Louisiana Department of Natural Resources
Coastal Restoration Division
Open-File Report 95-01

QUALITY MANAGEMENT PLAN

FOR

COASTAL WETLANDS PLANNING, PROTECTION, AND RESTORATION ACT

MONITORING PROGRAM

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September 1995
(Revised June 2000)

Reference citation:

Steyer, G.D., R.C. Raynie, D.L. Steller, D. Fuller and E. Swenson 1995. Quality management plan for Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Open-file series no. 95-01 (Revised June 2000). Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division. 97 pp.

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DISCLAIMER

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PREFACE

The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) of 1990 created an opportunity for projects to be implemented to help retard the serious loss of wetlands in Louisiana. This Act required that these projects be monitored, necessitating the development of a monitoring program to adequately assess their effectiveness. A document was produced entitled "Monitoring Program for CWPPRA Projects" (Steyer and Stewart 1992) that identified typically why, what, and how to monitor. This document was produced by technical experts from state, federal and local governmental agencies, academia and private firms, and serves as the Standard Operating Procedures (SOPs) for the monitoring program. A complimentary Quality Management Plan (QMP) was completed and approved in September 1995 to ensure that all activities associated with the CWPPRA Monitoring Program were documented and met a high standard of quality.

The September 1995 QMP was developed in accordance with EPA Executive Order 5360.1, Policy and Program Requirements to Implement the Mandatory Quality Assurance Program. The QMP is a program-level document, rather than a project-specific document, and therefore incorporates the Quality Assurance program elements that are required under EPA's Quality Management Plan and Quality Assurance Project Plan (QAPP) Guidelines.

This QMP updates the September 1995 document and illustrates how the monitoring program is structured and that adequate quality assurances and controls have been embedded in the program. Organizational changes and improved monitoring technologies have been incorporated into this QMP. CWPPRA management is fully aware that restoration science is a new field and that many avenues exist for improving monitoring technologies and the associated quality system. It is understood, therefore, that this is a "living" document that will continue to evolve over time.

Gregory D. Steyer

ACKNOWLEDGEMENTS

This quality management plan was written by Greg Steyer, Rick Raynie, and Diana Steller of the Biological Monitoring Section of the Louisiana Department of Natural Resources (LDNR), and Debbie Fuller of the National Wetlands Research Center (NWRC), and Erick Swenson of Louisiana State University (LSU). We extend our apppreciation to John Barras, William Jones, and Robert Greco of NWRC, Andy Nyman of the University of Louisiana at Lafayette (ULL), Steve Underwood, Kirk Rhinehart, and Shannon Holbrook of Coastal Restoration, and Don Baltz of LSU for their assistance in the preparation of this document. We are grateful for the constructive responses and critiques of the wetland scientists, resource managers, and interagency personnel. Review comments, suggestions, and criticisms were constructively submitted by Darryl Clark, Steve Gammill, Lisa Everett, Doug Meffert, Dan Llewellyn and Jim Rives of LDNR; Marty Floyd of the Natural Resources Conservation Service; Lee Foote of NWRC; Charlie Demas of the United States Geological Survey; and Robert Twilley of the University of Louisiana at Lafayette. A special thanks goes to Margo Olinde for editorial review and Elfrieda "Ozzie" Oswald and Renata Pitts for word processing, coordination, and general assistance.

I. INTRODUCTION

I.1 Monitoring Program Overview

In response to accelerated wetland loss in Louisiana, Act 6 of the 2nd Extraordinary Session of the Louisiana State Legislature in 1989 and the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) of 1990 were created to conserve, restore, create, and enhance Louisiana's coastal wetlands. The agencies responsible for designing and implementing coastal conservation and restoration projects include the Louisiana Department of Natural Resources, U.S. Department of Commerce, U.S. Department of Agriculture, U.S. Department of the Interior, U.S. Department of the Army, and the U.S. Environmental Protection Agency. The restoration plans developed pursuant to these acts specifically require an evaluation of the effectiveness of each coastal wetlands restoration project in achieving long-term solutions to arresting coastal wetlands loss. This necessitated the development of a monitoring program to adequately assess the effectiveness of coastal restoration projects. The above agencies have a responsibility to the State of Louisiana, and to the nation, to develop a monitoring program that will effectively ensure the best use of state and federal funds for the restoration and conservation of wetlands.

CWPPRA created an interagency task force and charged it with the development and implementation of a comprehensive approach to the long-term conservation and restoration of coastal wetlands. Because in a broader context, the mission of the CWPPRA is to provide appropriate management plans for the Louisiana coastal zone over the next 50–100 yrs, monitoring protocols could be applied on a regional scale across the coastal zone to provide the data necessary for effective management planning at that scale. CWPPRA requires that not less than 3 yrs after the completion and submission of the restoration plan, and at least every 3 yrs thereafter, a report shall be made to Congress containing a scientific evaluation of the effectiveness of the coastal wetlands restoration projects in creating, restoring, protecting, and enhancing Louisiana's coastal wetlands. Consequently, a quality management plan was needed to ensure that all activities associated with the CWPPRA Monitoring Program were documented and met a high standard of quality.

I.1.1 Program Goals

Monitoring of projects implemented from the CWPPRA restoration plan must provide:

1. "An evaluation of the effectiveness of each coastal wetlands restoration project in achieving long-term solutions to arresting coastal wetlands loss in Louisiana," PL 101-646 Sec. 303 (b)(4)(L); and

2. "A scientific evaluation of the effectiveness of the coastal wetlands restoration projects carried out under the plan in creating, restoring, protecting and enhancing coastal wetlands in Louisiana," PL 101-646 Sec. 303(b)(7).

In order for the above mandates to be achieved, the monitoring efforts must generate results that can aid in determining the effectiveness of existing projects, in the beneficial modification of existing projects, in the design of future projects, and most importantly, support future decisions on selection of projects proposed for creating, restoring, protecting, and enhancing Louisiana's coastal wetlands. Comparison of results among projects of similar types is a way to determine which projects are most effective in achieving long-term solutions to arresting coastal wetlands loss.

I.1.1 (1) Mission Statement

The highest quality data are needed to ensure that the monitoring efforts are successful. Therefore, it is our mission to collect, analyze, and interpret high-quality ecological, hydrological and climatological data. This mission will be realized by: (1) pragmatic data collection based on specific goals and objectives, using sound experimental design, (2) unbiased evaluation of data to determine the effectiveness of wetland projects, (3) documentation and dissemination of project data, and (4) the evaluation of program effectiveness as the knowledge and technology base expands. The fulfillment of our mission will result in appropriate management decisions to ultimately create, restore, protect, and enhance coastal wetlands in Louisiana.

I.1.2 Program Structure, Responsibilities, and Coordination

CWPPRA directed the Secretary of the Army to convene the Louisiana Coastal Wetlands Conservation and Restoration Task Force to consist of the following members: Secretary of the Army; Secretary of the Interior; Secretary of Agriculture; Secretary of Commerce; Administrator, U.S. Environmental Protection Agency; and Governor, State of Louisiana. In practice, the Task Force members named by the law have delegated their responsibilities to other members of their organizations. The Task Force established the Technical Committee and Planning and Evaluation (P&E) Subcommittee to assist in the implementation of CWPPRA. Each of these bodies contains the same representation as the Task Force: one member from each of the five federal agencies and one from the state. The P&E Subcommittee established several working groups to develop and/or evaluate critical information necessary for selection and implementation of priority list projects. The Monitoring Work Group (MWG) established a standard procedure for monitoring CWPPRA projects, developed a monitoring cost-estimating procedure, and determined how the monitoring program would be implemented. The Technical Advisory Group (TAG) ensures that the monitoring program is implemented properly. Figure 1 illustrates the CWPPRA Program Structure.

Coastal Wetlands Planning, Protection, and Restoration Act
Program Structure

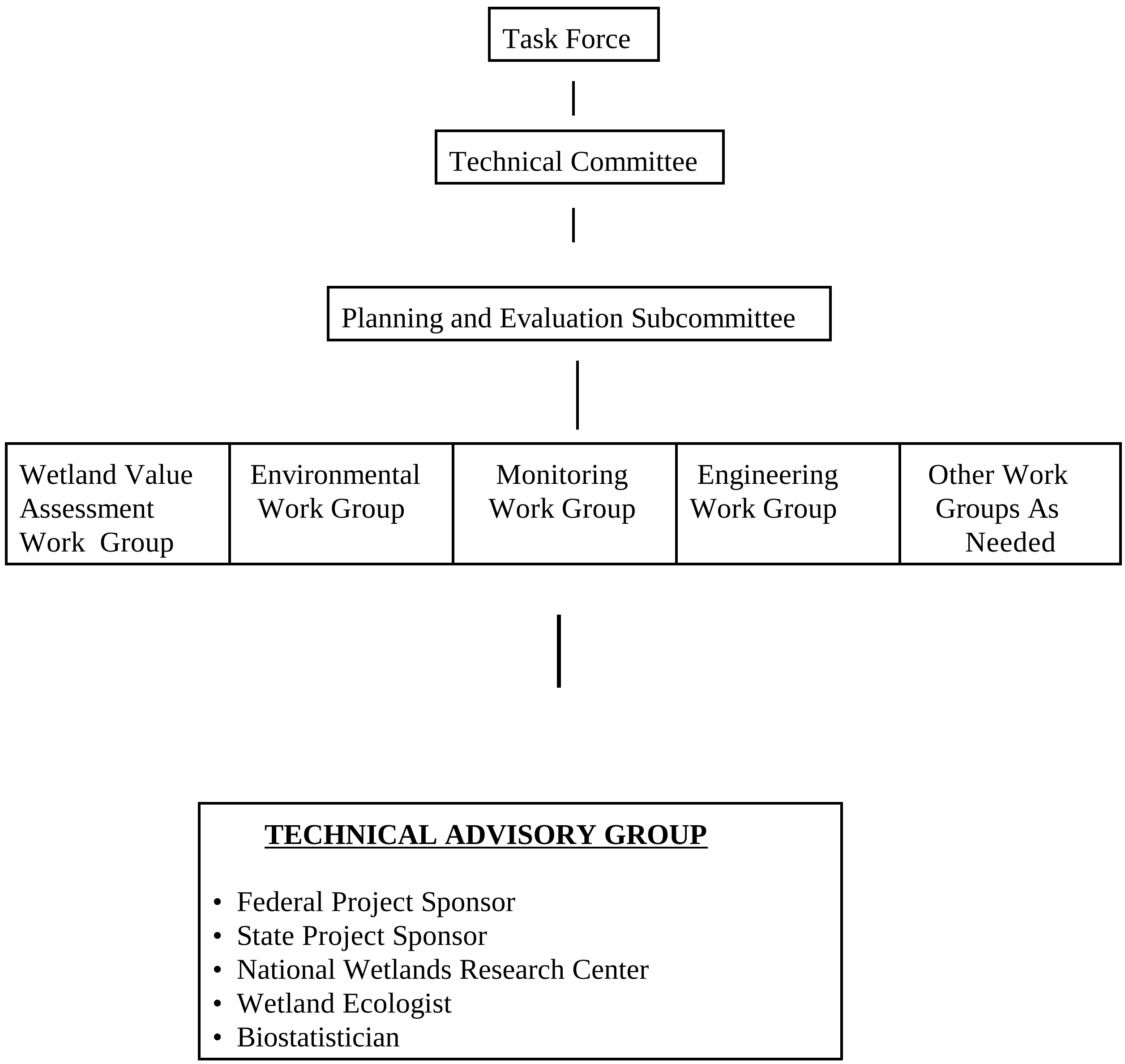


Figure 1

The Louisiana Department of Natural Resources, Coastal Restoration Division (LDNR/CRD) is responsible for management of all monitoring activities of CWPPRA including monitoring plan development, data collection and storage, statistical analysis, quality control, data interpretation, and report generation. The U. S. Geological Survey, National Wetlands Research Center (NWRC) is responsible for habitat mapping and GIS analysis (geographic information systems support) and other related monitoring as deemed appropriate by LDNR/CRD for each project. LDNR/CRD and NWRC jointly prepare reports for each CWPPRA project implemented. These reports are submitted to the P&E Subcommittee, Technical Committee, and Task Force for final approval. The P&E Subcommittee shall direct the MWG to provide a technical review of the project reports. The implementation of all monitoring plans will follow the protocols developed in the CWPPRA Monitoring Program Document (Steyer and Stewart 1992). A Technical Advisory Group (TAG), consisting of a federal project sponsor representative, state (LDNR/CRD) project sponsor representative, NWRC representative, wetland ecologist, and biostatistician, assists in the development of project-specific monitoring plans. The P&E Subcommittee is advised of all TAG meetings. Assistance by the other sponsoring agencies in the development of the monitoring plans is available on a voluntary basis. These plans are reviewed by the MWG and Scientific Advisory Group and submitted to the P&E Subcommittee, Technical Committee, and Task Force for final approval (figure 2). The contracted wetland ecologist and biostatistician will also provide an independent evaluation of quality assurance and verification of data interpretations to ensure unbiased determinations of results.

Information that is generated in the CWPPRA monitoring program is developed, reviewed and/or quality controlled by the TAG Committee. Further review is conducted by the following entities: academic and interagency peers, MWG, Scientific Advisory Group, P&E Subcommittee, Technical Committee, and the Task Force. This thorough review and coordination provides the highest level of quality assurance and promotes credibility. Additionally, this coordination aids in the information exchange process that is critical to understanding and promoting wetland restoration science.

The CWPPRA involves federal, state, and local governments, as well as private landowners; thus, the ultimate customers of information generated are the citizens of the state of Louisiana. Generally, the federal sponsoring agency of a given project will be the primary customer for the monitoring information which will be generated by the LDNR/CRD and NWRC.

