Draft FINAL

Wetland Ecological and Compliance Assessments in the San Francisco Bay Region, California

Andree Breaux, Ph.D. & Molly Martindale

July 31, 2003

With the assistance of the following:
Steve Cochrane, Frost-Cochrane, Inc., (Invertebrates and Plants)
Jules Evens, Avocet Research, (Vertebrates with an emphasis on Birds)
Bruce Pavlik, Ph.D., BMP Ecosciences (Plants)
Lynn Suer, Ph.D., San Francisco Bay Regional Water Quality Control Board (Zoology and State Regulations
Diana Benner (Permit research and Plants)

A report to the San Francisco Bay Regional Water Quality Control Board, California State Water Resources Control Board, California Coastal Conservancy, and U.S. Army Corps of Engineers, San Francisco District.

Contents:

Tables:

Appendices (authors are noted in parentheses; "Wetland Ecological Assessment Team" (WEA Team) refers to all team participants listed as authors or contributors):

ACRONYMS USED:

CCR – California Clapper Rail
CRAM – California Rapid Assessment Method [being developed in CA]
GPS Geographic Positioning System
HGM – Hydrogeomorphic Approach
PC – Performance Criteria
SFB RWQCB – San Francisco Bay Regional Water Quality Control Board
SMHM – Salt Marsh Harvest Mouse
U.S. ACOE – U.S. Army Corps of Engineers
WEA – Wetland Ecological Assessment [used in northern CA.]
WRAP – Wetland Rapid Assessment Method [used in Florida]
U.S. EPA – U.S. Environmental Protection Agency

ABSTRACT

The San Francisco Bay Regional Water Quality Control Board (SFB RWQCB) and the San Francisco District of the U.S. Army Corps of Engineers (U.S. ACOE) are looking for an expeditious means to determine whether regulated wetland projects produce ecologically valuable systems and remain in compliance with their permits (i.e., fulfill their legal requirements) until project completion. A study was therefore undertaken in which twenty compensatory wetland mitigation projects in the San Francisco Bay Region were reviewed and assessed for both permit compliance and habitat function, and this was done using a rapid assessment method adapted for this purpose. Thus, in addition to determining compliance and function, a further goal of this study was to test the efficacy of the assessment method, which, if useful, could be applied not only to mitigation projects, but also to restoration projects and natural wetland systems. In addition to the State and Regional Water Boards, the results should prove useful to other state agencies such as the California Coastal Conservancy which is increasingly responsible for more and larger wetland acquisition and restoration projects.

Survey results suggest that most projects permitted five or more years ago are in compliance with their permit conditions and are realizing their intended habitat functions. The larger restoration sites or those situated between existing wetland sites tend to be more successful and to offer more benefits to wildlife than the smaller isolated ones. These results are consistent with regulatory experience suggesting that economies of scale could be realized both with (1) large scale regional wetland restoration sites, through which efforts are combined to control invasive species and share costs, and (2) coordinated efforts by regulatory agencies to track project information and to monitor the increasing number and size of mitigation and restoration sites.

INTRODUCTION

Under the national and California "no net loss of wetlands" policy, attempts are made to avoid wetland losses whenever possible. In the regulatory context, when the permit applicant has attempted but has been unable to avoid or minimize such losses, compensatory mitigation projects are required to offset the adverse impacts on existing wetlands. The policy also supports projects for restoration, creation, and preservation or enhancement of wetlands.[1] In order to measure the need and success of such projects, an efficient and accurate wetland assessment method has long been sought.

---

[1] The following terms apply to wetland projects:
Restoration is used here to describe the return of functions that once existed in the area but that do not presently exist. Creation refers to establishing wetland functions to a site where they never existed. Enhancement refers to improving functions at an existing wetland site. Preservation refers to maintaining a wetland in its existing condition and providing some mechanism to maintain its current state.

Over forty wetland assessment methods have been published since 1990 and more are being developed (National Research Council, 2001; Bartoldus, 1999 & 2000). Other methods are not formally categorized but perform the same general function of evaluating sites for biological, hydrological, or physio-chemical success or for compliance with regulatory permits (e.g., DeWeese, 1994). There have been repeated calls over the last two decades for "science-based" assessment methods, but few have proven to be reliable in all regions or even in the same region over a substantial amount of time. At the same time, databases run by regulatory agencies are becoming bloated with useless project information that cannot always answer questions so basic as "where is the project site?", "what are the goals?", and "what are the criteria used to determine project success?" Too much is left to institutional memory which relies on people who are likely to be unavailable when the projects or their monitoring periods are completed.

We reviewed many assessment methods and selected one that gave more attention than most to the presence of wildlife in wetlands. In the San Francisco Bay Region, wildlife habitat is one of the primary functions served by a stream or wetland to be filled, but most evaluation methods do not specifically evaluate this aspect of wetland projects. The method chosen was the Wetland Rapid Assessment Procedure (WRAP), a rating index developed by the South Florida Water Management District (Miller and Gunsalus, 1999). We then modified and adapted the WRAP to better reflect the conditions of Bay Area habitats. We call the revised method, the Wetland Ecological Assessment (WEA).

The purpose of both of these assessment methods is to assist in the regulatory evaluation of permitted mitigation or restoration sites (i.e, wetland sites that are created, restored, enhanced or preserved). The stated objectives of South Florida's assessment method are to:

1. establish an accurate, consistent, and timely wetland assessment tool;
2. track trends over time (land use vs. wetland impacts); and
3. offer guidance for environmental site plan development.

Both the WRAP and the WEA evaluations are rapid assessments, to be used within the limited timeframes of the regulatory process. Test results of the WRAP procedure used in Florida showed it to be highly repeatable and an effective training tool for biologists (Miller and Gunsalus, 1999). It is important to note that our purpose in testing and developing wetland assessments in the San Francisco Bay Region was twofold: (1) to determine whether mitigation sites were producing viable wetlands and (2) to assess the extent of permit compliance. Given the large number of assessment methods available, and given our small sample size of twenty projects, results are intended only to provide preliminary guidance for further research and development of wetland assessment methods used in California and the United States.

