Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

Project Information

1. **Proposal Title:**

   Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

2. **Proposal applicants:**

   Lyndon Lee, L.C. Lee & Associates, Inc.
   Peggy Fiedler, L.C. Lee & Associates, Inc.
   Shane Staten, L.C. Lee & Associates, Inc.

3. **Corresponding Contact Person:**

   Shane Staten
   L.C. Lee & Associates, Inc.
   1501 Viking St. Suite 103 Alameda, CA 94501
   510 748-0362
   shane@lclee.com

4. **Project Keywords:**

   Habitat Evaluation
   Habitat Restoration, Riparian
   Habitat Restoration, Wetland

5. **Type of project:**

   Research

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   Shallow Water, Tidal and Marsh Habitat

8. **Type of applicant:**

   Private for profit

9. **Location - GIS coordinates:**

Latitude: 38.198

Longitude: -122.031

Datum: NAD83

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

Various locations throughout Suisan Marsh.

10. **Location - Ecozone:**

    2.1 Suisun Bay & Marsh

11. **Location - County:**

    Solano

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    1

15. **Location:**

    California State Senate District Number: 4

    California Assembly District Number: 8

16. **How many years of funding are you requesting?**

    2

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

       No

       If no, list single overhead rate and total requested funds:

Single Overhead Rate: 0

Total Requested Funds: $235,515.00

b) Do you have cost share partners already identified?

No

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above?

No

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

No

Have you previously received funding from CVPIA for other projects not listed above?

No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

No

Please list suggested reviewers for your proposal. (optional)

Dr. Dennis Whigham	**Smithsonian Environmental Research Center**	**410-798-4424**	**whigham@serc.si.edu**
Ms. Mary Butterwick	**US EPA Reg. IX**	**415-744-1985**	**butterwick.mary@epamail.epa.gov**
Ms. Prentiss Williams	**California Coast Conservancy**	**510-286-3773**	**prentiss@scc.ca.gov**

Dr. Mark Brinson	**East Carolina University**	**252-328-6307**	**brinsonm@mail.ecu.edu**

21. **Comments:**

Regarding question #17: Our overhead rates are subsumed in our billing rates. Our profit margin is expected to be approximately 10%.

Environmental Compliance Checklist

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      This project is a scientific study only; no land use change that would require CEQA/NEPA compliance is involved.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      Not Applicable

   b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land. Agency Name:	
Permission to access state land. Agency Name: California Department of Fish & Game	Required
Permission to access federal land. Agency Name:	
Permission to access private land. Landowner Name:	Required

6. **Comments.**

Land Use Checklist

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   Yes

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   This is a "research only" proposal.

4. **Comments.**

Conflict of Interest Checklist

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Lyndon Lee, L.C. Lee & Associates, Inc.
Peggy Fiedler, L.C. Lee & Associates, Inc.
Shane Staten, L.C. Lee & Associates, Inc.

Subcontractor(s):

Are specific subcontractors identified in this proposal? No

Helped with proposal development:

Are there persons who helped with proposal development?

No

Comments:

Budget Summary

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary** ***(per year)***	**Benefits** ***(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Assemble A-team / initial training in HGM protocols	10	810	$0**	1800	0	0	0	0	2610.0	0	2610.00
2	Identify study area / reference domain	20	1880	$0**	0	0	0	0	0	1880.0	0	1880.00
3	Identify, define and develop first approximation subclass profiles, functions, variables, field indicators and HGM models. Compile and analyze available GIS and remote sensing data. Incorporate existing databases, research, etc.	120	8520	$0**	0	0	0	0	0	8520.0	0	8520.00
4	Develop and standardize field forms	56	4945	$0**	1800	0	0	0	0	6745.0	0	6745.00
5	Build the reference system (collect data from reference sites)	740	68400	$0**	7650	0	0	0	0	76050.0	0	76050.00
6	Consolidate data, quality assurance / quality control	55	3790	$0**	0	0	0	0	0	3790.0	0	3790.00

7	Data input, quality assurance / quality control	50	2750	$0**	0	0	0	0	0	2750.0	0	2750.00
8	Data analyses / synthesis	42	3310	$0**	0	0	0	0	0	3310.0	0	3310.00
9	Refine profile of subclass by incorporating reference site data	200	18800	$0**	0	0	0	0	0	18800.0	0	18800.00
10	Write second approximation HGM models	200	18800	$0**	0	0	0	0	0	18800.0	0	18800.00
11	Internal review / field test second approximation model(s)	150	14100	$0**	1800	0	0	0	0	15900.0	0	15900.00
12	Draft third approximation (peer-review) model(s) / guidebook (First half))	200	16500	$0**	0	0	0	0	0	16500.0	0	16500.00
		1843	162605.00	0.00	13050.00	0.00	0.00	0.00	0.00	175655.00	0.00	175655.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
12	Draft third approximation (peer-review) model(s) / guidebook (Second half)	200	16500	$0**	0	0	0	0	0	16500.0	0	16500.00
13	Submit the draft HGM model to initial outside peer review	46	2270	$0**	0	0	0	0	0	2270.0	0	2270.00
14	Initiate A-team reviews of third approximation guidebook	59	5240	$0**	0	0	0	0	0	5240.0	0	5240.00
15	Respond to peer-review with operational draft	200	13000	$0**	0	0	0	0	0	13000.0	0	13000.00
16	Present operational draft / train future users	200	18800	$0**	4050	0	0	0	0	22850.0	0	22850.00
		705	55810.00	0.00	4050.00	0.00	0.00	0.00	0.00	59860.00	0.00	59860.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=<u>235515.00</u>

Comments.

*See budget justification. **See budget justification for explanation. Our overhead rates are subsumed in our billing rates. Our profit margin is expected to be approximately 10%. Numbers in the Salary column represent the total salary estimated for each task. Because the billing rate for NWSTC is

variable, our billing method does not entirely fit the budget summary forms. As a result, we have multiplied each NWSTC member's salary by their expected labor hours for each task to determine their total salary per task. NWSTC members' total salaries per task are summed to provide the total amount of salary estimated per task. We apologize for the confusion, but this is the only way we can input the budget data into this form. Feel free to contact us for a more detailed budget (510-748-0362).

Budget Justification

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

Direct Labor Hours. Provide estimated hours proposed for each individual.

Fiedler 401 Lee 384 Stewart 390 Partridge 482 Staten 531 K. Lee 80 Romero 80 Pitts 120 Mason 60 Total hours = 2,488

Salary. Provide estimated rate of compensation proposed for each individual.

Fiedler $100/hour Lee $150/hour Stewart $90/hour Partridge $65/hour Staten $65/hour K. Lee $75/hour Romero $75/hour Pitts $40/hour Mason $65/hour These figures represent company billing rates, not salary.

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

Benefits are included in billing rates. Based on company history, benefits represent approximately 15% of project costs.

Travel. Provide purpose and estimate costs for all non-local travel.

All non-local travel involves roundtrip airfare for NWSTC/LCLA Seattle staff to travel to field sites to assist local NWSTC/LCLA staff. Airfare is calculated at $450/roundtrip Seattle - Oakland; total of 21 individual tickets estimated. Hotel and food calculated at $150/day; total of 51 days predicted.

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

No supplies or expendables costs are included in this budget.

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

None are required.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

No new equipment is needed.

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

Project management is included as 10% of Fiedler’s total hours. This amounts to 40 hours or $4,000.

Other Direct Costs. Provide any other direct costs not already covered.