MONITORING IMPLEMENTATION PROTOCOL

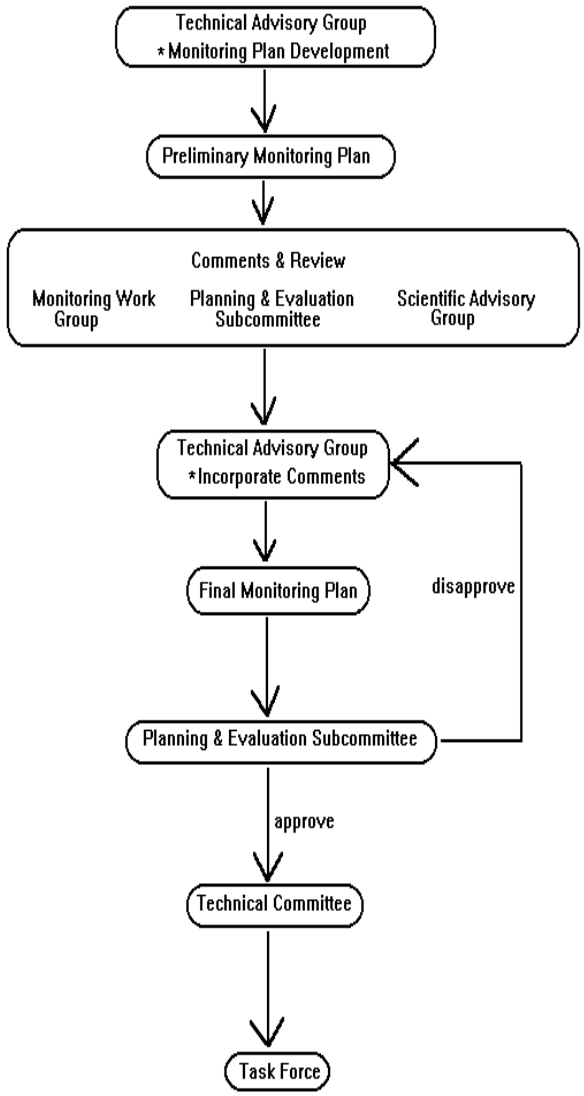


Figure 2. Protocol for Monitoring Implementation

I.1.3 Program Description

The CWPPRA monitoring program was developed by MWG using a broad-based, standardized approach. Steyer and Stewart (1992) provide a guidance document that can be used to develop project-specific and basin-wide monitoring plans and monitoring cost estimates. The monitoring protocols developed by Steyer and Stewart (1992) broadly categorize project types, goals, and biological variables, and standardize data collection methodologies using a matrix design. The protocols were developed by subgroups of technical experts for seven categories of monitoring variables: water quality, hydrology, soils and sediments, vegetative health, habitat mapping, wildlife, and fisheries. This organization provides accessibility to three levels of information: project type, category of variable, and variable. These three levels are cross referenced and ranked to guide personnel in the development of appropriate monitoring plans. The highest priority variables to be considered for monitoring by project type are listed in table 1.

Monitoring plans for CWPPRA projects were developed based on the minimum monitoring variables necessary to provide sufficient information to determine if project goals and objectives are being met. The essential variables category illustrates those variables that generally will be measured for each project type. However, due to the limited availability of funds, all of the highest priority variables may not be monitored. MWG determined by project type which variables were essential in judging project effectiveness and which additional variables may need to be monitored based on project objectives and possible impacts. This list does not preclude other variables from being monitored if determined necessary by TAG.

However, project-specific goals and objectives may dictate that some of these variables may be non-essential. Additionally, monitoring budgets may be insufficient to measure all essential variables.

Table 1. Highest priority monitoring variables by project type.

Project Type	Essential Variables	Additional Variables or Substitutions
Freshwater Diversion	Habitat Mapping Salinity Water Level Vegetation	Fisheries Discharge Precipitation Wind Speed/Direction
Marsh Management	Habitat Mapping Salinity Water Level Vegetation Fisheries	Sediment Accretion
Hydrologic Restoration	Habitat Mapping Salinity Water Level Vegetation	Fisheries Sediment Accretion Water/Sediment Quality
Outfall Management	Habitat Mapping Salinity Water Level Vegetation	Sediment Accretion
Sediment Diversion	Habitat Mapping Bathymetry/ Topography	Vegetation Suspended Sediment Discharge
Vegetative Planting	Vegetation Shoreline Markers	Habitat Mapping Salinity
Beneficial Use of Dredged Material	Habitat Mapping Vegetation Bathymetry/ Topography	Shoreline Markers
Barrier Island Restoration	Habitat Mapping Vegetation Bathymetry/ Topography	Shoreline Markers
Sediment/Nutrient Trapping	Habitat Mapping Vegetation	Suspended Sediment Bathymetry Nutrients
Shoreline Protection	Habitat Mapping Shoreline Markers	Vegetation Bathymetry/Topography

CWPPRA Task Force required that monitoring costs be standardized for each project type. Monitoring costs vary considerably depending upon the size and complexity of projects and site-specific concerns within the project area. Therefore, it was a difficult task to standardize monitoring costs. MWG determined that monitoring costs cannot be set at a fixed percentage of project cost due to varying project goals and objectives and project sizes. They did, however, generate an initial estimate of an average annual cost (below) necessary to adequately monitor each type of wetland restoration project. This cost estimate was reviewed by the P&E Subcommittee, Technical Committee, and Task Force, and was reduced by 40%.

Average annual monitoring costs for each project type will not exceed the following:

Project Type	Average Annual Cost (1998)
Freshwater Diversion	$ 29,291
Marsh Management	$ 29,291
Hydrologic Restoration	$ 29,291
Outfall Management	$ 29,291
Sediment Diversion	$ 9,764
Vegetative Planting	$ 4,896
Beneficial Use of Dredged Material	$ 4,896
Barrier Island Restoration	$ 4,896
Sediment/Nutrient Trapping	$ 4,896
Shoreline Protection	$ 2,434

Freshwater diversion, marsh management, hydrologic restoration and outfall management project costs can be prorated based on project size as follows:

less than 1,000	acres =	60%
1,000–5,000	acres =	70%
5,000–15,000	acres =	80%
15,000–60,000	acres =	100%

In addition, those projects that require continuous data recorders for active management will also be funded at 100%, regardless of project size. Monitoring costs for any given project will not exceed 125% of the original, fully-funded monitoring cost estimate. Monitoring costs for any given project will not exceed 50% of the fully-funded project cost without monitoring.

Project-specific exemptions to the preceding monitoring costs will be mutually agreed upon by the State of Louisiana and the federal cost-share sponsor. Monitoring costs will be included as a component of the fully funded project cost using the above average annual monitoring cost guidelines. In situations where monitoring costs must be added to a previously approved project, such an addition should not cause the previously approved fully funded project cost to be exceeded by more than 25%. If the cost is exceeded, approval must be obtained from the P&E Subcommittee, Technical Committee, and Task Force.

Once budgets have been determined and projects have been planned, designed, and approved for construction, preconstruction aerial photography planning is conducted and monitoring plans are developed. Once project boundaries have been finalized, these boundaries are provided through the Wetland Value Assessment (WVA) planning effort to the NWRC for incorporation into the CWPPRA Regional GIS Data Base. In order to obtain photography for preconstruction conditions in the project area, these boundaries are then transferred to the mapping section of NWRC. There, preflight planning is initiated. Flight lines are reviewed by personnel at NWRC and LDNR/CRD before the photography is flown.

Monitoring plans undergo a thorough development and review process prior to finalization and acceptance. The following steps are initiated in completing a monitoring plan:

1. The monitoring manager is LDNR/CRD's representative on the TAG committee. Monitoring managers have the job classification of geoscientist. The monitoring manager should make initial contact with the LDNR/CRD project manager and the lead federal agency representative for acquisition of historical data, research reports, feasibility studies, WVA analyses, etc., in order to develop project objectives, goals, reference areas, monitoring elements, null hypotheses, and anticipated statistical analyses. The LDNR/CRD monitoring manager should develop the preliminary monitoring plan. The following documents should be used as templates in preparing the plan: standardized monitoring plan format; standardized null hypotheses and statistical analyses; LDNR/NWRC joint monitoring proposal; and the CWPPRA Monitoring Program Document (Steyer and Stewart 1992). A plan-view map of the project area should be developed during this stage. If known, sampling stations, transect lines, etc., should be included on the plan-view map. Once this plan is developed, it should be reviewed by the monitoring supervisor and program manager, then sent to the lead federal agency representative for refinement. A site-visit, travel or meetings may be necessary with the lead federal agency representative in order to develop a mutually agreeable preliminary plan. Once a mutually agreeable preliminary plan is completed, a preliminary budget is prepared by the monitoring manager. The plan developed at this stage should have the goal of needing minimal changes to be approved by TAG.

2. Monitoring managers initially mail-out to the NWRC representative, ecologist, and statistician the preliminary monitoring plan and budget, project description report, and WVA analysis, at a minimum. A copy of the preliminary monitoring plan <u>only</u> will be mailed out to representatives of MWG and TAG. This mail-out will be completed at least three weeks prior to a scheduled TAG meeting. Other data or information requested should be supplied unless it is too bulky or large to copy. Otherwise, all

other project information, documents, drawings, etc., should be brought to the TAG meeting.

3. All comments at the TAG meeting must be noted by the monitoring manager. All areas of consensus, conflict, changes, and tasks to be completed, by whom and when, must be noted. It is the responsibility of the monitoring manager to type up these notes and have them sent, via FAX mail, to the TAG representatives within two days.

4. The goal of the TAG meeting is to finalize a monitoring plan and budget, however, it may not be finalized after one meeting. Additional telephone calls, FAX mail, and/or meetings may be necessary. If major changes are made during the process, then all members of TAG must receive copies of the revised document. Some projects may require a field trip by TAG representatives either before or after the TAG meeting.

5. Other agency personnel are able to attend the TAG meetings on a voluntary basis. Their input is considered but they are not voting members.

6. Once a monitoring plan is finalized by TAG, it is sent to the Scientific Advisory Group, MWG, and P&E Subcommittee representatives for a two-week review. Comments received by the monitoring manager must be considered by TAG. A justification by TAG is needed for any comments not incorporated.

7. After review comments are incorporated, the final monitoring plan is sent to the P&E Subcommittee chairman for final approval. Attached to the final plan are all comments received during review, a written response to comments, and a proposed budget. It is the responsibility of the P&E Subcommittee chairman to submit the final monitoring plan to the Technical Committee and Task Force.

8. Once a monitoring plan is developed, it is the responsibility of LDNR/CRD and NWRC to implement the plan following the procedures outlined in this Quality Management Plan (QMP).

9. The implementation of the monitoring plan will be dependent on project construction timetables. In cases where a project is delayed due to unforeseen causes, the monitoring activities timetable will be adjusted accordingly.

I.1.4 Program implementation

The development and implementation of monitoring plans require a significant amount of management oversight and inspection. Monitoring managers (Geoscience Specialists) meet with their supervisors on a monthly basis to discuss individual projects, job performance, quality control procedures, and to plan for the following month. Each employee then provides his supervisor with a list of items that were agreed to in the meeting, which is subsequently used as a guide throughout the month. This list of agreed-to-items is then used as an outline in the subsequent meeting to ensure that issues raised in the previous meeting were addressed during the month. Field trip reports are generated for each field trip which address both logistical and biological components of the field trip and identify any problems encountered. Field procedures and any quality control items are also discussed during monthly meetings with supervisors to ensure that each employee is familiar with standard operating procedures and that problems encountered in the field are not recurring. Inspection oversight is conducted by the Geoscience Program manager and the QA Auditor.

Procedures for field and office protocols within the Biological Monitoring Section (BMS) have been developed and implemented through the issuance of a BMS Policies and Procedures Manual compiled by the Geoscience program managers. Standard office protocols for the LDNR/CRD are utilized where applicable and specialized protocols have been developed under the direct supervision of Geoscience program managers. Specialized policies are developed when certain procedures become frequent enough to warrant the Geoscience program managers' attention. Departmental policies which are periodically updated by upper management and new policies that are developed by Geoscience program managers are introduced and reviewed at monthly staff meetings.

I.1.5 Approach

The CWPPRA Monitoring Program develops monitoring plans and collects data on individual projects based on specific project goals and objectives. The framework on which the plans are developed is based on a basin level approach. All monitoring efforts are coordinated within each hydrologic basin in order to adequately address secondary or cumulative effects of projects.

I.1.6 Deliverables

The CWPPRA Monitoring Program will generate data on all implemented projects under CWPPRA. Results from these projects will be published in comprehensive reports every three years and in evaluation reports to the U.S. Congress and Louisiana Legislature not less than 3 yrs after the completion and submission of the restoration plan, and at least every 3 yrs thereafter.