The results of the WEA scores can be compared to a third method currently being developed by the U.S. EPA (Region 9) and several other entities in California (including the SFB RWQCB, U.S. ACOE, and the State Water Resources Control Board). This method has been denominated as the California Rapid Assessment Method (CRAM). The CRAM seeks to develop reliable scientific methods for rapid assessments for use in California, and to follow up rapid assessments with intensive field monitoring that could take several years per site to complete (Collins et al., 2003). CRAM is derived from the

Ohio Rapid Assessment Method (ORAM), which in turn relies heavily on the Washington State Wetlands Rating System. The major metrics used in most of these assessment methods, including the WEA, are typically vegetation, hydrology, surrounding land use, buffer quantity and quality, and wildlife habitat.

METHODS

Office Methods:

A database was developed in 1994-95 at SFB RWQCB, with the assistance of the U.S. ACOE. This database was designed to track all the components of compensatory wetland mitigation projects necessary to monitor their success upon project completion, usually five to twenty years after planting (Holland and Kentula, 1991). Information was collected on approximately 120 projects that were permitted between 1988 and 1995. The information included project goals, wetland habitats affected, performance criteria, monitoring elements, and reference sites used.

In 2003, we randomly selected eighteen of these projects from the database to determine whether they were in compliance with their permits and whether they had produced acceptable wetlands to compensate for destroyed wetlands. Two additional projects were deliberately selected because of their large size and high profile (Sonoma Baylands and Roberts Landing). Three of the original eighteen randomly selected projects could not be evaluated because they were known to be out of the region, to have never happened, or to have been inaccessible[2]. Consequently, three non-random projects with completed monitoring periods were selected as replacements (Red Top Road, Coyote Creek, and Fleeman Property). Two others were visited in the field but not completely evaluated because they either had been avoided completely but not removed from the database (Mayhews Landing), or were part of a larger project that could not be differentiated at the time of the assessment (Bettencourt Detention Basin). All of the final twenty wetland sites selected for evaluation were located throughout the San Francisco Bay Region (Figure 1[3]). Table 1 lists the twenty wetland projects visited and/or evaluated in the Spring of 2003.

Background information not contained in the database was researched at the SFB RWQCB office in Oakland, CA or the U.S. ACOE office in San Francisco, CA. The required office data dealing with project compliance and typically found in permits and monitoring reports is listed in Appendix I (A) and based primarily on the experience of staff at the SFB RWQCB and U.S. ACOE, and on guidance contained in the U.S. EPA Region 6's Mitigation Circuit Rider Program (2001). Field data collected from each site dealing with the wetland ecological assessment (WEA) of the project site is listed in Appendix I (B).

Field Methods:

The WEA Team consisted of four full-time members who assessed all twenty projects. These consisted of an ornithologist/naturalist, an invertebrate

[2] Projects that were dropped were California Oak Creek, Farrell Parcel, and Sheldon North Subdivision.
[3] GPS coordinates were suspected of being inaccurate for sites 11, 12, 13, 14, 15, 16 (?), 17, and 18, so locations for these sites are estimated.

specialist/naturalist, and two wetland mitigation regulators -- one from the SFB RWQCB and the other from the U.S. ACOE. A fifth member included a professional botanist who evaluated eight of the twenty projects. A student botanist also helped assess two projects in the field. A zoologist with wetland regulatory experience served as an outside evaluator and conducted three assessments in isolation (i.e., without communicating with the WEA Team) in order to compare scores. Additional staff from the SFB RWQCB, U.S. ACOE, and the San Francisco Estuary Institute provided various degrees of expertise and experience. Assessments were conducted between March 18, 2003 and May 5, 2003 and generally took between two to four hours for each site depending on size and site complexity.

Project information was reviewed by some of the team members before the site visit. In the field, attempts were made to view 100% of the site by walking, driving, or seeing it from an upland vantage point. At least 50% of the sites were walked in most cases. If sites were larger than 100 acres, they were assessed from more than one point.

Project evaluations consisted of the WEA for ecological wetland function as well as a determination of permit compliance. Ecological assessments included vegetation, bird, and invertebrate surveys with notations made for observations of mammals, amphibians, reptiles, fish or any sign of those wildlife groups. The project team discussed scoring rationale for each category until consensus was reached. The following methodologies were used to assess invertebrates, birds, and vegetation in the project areas:

- Invertebrates were collected in vegetation along a transect using timed insect sweeps, with an insect net passed over the same area twice. For aquatic areas, five sweeps were taken with a D-ring net. In both cases insects were identified, tallied, and released.

- Birds were detected by ear or viewed with binoculars or a spotting scope and the species recorded.

- Vegetation was described from assessment points with maximum visibility as well as from transects run through project areas that provided information on species, dominants, patterns, vigor, and invasive species. The surrounding area was also assessed. All team members contributed to the evaluation based on what was expected to be and what was actually in the site. When the professional botanist assessed a site, he used his own rating system along with the botanical site evaluations for each of the eight evaluations that he made (BMP Ecosciences, 2003). The rating system and evaluations have been incorporated into the twenty site summaries found in Appendix II. The vegetation at the other sites was evaluated by the remaining team members (particularly the vegetation transect data contributed by the invertebrate specialist).

Other summary information on each individual site is found for birds (Appendix III), invertebrates (Appendix IV), and mammals, fish, amphibians, and reptiles (Appendix V). Note that specific surveys were not conducted for the wildlife groups covered in Appendix V, which were only noted incidentally in the surveys conducted specifically for birds, invertebrates, and plants. Appendix VI lists most plants observed at the sites and Appendix VII lists some important exotic vegetation in the San Francisco Bay Region.

RESULTS

Table 2 lists the projects evaluated by size and provides information on predominant habitat type, WEA score, Compliance score, and, if available, a Botanical score (labeled "BMP Vegetation" score after the project consultant). The twenty project summaries in Appendix II include a Compliance Form and a Wetland Ecological Assessment (WEA) form that incorporates the available supplemental botanical evaluations as noted above.

Projects ranged in size from 0.1 acres to about 300 acres and included seven riparian, six tidal, three perennial freshwater (one not assessed in field), one vernal pool (consisting of two actual project sites under one permit application), and three other seasonal wetlands (one not assessed in field). Some projects had more than one type of wetland, in which case the larger type was evaluated. Wetland restoration and creation were counted as net gains in wetland extent, but enhancement or preservation were not.