The only direct cost is document production, which has been calculated at $5,000.

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

No indirect costs are included in this cost estimate.

Executive Summary

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

The National Wetland Science Training Cooperative (NWSTC) proposes the development of a hydrogeomorphic (HGM) guidebook for assessing ecosystem functioning of 1st and 2nd order riverine wetland systems in the Suisun Marsh Ecosystem. The draft HGM guidebook will address directly several CALFED priorities relating to ecosystem restoration projects in the Bay Region. Additionally, this draft HGM guidebook will improve future restoration projects and provide a framework for the monitoring of existing projects. The HGM method of functional assessment has been adopted as the preferred methodology for the design and monitoring of wetland restoration by federal agencies involved in the regulatory aspects of wetland protection. These agencies include the Natural Resources Conservation Service, the U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency. The HGM approach will assist in the coordination of local restoration efforts by creating and distributing a framework for the assessment of wetland ecosystem functions and by assembling information about reference sites that can be used in future studies and restoration projects. This draft guidebook will undergo an external peer-review as a required step in HGM guidebook development.

Proposal

L.C. Lee & Associates, Inc.

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for First and Second Order Riverine Wetland Ecosystems in Suisun Marsh

Lyndon Lee, L.C. Lee & Associates, Inc.
Peggy Fiedler, L.C. Lee & Associates, Inc.
Shane Staten, L.C. Lee & Associates, Inc.

Development of a Hydrogeomorphic (HGM) Functional Assessment Guidebook for 1ST & 2ND Order Riverine Wetland Ecosystems in Suisun Marsh

L.C. LEE & ASSOCIATES, INC.
1501 VIKING, STE. 103
ALAMEDA, CA 94501

CALFED BAY-DELTA PROGRAM

OCTOBER 2001

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I. EXECUTIVE SUMMARY

The National Wetland Science Training Cooperative (NWSTC) proposes the development of a hydrogeomorphic (HGM) guidebook for assessing ecosystem functioning of 1st and 2nd order riverine systems in the Suisun Marsh Ecosystem. The draft HGM guidebook will address directly several CALFED priorities relating to ecosystem restoration projects in the Bay Region. Additionally, this draft HGM guidebook will improve future restoration projects and provide a framework for the monitoring of existing projects. The HGM method of functional assessment has been adopted as the preferred methodology for the design and monitoring of wetland restoration by federal agencies involved in the regulatory aspects of wetland protection. These agencies include the Natural Resources Conservation Service, the U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency. The HGM approach will assist in the coordination of local restoration efforts by creating and distributing a framework for the assessment of wetland ecosystem functions and by assembling information about reference sites that can be used in future studies and restoration projects. This draft guidebook will undergo an external peer-review as a required step in HGM guidebook development.

A. Project Description

The largest brackish-water wetland in the United States, Suisun Marsh is an important resting and feeding stop for migratory birds along the Pacific Flyway (DWR 1993, Williams and Fishbain 1987). Despite its ecological importance, Suisun Marsh has been modified greatly from its natural state by several anthropogenic factors. First, the creation of an extensive network of dikes and levees has eliminated tidal influence from approximately 90% of the marsh (Howard 1979). Second, large-scale water developments (*e.g.*, the Central Valley Project) have resulted in salt-water intrusion from the bay to the Sacramento-San Joaquin Delta. These factors have resulted in the conversion of large areas of brackish marsh to tidal saltwater marsh (Williamson and Fishbain 1987). Finally, expansion of the Fairfield-Suisun City urban area from the north threatens this region of the Bay-Delta system. As a result of all of these factors, CALFED has made restoration of high marsh ecosystems a priority of planning efforts for ecosystem recovery in the San Francisco Estuary (CALFED 2001).

The development of an HGM guidebook for 1st and 2nd order riverine wetland ecosystems in the Suisun Marsh Ecosystem will further this goal. By applying federally accepted methods, NWSTC will prepare an HGM guidebook that can be used as a framework for future ecosystem restoration projects. The guidebook will present a detailed model describing the ecosystem functioning of upstream riverine waters/wetlands and will provide a methodology for assessing the levels of ecosystem functioning of a particular location. The levels found at this location can be compared to information provided in the guidebook regarding reference sites that represent the highest level of ecosystem functioning with regard to past disturbance and land use. The application of the HGM approach to the Suisun Marsh Ecosystem will standardize and enhance current methods of ecosystem restoration and will provide valuable information for future scientific studies.

1. Project Goals

The goal of this proposed project is to prepare an HGM guidebook that will provide a framework for the assessment of ecosystem functions of 1st and 2nd order riverine systems in Suisun Marsh. Guidebook development will be subject to external peer-review. Additionally, future potential users of the guidebook will be identified and trained in the use of the guidebook.

2. *Scope of Work*

Steps in Development of an Operational Draft HGM Guidebook
(Adapted from Federal Register (Volume 61, Number 160, Pages 42593-42603)

- Task 1: Assemble A-team / initial training in HGM protocols
- Task 2: Identify study area / reference domain
- Task 3: Identify, define and develop first approximation subclass profiles, functions, variables, field indicators and HGM models. Compile and analyze available GIS and remote sensing data. Incorporate existing databases, research, *etc.*
- Task 4: Develop and standardize field forms
- Task 5: Build the reference system (collect data from reference sites)
- Task 6: Consolidate data, quality assurance / quality control
- Task 7: Data input, quality assurance / quality control
- Task 8: Data analyses / synthesis
- Task 9: Refine profile of subclass by incorporating reference site data
- Task 10: Write second approximation HGM models
- Task 11: Internal review / field test second approximation model(s)
- Task 12: Draft third approximation (peer-review) model(s) / guidebook
- Task 13: Submit the draft HGM model to initial outside peer review
- Task 14: Initiate A-team reviews of third approximation guidebook
- Task 15: Respond to peer-review with operational draft
- Task 16: Present operational draft / train future users

B. Project Justification

Background on the Hydrogeomorphic (HGM) Approach

The hydrogeomorphic (HGM) approach of wetland ecosystem functional assessment was developed by a team of wetland scientists. This method is based on (1) the recognition that the various wetland types (*e.g.*, bogs, marshes, and swamps) differ in hydrology and landscape position and (2) the use of reference sites as the basis for assessing changes in the ecosystem functioning of a site. Reference sites are defined as locations that have the highest level of ecosystem functioning possible for a wetland type within the constraints of disturbance history

and land use of the region of study. The hydrogeomorphic approach classifies wetlands based on their (1) landscape position, (2) water source and transport, and (3) direction of flow and strength of water movement.

By incorporating HGM into the development of a restoration or management plan, project proponents, regulatory specialists, or resource managers can effectively (1) utilize an extensive data-based reference system founded on ecological and land use history, (2) identify the highest level of functioning for identified ecosystem functions through reference standard conditions as identified in the reference system, (3) utilize the functional assessment model to compare conditions both before and after development or restoration construction, (4) identify potential mechanisms to integrate goals for use and conservation to achieve responsible stewardship and public service, and (5) identify alternatives to guide decision making and restoration efforts in the context of surrounding land use and development.