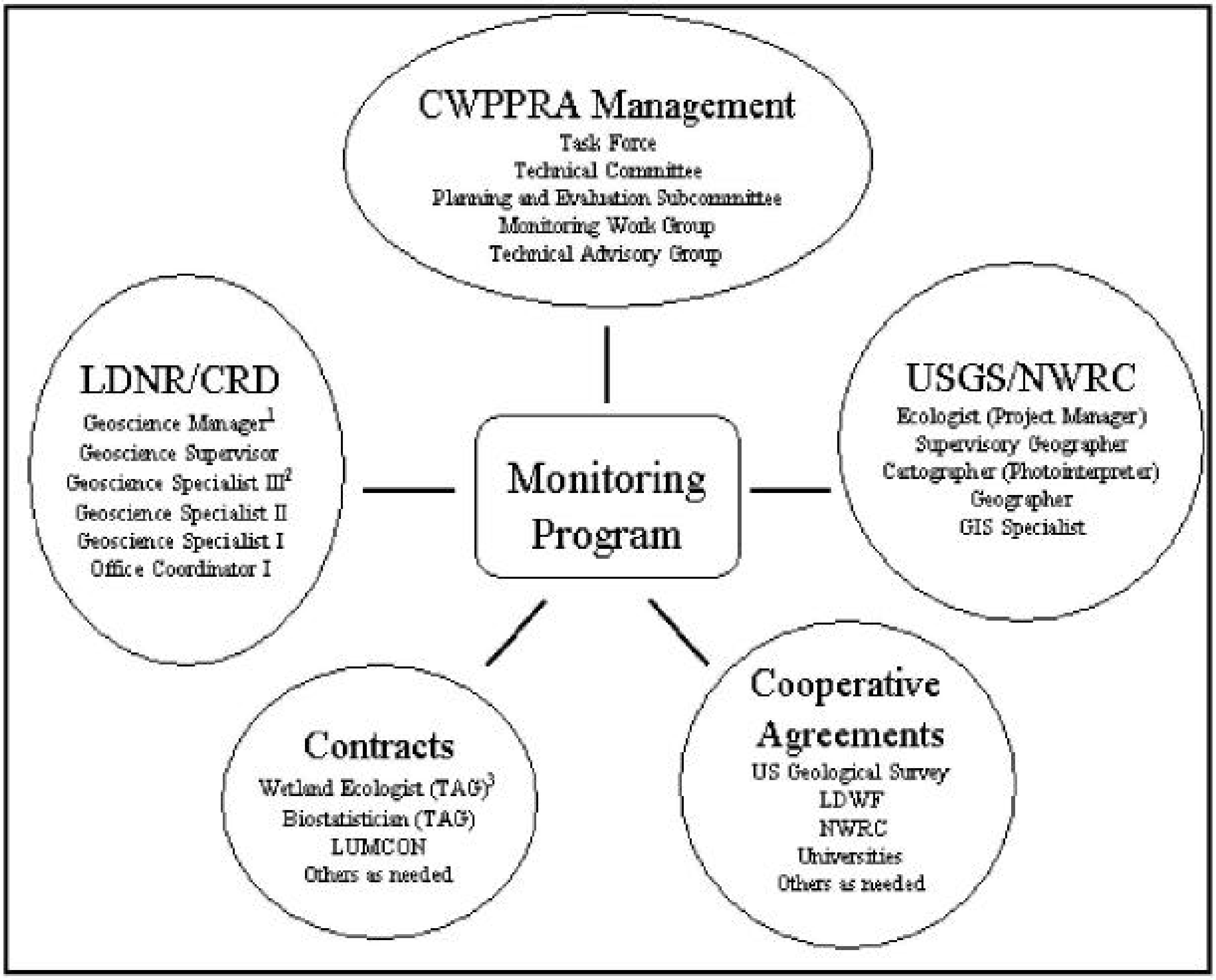
I.2 Management and Organization

The importance of a sound Quality Assurance (QA) program is acknowledged by CWPPRA and is addressed in CWPPRA's overall program goals. It is the specific policy of LDNR/CRD and NWRC that all environmentally related measurements are of known and documented quality. This level of assurance is necessary because of the vast quantities of data collected by numerous entities. These data will ultimately assist in a decision regarding project and program-level effectiveness, therefore, it is critical that this information is of the highest quality.

CWPPRA has dedicated resources to the monitoring program for 20 yrs. These resources will provide the commitment for the continued development and improvement of the monitoring program as technologies advance and protocols are improved upon. Necessary training and technical support will be afforded to meet program needs. Quality control (QC) checks have been provided throughout the program to minimize impacts on data quality and integrity and to identify problems which could influence program implementation. Any situation that compromises data quality will be identified and addressed immediately.

It is understood that the QMP is a "living" document that will evolve over time. Any changes to the QMP will be distributed to all individuals performing work under the QMP as the change occurs. Additionally, all changes that occur throughout the year will be reviewed during Field Methods training. If significant changes are made to the QMP, a revised version will be published and distributed. Quality assurance training and evaluation will be conducted annually to assess the effectiveness of the Quality Management System, both organizationally and procedurally.

The team responsible for the implementation of the monitoring program and Quality System is identified in the organizational chart in figure 3.



1 Serves as QA Manager
2 Serves as QA Officer
3 Serves as QA Auditor

Figure 3. Illustration of team responsible for implementation of monitoring program

QA responsibilities are dispersed throughout all levels of the organization. However, specific oversight and management of QA activities are carried out by three authorities: QA Officer (Geoscience Specialist III), QA Auditor (Contract Wetland Ecologist), and QA Manager (Geoscience Manager).

The QA Officer is responsible for assuring compliance of daily QA activities and reporting problems immediately to the QA Manager. The QA Auditor performs an independent evaluation of QA activities periodically in order to provide management oversight to maximize the success of the QA activities. The QA Auditor reports directly to the QA Manager and provides a written quality assurance report to the QA Manager. The QA Manager will keep the P&E Subcommittee, Technical Committee, and Task Force informed about quality issues, and has complete authority and accountability for the QA program.

I.3 Quality Management System

The Quality Management System of the Monitoring Program is nested inside a larger Quality Management System for the entire CWPPRA process (figure 1). At the largest scale, quality is assured by the Project Selection Process; i.e., only projects with a high likelihood of success and large increases in wetland function relative to cost are selected for implementation. Likewise, the Monitoring Program is the quality control system of CWPPRA activities. The Monitoring Program is so vital to the achievement of the CWPPRA mandates that the Program itself is the subject of this Quality Management Plan. Activities outside the Monitoring Plan, such as the Project Selection Process, and deciding when to modify or abandon a particular project, are not within the scope of the Monitoring Program and the Quality Management System described in this document. Instead, the Quality System described in this document is designed to provide a review process of the Monitoring Program.

Monitoring is more critical to the success of CWPPRA than to traditional mitigation programs because large spatial scales and uncertainty regarding the status of the wetlands at any given time preclude the use of repeated trial and error, which is allowed in the Clean Water Act, Section 404, process. Instead, monitoring plans prepared by this Monitoring Program will be designed with the expectation that some projects will be less effective than others to facilitate learning from all projects, regardless of their success. This monitoring philosophy is a departure from traditional monitoring programs in which documenting effectiveness of a project is the goal of monitoring, and understanding why and how a project was effective (or not) is of minor importance. Thus, the monitoring philosophy behind the CWPPRA Monitoring Program is based on adaptive management (Boesch et al. 1994:71, Steyer and Llewellyn 2000) and feedback monitoring (Gray and Jensen 1993). Consequently, the Monitoring Program not only detects unsuccessful projects, but also provides other CWPPRA working groups with a basis for improved project designs and operation.

Determining the effectiveness of CWPPRA projects in creating, restoring, protecting, and enhancing coastal wetlands in Louisiana is a daunting task because spatial and temporal variability cause differences between reference and project areas that hinder traditional experimental design and statistical techniques (Underwood 1994). The temporal variability and large spatial variability across the Louisiana coastal zone in wetland loss rates not only reduce the value of traditional experimental design and statistical techniques but also require a monitoring approach with a high degree of flexibility if the effectiveness of management actions under different environmental conditions are to be detected (Boesch et al. 1994:71-75). Thus, the Monitoring Program is designed not only to detect unsuccessful projects, but also to provide a basis for improved project designs and operation. The data generated from the Monitoring Program will be used to refine decision criteria and improve the level of accepted decision error. This will improve the quality of results and confidence in management decisions.

Management of all monitoring activities is the responsibility of LDNR/CRD, however, QC responsibilities (i.e., verifying that all decisions and practices will result in quality data) are shared by senior staff members. QC is consolidated under the QA Manager who has final QC authority.

A critical early step by MWG was the development of rigorous, standardized protocols that could guide the monitoring of projects (Steyer and Stewart 1992). That document was prepared with the input of the academic community and categorized project types, goals, and biological variables, and standardized data collection methodologies. Its use by project managers ensures that project monitoring plans will dictate the proper variables to be monitored, along with proper sampling methods, proper sampling frequency, and appropriate statistical tests.

MWG verifies that project monitoring plans were designed according to the standardized protocols and that deviations from the protocols will not alter the ability to draw conclusions on the effectiveness of the project at protecting or restoring coastal wetlands. After verification by MWG, project monitoring plans are finalized by TAG and submitted to the P&E Subcommittee.

A technical audit will be conducted periodically by a consulting wetland ecologist (QA auditor) from the academic community. The primary focus of the technical audit is to verify that instructions laid out in the monitoring plans are being followed. Field collection methods, data handling methods, data analyses methods, and prepared project monitoring reports will be audited.

A program audit will be conducted annually by the QA Manager and periodically by the chairman of the P&E Subcommittee. The primary focus of this audit is to verify that the management decisions made by TAG and the Program Manager advance the goals of the Monitoring Program. This audit will use the benefit of hindsight to determine if policies should be re-evaluated. TAG and the Program Manager will use the technical and program audits to revise monitoring activities.

An accessible data base of temporal and spatial monitoring data, maintained by the State of Louisiana, will encourage the publication of monitoring results so that the ecosystem management techniques developed in Louisiana can be made available to and be peer reviewed by a national and international audience. Peer review is a final step that will verify that monitoring plans provide the data necessary to determine the effectiveness of projects.

II. PERSONNEL

CWPPRA provides for the selection of approximately 5–20 projects each year for implementation. A priority list of projects has been approved each year since 1991 and will continue through 2000. Pending availability of funds, additional project lists may be approved for implementation. With the approval of each successive priority list, monitoring responsibilities increase and personnel requirements expand. LDNR/CRD assures that adequate staffing levels will be provided to meet monitoring responsibilities.

II.1 Qualifications

The broad range of ecological data collected in the monitoring program requires a diversity of expertise in the collection, analysis, and interpretation of such data. Personnel within the program have specialties in the following areas: estuarine ecology, wetland ecology, coastal processes, wildlife and fisheries science, plant and soil taxonomy, hydrology, water quality, geography, and statistics. Most personnel on-board have graduate degrees. All personnel who conduct data collection are familiar with basic wetland ecology or biology. Appendix A includes position descriptions and qualifications of all personnel involved in the program. Figures 4a and 4b list current personnel involved in the monitoring program.

LNDR/CRD MONITORING STAFF
June 1, 2000

EMPLOYEE	TITLE
Steyer, Gregory	Natural Resources Geoscience Manager
Rhinehart, Kirk	Natural Resources Geoscience Manager (QA Manager)
Libersat, Ralph	Natural Resources Geoscience Supervisor
Lee, Darin	Natural Resources Geoscience Supervisor
Troutman, John	Natural Resources Geoscience Supervisor
Fugler, Marc	Natural Resources Geoscience Specialist 3 (QA Officer)
Vacant	Natural Resources Geoscience Specialist 3 (QA Officer)
Thibodeaux, Christine	Natural Resources Geoscience Specialist 2 (QA Officer)
Townson, Mary Ann	Natural Resources Geoscience Specialist 3
Vincent, Karl	Natural Resources Geoscience Specialist 3
Weifenbach, Dona	Natural Resources Geoscience Specialist 3
Rapp, John	Natural Resources Geoscience Specialist 2
Folse, Todd	Natural Resources Geoscience Specialist 2
Hubbell, Todd	Natural Resources Geoscience Specialist 2
Lear, Elaine	Natural Resources Geoscience Specialist 2
Curole, Glen	Natural Resources Geoscience Specialist 2
Mallach, Troy	Natural Resources Geoscience Specialist 2
Castellaneous, David	Natural Resources Geoscience Specialist 2
Barrilleaux, Troy	Natural Resources Geoscience Specialist 2
Miller, Mike	Natural Resources Geoscience Specialist 2
Sealy, Mike	Natural Resources Geoscience Specialist 2
Boshart, Bill	Natural Resources Geoscience Specialist 2
Snedden, Gregg	Natural Resources Geoscience Specialist 2
Vacant	Natural Resourcs Geoscience Specialist 2
Pitts, Renata	Office Coordinator 1

Figure 4a

NATIONAL WETLANDS RESEARCH CENTER STAFF
June 1, 2000

EMPLOYEE	TITLE
Johnston, James	Ecologist
Handley, Lawrence	Supervisory Geographer
Jones, William	Geographer (GIS Specialist)
Creed, Steven	Geographer
Clark, Norma	GIS Specialist
MacInnes, Andrew	GIS Specialist
Seeger, Eric	Cartographer (Photointerpreter)

Figure 4b

II.2 Training

II.2.1 Field Methods

Field data required by project monitoring plans will be collected by Geoscience Specialists stationed at regional field offices of the Biological Monitoring Section, LDNR/CRD. Qualifications for those positions are given in Appendix A. All Geoscience Specialists will attend Field Methods training where personnel will practice standardized techniques to ensure adequate competence. Personnel will practice using all field gear including, but not limited to, Global Positioning Systems (GPS) (section V.6), continuous data recorders, dissolved oxygen meters, velocity meters, soil redox electrodes, soil coring devices, salinometers, staff gauges, and transit levels. Personnel will practice collection and handling techniques of biomass plots, soil samples, water samples, and fishery samples. Personnel will practice species identification of all common emergent and submersed plant species and visually estimating distance and cover. The meeting will be conducted over 3–5 days and be developed and directed by the Geoscience Program Manager with assistance from the Geoscience Program Supervisors and the academic community. The Geoscience Program Manager will identify academic trainers and appropriately certified instructors and will be responsible for ensuring that all instructors and materials are current for any particular training under sections II.2.1 - II.2.5 before that training is administered. Training will be verified by testing at the conclusion of the Field Methods meeting and via Louisiana Civil Service evaluations. The course will be evaluated by Geoscience Specialists and comments will be provided to training personnel as part of the quality improvement process.