The following scoring techniques were used (See Appendix I (B) for complete description of metrics used for WEA scores and Botanical scores; criteria used for Compliance scores are described below in Table 4):

- WEA scores were rated from 15 (high) to 1 (low). Five metrics were scored each with a possible high score of 3 points (wildlife habitat, vegetation, hydrology, buffer, surrounding land use);
- Compliance scores were rated as 5 (high) to 0 (low);
- Botanical scores (BMP) were rated (for 8 of the 20 projects) from 3 (high) to 1 (low). 3 categories were used to evaluate vegetation (composition, structure, and re-establishment).

The average WEA score for all projects was 10.1, with a range of individual scores from 6.9 to 13.1.[4] All of the five sites that scored the highest overall in the WEA also scored the highest in hydrology (score of 3) -- four of those sites are tidal sites and one is a perennial stream. Hydrology scores ranged from 1.5 at a site where check dams supporting wetlands had failed, to 3.0. Wildlife scores were generally high, with twelve of the eighteen sites evaluated scoring 2 or above. Only Sonoma Baylands received a score of 3.0 and this score may be revised downward after further consideration of how long the site will take to develop the intended California clapper rail (CCR) habitat. Vegetation scores were somewhat higher overall, although no site received a score above 2.9. The highest score for surrounding land use was again achieved by Sonoma Baylands which received a 2.6.

The three scores provided by the outside evaluator were generally in agreement with those reached by the WEA Team by consensus. Scores were as follows with the

[4] Two sites, Sonoma Baylands and Dublin Meadows, were reconsidered after the site visits because further investigation indicated that wetland function or wetland permit compliance should be reduced from the score given at the site visit. The original scores are used in this analysis, but the suggested revisions may replace those scores in the future.

WEA Team listed first, followed by the outside evaluator: Richmond Parkway – 12.3 and 12.2; Triangle Schnitzer – 10.9 and 9.7; and Calera Creek 13.1 and 12.0. Scoring differences at Triangle Schnitzer were primarily based on buffers and surrounding land use, and at Calera Creek were based on buffers and hydrology. Though there was not more than a ten percent difference between the outside evaluator and the WEA Team on any of the three projects, definitions of adequate buffers, surrounding land use and reliable hydrology should be expanded and re-tested for future assessments.

In addition to WEA scores, Table 2 also lists compliance scores along with comments about the project's performance in relation to its permit requirements. Compliance is based mainly on meeting the performance criteria contained in the permit and on turning in timely (usually annual) monitoring reports. Table 3 shows the number of projects by size category that met or failed various levels of compliance.

In general, compliance for seventeen of the eighteen projects evaluated and ranked was good. (Of the original twenty, impacts to Mayhews Landing were avoided so the mitigation project never took place, and Bettencourt detention basin could not be evaluated in the field due to a lack of clear project performance criteria). Only one very small project permitted by the U.S. ACOE apparently failed to be completed (at the Pittman Road site, 0.2 acres was supposed to be restored and was not). Several of the larger projects are still young and some took longer than expected to begin construction. Most projects are completed and successful or still monitoring but proceeding in the right direction. Consideration should be given to raising the criteria in terms of requiring native species on and surrounding project sites, in order to assure native plant and wildlife diversity for the future.

Table 4 lists the WEA scores by habitat type showing tidal projects as having the highest average scores. Sample size for seasonal (two assessed in field), vernal pools (two assessed in field but part of one project), and perennial fresh (two assessed in field) are generally too small to draw reliable conclusions. Table 5 provides additional summary data for birds indicating extremely high use by waterbirds, shorebirds, and landbirds at or near the Sonoma Baylands site; high use at Robert's Landing by a diversity of bird groups; high use by landbirds at Dublin Meadows, Calera Creek and, to a lesser extent at Calabazas Creek and Coyote Creek. If future funding is available for summary and analysis of the invertebrate data found in Appendix IV, that analysis will further enhance the site descriptions.

Most projects were providing some ecological wetland function and were in compliance with their permits. Increases in the net gain of wetlands came mostly from the larger projects. Overall the projects reviewed for this study show that unlike some areas of the country or the state where the no net loss of wetlands is generally not occurring (e.g., National Research Council 2001), the San Francisco Bay Region is increasing its wetland base by emphasizing avoidance and by allowing more and larger wetland restoration projects (note that these are not always projects that entail mitigation). The true test will be the monitoring and assessment of these projects over the coming decades to determine if they continue to produce viable and ecologically diverse wetland systems.

The sample size of twenty divided between five wetland types is too small to draw any broad conclusions about its validity for assessing wetland function and compliance generally. However, there seem to be certain patterns and associated implications, arising from the assessments that are worthy of note.

First, as a group, the six tidal projects in this study had the highest average for wetland ecological success. All of these tidal projects were located between or adjacent to existing tidal marsh sites and therefore served to expand or connect already successful natural sites. Point Richmond, Bay Point Corner Lot, Triangle Schnitzer, and Robert's Landing all scored high in a relatively short period of time, in part as a result of their proximity to established natural wetland sites. This is consistent with findings that tidal marsh restoration sites are sometimes easier to restore or create than other wetland types when wave energy is low (e.g., NRC 2001; Kusler and Kentula 1990). On the other hand, these tidal marshes may be successful because of their contiguity with existing marshes.

Secondly, in regard to the seven riparian projects assessed, we found that where a mitigation site is small and located in a highly developed urban area with multi- or single family housing on small lots, there is little room for adequate buffers to protect the creek. Without space wide enough to allow dense or even partial riparian canopies, the absence of shade is likely to exclude diverse invertebrate communities and allow, instead, dense stands of cattails. While these projects undoubtedly have value from a local or neighborhood perspective, they have little value from an ecological perspective. We therefore determined that large size is a determining factor in the success of most of these projects, and in Table 2, we have accordingly grouped them by size. Based on the projects we assessed, the larger the riparian project, the higher it was ranked.

And finally, only two vernal pools (under one permit) were evaluated and the same general conclusion could be drawn about those, i.e., they met permit conditions but their success was limited by small size and relative isolation. One was located in a small field surrounded by roads and houses, and the other was in a dry agricultural area surrounded by non-native grasses. They were "successful" in terms of establishing vernal pool species (both native and non-native) but they might be better situated in a larger watershed complete with adequate drainage areas, swales, and native grasslands. The project applicants in cases like these choose the least expensive and most practical sites for these mitigation projects. A coordinated effort among interested parties with a regional landscape perspective could combine resources, help site projects in a regionally rational context, help control invasive species, conduct experiments to inform flexible management practices, and provide long-term monitoring which could extend beyond the typical five year period for small projects.