The HGM functional assessment method looks at four groups of wetland functions at site-specific and landscape scales (Table 1). Because it is usually impractical to measure functioning directly, the hydrogeomorphic approach relies of the measurement of indicators of functioning. For example, one hydrologic function that riverine wetlands serve is the dissipation of the energy of high flows from floodwaters. An indicator that a wetland is serving this function is the presence of complex geomorphic features such as oxbows, meander scrolls, abandoned channels and backswamps. A set of variables found in the landscape has been developed for riverine wetland functions; these variables are measured at the reference wetlands. From these data, functional profiles of reference wetlands can be developed and compared to existing conditions at the project site to measure the directions and degree of differences in wetland functions. This comparison allows restoration designers an opportunity to see clearly the differences between attainable wetland conditions and conditions on the project site.

Table 1. Riverine Wetland Functions (Brinson *et al*. 1995)

Functional Group	**Wetland Function**
Hydrology	Dynamic surface water storage
	Long-term surface water storage
	Energy dissipation
	Subsurface storage of water
	Moderation of groundwater flow or discharge
Biogeochemistry (water quality)	Removal of imported elements and compounds
	Particulate retention
	Nutrient cycling
	Organic carbon export
Plant Community Maintenance	Maintain characteristic plant communities
	Maintain characteristic detrital biomass
Habitat/Faunal Community Support	Maintain spatial habitat structure
	Maintain habitat interspersion and connectivity
	Maintain distribution and abundance of invertebrates
	Maintain distribution and abundance of vertebrates

Relevant to CALFED's goals of ecosystem restoration throughout the Bay-Delta ecosystem, HGM assessment can be used for any (and potentially all) ecosystem restoration efforts, such as documentation of site conditions, restoration design, assessment of restoration success, and for suggestion of when and if remedial actions would be taken. HGM embraces the participation of multiple stakeholders by taking an interdisciplinary approach. And because HGM is used throughout the life of a project (reference framework, permitting, setting project goals, monitoring, *etc*.), this protocol provides the ideal platform for adaptive management. Should a project not be progressing toward its HGM-articulated project targets, then the reference data set provides guidance as to how best to move the project towards those articulated goals.

HGM offers a relatively rapid, efficient, and reference-based method for the assessment of changes in the functioning of waters/wetlands ecosystems. This is particularly useful in support of regulatory processes such as the CEQA/NEPA process to evaluate project impacts and potential mitigation effectiveness. The HGM approach is also unbiased because it is founded in the best available science. Additionally, the use of peer-reviews and workshops with professionals of different agencies and professional backgrounds, in combination with the dissemination of the draft guidebook to managers and other decision-makers, ensures that the effects of this proposed project will be integrated and far-sighted.

In several types of federal, state or local regulatory processes, HGM can be used as an impact assessment and predictive tool that can help regulatory specialists and managers suggest, and/or examine, alternatives for projects involving waters/wetlands. Furthermore, HGM can be used in several aspects of waters/wetlands management and regulatory processes and at several different spatial scales. Facets of the HGM approach (*e.g.*, classification, identification of functions by HGM class) lend themselves to reconnaissance-level inventories. Standard HGM approaches can and have been used to minimize project impacts, to develop and condition restoration project targets, and to trigger contingency measures when restoration project targets or standards are in jeopardy. Finally, a properly focused HGM effort can identify specific areas of concern in an impact assessment process, and thus target efforts for further study or restoration.

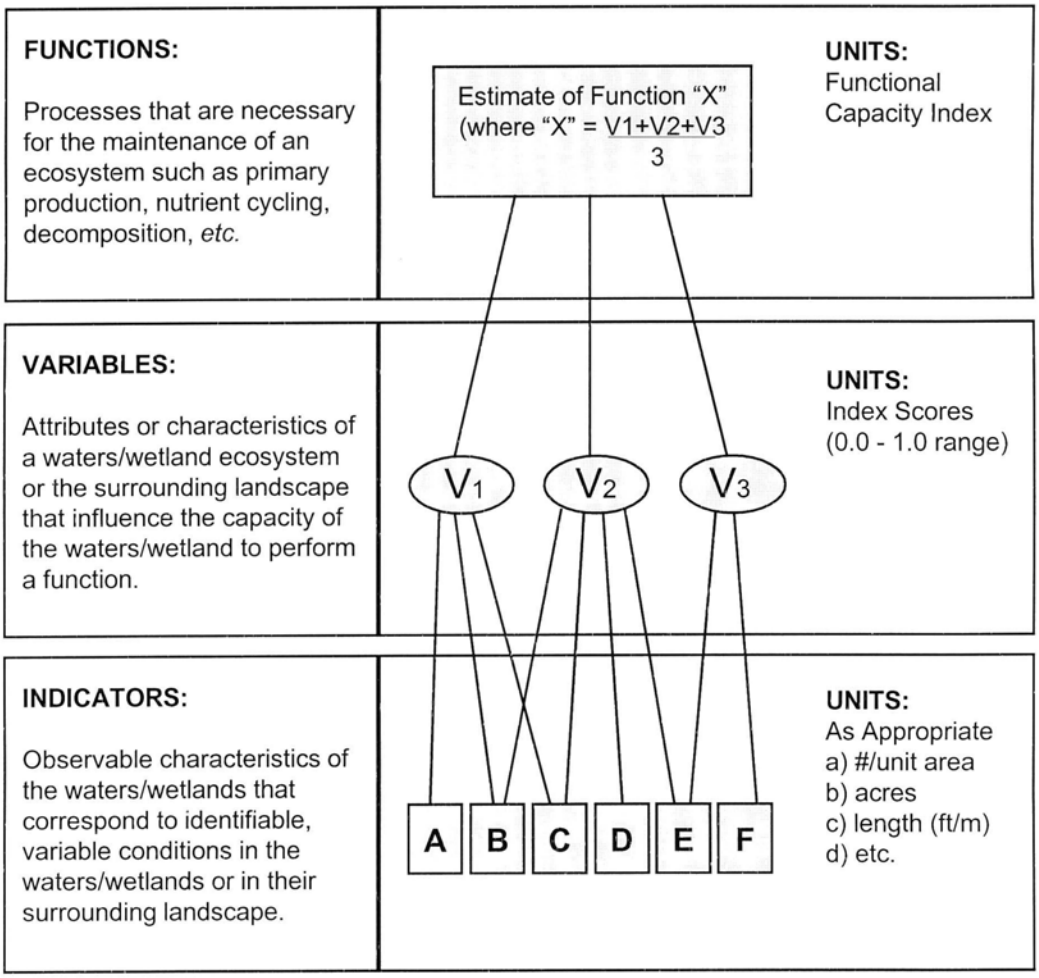
Restoration of natural wetland ecosystems has been recognized by CALFED as necessary for the revival of the health of the Bay-Delta system. The hydrogeomorphic approach of wetland functional assessment has been adopted as a fundamental method for wetland restoration by the federal agencies involved in the regulatory aspects of wetland protection, including the Natural Resources Conservation Service, the U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency (Federal Register 1996, Federal Register 1997). However, for the HGM approach to be applied successfully, regional HGM guidebooks need to be created that are specifically adapted to local wetland types.

In addition to the previous listed benefits of the HGM approach, the creation of a draft HGM manual for 1st and 2nd order riverine systems in the Suisun Marsh wetland ecosystem will assist greatly in the coordination of local restoration efforts by (1) creating and distributing a framework for the assessment of riverine wetland ecosystem functions, and (2) assembling information about reference sites that can be used in future studies and restoration projects.

Framework for Functional Assessment

The guidebook will provide information about the hydrologic, biogeochemical, plant community maintenance, and faunal habitat ecosystem processes that are present in Suisun Marsh. The ecological factors associated with 1st and 2nd order streams will be described in terms of ecosystem functions and variables (Figure 1).