II.2.2 Laboratory Methods

All personnel who conduct routine laboratory procedures will attend Laboratory Methods training where personnel will review standard laboratory practices related to the handling and measurement of samples for soil bulk density, dry weight of soil and vegetation samples, soil organic matter content, and water salinity. Laboratory training related to more complicated or less used techniques, or techniques requiring the use of hazardous materials, will not be conducted because those analyses will be contracted to commercial and academic laboratories. Personnel will be trained, however, in the preparation of spiked samples that will be sent to contract laboratories to verify the quality of those analyses. The Laboratory Methods meeting will be developed and directed by the Geoscience Program Manager with assistance from the Geoscience Program Supervisors and the academic community and will generally be conducted concurrently with the Field Methods meeting. Training will be verified by testing at the conclusion of the meeting and via Louisiana Civil Service evaluations. The course will be evaluated by Geoscience Specialists and comments will be provided to training personnel as part of the quality improvement process.

II.2.3 Data Processing and Analysis Training

All personnel who conduct data processing and analysis will attend training in the use of relevant software packages.

Spatial data are processed by NWRC via a cooperative agreement with LDNR/CRD.Their training is described in a Standard Operating Procedures (SOP) document (NWRC n.d.).

Non-spatial data are processed by the Biological Monitoring Section, LDNR/CRD. Data will be processed and analyzed by Geoscience Specialists trained in the use of ORACLE, EXCEL, WordPerfect®, and SAS software. Training will be developed and directed by a Biostatistician and Senior Geoscience Specialists.

II.2.4 Safety

Safety training is a critical component of the monitoring program due to exposure to potential hazards in land, sea, and air. All personnel will be required to attend safety training every 3 years. The following is a list of types of trainings required in this program:

1. Water safety and boat handling: U.S. Coast Guard—approved boat safety training required of all field personnel involved in boat operation.

2. Airboat training: Eight hours of airboat training, including operation,by a qualified airboat operator.

3. First aid and CPR: Mandatory for field personnel and encouraged for office personnel.

4. All-terrain vehicle (ATV): Eight hours training by a certified instructor in the safety and use of an ATV before operation.

5. Aviation Safety Training: NWRC employees flying special use missions or serving as aircrew members must have OAS Aviation User training every three years. NWRC policy requires pinch-hitter training and certification for employees flying regular missions on projects.

6. Laboratory Safety Standards: Training and certification required.

II.2.5 Technical and Project Management

All personnel having technical and/or project management responsibilities will initially attend introductory project management training upon accrual of these duties. The training will be developed and directed by the Geoscience Program Manager with assistance from the

Geoscience Program Supervisors. Continuing training will be required as additional responsibilities are accrued.

II.2.6 Professional Development

All personnel will be encouraged and solicited to make presentations at scientific and professional meetings. Personnel are required to stay current in the scientific literature and are encouraged to seek additional scientific/academictraining. Professional development is also maintained through the state of Louisiana 's Certified Public Training Program.

III. PROCUREMENT OF EQUIPMENT, SERVICES, AND SUPPLIES

III.1 Contract and Purchasing Procedures

LDNR/CRD Program Managers have the responsibility of acquiring services needed to fulfill all the obligations and requirements of the monitoring program. LDNR/CRD has an administrative staff that is responsible for administering contracts and legally binding agreements through which LDNR/CRD acquires or renders all goods (deliverables) and/or services.

LDNR purchasing, individually and in conjunction with other state entities, operates under various statutes (Louisiana Revised Statutes (LRS)); administrative codes (Louisiana Administrative Codes (LAC)); and Executive Orders. The documents pertinent to procurement of equipment, services, and supplies include, but are not limited to:

a. LRS 39, Chapter 17, Louisiana Procurement Code

b. LAC 34, Part I, Rules and Regulations

c. Executive Order EWE 92-53 (Small Purchases)

d. LRS 38:2211 et al, Chapter 10 (Construction/Public Works-Letting Bids)

e. LRS 39, Chapter 19 (Louisiana Minority and Women's Business Enterprise Act)

The administrative staff have extracted and simplified these documents to provide in-house guidelines (unpublished Policy and Procedural Memoranda) that identify procedures to be followed to adequately track and manage contracts. The completed codification of procedures, however, appears in the above listed documents. Specific guidelines include, but are not limited to: (1) Requests for Contracts and Amendments, (2) Billing and Invoices, (3) Selection of Vendor, (4) Contracting Party Requirements, and (5) Purchasing Process. Checklists are provided to ensure submission and routing of appropriate information to minimize contracting and purchasing problems. The administrative staff are expected to, at a minimum:

1. Review and track all significant paperwork, including: project narrative; scope of services; budget; request for contracts and amendments or proposals; purchase and change orders; invoices; payments; ensure dual sign-off where needed for technical and administrative review; and ensure all commitments/requests of any kind are in writing and by the appropriate persons.

2. Ensure complete documentation and filing of all significant documents, correspondence, and other information.

3. Coordinate, develop, or initiate correspondence, written alternatives, recommendations, responses, and preventative actions to project concerns/problems.

4. Prepare post-assignment reports on all projects and contracts when completed.

5. Inquire and arrange for orderly transfer of project/contract management responsibilities.

6. Ensure that minority/disadvantaged business enterprises have the maximum opportunity to compete for and perform contracted services.

7. Personally inspect all purchases and deliverables and verify whether they are satisfactory and in keeping with the terms and conditions of the contract. Authorization or payment of invoices should not be processed until deliverables are in-hand or documented.

8. In the case of contracted facilities or laboratories, monitoring reports are provided by the contractor at the time of invoicing and reviewed by LDNR/CRD program managers for compliance and provided to the administrative staff. The LDNR/CRD program managers complete a performance evaluation form at the end of the contract period and provide this to the administrative staff. The review of the contractor includes evaluating compliance with LDNR/CRD standards and the contract conditions and deliverables.

IV. QUALITY ASSURANCE OBJECTIVES

IV.1 QA Mission Statement

The objective of this QMP is to define and assure that processes involved in the implementation of the monitoring program meet QA and QC requirements of CWPPRA. The QA mission is to certify that all data collected in this program meet the quality objectives defined below, and that CWPPRA management will support decisions necessary to meet the level of detail described in this QMP.

IV.2 Measurement Quality Objectives

IV.2.1 Introduction

QA methodology, as set forth in this QMP, is used to ensure that the QA Goals, outlined in this section, are met. All participants must be impressed from the beginning with the importance of maintaining a commitment to QC throughout the program. Training field personnel is an important part of QC. All personnel must be familiar with the procedures to be used, and confident in their ability to use the equipment, and that those procedures used are standardized among personnel to keep errors associated with data collected by different people to a minimum. Field and laboratory personnel must be given the opportunity to assess procedures and to suggest improvements. The Standard Operating Procedures for each method are discussed in detail in section V. This section presents only general QA considerations.

Measurement of quality objectives will be determined from manufacturer specifications, analytical methods, and the judgment of experts (if required). The five general quality objectives are discussed below.

IV.2.2 Accuracy

Accuracy is the degree to which a measured value agrees with an accepted known value (Taylor 1988). Bias is the systematic error inherent in a method or caused by a particular measurement device. Accuracy will be assessed through the use of standards (manufacturer supplied) whenever such standards exist. Internal standards will be devised for methods where a commercially available standard does not exist. Accuracy is also ensured by field training to be sure that all personnel follow the same procedures.

IV.2.3 Precision

Precision is a measure of scatter among repeated independent observations of the same property under controlled similar conditions (Taylor 1988). Precision in the field will be assessed by replicate measurements. Laboratory method precision will be estimated by repeating measurements of a sample standard. The sample precision will be estimated by repeated measurement of a sample or sample split.

IV.2.4 Representativeness

Representativeness, or the degree to which data truly characterize a population or environmental condition (Stanley and Verner 1985, Smith et al. 1988), will be assessed by the use of the replicate samples. In the laboratory multiple subsamples will be made, and each of the subsamples will be analyzed in order to determine its variability. This will allow for the calculation of the number of laboratory subsamples needed to adequately describe the field sample.

Representativeness of the environment can only be assessed by examining both the temporal and spatial variability on a given project area. Environmental variability is usually estimated by collecting replicate samples (randomly chosen) over space and time. However, randomly selected samples may not adequately characterize a study area unless a large number of replicates are collected. Where spatial variation within a study area is evident, stratified random sampling may be employed. Temporal variation may be accounted for by restricting sampling to comparable time periods.

IV.2.5 Comparability

Comparability is the degree of confidence with which data sets may be compared. Comparability will be ensured for laboratory analyses through the use of standard methods for which there is a known accuracy and precision. Comparability of field data sets will be accomplished by ensuring that the same procedures are followed by all sampling personnel. This is accomplished through the use of SOPs and proper training in field and laboratory techniques.

IV.2.6 Completeness

Completeness, which is the ratio of the amount of valid data obtained to the amount expected (Stanley and Verner 1985, Smith et al. 1988), will also be used as an overall index for the program. If the completeness is not high enough the evaluation of a project may be compromised. Completeness for an individual project is defined as the amount of data and samples actually collected as a percentage of the amount of data and samples assigned to the monitoring effort when monitoring begins.

IV.3 Quality Assurance Goals

The quality assurance goals are summarized in table 2, which will serve as the overall guideline for the monitoring program by presenting, for each variable to be monitored, the accuracy, precision, and completeness goals as well as the expected range of values to be encountered. The variables to be monitored and the exact method by which each of these goals will be met for an individual project will be outlined in the project monitoring plan. However, the individual project plan must demonstrate that the goals listed in table 2 will be met. Table 3 lists the types of QC samples that will be employed.

Table 2. Quality Assurance Goals and expected ranges. Accuracy is in absolute units where possible; precision is based on the difference between replicated measurements. Percentages in the accuracy and precision goal columns represent tolerable error. The precision goal refers to individual measurements as well as between sampling crews. Data collected outside the expected range may be real but should be verified.

Type of Measurement	Units	Accuracy Goal	Precision Goal	Completeness Goal	Expected Range
1. Habitat Mapping					
Photointerpretation	habitat	7%	NA	100%	NA
Photoregistration	m	15 m	NA	NA	NA
2. Meteorological and Hydrologic Sampling					
Precipitation	cm/h	0.1 cm/h	5%	85%	0–15
Wind Speed	m/s	0.7 m/s	0.5 m/s	85%	0–67
Wind Direction	degrees	5 degrees	5 degrees	85%	0–360
Water Level (Stage)	m	0.06 m	0.06 m	85%	-3–6
Water Depth	cm	1 cm	1 cm	85%	0-305
Salinity	ppt	0.5 ppt	0.5 ppt	85%	0–36
Specific Conductance	microsiemens	5%	1000µS	85%	0–55,000
Temperature	centigrade	0.5 C	0.2 C	85%	0–35
pH	pH units	0.2	0.1	85%	6–8.5
Discharge					
Current Speed	m/s	0.1 m/s	0.1 m/s	85%	0–3
Cross-Sectional Area	m^2	5%	5%	85%	NA
Suspended Sediments	mg/L	2 mg/L	2 mg/L	85%	0–200
Bathymetry	cm	4.0	4.0	85%	-200–0
Topography	cm	4.0	4.0	85%	-90–90
3. Soil/Sediment Sampling					
Redox	mV	20 mV	20%	85%	-450–400
Percent Organic Matter	%	10%	15%	85%	0–100
Bulk Density	g/cm^3	0.05 g/cm^3	15%	85%	0.01–0.90
Percent Water	%	10%	15%	85%	0–100
Salinity	ppt	0.5 ppt	0.5 ppt	85%	0–36
Sulfides	ppm	1 ppm	25%	85%	0–150
Grain Size	microns	NA	30%	85%	0.2–500
4. Surveying (horizontal)					
GPS	m	1 m	1 m	85%	NA
Conventional	m	0.3 m	0.3 m	85%	NA

Table 2. (continued)

Type of Measurement	Units	Accuracy Goal	Precision Goal	Completeness Goal	Expected Range
5. Vertical Accretion					
Feldspar	cm	0.1 cm	30%	85%	0–2
SET Table	cm	0.1 cm	30%	85%	0–2
Radionuclide	cm	0.5 cm	30%	85%	0–2
6. Subsidence					
From Tide Gauges	cm/yr	0.5 cm/yr	0.5 cm/yr	85%	0–2
From C-14 Dating	cm/yr	0.5 cm/yr	0.5 cm/yr	85%	0–2
From Extensometers	cm/yr	0.5 cm/yr	0.5 cm/yr	85%	0–2
From Survey Monuments	cm/yr	0.5 cm/yr	0.5 cm/yr	85%	0-2
7. Marsh Erosion and Soil Creation					
Large Scale	m	2 m	2 m	85%	0–100
Small Scale	cm	5 cm	5 cm	85%	0–200
8. Vegetative Health					
Species Composition and relative abundance					
Taxonomic ID	species	NA	NA	85%	NA
Percent Cover	%	10%	10%	85%	0–100
Number of Stems	$\#/m^2$	$10/m^2$	10%	85%	1–2,000
Aboveground Biomass					
Clip Plots	g/m^2	$10\ g/m^2$	20%	85%	0–2,000
Stem Length	cm	1 cm	20%	85%	1–300
9. Herbivory	%	10%	10%	85%	0–100
10. Fisheries Sampling					
Taxonomic ID	species	NA	NA	85%	NA
Organism Counts	numbers	10%	10%	85%	NA
Size	mm	1 mm	1 mm	85%	NA
11. Water Quality Sampling*					
a) NH_4	mg/L	15%	15%	85%	0.4–40
b) NO_3	mg/L	15%	15%	85%	1–100
c) NO_2	mg/L	15%	15%	85%	0.1–10

Table 2. (continued)

Type of Measurement	Units Goal	Accuracy Goal	Precision Goal	Completeness	Expected Range
d) Ortho P	mg/L	15%	15%	85%	0.2–3
e) Organic Carbon	mg/L	15%	15%	85%	5–200
f) Volatile Organic Cs	µg/L	15%	15%	85%	Unknown
g) Pesticides	µg/L	15%	15%	85%	Unknown
h) Herbicides	µg/L	15%	15%	85%	Unknown
i) Insecticides	µg/L	15%	15%	85%	Unknown
j) Triazines	µg/L	15%	15%	85%	Unknown
k) Carbamates	µg/L	15%	15%	85%	Unknown
l) Priority Pollutants	µg/L	15%	15%	85%	Unknown
m) PCBs	µg/L	15%	15%	85%	Unknown
n) Dioxins	µg/L	15%	15%	85%	Unknown

* Accuracy and precision goals are dependent on detection level. The following are various detection limits for the nutrients and priority pollutants identified above: (a-d) 0.01–0.001 mg/L; (e) 0.1 mg/L; (f) 3 –0.2 mg/L; (g-h) 0.1–0.01 mg/L; (i) 0.1–0.001 mg/L; (j) 0.2–0.05 mg/L; (k) 0.5 µg/L; (l) 1–0.001 µg/L; (m) 0.1–0.001 µg/L; and (n) 0.001–0.0001 µg/L. Organic compounds are qualified by the percent recovery of the extraction procedures. The U.S. Geological Survey and U.S. Environmental Protection Agency typically consider extractions with efficiencies of 30%–140% as acceptable.