CONCLUSIONS/DISCUSSION

The key elements required to evaluate wetland restoration or mitigation projects are simple and have been noted many times before. Those are: an adequate tracking system, a standardized methodology, a "science-based" methodology, and funds to pay either regulatory staff or consultants for evaluation time. The methodology can be selected from existing wetland assessment techniques or newly designed by the agency carrying out the assessments or paid consultants. What is important is that steps are included in the program design that will test the method for repeatability by different users. To carry out a successful program data should be statistically analyzed to determine whether there is acceptable or unacceptable variation between samples. This requires that sites be representative of the population of wetland mitigation or restoration projects, that they be stratified by wetland type, age, and size, *and that there is a large enough sample to develop appropriate statistics*. In the beginning, efforts should be made to develop the appropriate databases and to test methods for repeatability. This can be done with fairly subjective metrics or with highly quantitative indices of biological integrity. It may be that subjective metrics, an outcome of professional judgment, may be more nuanced and reliable than highly quantitative indices. Once those steps have been accomplished, sites can be evaluated statistically providing a more meaningful analysis for the entire San Francisco Bay Region or the entire state of California.

Of the 120 projects in the SFB RWQCB database that were permitted between 1988-1995, more than half were small projects of less than one acre. Since the mid-1990's, many very large projects -- some over 1,000 acres -- have received permits to restore wetlands, as either compensatory mitigation projects requiring an increase in wetland acreage to adequately mitigate for anticipated temporal and permanent impacts, or simply as restoration projects seeking to return altered sites to their pre-existing wetland condition. While the small projects add up and can be important, they can also be a drain on scarce resources in terms of permitting and follow-up monitoring. Consideration should be given to combining these small compensatory wetland mitigation projects whenever possible into regionally integrated mitigation banks. If cities, counties, regional, state, and federal agencies select wetland restoration sites, future compensatory mitigation projects can be directed toward those larger, regionally integrated sites and economies of scale can be realized in their tracking and evaluation. Connecting new wetland habitats to old ones and combining mitigation sites can increase project success and provide relatively less expensive means to maintain native species habitats and provide the added value inherent in larger wetlands. For example, densities of CCRs, a federal and state endangered species, are positively correlated to larger marsh areas (Collins et al. 1994); this area/density relationship has also been found for the California black rail (Evans and Nur 2002), another federal and state listed ("threatened") tidal marsh-dependent species.

Rapid assessments can only capture a few hours at any site and are therefore likely to under- or over- estimate the importance of a site because they miss diurnal, seasonal, annual, or decennial variation. Rapid assessments should not be thought of as a substitute for longer and more thorough surveys that are typically found in mitigation monitoring reports, environmental site assessments, or scientific studies. Every attempt should be made to review all available pertinent information about the site before conducting the evaluation, and the assessors should be aware of the regional and policy contexts.

For example, Sonoma Baylands, the largest site assessed, scored high on the day of assessment for shorebird and waterfowl use. It did not score high that day for the CCR and the Salt Marsh Harvest Mouse (SMHM). These results of a mere half day, however, reflect a broader debate among regulators and scientists familiar with the site over its ability to provide habitat for these species. Restoration goals for CCR and SMHM were not met in the short term (six years since construction), however the long-term potential for these species is an open question, and the monitoring period is twenty years. Thus, a policy decision must still be made by regulators and interested members of the public whether to allow the site to continue to develop slowly, which benefits shorebirds and waterfowl, or to speed up tidal creek evolution by widening the channels in order to ultimately create high quality habitat for CCR and SMHM.[5]

It should also be noted that the current endeavor to restore tidal marshes is fairly recent, and it is too early in most places for tidal marsh restoration projects to be declared successful or not. Indeed, the larger projects in this study still have an additional five to ten years before a determination of success is required. Progress so far is variable depending on the amount of available sediment, wind/wave erosion, degree of subsidence, and tidal exchange through channels.[6] Because of these ambiguities arising from temporally limited assessments, assessors by necessity must focus on the *potential* of the site to accommodate healthy food webs and special status species. This practice should be incorporated into any formal assessment method used, so that credit is given to a site for the appearance of the structural complexity required for the survival of terrestrial and aquatic animals and plants. It is a good idea, therefore, to include in the final evaluation species *expected* at a site, based on professional judgment, in addition to those actually observed at the time of the assessment. Also, surveys should always include vegetation, and should be rotated between major animal species groups (birds, mammals, amphibians & reptiles, fish, and invertebrates) to assure adequate representation of all members of the food web. Special attention, however, should be given to “keystone” species, i.e., high trophic-level species integral to ecosystem function.

Other cautions regarding rapid assessment techniques include an emphasis on the seasonality of habitat use by biological species. In the San Francisco Bay Region, some migratory birds may not be present until May or may occur sporadically; some plants will flower in early spring but wetland species will be better identified in summer; terrestrial invertebrates may be late if spring rains are late (or not be present at all under drought conditions), but aquatic invertebrates and amphibians may not be present after May. Annual precipitation can vary widely, so habitat use can vary widely even by the same species. Generally the best time for wetland evaluations will be in the spring or early summer.

Finally, it cannot be overemphasized that a rapid assessment method cannot in itself compensate for lack of experience or knowledge in the assessor. These methods can efficiently focus attention on the pertinent factors, but the assessor must be capable of recognizing and evaluating these factors. Thus, our survey was conducted by a highly qualified and experienced team of scientists and regulators. Nonetheless, any deficiency in knowledge and experience can be offset by adequate preparation and research on all available information on the project before the assessor goes into the field. In this regard, an adequate data base, which incorporates the important and pertinent features of the project, is essential to preserve the “rapidity” of any assessment method used in the field. Future efforts should be put toward determining whether adequate databases and pre-

---

5 Some projects evaluators claim that it could be too late for the tidal marsh channels to develop because the soil has be come too consolidated and the vegetation may become too entrenched for the channels to form. The complete assessment for this site is found in Appendix II (Project # 1).