FIGURE 1. STRUCTURE OF AN HGM MODEL



A function is defined as a basic ecological process that is necessary for the maintenance of an ecosystem (*e.g.*, subsurface storage of water, or distribution and abundance of invertebrates). A variable is a factor that is required for a function to occur. An example of a function would be a process such as the cycling of elements and compounds. Some, but not all, of the variables used to describe this example function include decomposition, channel roughness, and sediment deposition.

To determine the levels of ecosystem functioning at a site, future scientific studies and restoration activities will use the list of ecosystem functions, variables, and reference conditions described in the proposed HGM guidebook to compare the level of functioning observed at a particular restoration or study site with the level of functioning described at relatively pristine reference sites. The difference between the overall levels of ecosystem functioning between the observed site and the information on reference sites is equivalent to the amount of degradation at the observed site.

Compilation of Information about Reference Sites

The compilation and dissemination of information about numerous reference sites from 1st and 2nd order riverine systems throughout Suisun Marsh will be of great use to future studies and restoration projects. Data from 20-30 reference sites will be provided in the draft guidebook. These reference sites will be chosen as examples of locations within Suisun Marsh that have the highest level of ecosystem functioning possible within the constraints of disturbance history and land use. Many studies use reference sites as an experimental control when comparing conditions at a relatively pristine site to the conditions at the site(s) that they are studying. The availability of this information will allow future studies funded by CALFED to use the same baseline information, which will decrease costs.

Wetland functional profiles will be developed from the data collected at reference sites. These profiles can be used as templates for restoration design, assessing project impacts, *etc*. Changes in wetland functions from one condition to another (*e.g.*, pre-project to post-project) are quantifiable because direction and/or degree of change from the reference state is the fundamental measurement of the HGM approach.

C. Approach

Study Design

The development of an HGM guidebook does not rely on the testing of hypotheses, so there is not a strict study design. However, there is a formal methodology to the development of a regionally specific guidebook as described in Brinson *et al*. (1995).

The development of a draft HGM manual begins with the selection and training of the personnel needed. After this has been completed, the team will assemble information about the landscape within the Suisun Marsh Ecosystem. Topographic and geologic maps, soil surveys, National Wetland Inventory (NWI) maps, aerial photographs, species lists, climatic data, and historical information will be reviewed and analyzed. This stage of work also will include the identification of potential reference sites and the development of initial working definitions of the reference domain, HGM wetland types and subtypes to be sampled. Pertinent literature to the riverine waters/wetlands ecology and functions of Suisun Marsh also will be assembled. Initial reconnaissance and sampling at a series of representative reference sites will occur at the outset of

the study. Observed site characteristics will be compared to the draft subclass definitions to ensure that the guidebook resembles the existing conditions.

The next task involves conducting a series of remote sensing and geographical information systems (GIS) analyses within the Suisun Marsh area to generate data for the HGM subclass profiles and functional assessment models. A remote sensing and GIS approach was chosen to capture landscape scale/regional data to augment the site-specific reference data collected in the field. For example, Landsat 7 enhanced thematic mapper (ETM) data may be used as the basis for a landuse classification of the Suisun Marsh area (reference domain). A robust scientific literature exists regarding the application and interpretation of this imagery (Jensen 1996, Sabins 1997). These data likely will be chosen because they are publicly available, inexpensive, easy to update, and compatible with other ancillary data at similar spatial resolutions (*e.g.*, digital elevation models of the reference domain).

The following step will be the identification, definition, and development of the first-approximation subclass profiles, functions, variables, field indicators and HGM models. After this has been completed, field data sheets appropriate to local conditions will be drafted to ensure consistent collection of reference site hydrology, soils, plant, habitat, and land use data.

The next task will include the collection of data from reference sites. Final reference sites will be decided upon with great care. Such caution is warranted because of limited field time and because of the intrinsic variability of riverine waters/wetlands within Suisun Marsh. Each reference site will have a great deal of influence or weight in the final data subsets that constitute the reference system. NWSTC will rely on our collective experience to develop data collection techniques at the reference sites. Based on our previous experiences, NWSTC believes that measurements stipulated in the final assessment procedure developed in the draft guidebook will be as efficient and rapid as possible for users with limited resources, staff and field time.

Approximately 30 days of field work will be required for the collection of data from the selected reference sites. These field data will include information about extent of tidal influence, the structure of living and detrital plant communities, other hydrologic information (*e.g.*, indicators of subsurface flow), biogeochemical and detrital cycling, soil properties, and additional indicators of ecosystem functioning appropriate to riverine wetland ecosystems. No facilities will be needed.

Data collected in the field will be inputted and quality assurance / quality control protocols will be followed. Once this has been completed, the data will be analyzed and synthesized with other information (*e.g.*, literature searches, GIS, *etc.*). Multivariate analysis (*e.g.*, DCCA ordination) will be used for statistical analysis.

The next step will be to refine the wetland subclass protocols by adding the reference site data. As part of this process, NWSTC will reexamine the critical functions and variables identified at the outset of field sampling. Descriptions of all functions identified for each subclass will be reconsidered and, when necessary, improved. Based on the results, NWSTC will refine the draft assessment models into a formal second approximation of the HGM models.

An internal review and field testing of the second approximation HGM models will follow. The feedback from these activities will be incorporated into the third approximation models. The first draft of the HGM guidebook will be developed using these models. With the benefit of the experience derived during the reference system fieldwork, NWSTC will hone and simplify field sampling approaches so that the draft guidebook will be accurate, easily understood, and thus widely used.

After completion of the draft HGM guidebook, it will be submitted to knowledgeable experts for external peer-review. The results of this external review will be combined with internal edits in the final operational draft of the HGM guidebook.

After completion of the operational draft, a training session will be held for all parties that may benefit from the development of the HGM guidebook. Participants will be trained in the HGM approach and in the use of the guidebook. Copies of the guidebook will be distributed at this training session and will be available upon request afterwards.

Information Maximization and Value to Decision-Makers

Information maximization is a direct result of the development of a draft HGM guidebook. Extensive knowledge will be gathered about the level of ecosystem functioning at reference sites. This knowledge and the framework provided in the draft HGM guidebook will be very valuable to decision-makers.

The proposed HGM guidebook will lead decision-makers through the process of assessing the level of functioning of 1st and 2nd order streams in the Suisun Marsh Ecosystem and their associated wetlands. Additionally, decision-makers will be able to assess rapidly the approximate state of ecosystem functioning after a restoration project. Comparison of ecosystem functioning of a site both pre- and post-restoration will be a powerful tool for managers and other decision-makers in the prioritization of which restoration projects offer the most ecosystem benefits.

At each reference site, the team of wetland scientists will use their best professional judgment to determine whether or not the site being sampled is an "attainable reference," a term meaning the highest level of ecosystem functioning possible for a wetland class within the constraints of disturbance history and land use of the reference domain. By defining attainable reference conditions, HGM functional assessment provides decision-makers with explicit measurable conditions that are possible to achieve in a wetland restoration. However, decision-makers may decide to restore a different level of wetland function due to budget constraints, political will, or other considerations. Wetland restoration designers are able to clearly see the differences between attainable and current conditions and to design the functional restoration accordingly.

D. Project Feasibility

This project will commence in mid-May of 2002 and will continue until mid-May of 2004. Based on the extensive experience of NWSTC in the preparation of HGM guidebooks (see Section III: Qualifications), this timeline should be appropriate for the creation of an HGM Guidebook for 1st and 2nd order Riverine Ecosystem Functions in Suisun Marsh.