Table 3. Summary of QC samples and procedures to be used. Indicated for each type of QC is the purpose for which it is to be used ® = representativeness, A = Accuracy, P = Precision, C = Comparability).

Type of QC Sample	Purpose
Field and Laboratory standard methods	R, C
Field Replicates at a sample location	
Spatial	R, C
Temporal	R, C
Reference Sites	R
Laboratory Replicates	
Sample Splits	R, C
Replicate Field Samples	R, C
Laboratory Standards	
Multiple Standards (i.e., 5–point calibration)	P, A, C
Blanks	P, A, C

IV.4 Quality Assurance Goals Sampling Protocols

Specific protocols for variables measured as part of the monitoring program are necessary to meet the accuracy, precision, and completeness goals outlined in table 2 . These protocols will be used to supplement the Standard Operating Procedures included within the QMP. All of the following protocols address the accuracy and precision concerns for each of the types of variables measured within the biological monitoring program. Completeness goals for each variable will be based on the amount of data collected over a one year period.

<u>Water Level</u> - At deployment and retrieval, the continuous recorder will be calibrated to zero out of water. The continuous recorder will then be checked out of water to ensure that the instrument was properly calibrated. Additionally, periodically (every six months in January and July) at least three discrete measurements should be taken of the same sample with the continuous recorder to determine instrument precision. For instruments that utilize pressure sensors to determine water depth, the sensor must be checked for accuracy at multiple known water depths (minimum of three) once every year.

<u>Specific Conductance, discrete</u>- At the beginning of each sampling day, the instrument will be calibrated to a standard. The instrument will then be checked against the standard to ensure that the instrument was properly calibrated. At the end of each sampling day, the instrument will be checked with a standard to ensure that the instrument is still in calibration. Multiple measurements (minimum of three) of one sample should be taken on each sampling day to determine instrument precision.

<u>Specific Conductance, continuous</u>- At deployment, the continuous recorder will be calibrated to a standard. The continuous recorder will then be checked against the standard to ensure that the instrument was properly calibrated. At retrieval, the specific conductance of the continuous recorder and a second calibrated instrument are noted. The continuous recorder is then cleaned and specific conductance is checked again against the calibrated instrument. If necessary, the continuous recorder will be calibrated to a standard before redeployment. Additionally, periodically (every six months in January and July) at least three discrete measurements should be taken of the same sample with the continuous recorder to determine instrument precision.

<u>Salinity, discrete and continuous</u>- By following the accuracy and precision protocols as outlined for the <u>Specific Conductance</u> variable, Salinity will be accounted for.

<u>Temperature, discrete</u> - At the beginning of each sampling day, the discrete recording instrument should be checked against a precision thermometer. A difference greater than 1°C between the precision thermometer and the discrete instrument should be noted and the instrument’s thermistor should be serviced. Multiple measurements (minimum of three) of one sample should be taken on each sampling day to determine instrument precision.

Temperature, continuous - At deployment and retrieval, the continuous recording instrument should be checked against the discrete recording instrument or a precision thermometer. A difference greater than 1°C should be noted and the instrument's thermistor should be serviced. Additionally, periodically (every six months in January and July) at least three discrete measurements should be taken of the same sample with the continuous recorder to determine instrument precision.

pH - At the beginning of each sampling day, the instrument will be calibrated to a pH 4 and pH 10 buffer solution. The instrument will then be checked against the standard to ensure that the instrument was properly calibrated. At the end of the sampling day, the instrument should be checked against the standards to ensure that the instrument is still in calibration. Multiple measurements (minimum of three) of one sample should be taken on each sampling day to determine instrument precision.

Suspended Sediments - Suspended sediment samples containing a known sediment concentration in the expected range of the unknown samples should be analyzed with any samples sent to a laboratory for analysis. This will be used as a measurement of accuracy. At least three samples within the same site should be taken during sampling and included with the samples sent to the laboratory for analysis. This is used to determine the precision of the sampling method and suspended sediment analysis protocol.

Bathymetry - When a fathometer is used to determine bathymetric profiles, the fathometer accuracy should be checked at the beginning and end of each sampling day. This is accomplished by a poling method. The depth of water should be checked using an incremented poling device and compared to the depth reading on the fathometer. Additionally, three or more samples should be taken at the same location during the sampling day to determine instrument precision.

Surveying, topography, GPS, conventional- At the beginning and end of each sampling day, a known benchmark should be surveyed to determine instrument accuracy. Additionally, on each sampling day, a minimum of three samples should be conducted at the same point location to determine the precision of the surveying technique.

Soil Redox Potential - Prior to sampling, all platinum electrodes should be cleaned and tested in a quinhydrone/pH buffer solution to determine the accuracy of the electrodes. During sampling, five or more measurements at the same location (including the same depth of soil) should be conducted to determine the precision of the electrodes.

Soil Organic Matter Content - Soil samples containing a known amount of organic matter in the expected range of the unknown samples should be analyzed with any samples sent to a laboratory for analysis. This will be used as a measurement of accuracy. At least three samples within the same site should be taken during sampling and included with the samples sent to the laboratory for analysis. This is used to determine the precision of the sampling method and soil analysis protocol.

Soil Bulk Density - Soil samples with a known bulk density in the expected range of the unknown samples should be analyzed with any samples sent to a laboratory for analysis. This is used as a measurement of accuracy. Three or more bulk density samples within the same site should be taken during a sampling trip to determine the precision of the sampling method and soil analysis protocol.

Interstitial Salinity - See Salinity, discrete and continuous for accuracy and precision protocol.

Interstitial Sulfide - A series of standards is used to determine sulfide concentration in soil porewater. The 10 ppm standard should be run every ten samples to determine the accuracy of the electrodes and meter. Additionally, at least one sample should be measured a minimum of three times to determine precision.

Felspar Marker Horizon - Prior to sampling, the calipers should be checked against a calibrated ruler for accuracy. Once during the sampling day, three measurements of the same core should be taken to determine sampling precision.

Sediment Erosion Table (SET) - Prior to sampling, the rods need to be checked against a new rod to insure that they have not been damaged or warped. This will be the test for accuracy. During sampling, a minimum of three measurements with the same rod at the same location should be conducted to determine precision.

Radionuclide - Radionuclide samples containing a known level of the radionuclide in the expected range of the unknown samples should be analyzed with any samples sent to a laboratory for analysis. This will be used as a measurement of accuracy. At least three radio- nuclide samples within the same site should be taken once during sampling and included with the samples sent to the laboratory for analysis. This is used to determine the precision of the sampling method and analysis protocol.

Percent Plant Cover - During sampling, at least two independent estimates should be made of the plant community to determine method accuracy. If a dramatic change in the plant community structure occurs (e.g., change from freshwater to brackish marsh community) then the independent estimates should be repeated in the new plant community. Additionally, three estimates of plant cover at the same station and plot should be conducted once during each sampling to determine precision of the method.

Number of Plant Stems - During sampling, at least two independent counts of plant stems within a plot should occur to determine method accuracy. Additionally, three replicate counts of the same site should be conducted once during each sampling to determine precision of the method.

Vegetation Clip Plots - Whenever sampling involves taking clip plots smaller than 1 m^2, a larger sampling should be conducted to determine the accuracy of the determination. The smaller clip plot should be harvested first and then the rest of the material surrounding the smaller clip plot within 1 m^2 should be taken and processed with the samples. A comparison between the smaller clip plots and the 1 m^2 clip plot can be conducted to determine the accuracy of extrapolating the data. Additionally, three replicate clip plots of the same site should be conducted once during each sampling to determine precision of the method.

Stem Length - During sampling, at least two independent measurements of stem length within a plot should occur to determine method accuracy. Additionally, three replicate measurements of the same stem should be conducted once during each sampling to determine precision of the method.

Herbivory - See Percent Plant Cover for accuracy and precision protocol.

Water Quality Sampling - Water quality samples containing a known concentration in the expected range of the unknown samples should be analyzed with any samples sent to a laboratory for analysis. This will be used as a measurement of accuracy. At least three water quality samples within the same site should be taken once during sampling and included with the samples sent to the laboratory for analysis. This is used to determine the precision of the sampling method and analysis protocol.

IV.5 Assessment of Measurement Quality

Periodic QC checks are necessary to ensure that all measurements made will be reliable. Such checks are performed throughout all stages of field sampling, laboratory preparation, and data analysis. Internal checks will be made on no less than 10% of the samples taken, or measurements or estimates recorded. Field QC checks will consist of discussions with the sampling personnel to ensure that all personnel are following the standard field procedures. Each individual must demonstrate consistency and accuracy for the measurement technique during training. Sufficient training of each individual will ensure comparability among individuals and sample sites. In addition, replication of field sampling will allow for an estimate of precision of the field and laboratory procedures.

The formulas discussed below outline the basic methodology for the calculation of each of the five QA objectives. It should be pointed out that these are not the only means that will be employed in assessing the QA objectives. The monitoring plan for each individual project may, depending upon project type, outline alternate methods of assessing the QA objectives. In all cases, the methods used will be reviewed to ensure that they are statistically valid.

1. Accuracy can be assessed by the relative percent difference between the measured value and the true value, as set by a standard, using the following formula:

$$\% \text{ difference} = \frac{|\text{true value} - \text{measured value}|}{\text{true value}} \times 100$$

In cases where more than two samples are involved (multiple readings of a standard), the relative standard deviation (RSD) that is the coefficient of variation (CV) expressed as a percentage can be used (Taylor 1988):

$$CV = \text{standard deviation} / \text{mean}$$

$$RSD = CV \times 100$$

2. Precision, Representativeness, and Comparability, when based on analysis of replicate samples, will use the following formula for comparing two samples (or two subsamples of a given sample) as A and B:

$$\% \text{ difference} = \frac{|A - B|}{(A + B) / 2} \times 100$$

In cases where there will be more than two replicates, the coefficient of variation can be used.

3. Completeness will be assessed by the percent of data collected as a percentage of the number of proposed samples to be collected and will be determined by the following formula:

$$\% \text{ complete} = \frac{|\text{samples collected} - \text{proposed samples}|}{\text{proposed samples}} \times 100$$

Data quality will be assessed using the above general principles along with the Quality Assurance Goals. During analysis the Geoscience Specialist or laboratory analyst will keep track of the standard, blank, and replicate readings each time samples are measured to ensure that the values fall within the guidelines. If values fall outside the guidelines, a decision will be made by the Geoscience Specialist in consultation with the Geoscience Supervisor regarding the acceptability of the error.

V. STANDARD OPERATING PROCEDURES

V.1 General Considerations

Introduction

Monitoring standard operating procedures (SOP) provides an established method that can be followed to direct the development and implementation of project-specific monitoring plans. Steyer and Stewart (1992) developed a plan to provide these procedures. The SOPs described in this QMP are taken and expanded from Steyer and Stewart and they describe in greater detail the QA/QC measures employed with each procedure. The SOPs were written by the CWPPRA Monitoring Work Group and refined by LDNR/CRD Geoscience Specialists and the academic community. Other SOPs not covered in the Steyer and Stewart (1992) document were written by academic experts contracted by the Geoscience Program Manager. All SOPs are reviewed and revised (if necessary) by the Geoscience Supervisors upon approval by the QA manager. The information provided in each document will have some redundancy but should also compliment each other.

Project types requiring monitoring

Under Act 6 and CWPPRA, all projects were categorized into ten types: freshwater introduction and diversions, sediment diversions, outfall management, marsh management, hydrologic restoration, beneficial use of dredged material/marsh creation, shoreline protection, barrier island restoration, vegetative planting, and sediment and nutrient trapping.