6 The apparent success of tidal marshes arising from naturally breached levees cannot provide an accurate measure of success for artificial restoration projects (Williams & Orr, 2001).

evaluation research on the site, combined with trainings on how to evaluate wetland projects, can provide results similar to those achieved by the experienced team of scientists and regulators.

RECOMMENDATIONS

1. Use any rapid assessment method with caution. It is important to gather background materials on the site including design plans, monitoring reports, etc. At the very least, the goals of the project need to be known before an assessment is done. The following steps should be followed before rapidly assessing projects and selecting a rapid assessment method for regional or state-wide use:

   a. have an appropriate database in place to enter all pertinent site information;
   b. review all documents relating to the site and its surrounding areas;
   c. conduct rapid assessments with a team of local experts on vegetation and wildlife;
   d. provide follow-up surveys at different seasons to observe different species (especially target species listed by wildlife agencies as being endangered, threatened, or merely sensitive to habitat alterations); and
   e. have different assessors rate the same site to determine if results are repeatable.

2. A program should be put in place to require that mitigation and restoration sites set aside at least 40% of project funds to allow meaningful monitoring and assessment of projects. Required resources should fund a state-wide wetland monitoring program that would provide standardized assessment tools, guidelines for statistical analysis, and quality assurance for data collection. Data could then be collected on each project with specific monitoring requirements for each project.

3. Agencies with responsibilities for restoring wetlands (either as regulators or purchasers) should put an adequate amount of resources toward tracking and monitoring those projects. This would require: (a) the proper information in a database; (b) reading and reviewing all pertinent documents related to the site; and (c) assessing the site in the field. It is preferable to keep up with the progress of restoration sites in a timely fashion (i.e., annually) but if this is impossible due to limited staff or funding, the effort can be made at 5 year intervals at a minimum.

4. A central agency should manage data and track the progress of mitigation or restoration sites. Project locations, permit application information, and entire monitoring reports can be put on websites and easily accessed (e.g., the Wetland Tracker managed by the San Francisco Estuary Institute). All information required for later review could be put in a single file for that project. This would include detailed diagrams of the locations of plantings. Some of these can never be found without the original project manager present. Clear visuals are needed in addition to detailed descriptions, latitude/longitude, or other GPS data using standardized GPS coordinate systems. Note that GPS data sometimes requires confirmation and is not always correct.

5. Appendix I has the basic elements that should be included in a mitigation or restoration project database for later determinations of permit compliance and ecological site assessments.

6. Develop region-wide guidance for the San Francisco Bay Region for removal of aggressive non-native species. It is counterproductive for agencies to require removal of exotics in some projects but not others or in areas surrounded by source populations. Project applicants and their contractors should be required to coordinate their efforts with counties, cities, state, and federal agencies to remove those species that could threaten the life or the integrity of the restoration project. Such coordination would enhance the regional and site-specific efficacy of control projects.

7. Encourage mitigation banks or regional or local efforts that combine resources and responsibilities for the site. For example, it is clear from our assessments that non-native invasive species are a major threat to most mitigation or restoration sites. While tidal wetland habitats may be more protected from invasive species due to inundation and salinity than other wetland types, even their transition areas and upland borders (important refugial habitats for several listed species) appear to be dominated by aggressive non-natives. Cost sharing and regional coordination to eradicate aggressive non-native species could be an effective means of ridding the region of troublesome exotics. Appendix VII has a list of the most threatening exotic invasive species in the San Francisco Bay Region.

8. Test the validity and repeatability of the results of this report with other methods and assessors:

(a) compare the WEA scores from this study to scores derived from assessing the same sites with the CRAM when that method is ready for use; and
(b) determine whether staff trainings combined with adequate project research can result in similar WEA assessment scores between the projects evaluated for this report by the team of scientists and regulators, and those provided by future trained staff.

9. Mitigation sites should monitor for a minimum of five years or until performance criteria are met, whichever is longest. Letters by project proponents stating that the performance criteria have been met early should not excuse monitoring for at least five years. This should assure that aggressive species are eradicated both within and surrounding the mitigation site, thus giving the site a good chance to develop a strong native species community.

10. Temporal losses of wetland values should be included when determining mitigation amounts.

The following six recommendations are from BMP (2003), based on site evaluations conducted for this project:

11. Performance Criteria should require plant species native to the site or to local reference areas, not just native to California.

12. Absolute cover of vegetation, rather than relative cover, should be used to clearly represent the structure of the restored vegetation.

13. Projects that are isolated or at some significant distance from propagule sources should not rely solely on natural dispersal to determine species composition.

14. Cover and abundance data from non-native wetland plants (e.g., *Lolium* sp.) should not be lumped together with data from native wetland species. This obscures project values and works against higher standards needed to ensure proper function, structure and wildlife use. Performance standards will also need to recognize this distinction.

15. Control of non-native invasives is a long-term obligation of the project proponent and must be enforced.

16. Management of the immediate project context, including control of noxious weeds, should be part of the regulatory agreement, especially if mitigating for wildlife values.

ACKNOWLEDGEMENTS

Funding for this project was provided by the California Coastal Conservancy, and staff resources were provided by the San Francisco Bay Regional Water Quality Control Board and the U.S. Army Corps of Engineers, San Francisco District. In addition to the project team, additional field assistance was provided by Abigail Smith and Brian Wines. Assistance was also provided by Jeff Kapellas with GPS mapping and by Michael Peterson with data management. Bruce Wolfe, Ron Gervason, and Nadine Hitchcock provided agency guidance for this project.

REFERENCES

Bartoldus, C. 1999. A comprehensive review of wetland assessment procedures: a guide for wetland practitioners. St. Michaels, MD: Environmental Concern Inc.

Bartoldus, C. 2000. The process of selecting a wetland assessment procedure: steps and considerations. *Wetland Journal*, Vol 12, No. 4.

BMP Ecosciences. 2003. Evaluation of the vegetation of wetland restoration projects in the San Francisco Bay area. San Francisco, CA.

Bossard, C., Randall J., and M. Hoshovsky. 2000. Invasive Plants of California's Wildlands. University of California Press, Berkeley, CA.

CalEPPC. 1999. Exotic pest plants of greatest ecological concern in California. California Exotic Pest Plant Council, UC Davis, Davis, CA.