The approach described in the previous section is appropriate for the creation of an HGM guidebook as it follows strictly the approach described in *A Guidebook for Application of Hydrogeomorphic Assessments to Riverine Wetlands* (Brinson *et al*. 1995) and stated in the Federal Register (1996). Field work is not contingent on the outcome or timing of other projects, natural or operational conditions, or weather conditions. No permit or environmental compliance is necessary. Although this proposed project involves no physical changes to private property, landowner permission for the collection of data will be required. This will be accomplished at a later date.

E. Project Performance Measures

The following is a list of performance measures that can be used to determine the progress of this proposed project:

- Completion of draft guidebook
- Submittal of draft guidebook for peer-review
- Interagency and interdisciplinary workshop
- Publishing of draft guidebook
- Dissemination and assistance to users of guidebook

F. Data Handling and Storage

Data will be handled by NWSTC staff and stored in Alameda, California. Ten hard copies of the draft HGM guidebook will be produced. Two electronic copies will be made available. These guidebooks will be made accessible on request.

G. Expected Outcomes & Products

The final product will be an HGM guidebook that will be used for the functional assessment of 1st and 2nd order riverine wetland ecosystems in Suisun Marsh.

The outcomes of this proposed project will be an interagency and interdisciplinary workshop regarding the draft guidebook as well as the identification and training of users of this guidebook, as well as continued assistance to users. The participants in this workshop will be determined at a later date.

H. Work Schedule

Table 2. Work Schedule.

Task	Spring 2002	Summer 2002	Fall 2002	Winter 2002	Spring 2003	Summer 2003	Fall 2003	Spring 2004
1. Assemble A-team / initial training								
2. Identify study area								
3. Analyze GIS and remote sensing data								
4. Develop sub-class profiles, functions, variables, *etc.* Incorporate existing research, *etc.*								
5. Develop field forms								
6. Collect data from reference sites								
7. Consolidate data, QC/ QA								
8. Data input, QA / QC								
9. Data analyses / synthesis								
10. Refine subclass profile								
11. Write second approximation HGM model								
12. Internal review / field test second approximation model								
13. Draft third approximation (peer-review) model / guidebook								
14. Submit the draft HGM model to peer review								
15. Initiate A-team & peer-reviews of third approximation draft guidebook								
16. Respond to peer-review with operational draft								
17. Present operational draft								

II. APPLICABILITY TO CALFED ERP AND SCIENCE PROGRAM GOALS, AND IMPLEMENTATION PLAN AND CSPIA PRIORITIES

A. ERP, Science Program, and CVPIA Priorities

The proposed creation of a draft HGM guidebook for the assessment of wetland functions of 1st and 2nd order streams in Suisun Marsh directly addresses the Bay Region draft Stage 1 PSP priority of understanding the performance of wetlands restoration efforts on a local and regional scale. This is because users of the HGM model will be able to assess the level of ecosystem functioning both pre-and post-project, providing a quantitative measurement of the success of regional wetland restoration (or development) projects. In addition, a draft HGM guidebook will aid in the establishment and measurement of monitoring objectives, which meets the Bay Region restoration priority and action of retrofitting monitoring to existing restoration projects. The ecosystem variables described in the draft HGM guidebook are indicators of the ecosystem processes that should move toward reference conditions as a result of ecosystem restoration, and thus are well-suited for monitoring existing projects. The variables can be measured easily and rapidly in methods that will be described in the draft guidebook. Finally, the completion of this proposed project also indirectly addresses the priority of restoring wetlands in critical areas throughout the Bay, either via new projects or improvements that add to or help sustain existing projects because a draft HGM guidebook will provide a framework for the permitting, design, and monitoring of new projects.

The creation of an HGM guidebook for 1st and 2nd order streams of Suisun Marsh dovetails with the long-term goal of the CALFED Science Program of increasing the amount of available knowledge that will improve the effectiveness of restoration projects and the tracking of the progress of restoration. This is because of the information about reference sites that will be made available in the draft HGM guidebook and because of the ability of the HGM model to quantify the progress of a restoration from the level of functioning before the project to the desired level of post-project functioning.

A completed *Guidebook* meets the following specific priorities:

1. Development of performance measures to track the success of restoration projects;
2. Advancement of process understanding of the physical, biogeochemical, and ecological processes of the target ecosystems;
3. Establishment of integrated science programs in complicated field settings, and;
4. Comparison of the relative effectiveness of different restoration strategies.

B. Relationship to Other Ecosystem Restoration Projects

The HGM guidebook produced as a result of this project would aid previously approved restoration projects associated with 1st and 2nd order streams of Suisun Marsh. The information regarding the level of ecosystem functioning of reference sites can be used in the setting of monitoring targets appropriate to the site as defined by the historic conditions of the specific restoration project. An example of such a project is the Suisun Marsh Property Acquisition and Habitat Restoration Project submitted by the California Department of Water Resources (project 2001-E205). This project involves the purchase of a property that has been removed from tidal influence by levees and that can be restored. The landscape position of this parcel makes a study of first and second order streams in this region very useful for the restoration and monitoring of this project.

Future projects would be the main benefactors of the creation of the proposed draft HGM guidebook. The easily accessible information regarding the level of functioning of reference sites as well as the application and use of the HGM guidebook that will describe such aspects as the background preparation, field work, and preparation of reports, will be of great use to future restoration projects of 1st and 2nd order streams and their associated wetlands.

C. Requests for Next-Phase Funding

Next-phase funding will not be required for this project.

D. Previous Recipients

The National Wetland Science Training Cooperative has not been a recipient of previous CALFED funding.

E. System-Wide Ecosystem Benefits

As a tool for current and future restoration projects in Suisun Marsh, the creation of a draft HGM guidebook will aid restoration projects in 1st and 2nd order riverine systems. The beneficial effects of restoring the headwaters of riverine systems in Suisun Marsh (*e.g.*, water quality, faunal habitat, *etc.*) will be experienced throughout the system. Because this guidebook will aid in future restorations located throughout Suisun Marsh, the benefits of this project will be system-wide.

F. Additional Information

No additional information is required.

III. QUALIFICATIONS

A. L.C. Lee & Associates, Inc. & the National Wetland Science Training Cooperative

L.C. Lee & Associates, Inc. (LCLA) is an environmental consulting firm specializing in wetland and riparian ecosystem science, restoration, wetland and endangered species regulatory assistance, and training. LCLA takes a multi-disciplinary approach to resource assessment, restoration, and management. LCLA's work is based upon current federal, state, and local regulations and substantiated by thorough scientific analysis. The firm's strict adherence to scientific accuracy and objectivity allows it to resolve complex permitting or design problems in a non-confrontational and timely fashion. LCLA has been based in Seattle since 1990, qualifying as a Minority/Women Owned business under Washington state guidelines. LCLA opened a San Francisco Bay Area office in the city of Alameda in Summer 2001.

LCLA has had extensive experience over the last twelve years in ecosystem functional assessment, and wetland ecosystem restoration, as well as the management of waters of the U.S., including waters/wetlands, throughout North America. Lyndon C. Lee Ph.D., founded LCLA in 1989 after leaving the U.S. Environmental Protection Agency Headquarters, Washington, D.C. as the senior wetland ecologist. Since founding LCLA, Dr. Lee has completed more than 125 wetland contracts focused primarily on the West Coast, and has developed eleven (11)

Hydrogeomorphic (HGM) Functional Assessment models for a variety of wetland types (Figure 2). LCLA has consistently used HGM functional assessment models in guiding management/policy decisions, as well as restorations of waters/wetlands along the West Coast.