A critical step in establishing a successful monitoring program is to define the goals used to conduct the monitoring. If the goals are poorly defined, there will be no guidance in the establishment of protocols. CWPPRA requires an evaluation of the effectiveness of each project in achieving its specific goals directed towards creating, restoring, protecting, and enhancing coastal wetlands. For example, a project using dredged material may be built to reduce wave energies and consequent physical erosion, or develop a new soil and sediment base at a proper elevation to restore or maintain vegetated marsh. Each of these projects begins with a hypothesis or set of hypotheses related to the expected change in physical, biological, or chemical variables of the project area. These hypotheses then guide the monitoring program as to which variables will be monitored and how frequently.

Freshwater introduction and diversion

Freshwater introduction and diversion projects are designed to introduce fresh water and alluvial material from available sources to shallow marsh estuaries. Areas targeted for freshwater diversion projects are characterized by saltwater intrusion, sediment subsidence, and shoreline erosion. The primary goal of these projects is to enhance wetlands by increasing the use of fresh water, nutrients, and sediment that will be provided by the freshwater diversions. Management of the outfall will route the fresh water through the wetlands and provide greater deposition of sediments in the marsh to offset subsidence, greater availability of nutrients to vegetation, and a more gradual release of fresh water to the benefit of wildlife, fish, and shellfish. Monitoring freshwater diversions will help to determine if any changes or modifications are needed in the operation.

Sediment diversion

Sediment diversions are projects that increase deposition of river-borne sediment in shallow bay areas that cannot keep pace with subsidence through sediment accretion. A small-scale sediment diversion project is designed around the concept of natural crevasse splay development. Where a breach occurs in the bank of a river, sediment infilling begins within the surrounding distributary bays, and crevasse splay sediment eventually becomes subaerial and established with marsh vegetation. Large-scale sediment diversions on the Mississippi River are designed to be similar to the large natural crevasses such as the one at Baptiste Collette, La. The primary goal of the project is to create and manage crevasses through the natural levee ridges of rivers and major distributary channels so that the natural land-building process can create emergent and submergent aquatic communities critical to the overall productivity of the deltaic systems. Monitoring of sediment diversions will help to determine the management of the crevasses.

Outfall management

Outfall management projects are used to maximize the benefits of a river diversion project. This technique involves regulating water levels and direction of water flow to increase the dispersion and retention time of fresh water, nutrients, and sediment in the marsh. The water flow may be regulated by a combination of gates, locks, weirs, canal plugs, and gaps cut in artificial levee banks.

Marsh management

In marsh management projects, structures actively manipulate local hydrology to control water levels and salinity, while concurrently allowing ingress and egress of marine organisms. Marsh management plans generally incorporate existing canal spoil banks, the construction of short levees to connect these spoil banks, the installation of water control structures, and/or the construction of pump and other control structures to introduce fresh water into the managed area and keep out saline water. The main goals of marsh management are to minimize the loss of and promote the growth of emergent and submergent plant communities by reducing salinities, stabilizing water levels, and restricting tidal exchange. Monitoring of marsh management projects will help determine operation schedules for pumps and structures.

Hydrologic restoration

Hydrologic restoration projects typically try to reestablish former hydrologic pathways and flow regimes, with the goal of redistributing fresh water to influence water levels and salinity. Specifically, hydrologic restoration tends to reduce rapid tidal fluctuations and improve freshwater retention. These manipulations of the local hydrology will aid in the reestablishment of emergent and submergent plant communities. Monitoring will help determine hydrologic effects on biological resources.

Beneficial use of dredged material/marsh creation

Open-water bodies and navigational channels are often sources of dredged sediment material that could be beneficially used to create vegetated wetlands or to restore areas of deteriorating marsh. Sediment can be pumped into confined or unconfined areas to a height conducive to marsh development. Once the dredged material settles, growth of emergent vegetation can be promoted. Monitoring will help determine the applicability of this technique for marsh creation.

Shoreline protection

Shoreline protection projects use structural and nonstructural measures such as breakwaters, bulkheads, revetments, longyard tubes, wave-damping fences, and levees to reduce wave energies and erosive action. Critical shoreline areas threatened with hydrological breaches could be protected to prevent wave erosion and water exchange from jeopardizing the physical integrity of the shoreline and adjacent marshes. Vegetation could also be incorporated into the shoreline protection design to create habitat as well as an additional erosion buffer. Monitoring will help determine the effectiveness of different shoreline protection techniques in reducing wave erosion and in creating wetland habitat.

Barrier island restoration

Barrier islands provide protection to backbarrier bays, estuaries, and marshes. This protection includes reduction of erosional effects and wind and wave energies, dissipation of storm surges, and prevention of saltwater intrusion. Over the last century, Louisiana's barrier islands have been reduced by approximately 40 %, resulting in loss of habitat and protection for the coastal mainland. Barrier island restoration projects are needed to reestablish this natural protective zone. Barrier island restoration projects include creation of barrier islands or augmentation of existing islands. The objectives of these projects are to increase the height and width of the barrier island and close any shoreline breaches by using dredged materials and vegetation. Monitoring will help determine the effectiveness of restoration and creation techniques.

Vegetative planting

Vegetative planting projects are designed to introduce suitable plant species into deteriorating marsh areas and along eroding shorelines to provide a buffer against erosive wave action. Vegetative plantings also provide many other functions such as sediment stabilization, sediment trapping, and habitat value. Monitoring will help determine the success and effectiveness of different vegetative planting techniques in reducing wetland erosional loss and in creating wetland habitat.

Sediment and nutrient trapping

Sediment and nutrient trapping projects use structural devices such as brush fences or earthen berms to reduce wave energies, promote the deposition of suspended sediment, and increase water clarity. The goals are to reduce erosion of windward marsh edges, promote the growth of emergent vegetation, and increase the overall productivity of the area. Monitoring will help determine the effectiveness of different sediment- and nutrient-trapping techniques.

Reference areas

The importance of using appropriate reference areas cannot be overemphasized. Monitoring on both project and reference areas provides a means to achieve statistically valid comparisons, and is, therefore, the most effective means of evaluating project success.

If appropriate reference areas are available, they should always be included in the design to allow for interpretation of the influence of temporal and spatial variation on projects. When monitoring projects without a reference area(s), differences between pretreatment means and posttreatment means may be misinterpreted. Long-term means are often averages that do not adequately represent rates or conditions that vary in space or time.

Selection of a reference area should ideally be done before project initiation. Reference areas should be ecologically similar to the project area yet located far enough away so as not to be influenced by the project. Potential reference areas can be selected by use of WVA methods or through more basic comparisons of structural and functional attributes. To ensure the selection of appropriate reference areas, an interagency team of scientists should be convened. If there is any question concerning the similarity of the reference and project areas, more than one reference area should be selected. Appropriate reference areas are more likely to be found in smaller project areas.

It is recognized that in many areas of Louisiana, appropriate reference areas cannot be identified. In addition, the extent of wetland modification (both planned and unplanned) occurring in this region often results in the loss of reference areas before monitoring efforts are completed. We also recognize that occasionally, especially in the case of very large projects (e.g., sediment diversions and freshwater diversions from the Mississippi River or watershed projects) it may be difficult to select reference areas that adequately reflect the same marsh type and function as those being affected by the project. In these cases, two strategies can be adopted:

(1) Monitoring before and after project implementation. The disadvantages of this strategy include delay in project implementation, temporal variability, and the inability to clearly identify cumulative impacts of the project in comparison to unaffected areas. In addition, before and after monitoring cannot ensure that the same events are being monitored for comparison; therefore, interpretation of the results will be difficult. However, such monitoring would provide some indication of project performance and impact.

(2) Baseline data collection. This may be especially important in areas where reference areas cannot be selected for monitoring. As a "once only" data collection program, it would not delay project implementation as much as full-scale monitoring before implementation [as in (1) above]. It would provide a datum against which changing biological variables could be compared. In some cases, existing data bases might be considered appropriate as baseline data. If this were to occur, an interagency team of experts or their scientific advisors should be convened to evaluate the suitability of the existing data bases for this purpose.

Although before and after monitoring of the project implementation and baseline data collection do provide valuable information, they do not necessarily provide a statistically valid evaluation of projects.

Statistical analyses

The size of the project area, the number of different habitats present, and the heterogeneity within those habitats should define the number of statistical strata necessary for an analysis.

Before sampling is initiated, it is important to determine the desired statistical power for the analysis (Fairweather 1991). This procedure involves using a variance estimate to calculate the number of samples required to detect a percentage difference between two means. Initially, the sample size required to achieve this power can be estimated from sample variances reported in the literature, and these estimates can be refined by using data collected in the reference area selection process. It should be recognized that this power will often improve with the use of data transformations and more complex analysis of variance (ANOVA) designs.

Adequate characterization of environmental conditions in project and reference areas requires that temporal and spatial variations are addressed in the statistical design. A statistical comparison is only valid if the statistical parameters being compared have been carefully and adequately estimated by a sampling design that considers heterogeneity. Randomly selected sample sites may not adequately characterize a study area unless a large number of replicate samples are collected. Where spatial variation within study areas is evident, stratified random sampling is a more appropriate approach to adequate characterization. Temporal variation may be accounted for by restricting sampling to comparable time periods. When spatial variations within project and reference areas require replicate sampling within environmental strata, sampling efforts among strata may be uneven. Balance in the data set may be adjusted by weighing where sampling efforts are not equal among strata. Habitat mapping of project and reference areas is useful in defining weighing factors for statistical comparisons.

The adequacy of sampling may be evaluated by plotting the behavior of means and variances against sample size. As the number of samples approaches adequacy, the mean and variance should stabilize (Hurtubia 1973; Pielou 1969).

Data analysis for a project may include a two-way ANOVA with area and habitat as main effects. In the most basic design, the null hypothesis is a two-tail test of whether the mean value for some variable is equal between the project area and the reference area(s), or between the preproject and postproject condition. The alternate hypothesis should be whether the mean value for that variable at the project area is greater or less than in reference areas or whether the preproject condition is greater or less than the postproject condition. It is important to determine whether the mean value for the variable increased or decreased because of the project, taking into consideration other outside influences.

Field data

A coding scheme will be used to identify the type of project, the project name, the type of data, the date the data were collected, and the location where the data were collected for each sample. The location will be provided in either latitude/longitude or UTM coordinates. These steps are needed to ensure that sufficient documentation exists for verification of data accuracy. Data coding will be the responsibility of Geoscience Specialists and oversight will verify that all data are properly coded to ensure compatibility with the CWPPRA Regional GIS Data Base.

Spatial data

All spatial data will conform to an Executive Order dated 11 April 1994, describing standardized methods of data acquisition and access. The proper coding of spatial data will be the responsibility of the Supervisory Geographer and GIS Specialist to ensure compatibility with the CWPPRA Regional GIS Data Base.

Routine QA procedures

Field

For accurate data collection, necessary equipment must be in good working order. The equipment will be checked and calibrated prior to departure from LDNR/CRD or NWRC (appendix B). Proper storage and stowage must be practiced to prevent damage. At each site, equipment will be given a routine check and, if necessary, calibrated before field use.

The entry of data onto a data sheet must be done accurately and neatly. The following general guidelines will be observed and checked by the QA officer.

1. Ensure you are entering the correct data in the correct place on the proper data sheet.

2. Double check sample numbers and station location ID codes when recording data.

3. If data are entered in a nonstandard location on the data sheet, be sure to document the reason for doing so.

4. All data are to be recorded in pencil.

5. Print all entries legibly, be sure that similar numbers (e.g., 5s, 8s, and 2s) are distinguishable.

6. Double check all entries on the data sheets.

7. Do not erase or use paper correction fluid; cross-out the entry and write the corrected number nearby and initial the cross-out. If there is not room to write the new number, write it in the margin or at the bottom of the page. Be sure to annotate all entries.

   Upon completion of sampling but before departing a site, the monitoring manager will examine all data forms for completeness and legibility. All samples must be checked for proper identification and storage. If data are missing or incomplete, the monitoring manager should attempt to collect it before leaving the site. If the situation cannot be corrected, it will be fully documented.

   In the case of data readings that are outside the expected measurement bounds (table 2), an attempt will be made to determine the cause of the problem. The SOP will be checked for the method to be sure that the correct procedures are being followed, and the field equipment will be rechecked to be sure that it is functioning properly. If the field equipment is functioning properly, record the data along with a note as to what was done. This will help ensure that any outliers on the data set are real values, and not due to sampling error. This procedure will also be followed on laboratory analyses.

Laboratory

The following minimum criteria will be used in routine laboratory analyses and will be checked by the QA officer. Details of any additional criteria for a specific variable will be discussed in the SOP for that variable.

1. Weighing Accuracy: balances will be checked by weighing standard weights at the beginning of each batch. The number of samples in a batch are defined in the laboratory SOP for the particular analysis. Three standard weights will be weighed and the values recorded on the appropriate data sheet. The values obtained must be within ±5% of the standard weights. If the standard weights are not within 5%, stop the analysis and contact the Geoscience Supervisor since it is likely that the balance needs repair.

2. Weighing Precision: determined by having 10% of the samples from each analysis run reweighed, and the values recorded on the appropriate data sheet. The samples are to be randomly selected. The weighings are to be done independently and the data from the two weighings merged and analyzed by one of the monitoring managers. The separate weightings must be within ±5% of each other.

3. Temperature and Time Precision: analysis involving drying and/or ashing samples for specified times and temperatures (as set forth in the SOP for the variable being analyzed) shall have the times and oven (or furnace) temperatures (determined with laboratory thermometer) logged on the appropriate data sheet when a batch is placed in or removed from the drying oven (or furnace).

4. Data Completeness: expressed as the percentage of data obtained of the total that was possible from the analysis based upon the number of samples brought to the lab. Data loss arises from improper storage, illegible data sheets, or failure to follow the SOP. The program goal is to have a data completeness value of 85% or greater.