Collins, J., M. Sutula, and E. Stein. 2003 (draft). California rapid assessment method for wetlands. Version 1.5. June 2003. Draft manuscript submitted to CA. Environmental Protection Agency, San Francisco, CA [available at www.wrmp.org].

Collins, J., J.G. Evens, and B. Grewell. 1994. A synoptic survey of the distribution and abundance of the California clapper rail, *Rallus longirostris obsoletus*, in the northern reaches of the San Francisco Estuary during the 1992 and 1993 breeding seasons. Technical Report to California Department of Fish and Game.

DeWeese, J. 1994. An evaluation of selected wetland creation projects authorized through the Corps of Engineers section 404 program. U.S. Fish and Wildlife Service, Ecological Services, Sacramento, CA.

Evens, J. and N. Nur. 2002. Distribution, population variation, and habitat affinities of the California Black Rail in the San Francisco Bay Region. *Bird Populations* 6:1-12.

Holland, C. and M. Kentula. 1991. The permit tracking system (PTS): a user's manual. EPA/600/8-91/054. U.S. EPA, Environmental Research Laboratory, Corvallis, OR.

Kustler, J. and M. Kentula. 1990. Executive Summary *in Wetland Creation and Restoration, the Status of the Science*. Island Press, Washington, D.C.

Miller, R. and B. Gunsalus. 1999. Wetland Rapid Assessment Procedure (WRAP). Technical Publication, REG-001, Natural Resource Management Division, Regulation Department, South Florida Water Management District.

National Research Council. 2001. *Compensating for Wetland Losses under the Clean Water Act*. National Academy Press, Washington, D.C.

U.S. Environmental Protection Agency Region 6. 2001. Mitigation circuit rider program. In coordination with the U.S. Army Corps of Engineers.

U.S. Environmental Protection Agency and San Francisco Bay Regional Water Quality Control Board. 1999. *Baylands Ecosystem Habitat Goals*. San Francisco & Oakland, CA.

Williams, P. and M. Orr. 2001. Physical evolution of restored breached levee salt marshes in the San Francisco Bay estuary. *Restoration Ecology*. Vol 10. No. 3: 527-542.

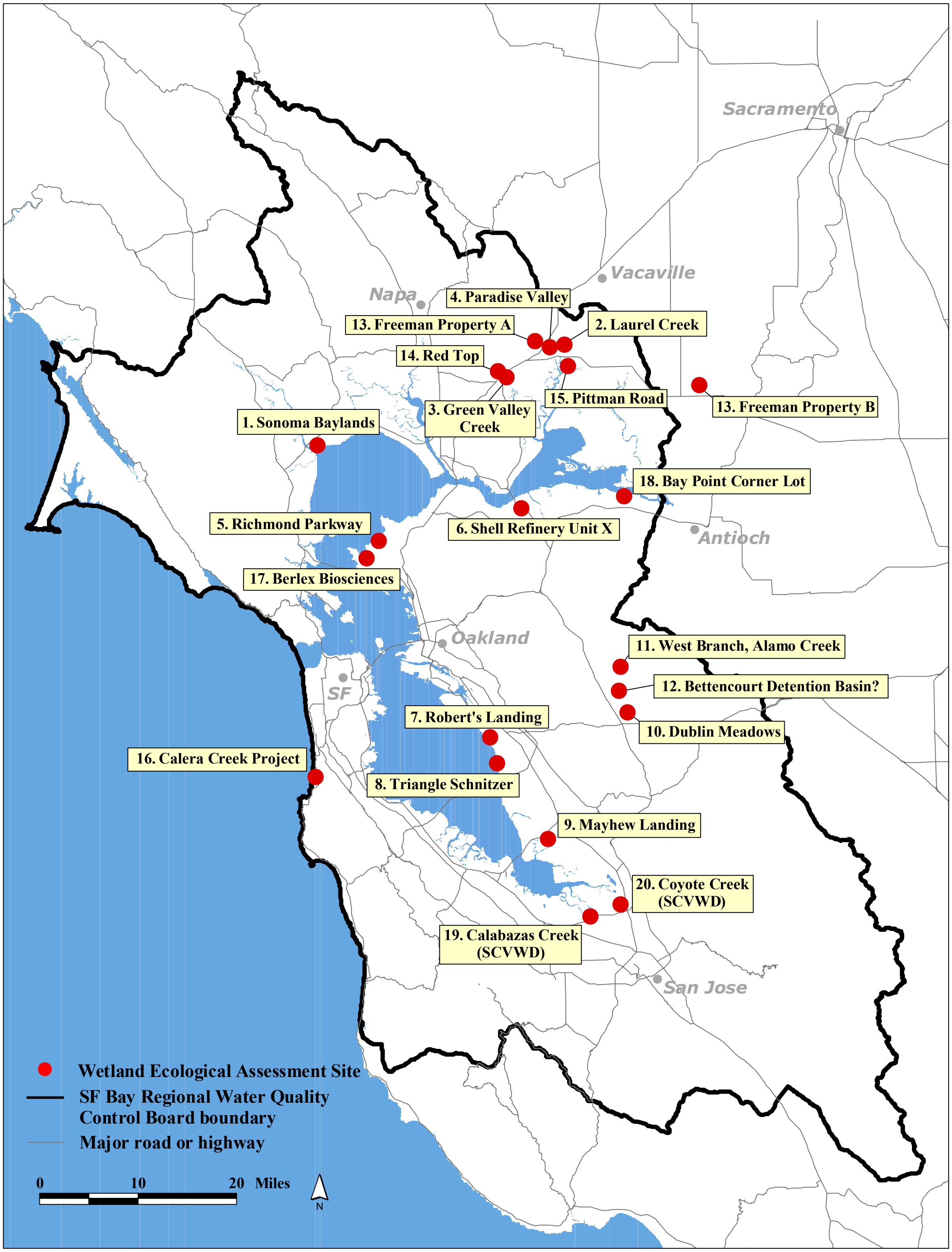

Figure 1: Wetland Ecological and Compliance Assessments in the San Francisco Bay Region (Spring 2003), locations approximate.

