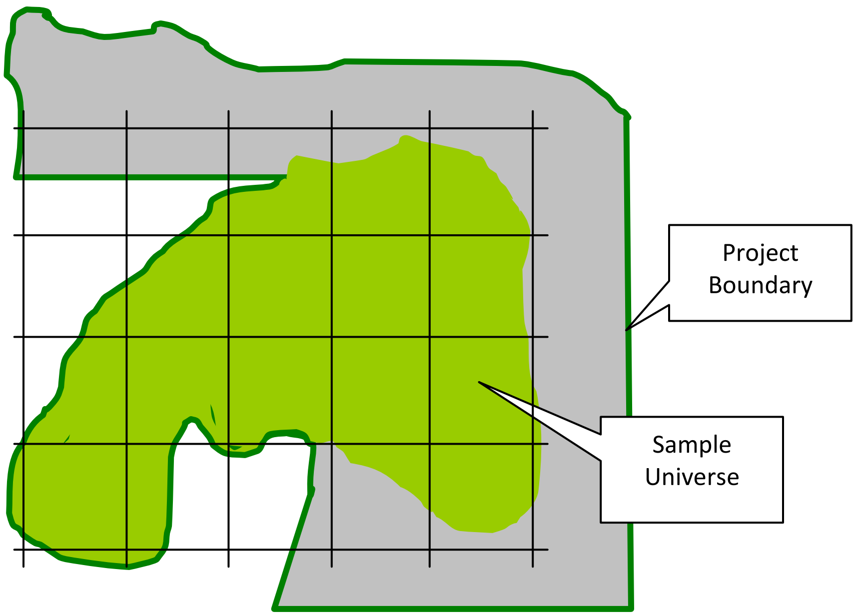


Figure D2: Map of the maximum number of candidate AAs generated in a GIS.

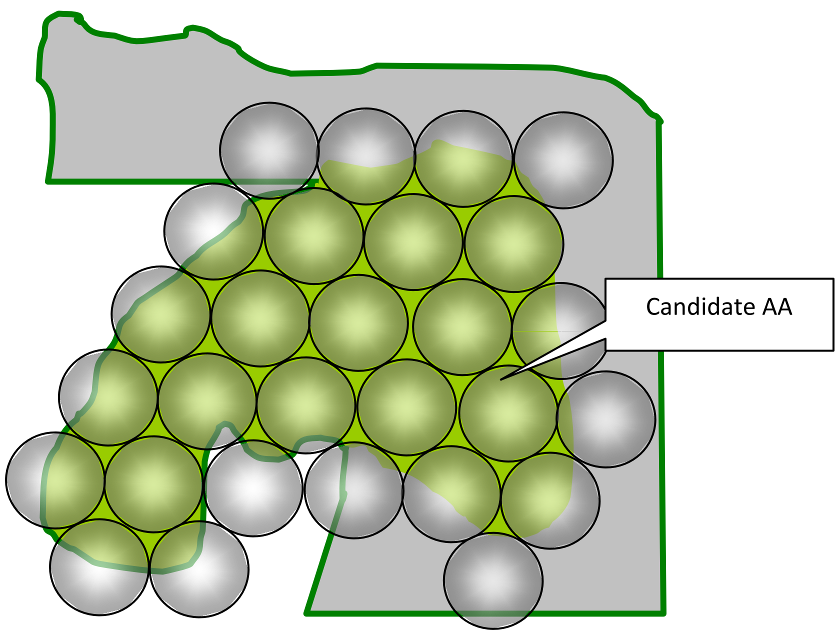


Figure D3: Map of the maximum number of candidate AAs showing AAs rejected for being more than 50% outside of the sample universe (red AAs).