5. Sample Representativeness: an estimate of how well an individual analysis represents the value for the entire sample. This will be assessed by taking three subsamples from every tenth sample. The values obtained from the subsamples should be within the accuracy guidelines listed in table 2.

In addition to the above general laboratory QA guidelines, laboratory personnel are responsible for maintaining a sample custody log (appendix B). The sample custody transfers to the laboratory when the monitoring manager turns in the samples to be analyzed (the laboratory QA Manager signs for the samples upon receipt). While samples are being inventoried and analyzed, data sheets documenting receipt of samples, date of processing, analysis results, and any problems encountered will be filled out and kept on file. The entry of data into the laboratory notebook or onto a data sheet must be done accurately and neatly, following the same guidelines used for field data entry.

Samples will not be discarded until after all analyses have been performed and the quality of the analyses checked. Should an analysis not meet the quality guidelines, the samples will be reanalyzed.

V.2 Project Boundaries

Initial Determination Procedures

The WVA work group initially determines boundaries once a project has been proposed for nomination as a priority project. The NWRC obtains these preliminary boundaries (delineated on various forms of base maps) from the WVA work group. These boundaries are then digitized (either from 7.5-min quad sheets or heads-up digitizing), incorporated into an ARC/INFO data base and overlaid on thematic mapper (TM) base maps.

Final Determination Procedures

Once a reduced list of priority projects has been decided upon, a final WVA assessment is conducted. During this process project boundaries may be redefined or modified by the WVA work group. These modified boundaries are then transferred to the NWRC and appropriate changes made to the data base.

The final determination of which priority projects have been approved for the current fiscal year is determined by the CWPPRA Task Force. The list of final projects is entered into the CWPPRA Regional GIS Data Base housed at LDNR/CRD.

V.3 Habitat Mapping

Color-infrared photography will be acquired for each project according to each project’s monitoring plan specification. Certain types of restoration projects (such as vegetative plantings or shoreline protection) may only require aerial photography, while others (e.g., hydrologic restoration or marsh management) require detailed habitat mapping or land/water analysis in order to assess restoration success or failure. The basic goal of habitat mapping is to provide a consistency of products by using the U.S. Fish and Wildlife Service (USFWS) wetland classification system (Cowardin et al. 1979) so that wetland habitat changes can be accurately and similarly assessed throughout the project’s life. For those projects where detailed mapping is required, the photography will be photointerpreted and the linework will be transferred to a stable base by using a zoom transfer scope (ZTS). During the ZTS process, the distortion that exists in each frame of photography is removed. After the photoacquisition and photointerpretation phase, the data will go through a digitizing process which will enable Geographic Information System (GIS) analyses to be performed. Where land/water analysis is required, rectified color-infrared photography will be classified into two catagories: land and water. Land represents uplands and wetlands, and water represents any open water, floating or submerged aquatics, and nonvegetated mud flat. The resulting classification will be used to calculate land to water ratios. Land/water classification aides the identification and location of land loss and land gain due to land management activities.

Aerial Photography Acquisition

High-resolution, color-infrared aerial photography will be the primary mapping medium for habitat monitoring. Project areas to be flown will be identified by July 1 each year and acquired during late fall (prior to senescence) in order to obtain peak biomass for emergent marsh. In the event that conditions arise where photography cannot be flown during this period, plans will be made to acquire the photography during the next fall season. When a successive year is to be flown for a project, arrangements will be made to fly that year's photography as close to the date/season as previous years. The scales of the aerial photography vary depending on the project size: 1:6,000 [200 acres or less], 1:12,000 [200 to 20,000 acres], and 1:24,000 [over 20,000 acres]. The level of effort needed to establish baseline conditions, as described in each site-specific monitoring plan, may differ depending on the project type. All of the restoration projects that have photography flown will have horizontal controls established in the field using Global Positioning System (GPS) for georeferencing. The georeferencing will be used for the development of project base maps, photorectification, and replication of mapping for future trend analysis.

The boundaries for each unit will be converted into digital files compatible with MapGrafix on the MacIntosh for flight planning. Preflight planning will include manipulation of the boundary files in MapGrafix to determine number of frames of photography to be acquired and the optimal location of flight lines. Prior to photo acquisition, digital flightline files shall be reviewed by the U.S. Geological Survey (USGS)/National Wetlands Research Center (NWRC) mapping section leader and spatial analysis branch (SAB) chief, and the chairman of the Technical Advisory Group (TAG) for approval. Digital flight planning files shall be delivered to the photoacquisition contractor for coordination of photography coverage. Preflight planning will be coordinated with the contractor in order to provide detail for areas to be converted and to obtain maximum coverage, given potential constraints imposed by weather, seasonal aspects of vegetation, and budget. A communications network will be developed with the contractor so that researchers can be deployed at the time of the flight to obtain data, such as water levels, wind direction, and speed, that will be correlated with photography. When possible, the contractor will notify the project officer at least 24 hours in advance of any flight to allow researchers enough time to get into the field.

Because of the uncertainty of weather conditions such as afternoon thunderstorms, haze, and cloud cover, conditions for photo acquisition are set for optimal clarity. The contractor will take vertical photographs, free of clouds, between 10:00 a.m. and 3:00 p.m. to minimize shadowing. The sun angle must not be less than 30°. Photographic images of marsh vegetation and open water will be acquired using a stabilized camera mounted on the aircraft. The scale of the photography must be held as close as possible to the required scales for all photos. A 60% end lap and 20% side lap will be required for the photography, which allows the photointerpreter to map in stereo. GPS navigation with digital readout in the airplane's cabin is the minimum accepted. The contractor will acquire high quality transparency film for the project. A minimum of two frames will be acquired at the beginning of each flightline to reduce flightline syndrome on useable photography. All duplicate transparencies will be made individually using an automatic dodging printer which reduces color differences between the original and the duplicate.

All original aerial photography is duplicated and film is stored at the USGS/NWRC photograph archive. All aerial photographs will be indexed by locating the center point of each frame on a 1:100,000 USGS quadrangle. The center points of each frame will be labeled with the frame number and joined together to show flightlines. The 1:100,000 will be labeled with the roll number(s) and dates of photoacquisition. Each year's photographs will be indexed on separate 1:100,000 scale quadrangles. The centerpoints of each frame will be converted into a digital format. A copy of the final digital flightline data (with ancillary information such as date of acquisition of photography, scale, emulsion, and project name) will be submitted to the USGS/NWRC Project Manager in UTM NAD 83 for inclusion into the CWPPRA GIS database.

Global Positioning System

Whenever possible, ground control points using GPS will be collected to rectify individual frames for the first year of each project. When collecting GPS point locations, man-made, permanent features will be used for horizontal ground control. Where permanent features are not present, nonpermanent features such as sharp points of marsh, trees, etc., will be used. In order to use these nonpermanent features, field trips to collect GPS will have to be scheduled soon after date of photography (usually within one year) to ensure that these features do not change significantly before points can be collected. These individual rectified frames will be mosaicked together to create a composite image of the project area. All subsequent years of photography will be rectified to the first year's composite image. Where corresponding natural or man-made feature locations cannot be identified on both years of photography, other sources will be used. Other sources include SPOT panchromatic imagery (10-meter ground resolution), and Digital Ortho Quarter Quads (1-meter ground resolution), all of which meet national mapping accuracy standards. GPS collection is performed with Trimble Pro XR series loggers capable of sub-meter accuracy. GPS data are collected in World Geodetic Survey 84 and projected to Universe Tranverse Mercater (UTM) and North American Datum (NAD) 83 for rectification purposes.

Scanning

Because of the color differences that exist from frame to frame, a visual check prior to scanning is made to identify photo frames that exhibit the best color quality and minimal sun glint. This process eliminates or reduces the need to color correct the frames and minimizes dark and sun glint areas that make classifying an area difficult.   Aerial photography of the project area will be scanned at 300 dots per inch (dpi) and converted into a tagged interchange file format (tiff) digital file. These digital files will be converted into an Erdas Imagine format. They will be rectified and mosaicked to create a basemap in UTM NAD 83. These basemaps will be used in the cartographic registration and land/water analysis procedures.

Land/Water Analysis

For every year of photography that is acquired, each project will have acreage reports and maps generated that compare land to open water ratios within the defined project and reference boundary. An unsupervised classification based on a 50-class assignment, 0.950 convergence threshold, and a maximum of 10 iterations will be performed on the appropriate aerial photography for the project and reference areas. The new image will be analyzed and interpreted and the original 50 classes will ultimately be combined into two classes: land and water. Under certain circumstances, a vegetated mud flat catagory will be classified if it is significant to the project's goals and objectives. Unless otherwise noted as a specific preliminary condition relevant to the project's goals, all vegetation such as scrub-shrub, emergent vegetation, and forested areas will fall under the land classification, while open water, nonvegetated mud flats, and aquatic beds will be characterized as water. As an aid to proper classification, the GIS analyst will consult the expertise of the photointerpreter in order to minimize and eliminate the representation of incorrectly classified habitat types. After classification is complete, an accuracy assessment will be performed to determine a percent accuracy level of the land/water classification. Using the image processing software, no less than 100 points are randomly generated and distributed throughout the image, which is then identified, labeled, and compared to the original classification. After all points are identified and compared to the original classification, an accuracy percent is calculated. The final image will be submitted to the photointerpreter, LDNR monitoring manager(s), as well as other members of the CWPPRA team for review to ensure proper classification. All edits and suggestions will be considered and amended where appropriate. After accuracy has been determined, maps depicting the analysis, with acreage amounts overlaid onto the project area photography, will be created in report compatible (8.5 x 11 in.) and presentation (display size) formats. Each will follow standard cartographic properties.

When two or more land/water analyses are to be compared for land accretion or loss acreage, the GIS analyst will create a composite file that congregates the different years of data. Four categories of data will be displayed on a composite image: land and water areas that remained unchanged between the two images, as well as classes depicting the areas where land/loss and land/gain occurred.

Habitat Analysis

Habitat analysis will be determined by the individual project's monitoring plan. For every date the analysis is required, the aerial photography of the project will be photointerpreted according to the "Classification of Wetlands and Deepwater Habitats of the United States" Cowardin et al. 1979 as modified for the National Wetland Inventory Mapping Convention. Once the photointerpretation is completed, the habitat delineation will be transferred onto a stable base mylar using a ZTS. The delineated habitats will then be converted into an ARC/Info digital format through digitizing. Verification plots are generated to ensure edge-matching and classification code accuracy. The habitat classification will be aggregated into wetlands, uplands, and water in the analyses. As the next time period of data are accumulated on a project-by-project basis, the analyses will be aggregated according to the original classification. For special projects, different combinations of the original classification scheme can be used to determine more specific types of change. A habitat acreage summary report will be generated by using the coverage for each date, and a habitat area change table identifying and quantifying types of change will be generated for each comparison. A summary change table and a simplified change map will also be produced for interpretation and presentation purposes. Large-scale and small-scale habitat maps will be produced. The maps will employ standard color schemes and a cartographic layout that depends exclusively on the project's profile. Draft maps and reports will be prepared and sent to the USGS/NWRC editor for review. Once a map is finalized, a master version will be produced for distribution. All digital plot files used to produce the maps will be saved in both a device-specific and a PostScript format. The maps will be clearly identified with the USGS/NWRC map identification system. The hard copy maps and digital plot files will be archived at both USGS/NWRC and LDNR/CRD.

The USGS/NWRC contact will receive copies of the final digital and hard copy versions of the habitat data. The contact will then ensure that the hard copy and digital data are transmitted to LDNR/CRD and the data are properly archived at USGS/NWRC. The digital habitat data will be stored at the USGS/NWRC and made available to end-users along with the rectified photomosaic image that was used to create the habitat data.

V.3.1 Photointerpretation

Preparing a Flightline Index

1. If a flightline index does not exist, prepare an index that shows the frame numbers and flightlines on an appropriately scaled (1:100K) basemap. A photocopy of the index will be added to the document folder in front of the photo packet.

2. Organize each flightline of photography into a separate folder within the photo packet. Indicate on the front of the folders which frames are included.

Data Preparation

1. Cover each 9x9 inch work photo with a clear acetate overlay, and tape down with drafting tape.

2. Using a black pen, trace the fiducial marks and photo numbers. This ensures proper realignment should the overlay be shifted or removed.

3. Place one photo over an adjacent photo in the flight strip, find the halfway point of the overlap, and draw a neat line on the overlay of the first frame.

4. Using a stereoscope, find matching points along the edge of the second photo that coincide with the top and bottom of the neat line previously drawn on the first photo. Connect these points with a straight edge.

5. Repeat this process on all sides of each photo until the entire project area has been covered.

Prephotointerpretation Field Trip

1. Field-check aerial photography in order to ensure correct photo signature recognition and classification. A standard check sheet (appendix B) will be used to record the field data.

2. Prior to field-checks, conduct a review of available information on the area to be checked. Examples of information include: CWPPRA data, CWPPRA reports, field guides, plant lists, soil surveys, salinity maps, any previous photography, and National Wetlands Inventory (NWI) maps. The field crew should check with the LDNR monitoring manager to gain access to the property and to discuss any problems they might encounter while in the field.

3. When choosing check sites, examine photographs for : (1) unusual but important signatures; (2) problem signatures; (3) water regime signatures (salinities); and (4) specific signature problems based on forest types.

4. Prepare photography for the field by duplicating the work frames in the darkroom and then laminating them or carefully registering the photo jacket to the fiducial marks on the photo transparency and tracing the frame number with a black pen. Mark the check on the photographs and the topographic maps. In order to separate comments written prior to a field trip from those taken while in the field, red and green pens should be used for prefield notes and black pens should be used for infield notes.