Table 1: Wetland Projects Visited and/or Assessed in Spring 2003

SITE NAME and Number	DATE VISITED (2003)
1. Sonoma Baylands	March 18
2. City of Fairfield, Laurel Creek	March 18
3. Green Valley Creek	March 19
4. Paradise Valley	March 19
5. Richmond Parkway	March 20
6. Shell Refinery Unit X	March 20
7. Robert's Landing (aka Heron Bay or Citation Homes)	March 27
8. Triangle Schnitzer	March 27
9. Mayhew Landing	March 27
10. Dublin Meadows	March 28
11. West Branch Alamo Creek	March 28
12. Bettencourt Detention Basin	March 28
13. Fleeman Property (aka Peabody Road)	April 7
14. Red Top	April 7
15. Pittman Road	April 7
16. Calera Creek Project (Pacifica Wastewater Treatment Plant)	April 9
17. Berlex Biosciences	April 10
18. Bay Point Corner Lot (aka Allied Signal or General Chemical)	April 10
19. Calabazas Creek (Santa Clara Valley Water District)	May 5
20. Coyote Creek (SCVWD)	May 5

Table 2: Project Size, Wetland Evaluation Assessments (WEA) Scores, and Compliance Scores (Spring 2003)

[Red or second occurrence of project name indicates a project assessed by 2 different assessment teams, one with a suggested score revision.]

WEA = Wetland Ecological Assessments

WEA SCORES 5:

WEA # [1]	Major Habitat Type [2]	Project Name	Acres Lost	Acres Created, Restored, or Enhanced	C, R, E, or P [3]	BMP Plant Scores: Project [4]	BMP Plant Scores: Context [4]	WEA Wildlife	WEA Vegetation	WEA Buffer	WEA Hydrology	WEA Surrounding Land Use	TOTAL WEA SCORE	Compliance Score [6]	Comments on Compliance [7]	Gain(+) /Loss(-) in Acres 8	Additional Enhancement
0 to 2 Acres																	
17	PF	Berlex Biosciences	0.07	0.01	C			1.5	2.9	1.5	3.0	2.1	**11.0**	5?	SPC	0 (A)	
15	PF	Pittman Rd	0.2	0.2	R	1-1-2	1-1-1							0.0	Project should have happened but was never carried out?	0	-0.2
6	PF	Shell Marsh Unit X	0.7	0.7	C	2-2-2	1-1-1	2.0	2.0	1.5	2.0	1.2	**8.7**	5?	SPC	0 (R)	
2	R	City of Fairfield, Laurel Ck	0.8	1.2	E			1.0	1.6	1.0	2.0	1.5	**7.1**	3?	Performance criteria not successfully met	-0.8	1.3
18	T	Allied Signal [now General Chemical]	1.4	1.4	R			1.0	2.8	2.0	3.0	1.0	**9.8**	5?	SPC	0 (R)	
12	S	Bettencourt [Camino Tassajara]	1.6	0.2	E			0.5	2.2	1.0	2.0	1.2	**6.9**	1? Or NA?	N.A. Assessed only o.2 of 1.8 acre project	? NA	
19	T	Calabazas Creek (SCVWD Mitigation)	1.9	1.7	C			2.0	2.0	2.0	3.0	2.0	**11.6**	5?	SPC	-0.2	
13A*	VP	Fleeman [On-site Restored]	1.4	0.7	R/C	2-2-2	1-1-1	1.5	2.3	2.0	2.0	1.5	**9.3**	5?	SPC [count 13A & 13B as one project]	1.5 (A)	
13B*	VP	Fleeman [Off-site Created]		1.4		2-2-2	2-2-2	1.0	2.3	3.0	2.0	1.5	**9.8**	5?	SPC	[included under 13A]	
															TOTAL	0.5	1.1
3 to 5 Acres																	
5	T	Richmond Parkway WEA TEAM	2.6	2.6	C	3-3-3	1-1-1	2.0	3.0	2.0	3.0	2.2	**12.2**	4?	Was supposed to stop after 5 years or whenever perf. Criteria met whichever took longest. SPC	0 (R)	

Table 2 (Continued)

WEA # [1]	Major Habitat Type [2]	Project Name	Acres Lost	Acres Created, Restored, or Enhanced	C, R, E, or P [3]	BMP Plant Scores: Project [4]	BMP Plant Scores: Context [4]	WEA Wildlife	WEA Vegetation	WEA Buffer	WEA Hydrology	WEA Surrounding Land Use	TOTAL WEA SCORE	Compliance Score [6]	Comments on Compliance [7]	Gain(+) /Loss(-) in Acres 8	Additional Enhancement
5		Richmond Pkwy (Outside Evaluator)						2.0	3.0	2.6	3.0	1.7	**12.3**				
14*	S	Red Top	1.0	C= 0.4 (seasonal);E= 2.2 (riparian)	E/C	2-2-2	1-1-2	1.0	1.9	2.0	2.0	2.0	**8.9**	3?	Replant non-native trees with trees more approriate to site? PC not completely met.	-0.6	2.2
4	R	Paradise Valley	3.0	3.1	C			2.0	2.0	2.0	1.5	1.6	**9.1**	5?	SPC	0	
10	R	Dublin Meadows	0.1	3.8	E			1.5	2.1	0.0	3.0	1.1	**7.7**	2?	Replant some trees and remove exotics?	-0.12	3.8
10		Dublin Meadows REVISED		3.8	E			1.5	1.5	0.0	3.0	1.1	**7.1**				
9	S	Mayhews Landing	0.0	0.0	R			NA	NA	NA	NA	NA		NA	Project never happened due to avoidance	NA	
															TOTAL	-0.72	6
6 to 10 Acres																	
8	T	Triangle Schnitzer Marsh* (WEA Team)	1.3	7.0	R	2-2-3	1-1-1	2.0	2.4	2.0	2.0	2.5	**10.9**	5?	SPC (but poor perfmornace criteria)	5.7 (R)	
8		Triangle Schnitzer Marsh* (Outside Evaluator)						2.0	2.4	1.0	2.5	1.8	**9.7**				
20*	R	Coyote Creek (SC Valley Water District)	??	7.0				2.0	2.8	3.0	3.0	2.2	**13.0**	4?	Ongoing but SPC	??	
16	R	Complete Calera Creek Project [or Pacifica WW Trt Plant]	7.1	8.0	R	3-3-2	2-2-2	2.5	2.4	3.0	3.0	2.2	**13.1**	4?	MNC but successful so far	0.9 (A)	
16		Calera Ck [Riparian]				3-3-2	2-2-2										