The National Wetland Science Training Cooperative (NWSTC) is a division of LCLA. It was founded in 1987 by Dr. Lee while he was serving as the senior wetland ecologist for the U.S. Environmental Protection Agency in Washington, D.C. The idea behind the NWSTC was to provide high quality technical training on wetland science, management, and regulatory processes to governmental personnel and other persons involved with wetland issues.

Recently, the NWSTC has expanded into the development of hydrogeomorphic functional assessment models throughout the United States. Principal scientists involved in the development of HGM models include Dr. Lyndon Lee (Principal of LCLA), Dr. Peggy Fiedler (Senior Associate with LCLA, NWSTC instructor), Dr. Scott Stewart (Senior Associate of LCLA), Dr. Mark Brinson (Professor of biology at East Carolina University and NWSTC instructor), Mr. Garrett Hollands (principal of Fugro (East), Dr. Wade Nutter (Professor of hydrology at the University of Georgia), and Dr. Dennis Whigham (Senior research ecologist at the Smithsonian Research Center, Edgewater, Maryland).

Members of the team of researchers involved in the creation of a draft HGM guidebook for Suisun Marsh are nationally and internationally recognized scientists and wetland regulatory experts who developed the HGM functional assessment method. In particular, the co-principal investigator Dr. Lee developed the Riverine HGM Model nationally and regionally; both principal investigators recently developed the Central California Coast HGM riverine model for the restoration of riverine wetlands in that geographic region. Overall, the proposed research team has extensive experience in wetland community ecology, hydrology, geochemistry, wetland protection, as well as functional and cumulative impact assessment in wetlands (*e.g.*, vernal pool ecosystems, riverine ecosystems, slope and depressional wetlands). All NWSTC scientists have worked in several different types of wetlands throughout the U.S. as well as in California.

To date, NWSTC has employed the HGM method of functional assessment for a variety of wetland ecosystems across the country. The draft and operational guidebooks produced also cover a diversity of reference domain areas and clients/sponsors who have requested the production of a draft HGM guidebook for a variety of reasons, reflecting the multiple uses of the HGM approach. Figure 2 summarizes the HGM models and guidebooks that have been produced by NWSTC/LCLA.

FIGURE 2. HGM MODELS AND GUIDEBOOKS DEVELOPED BY L. C. LEE & ASSOCIATES, INC. AND THE NATIONAL WETLAND SCIENCE TRAINING COOPERATIVE

STATE / REGION	HGM CLASS	WETLAND DESCRIPTION & LOCATION	GUIDEBOOK TITLE	AUTHORS / YEAR	SPONSOR(S) / PREPARED FOR	STATUS
California						
	Riverine	Riverine Wetlands South Coast Region of Santa Barbara County	*Draft Guidebook for Reference-Based Assessment of the Functions of Riverine Waters/Wetlands Ecosystems in the South Coast Region of Santa Barbara County*	*L.C. Lee & Associates, Inc. and the National Wetland Science Training Cooperative. 2001.*	Prepared for the Santa Barbara County Water Agency, Santa Barbara, California	Peer Review Draft
	Riverine	3rd and 4th Order Rivers Central California Coast	*Draft Guidebook to Functional Assessments in 3rd and 4th Order Riverine Waters/Wetlands of the Central California Coast*	*National Wetland Science Training Cooperative. 1996.*	Prepared for US EPA Region IX; City of Pacifica, CA Coastal Conservancy.	3rd Review Draft
	Riverine	1st, 2nd, 3rd , 4th and 5th Order Rivers Southern California	*Guidebook to Hydrogeomorphic Functional Assessment of Riverine Waters/Wetlands in the Santa Margarita Watershed*	*National Wetland Science Training Cooperative. 1997.*	Prepared for US EPA Region IX.	Through Peer Review
	Depressional Slopes Riverine	Vernal Pools, Slopes and 1st, 2nd, & 3rd Order Riverine Central California	*A Guidebook for Assessment of the Functions of Waters of the US, Including Wetlands, on the Borden Ranch, Sacramento and San Joaquin Counties, California*	*L. C. Lee & Associates, Inc./National Wetland Science Training Cooperative. 1996.*	Prepared for US EPA Region IX, US Department of Justice.	Peer Review Draft
West Coast						
	Depressional	Lowlands Puget Sound, Washington	*Draft Guidebook for Functional Assessment of Depressional Wetlands in the Pacific Northwest/Puget Sound Lowlands Region*	*National Wetland Science Training Cooperative. 1995.*	Prepared for USDA Natural Resource Conservation Service.	2nd Review Draft
	Slopes Riverine	Slope and Riverine Wetlands Southeast Alaska	*Draft Regional Guidebook to Functional Assessments in Riverine Wetlands and Slope Wetlands in Southeast Alaska*	*National Wetland Science Training Cooperative. 1996.*	Prepared for State of Alaska Department of Environmental Conservation.	2nd Review Draft
	Flats Slopes	Wetlands on Discontinuous Permafrost Interior Alaska	*Operational Draft Guidebook for Reference Based Assessments of the Functions of Precipitation-Driven Wetlands on Discontinuous Permafrost in Interior Alaska*	*National Wetland Science Training Cooperative. 1999.*	Prepared for State of Alaska Department of Environmental Conservation.	Operational Draft
Mid West						
	Depressional	Prairie Potholes in North Dakota / Northern Prairie Region	*Guidebook for the Hydrogeomorphic Assessment of Temporary and Seasonal Pothole Wetlands*	*National Wetland Science Training Cooperative. 1997.*	Prepared for USDA Natural Resource Conservation Service and the US Army Corps of Engineers.	Operational Draft
East Coast						
	Depressional	Maryland / Chesapeake Bay	*Draft Guidebook for Functional Assessment of Riverine Wetlands in the Inner Coastal Plain of Chesapeake Bay*	*National Wetland Science Training Cooperative. 1995.*	Prepared for USDA Natural Resource Conservation Service and US EPA Region III.	2nd Review Draft
	Riverine	Maryland / Del Mar Va Peninsula / Chesapeake Bay	*Draft Guidebook for Functional Assessment of Depressional Wetlands in the Mid-Atlantic Coastal Plain*	*National Wetland Science Training Cooperative. 2000.*	Prepared for USDA Natural Resource Conservation Service and US EPA Region III.	2nd Review Draft
National						
	Riverine	National	*A Guidebook for Application of Hydrogeomorphic Assessments to Riverine Wetlands. WRP-DE-11*	*U.S. Army Corps of Engineers Waterways Experiment Station*	Prepared for the US Army Corps of Engineers Waterways Experiment Station	Published
	Reference System	National	*Draft National Guidebook on HGM Reference Systems*	*National Wetland Science Training Cooperative. 2000.*	Prepared for US EPA Headquarters.	In preparation

B. Key Personnel

1. Peggy L. Fiedler, Ph.D.

Dr. Peggy L. Fiedler has more than 20 years of field research and teaching in ecology and evolutionary biology. Currently her interests are focused on (a) the design of plant community types in mega diverse floras for ecosystem restoration, (b) applying population viability models and metapopulation theory to the reintroduction of rare plant species, (c) demographic patterns of rare plants, and (d) improving monitoring protocol in wetland ecosystem restoration.