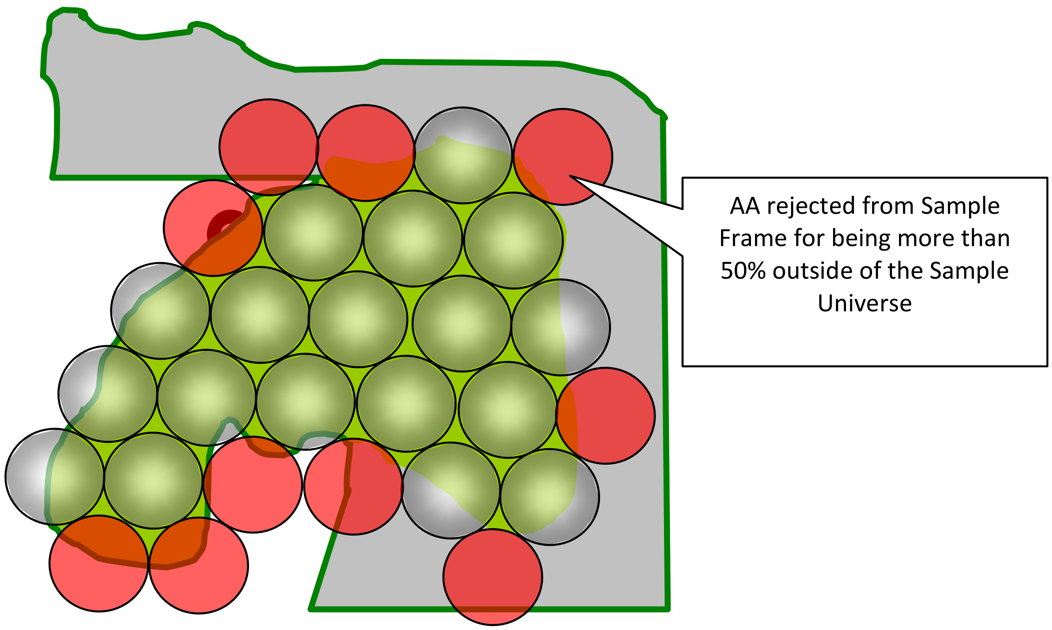
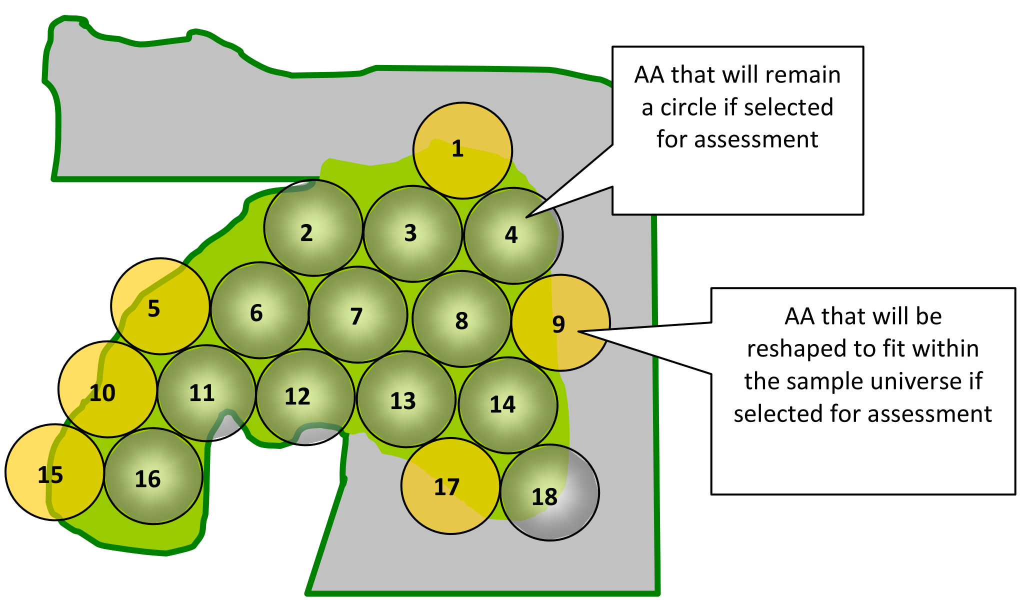


Figure D4: Sample Frame of final candidate AAs showing those that are 90% within the Sample Universe (grey AAs) and do not have to be re-shaped if selected for assessment, and those that are between 90% and 80% within the Sample Universe (yellow AAs) and will be reshaped if assessed. Each AA is numbered for random selection.



ATTACHMENT H
WRAMP Implementation Priorities

Priority 1 (Existing Funding):

<u>Level 1 implementation plan:</u>
1. Wetland, Stream, Riparian Classification Systems
2. Procedures for reporting net change in extent

<u>California Wetland Portal functionality:</u>
1. Online data entry
2. Online mapping of project boundaries and habitats
3. Basic reporting and query capabilities

<u>North Coast pilot project:</u>
1. Form NC Team through RB1
2. Demonstrate Level 1 and Level 2 tools
3. Watershed assessment
4. Wetland, stream, riparian area protection policies

Priority 2 (Short-term New Monies):

<u>Riverine wetland modules:</u>
1. First and second order ephemeral streams
2. Arid alluvial channels
3. Large river systems

<u>Portal implementation plan & Technical Bulletin:</u>
1. Agricultural activities
2. Unauthorized activities
3. Permit-related activities
4. Grant-funded restoration and conservation

Priority 3 (Pursue Additional Monies):

Merge eCRAM and Wetland Portal
1. Integrate systems into Wetland Portal
2. Coordinate with other systems (BIOS, CERES, Cal-ATLAS, CalFlora)

Develop stressor index
1. Build from USA RAM
2. Coordinate with reference stream and reference wetland projects
3. Coordinate with bio-objectives for wadeable streams

CRAM along condition gradients
1. Mitigation/restoration performance
2. Natural systems recovery following disturbance (e.g. fire)
3. Initial statewide ambient assessment for each wetland class

Appendix I-Detailed Cost Estimates for WRAMP Implementation

	unit cost		*units*	*total cost*	*annual cost*	
Wetland Mapping						
complete state wetland map	$5,000	quad	1000	$5,000,000		one time
develop mapping and classification protocols				$35,000		one time
vetting and review of procedure	$125	hour	200	$25,000		one time
implementation of status and trends program	$45,000	class/region	49	$2,205,000	$315,000	7 yr cycle
update base map for entire state	$3,000	quad	2800	$8,400,000	$420,000	20 yr cycle
Wetland Condition Assessment						
probabilistic assessment using RAMs	$120,000	class/region	49	$5,880,000	$840,000	7 yr cycle
Data Management						
develop approach and procedures	$125	hour	500	$62,500		one time
vetting and review of procedure	$125	hour	100	$12,500		one time
project tracking data management	$150	project	1500	$225,000	$225,000	
agency trainings	$10,000	class	10	$100,000	$100,000	
reference site management	$5,000	site	250	$1,250,000	$250,000	5 yr cycle
Field review 10% of CRAM assessments	$2,500	site	150	$375,000	$375,000	
Field review high profile/concern projects	$3,500	site	75	$262,500	$262,500	
Reporting	100,000	report	1	$100,000	$20,000	every 5 yrs