Table 2 (Continued)

WEA # [1]	Major Habitat Type [2]	Project Name	Acres Lost	Acres Created, Restored, or Enhanced	C, R, E, or P [3]	BMP Plant Scores: Project [4]	BMP Plant Scores: Context [4]	WEA Wildlife	WEA Vegetation	WEA Buffer	WEA Hydrology	WEA Surrounding Land Use	TOTAL WEA SCORE	Compliance Score [6]	Comments on Compliance [7]	Gain(+) /Loss(-) in Acres 8	Additional Enhancement
16		Calera Ck [Palustrine]				3-3-3	2-2-2										
16		Calera Ck [Outside Evaluator]						2.5	2.5	2.5	2.0	2.5	**12.0**				
11	R	West Branch Alamo Creek	1.9	9.2	C			1.5	1.9	0.0	3.0	1.8	**8.2**	5.0	SPC	7.3 (R)	
3	R	Green Valley Creek	5.4	14.0	C			2.5	1.7	2.0	2.0	1.7	**9.9**	4? PNF	MNC but successful so far	8.6 (A)	
															TOTAL	22.5	
11 to 50 Acres																	
> 51 Acres																	
1*	T	Sonoma Baylands	56.0	289.0				3.0	1.5	3.0	3.0	2.6	**13.1**	3?	Late with monitoring reports. Most of performance criteria being met but not all. MNC	233 (A)	
1*		Sonoma Baylands* REVISED						2.0	1.5	3.0	2.0	2.6	**11.1**				
7*	T	Roberts Landing (complete)	13.0	R=44; E=74	R/E			2.0	2.2	2.0	2.5	2.2	**10.9**	4?	Late with monitoring report. MNC but successful so far.	31 (A)	74 (A)
7*		Robert's Landing (Triangle)				2-3-3	1-1-2										
7*		Roberts Landing (Trojan)				2-3-3	1-1-2										
															TOTAL	264.0	74.0

1 WEA = Wetland Ecological Assessment Project (note "*" means project was not randomly selected).

2 R= Riparian; T = Tidal; S = Seasonal; VP = Vernal Pool; PF = Permanent Fresh

3 C = Created; R = Restored; E = Enhanced; P = Preserved

4 BMP Legend: (See Table Appendix I (B) for complete description.); 3 = high, 2 = medium, 1 = low; C = Composition, S = Structure, R = Re-establishment.

5 WEA scores added for final total score

6 Compliance Score: 0 to 5: 0= poor; 5 = good; PNF = Project Not Finished); note many have question marks because these are only suggested and not final scores.

7 MC = Monitoring Completed; SPC = Successfully met Performance Criteria; MNC = Monitoring Not Complete

8 Determines net gain/loss in quantity, not quality; (R) = Realized; (A) = Anticipated. Note that gain/loss is based on restoration and creation, not on enhancement.

NA = Not Appropriate

Table 3: Number of Projects by Compliance Score in Each Size Category

	Completed & Successfully Met Performance Criteria [5 = a typical score]	Not Completed but Proceeding in Right Direction; or Completed but missed some monitoring reports [4 = a typical score]	Completed but Did Not Meet All Criteria [3 = a typical score]	Not Completed and performance criteria poor so far and/or inadequate monitoring reports: [3 or 2 = a typical score]	Failed (no project; inadequate monitoring reports; or failure of major success criteria [1 or 0 = a typical score]
0-2 Acres	5* projects[1]		1 project		1 project
3-5 Acres [3]	1 project	1 project	1 project	1 project	
6-10 Acres	2 projects	3 projects			
11-50 Acres					
>51 Acres		1 project		1 project	
TOTAL	**8**	**5**	**2**	**2**	**1**

[1] Note both Fleeman Project Vernal Pools counted as one project.
[2] Bettencourt Detention Basin was not scored because it is still under review by the U.S. ACOE.
[3] Note that one project in this category never happened because wetland impacts were avoided.

Table 4: WEA Scores by Habitat Type (Highest possible score = 15)[1]

	Riparian (# = 7)	Tidal (# = 6)	Seasonal (# 3) [2]	Vernal Pool (# =1) [3]	Permanent Fresh (# = 3) [2]
Number of Sites with Scores between:					
0-8	2		1		
8.1-11.9	3	4	1	1	2
12 - 15	2	2			
AVERAGE WEA Score for Habitat Type	**9.7**	**11.5**	**7.9**	**9.6**	**9.8**

[1] (Note that some projects have more than one habitat type; some projects combine different areas under the same project; and 2 projects were not assessed because they never happened.)
[2] One project in this group was not assessed.
[3] One mitigation permit for this habitat type had 2 different projects that were assessed separately.

Table 5. Numbers of species observed at each site (or known to occur) grouped by type

Date		March												April						May	
		18	18	19	19	20	20	20	27	27	28	28	30	07	07	07	09	10	10	05	05
WAE site #	**# spp*.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
WATERBIRDS (grebes, pelicans, ardeiids, geese, and ducks)	**25**	19	0	1	1	0	0	5	2	1	2	0	0	1	0	0	2	0	1	6	1
RAPTORS	**10**	6	0	5	0	2	0	3	1	1	2	3	2	1	1	0	3	1	1	2	1
GALLINACEOUS BIRDS (quail & rails)	**7**	3	0	0	0	2	0	2	1	0	0	1	0	0	0	0	0	0	0	1	0
SHOREBIRDS	**19**	18	0	0	0	1	0	6	1	2	0	0	0	3	0	0	1	0	1	3	0
GULLS & TERNS	**10**	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
LANDBIRDS (doves thru goldfinches)	**81**	34	11	13	9	3	4	11	3	5	21	11	6	11	13	0	21	12	9	12	14
INTRODUCED BIRDS	**4**	1	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1	0	1	1	0
Total species**	**156**	**84**	**11**	**19**	**10**	**8**	**4**	**27**	**8**	**9**	**27**	**15**	**8**	**17**	**14**	**0**	**28**	**13**	**13**	**26**	**16**

*# Spp = Number of Species
** These totals include species observed on or adjacent to site or for which there are known occurrences; nunbers may vary from those provided in Appendix III, which includes more categories, (e.g., "expected occurrence".)