Since 1985, Dr. Fiedler served on the faculty of the Biology Department, initially as a visiting lecturer, but she assumed a tenure track appointment in 1989 as a conservation ecologist. From 1989 until 2000 she taught undergraduate and graduate courses in conservation biology as well as courses in general biology, plant ecology, systematic biology, organic evolution, and population modeling. Dr. Fiedler also directed the graduate program in conservation biology, which was the first masters' program of its kind in the nation. Dr. Fiedler resigned as full professor in Fall 2000.

Dr. Fiedler is recognized internationally as an expert on rare plant biology, and on the genus *Calochortus* (Calochortaceae). Her primary research has focused on the demography, evolution, and systematics of *Calochortus*, in particular, the biology of its rare species. Her dissertation work on the comparative demography of rare and common *Calochortus* species of is one of a few early comparative studies that established transition matrix analysis as the primary tool for assessing population viability for species of conservation concern. She has coauthored treatments of this genus for the *Jepson Manual: Higher Plants of California* (Hickman 1993), the *Flora of North America* (expected 2001), and the *Oregon Flora Checklist* (Oregon State University). With her students from San Francisco State University, Dr. Fiedler spent over 5 years researching Mason's lilaeopsis (*Lilaeopsis masonii* [Apiaceae]), a rare plant endemic to the Sacramento-San Joaquin Delta and Golden Gate Estuary ecosystems. Under the auspices of the U.S. Environmental Protection Agency, Dr. Fiedler, along with two collaborators in California, developed a methodology for the classification and description of wetlands in the coastal watersheds of central and southern California. This work also represents the first comprehensive inventory of wetlands in the state, and serves as a model for wetland ecologists interested in documenting the rich wetland heritage of California. Dr. Fiedler currently is completing another EPA contract to extend this methodology to vernal ecosystems in the state. In the early 1990's she also developed a plant identification book on common wetland plants for the Great Valley, published by the U.S. Army Corps of Engineers, Sacramento District.

In 1998, Dr. Fiedler received a Fulbright Senior Scholar Fellowship for collaborative research at Kings Park and Botanic Garden in Perth, Western Australia (now the Botanic Garden and Parks Authority). She spent six months in Western Australia working on the genus *Anigozanthos* (Haemodoraceae) as a model for understanding the demographic behavior of interspecific hybridization. Prior to her Fulbright fellowship, Dr. Fiedler traveled to Perth in 1985 as a guest speaker at the Fifth International Botanic Gardens Conservation Congress, and in 1983, to Trondheim, Norway, to speak at the United Nations/Norway Conference on Biodiversity. She has lectured nationally at a wide variety of venues as an invited speaker; for example, the Center for Plant Conservation conferences on rare plants (St. Louis [1993], Chicago [1999]), Ecological Society of America Symposium on Rare/Common Species (Knoxville [1994]), Institute of Ecosystem Studies Cary Conference (Millbrook [1995]), California Academy of Sciences Fellows Day (San Francisco [1989]), and at a variety of universities, including Stanford, University of California, Berkeley, and Colorado State University.

Dr. Fiedler is an active member of the conservation scientific community. She has published more than 30 journal articles, book chapters, and taxonomic treatments, as well as 12 technical reports. She has also edited two volumes on conservation biology published by Chapman & Hall, New York (1992. *Conservation Biology. The Theory and Practice of Nature Conservation, Preservation, and Management.* [with S.K. Jain] and 1998. *Conservation Biology. For the Coming Decade.* [with P.M. Kareiva]). Dr. Fiedler also wrote a popular science book entitled *Rare Lilies of California,* illustrated by C. Watters and published by the California Native Plant Society (1996). She served as President of the California Botanical Society from 1993-94, and as a board member from 1987-88 and 1995-97. Dr. Fiedler also served on the editorial board for the international journal *Biological Conservation* from 1992 - 1998 (Associate Editor 1992-95). Currently she is Associate Editor for book reviews for the Society of Conservation Biology's journal, *Conservation Biology,* and a member of the Reintroduction Specialist Group of the International Union for the Conservation of Nature / Species Survival Commission. Dr. Fiedler also holds an appointment as a Research Associate at the University Herbaria, University of California, Berkeley. In 1992, Dr. Fiedler was inducted as a Fellow of the California Academy of Sciences. In 1995, she received the Larry Heckard Fellowship at the Jepson Herbarium at the University of California Berkeley and was a nominee for the Pew Fellowship in Conservation and the Environment in 1995.

Dr. Fiedler will serve as the overall Team Leader and Project Manager in the development of the draft HGM guidebook for Suisun Marsh.

2. Lyndon C. Lee, Ph.D.

Dr. Lyndon C. Lee founded L.C. Lee & Associates, Inc. in 1989 after researching and working in wetlands, forestry, soils and wildlife for more than fifteen years. Currently his interests are focused on (a) the application of scientific information to federal, state and local regulatory processes, (b) the response of wetland and forest ecosystems to perturbation, (c) the problems of wetland mitigation, including wetland functional assessment, and construction and restoration of wetland ecosystems, (d) the assessment of site-specific and cumulative impacts in wetlands, and (e) the movement, fate and remedial management of contaminants in wetlands.

Dr. Lee served as senior wetland ecologist for the U.S. Environmental Protection Agency Headquarters, Washington, D.C. from 1986 to 1989. During this time, he was directly involved with the formulation of national wetlands policy and regulatory procedures. He directed a team of technical experts that dealt with top priority wetland problems throughout the country, and served as the Superfund and RCRA liaison from the Office of Wetlands Protection. During his tenure at EPA, Dr. Lee directed a landmark study of cumulative impacts to bottom-land hardwood forests of the southeast. Dr. Lee also founded the National Wetland Science Training Cooperative while at EPA, which he has continued to direct since leaving the agency.

Dr. Lee came to EPA from the University of Georgia Savannah River Ecology Laboratory in Aiken, South Carolina, where he was manager of the Wetlands Division for two years. He supervised the wetland research program at the U.S. Department of Energy's Savannah River Nuclear Facility and National Environmental Research Park with an annual budget of more than 4 million dollars. The program involved assessing and monitoring the effects of nuclear energy production on riparian and riverine wetland ecosystems, management of radionuclide, heavy metal and organic contaminants in wetlands, and restoration of wetland ecosystems degraded by chronic thermal and contaminant inputs.

While pursuing his graduate degrees, Dr. Lee spent six years researching and working in wetland, riparian, and forested ecosystems throughout the Pacific Northwest and Northern Rocky Mountains. He worked for several years as the Senior habitat ecologist for the Interagency Grizzly Team's Border Grizzly Project, Montana Forest and Range Conservation Experiment Station, Missoula, Montana. There he developed, conducted and supervised research dealing with the definition, description, classification, protection and restoration of Grizzly Bear and Grey Wolf habitat throughout the northern Rocky Mountains, southeastern British Columbia and northern Mexico.

The scope of Dr. Lee's consulting experience over the last 10 years has taken him to all areas of this country and to a number of other nations. He has completed more than 125 contracts with private industry, research and conservation organizations, and private landowners. These projects have involved applied wetland and riparian ecosystems ecology, development and implementation of silvicultural and land-use management prescriptions for wetlands and riparian ecosystems, jurisdictional delineation of wetlands and riparian zones, assessment of impacts to wetland and riparian ecosystems, wetland assessments for compensatory mitigation, wetland creation and restoration, recommendations for management of contaminants and/or hazardous materials in wetland ecosystems, expert testimony, and training in all of the above. He has extensive knowledge of wetland and wildlife ecology, forestry, and soil science and a national reputation on issues relating to wetlands science, regulations and assessment of wetland functions and impacts to wetlands.

Dr. Lee has been active in teaching and training throughout his career. He has served as Adjunct Assistant Professor at both the University of South Carolina and George Mason University. He held the position of Assistant Research Professor at the University of Georgia's Institute of Ecology while working at the Savannah River Ecology Laboratory and at EPA Headquarters. While at the Universities of Washington and Montana, he assisted in teaching a variety of courses and served as a principal instructor for the Montana Forest Habitat Type Short Courses. Since 1987, Dr. Lee has led over 60 training sessions through the National Wetland Science Training Cooperative.

Dr. Lee is an active member of the wetland scientific community. He has published more than 30 professional papers and 50 technical reports, and has presented more than 40 oral papers and seminars. In 1992, he was awarded Life Membership in the Society of Wetland Scientists and has received their designation as a Professional Wetlands Scientist. In addition, he is an active member of the Ecological Society of America, AAAS, the Society of American Foresters and the Association of State Wetland Managers. He continues to play a very prominent role in shaping national policies concerning wetlands protection and is regarded as one of the top national experts on wetland issues.

Dr. Lee will serve as the principal wetland ecologist for the project.

3. Scott Stewart, Ph.D.

Scott Stewart has worked with L.C. Lee & Associates, Inc. as a senior scientist since 1998, serving in the capacity of soil scientist/geomorphologist and biogeochemist. Prior to coming to LCLA, Dr. Stewart spent three years working as a soil scientist with the U.S. Department of Agriculture-Natural Resources Conservation Service in Alaska. He has three years experience as a laboratory technician at the University of Oregon in the field of genetics and microbiology, four years experience as a research assistant at the University of Oregon and three years experience as

a research and teaching assistant at Oregon State University in the field of soil and water sciences.

Dr. Stewart's doctoral research focused on surface and subsurface hydrology, redox chemistry, and the age and provenance of the strata and redoximorphic concretions and nodules underlying the Jackson-Frazier Wetland near Corvallis Oregon. The Jackson-Frazier wetland formed on Vertisols in Holocene alluvium incised into Pleistocene/Holocene valley fill materials. The biogeochemical and hydrologic processes within the Pleistocene/Holocene alluvium are driven as a function of current climatic conditions and Willamette Valley stratigraphy.

Since joining LCLA, Dr. Stewart, in conjunction with the LCLA field botanist has performed several jurisdictional wetland delineations throughout Washington and California. Additionally, he has performed numerous reconnaissance-level identification and mapping of sensitive areas including steep slopes, erosion hazards, seismic hazard, waters of the U.S. including wetlands; and has helped develop mitigation plans, budgets, and subsequent reports for private individuals as well as county and city governments. Dr. Stewart has also assisted in the process of permit acquisition, and has provided oversight on permitted work in and near waters of the U.S., including wetlands. He has also provided seasonal and annual oversight of sediment and erosion control practices and surface water quality at several large state (Washington) construction projects.

Dr. Stewart has been involved in four different Hydrogeomorphic Method (HGM) projects in Alaska, California, and Maryland. He has participated in fieldwork, development of field methodology, field and classroom training, and the writing of HGM Draft Guidebooks for the State of Alaska and Santa Barbara County, California.

Dr. Stewart shall serve as the lead in the analysis of soils and hydrology during the development of the reference system and HGM models required for this project.

4. Douglas Partridge, M.S.

Doug Partridge completed a Masters degree in Biology from the University of Michigan, with an emphasis in plant ecology in Spring 2000. His thesis project at the University of Michigan examined life history traits that help to explain abundance and distribution patterns of invasive herbaceous plants.

Prior to graduate school, Mr. Partridge worked on several ecological research projects focused on plant ecology. He was the project coordinator for research to determine the effects of seed weight and intraspecific competition on germination and seedling behavior. Mr. Partridge was also a research assistant for the University of Michigan Biological Station researching the effects of elevated concentrations of atmospheric carbon dioxide and soil nitrogen on the growth and survival rates of Trembling aspen (*Populus tremuloides*).

Since joining LCLA, Mr. Partridge has assisted on several jurisdictional wetland delineations, as well as numerous reconnaissance-level identification and mapping of sensitive areas including steep slopes, erosion hazards, and waters of the U.S. including wetlands. Subsequently, Mr. Partridge assisted in the development of reports for both delineations and reconnaissance-level investigations, the development of mitigation plans, and acquiring permits for private landowners, as well as city and county governments. Mr. Partridge has also been involved in rare plant surveys, as well as a Hydrogeomorphic Method (HGM) project in Santa Barbara, California.

These projects included the development of field methodology, fieldwork, data analysis, mapping, and assisting in the writing of a report and/or HGM Guidebook.

Mr. Partridge's duties for this project will include field survey, research design, data collection and analysis, and document production.

5. Shane Staten, M.E.M.

Mr. Staten received a Masters of Environmental Management from Duke University's Nicholas School of the Environment and Earth Sciences, specializing in wetland ecology, restoration and management, as well as forest management. In 1999, he was named a Doris Duke Charitable Foundation Conservation Fellow for outstanding promise in the field of conservation. Mr. Staten was a maintenance assistant in Duke Forest, helping with daily forest management, prescribed burns, and GPS data collection.

During the summer of 2000, as part of a wetland restoration project north of Klamath Falls, Oregon, Mr. Staten performed a seed bank germination study for The Nature Conservancy's Williamson River Delta Preserve. This study determined the locations of wetland seed banks on the property as well as the hydrologic levels most conducive for reviving wetland flora.

Prior to receiving his master's degree, Mr. Staten graduated with honors from the University of California, Berkeley, from the department of Integrative Biology (major) and the department of Conservation and Resource Studies (minor). Mr. Staten's honor thesis examined female mate choice of colonial Tuco-tucos (*Ctenomys sociabilis*), a species of Argentinean subterranean rodent. During the summer of 1999, Mr. Staten worked as a laboratory assistant for Prof. Whendee Silver in the College of Natural Resources at U.C. Berkeley on a project dealing with the carbon cycle and its relation to global climate change.

An associate of L.C. Lee & Associates, Inc. since July 2001, some of Mr. Staten's duties include site monitoring, data collection and analysis, permitting, and document production.

Mr. Staten's responsibilities for this project will include logistics, field survey, research design, data collection and analysis, and document production.

IV. COST

A. Budget

The proposed focused research is estimated to cost $235,515.00 as detailed in the budget section in the body of the proposal.

B. Cost-Sharing

NWSTC will share equipment, units, and other costs.

V. LOCAL INVOLVEMENT

While there are no additional local funds supporting this research, the proposed work complements completed HGM guidebooks produced by NWSTC on the Borden Ranch in Sacramento and San Joaquin counties and on the 3rd and 4th order riverine waters/wetlands of the

central California coast. More broadly, HGM models for a variety of riverine wetland ecosystems have been developed throughout the country, and as such, the models are all consistent with the HGM approach developed primarily by the NWSTC.

After completion of the draft guidebook, NWSTC will hold a training course that will be widely advertised to interested individuals and agencies. During this course, copies of the guidebook will be handed out and participants will be shown how to properly utilize the draft guidebook.

VI. COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

The NWSTC will comply with all standard State and Federal contract terms.

VII. LITERATURE CITED

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