5. Take groundtruth photos of all check sites to help recall details about the site once the interpreter is back in the office. Attach groundtruth photos of each check site to the check site sheet and store in the document folder in the front of the photo packet. After the field work, transfer all check site classifications onto the photographs. Place an asterisk on the aerial photograph as close to the exact spot visited as possible.

6. Become familiar with the mapping techniques and conventions created by the National Wetlands Inventory (NWI). These methods will be adapted to the specific needs of CWPPRA. The photointerpreter shall ensure that the overlays are correctly aligned to the fiducial marks on the photos before beginning the interpretation process. This step ensures that if the overlay is shifted or removed, it can be accurately replaced. All delineations and labeling are made with waterproof black or red ink in legible script.

Lines should be of uniform width and should closely follow the ground features on the photo. In order to insure accurate delineations from photo to photo, wetland cover types that occur along the outer borders of each frame should be edge-matched in stereo with the linework from the adjacent frame.

7. The boundary between the fresh and saline marsh will be determined by using the Chabreck and Linscombe (1997) maps unless other salinity data are available from the monitoring manager.

8. For the greatest consistency of each project, which impacts precision and accuracy, the same photointerpreter should interpret the pre and postconstruction photography. Photointerpretation should be conducted after photos are acquired.

9. Work methodically from the general to the specific and from the known to the unknown. Begin interpretation of photographs that have been groundtruthed to get a good grasp of the visual clues and photographic signatures.

10. When interpretation is completed, place a clean sheet of frosted mylar between the overlay and the photo to check for completeness of linework and labeling as well as interpretation errors.

11. Use production time log to track and record the completed work. Time logs are essential to record completed photos, to document problems or concerns, and to track progress.

Quality Control

1. A quality control check by an NWRC supervisor or another experienced photointerpreter and the LDNR monitoring manager who is familiar with the project is essential. To promote correctness and consistency of work, the basic guideline is to assume that errors exist and to search for them.

2. A frosted sheet of mylar will be placed between the delineated overlay and the photo to check that lines and labels are neat, clean, and complete. Check edge ties to adjacent photos.

3. Scan each polygon under the stereoscope to check the correctness of final linework and labels and the consistency of classification.

4. Sign your initials on the production time log in the photointerpreter, quality assurance and quality control (QA/QC) column.

V.3.2 Map Production

Zoom Transfer Scope (ZTS)

1. Base Map

The base map consists of scanned digital photos. The cartographic technician and the photointerpreter will check over the CWPPRA base maps for accuracy, consistency, and edgematching.

2. Initial Preparation

Use a production time log to track and record work. Time logs are essential to record progress and to document problems or concerns. Create a tie diagram to track edgematching between quads. Once base maps have been approved, they will be prepared for ZTS using three mylar overlays.

a. Linework layer. The mylar linework layer is punch registered and used for linework, tic marks, and map names created by a label maker.

b. Label layer. The mylar label layer is punch registered and used for labels. Tic marks* and map names should also appear on this layer.

c. Protective layer. Provide third mylar layer (QC mylar) for each map. This layer will be used for QA/ QC notes and to protect the other layers from scratches. This layer may consist of a lesser quality mylar or used mylar and should be wider than other layers to allow for QC notes in margins.

* *all four corners as well as several interior tic marks should be accurately transferred onto mylar layers. A size 0000 pen is used for tic marks.*

3. Draft Map

a. Draw linework layer using 1994 Cartographic Conventions for the NWI. This layer is created using a 0000 pen. This process is done under the ZTS. Use a hook leader in black ink on the tie diagram to indicate which maps have been tied together.

b. Create label layer using 1994 Cartographic Conventions for the NWI. A 0000 pen is used to create a label layer.

4. Quality Assessment (QA) of Draft Map

The cartographic technician must check over entire map looking for missing labels and polygons as well as alignment discrepancies and linework problems. Notes for corrections should be made in red ink, using NWI symbology, on third mylar sheet (QC layer). All edge ties should be checked and recorded on the edge tie diagram located in the photo packet. Use a hook leader in a different color to indicate which two maps have been tied. Corrections should be made where necessary. Check off notes as corrections are made. Erase all notes from QC mylar after corrections are made.

5. Quality Control (QC) of Draft Map

A second cartographic technician (who has not worked on the map) will check the map for missing labels, polygons, and linework, as well as alignment discrepancies and linework problems. QC notes will be made on the QC layer in red or with any color that contrasts well with the basemap using NWI editing symbology. Ties will be checked.

6. ZTS Corrections

Corrections to the map will be made by the cartographic technician who drafted the map. All notes will be checked off as corrections are made. Erase all notes from the QC layer after corrections are made.

7. Large-scale Review

The photointerpreter will check the map for missing labels, polygons, and linework, as well as alignment discrepancies and linework problems. QC notes will be made on QC layer in red ink, using NWI editing symbology. All ties will be checked.

8. Large-scale Review Corrections

Cartographic technician will make all corrections to the map. QC notes will be checked off as corrections are made. Erase all notes from QC layer after corrections are made. Maps are then sent off to be digitized.

<u>Digitizing</u>

1. Digitizing and Quality Control

Obtain maps and/or overlays and review the Project Assignment Sheet for detailed instructions, naming conventions, and attributes. Check the basemaps and/or overlays with all adjacent maps/overlays for unlabeled polygons, missing arcs, and inconsistent attributes or linework between map edges. Obtain the northwest and southeast corner coordinates from the map(s) assigned, and record them on the Map Information Sheet. Use the 1:100,000 index sheet or other map index provided by the supervisor to track the maps in progress for each theme in the project area. Create a new quad coverage based on the map corner coordinates and basemap projection. NOTE: Projection is always Universal Transverse Mercator (UTM) NAD 83. Determine the UTM zone by referring to the basemap and/or the Universal Transverse Mercator Grid Zones document (see Lee and Walsh 1984). Record the UTM grid zone on the Map Information Sheet. Register the map coverage to the digitizing tablet. Once all of the tics are entered, ARCEDIT will display the Root Mean Square (RMS) error. If the RMS error is greater than the acceptable limit of 0.01, re-register the map coverage until the acceptable error is achieved. Record the RMS error on the Map Information Sheet. Begin digitizing, following the ARC/INFO data entry procedures for ARCEDIT. Use the zoom and window commands to magnify specific areas of the coverage for more accurate digitizing. If adjacent coverages have already been digitized, edge snapping will be required. Identify data discrepancies and cartographic questions on the basemaps or map overlays, according to the instructions provided by the supervisor. Snap to any adjacent completed map coverage(s). Save the map coverage periodically (every 100 arcs) and after all digitizing is completed.

2. Verification

Manual verification: compare the hardcopy checkplot to the source map or overlay. Check the plot for missing, inaccurate, or incomplete data, and make necessary corrections to the digital map coverage. Perform software verification based on map scale by executing MAPCLEAN: verify and generate correct polygon or arc-node (linear data) topology for the map coverage after corrections are completed.

3. Create Labels

Label points are created solely for polygon map coverages. Point and linear coverages do not require label points because the attribute information will be directly associated with the individual point and linear features.

Create label points for polygon features . A "USER-ID" number is automatically assigned to each new label point created. Ensure that the new label point USER-ID numbers are assigned to the Polygon Attribute Table (PAT) by using the BUILD command. Obtain a list of polygon label errors. Note that polygon 1 (universe polygon) should always have 0 label points. Edit all polygons that are missing a label point or have more than one label point assigned to them by using the various editing commands in ARCEDIT.

4. Attribute Information

All map feature information is added to the INFO file: Use Polygon Attribute Table for polygon and point coverages or Arc Attribute Table for linear coverages. Save the map coverage periodically, as attributes are entered, to ensure that attribute information is not lost due to equipment failure or system crash. Select all labels or arcs and "LIST" to display the attributes of the selected features to ensure that each feature has correct and complete attribute information assigned.

5. Final Plot and File Maintenance

Produce a final hard copy plot, label the hard copy plot with project name, theme name, quad name, and state; complete remaining portions of the Map Information Sheet; and submit the final hard copy plot, Map Information Sheet, and hard copy attribute summary to the lead Data Entry Specialist. Identify each final map saved in the permanent database on the 1:100,000 index sheet or other map index for the project area and theme.

6. Quality Control

a) Compare the hard copy plot to the source map or overlay.
b) Check the digital data for node and label errors (polygon data only).
c) Verify the feature attributes.
d) Verify coincident lines between data layers.
e) Verify edge ties to adjacent coverages.
f) Check for "like" attributes (polygon data only).
g) Check node errors and label errors (only if the data have been modified).
h) Generate final reports and plots (only if the data have been modified).

V.4 Meteorologic and Hydrologic Sampling

V.4.1 General Considerations

The hydrologic and meteorologic sampling is characterized by variables that require monitoring at sampling frequencies ranging from continuous to daily, depending upon the type of variable and the relative stability of the environment in which it is being measured. Winds need to be monitored on a continuous (~5 min sampling interval) basis owing to the highly dynamic character of this variable. In near-coastal situations (salt, brackish, and possibly intermediate marshes) the water movements are characterized by fluctuations at periods ranging from tidal (25 hrs) to annual. In these areas, sampling generally needs to be at a 1-hr frequency. The fresh marsh, swamps, and riverine areas are characterized by water movements dominated by larger scale atmospheric frontal events that have time scales on the order of several days, or by seasonal water level patterns. In these areas, daily sampling is usually sufficient to characterize the system. The main QC consideration is proper data entry. The data collection and handling procedures should be carefully followed. Data should be verified independently against field and laboratory notebooks.

V.4.2 Precipitation

Precipitation is measured on the basis of the vertical depth of water that would accumulate on a level surface if the precipitation remained where it fell. Recording precipitation gauges are recommended when continuous records of precipitation are required. The tipping bucket continuous recording gauge is used with equipment (e.g., Handar) for real-time transmission. Other recording gauges include the weighing type gauge and the float type gauge. Precipitation is accrued on an hourly or more frequent basis until the gauge is reset. Standard rain gauges are used when continuous records are not required. These gauges need to be read daily and emptied. Precipitation is reported on a daily basis. The units of measure for precipitation data are generally centimeters per hour (cm/hr).

Precipitation measurements are subject to various errors. Individually the errors are small but cumulatively they could be significant. Errors are smaller for standard rain gauges than recording gauges. In rainfall of 12–15 cm/hr, the bucket of a tipping bucket gauge tips every 6–7 s. About 0.3 s is required to complete the tip, during which some water is still pouring into the already filled compartment. The resulting recorded rate may be 5% too low; however, the water is all caught in the gauge reservoir and can be measured independently of the recorder. The difference can be prorated through the period of excessive rainfall. The most serious error is the deficiency of measurements caused by wind, consequently, wind shields are recommended to reduce the error.

Methodology recommended for a project will depend on the uses for which the precipitation data are intended and the site at which the gauge will be located. Where accumulated volume of overland flow is of interest, the depth of rainfall measured by standard rain gauges should be adequate if the site is accessible on a daily basis. Recording precipitation gauges reduce the need for daily visits and can be serviced during the project site visits. Recording gauges also provide hourly or more frequent data. For high-priority projects, the standard protocol recommended is the use of tipping bucket gauges at water level or water quality sampling sites. This practice allows for continuous data collection and real-time transmission. Data of good quality will be obtained by establishing a system of quality control that includes not only periodic inspection of stations and maintenance or repair of equipment, but preliminary checking of data by internal consistency checks.

The uses for which the precipitation data are intended should determine network density. A relatively sparse network of stations would suffice for determining annual averages over large areas. In general, sampling errors in terms of depth tend to increase with increasing areal mean precipitation and decrease with increasing network density, duration of precipitation, and size of area. Average errors tend to be greater for summer than for winter precipitation because of the greater spatial variability. The minimum density of precipitation network recommended for general hydrometeorological purposes for flat regions of tropical zones is 600-900 km^2 per station. For lower priority projects, records from nearby precipitation stations may be sufficient. Gauges should be added, if necessary, to achieve a good spatial density.

V.4.3 Wind Speed and Direction

Wind speed is measured with anemometers. Both cup and propeller anemometers are commonly used. A wind vane measures the direction from which the wind is blowing. Surface winds are generally reported in miles per hour (mph), meters per second (m/s), or knots. Surface wind directions are generally reported in degrees. Reported wind speed above 1.5 m/s is nominally accurate to plus or minus 0.75 m/s under steady-state conditions. Wind vanes are constructed to indicate direction within plus or minus 5°.

Ideally, surface wind—sensing equipment should be placed 6 m above the ground on a freely exposed tower over terrain that is relatively level and free from obstructions to wind flow.

For high-priority projects, the standard protocol recommended is to use automatic windspeed and direction equipment linked to communication equipment for real-time data collection. Wind speed and direction equipment would be installed at each water level and water quality data collection station with a data collection platform. The advantages are continuous real-time collection of data and reduced maintenance costs of on-site equipment. This protocol is really the only effective way to measure data of this type.

The recommended frequency for wind speed and direction data collection is continuous. In many cases, the dynamics of the wind data may be more important than the actual data. The same reporting periods at the National Weather Service—hourly, daily, and monthly summations—should be adopted.

Spatial distribution of wind speed and direction equipment will be dependent on the use of the data collected and the complexity of the project area. As data collection efforts move east across the coastal zone, wind data become more important. Wind gauges are important in the Barataria Bay, Breton Sound, Atchafalaya floodway, and Lake Pontchartrain hydrologic basins. Wind gauges should be distributed closer than an 80 km radius in these basins because large-scale wind cells and circulation patterns develop in them. Wind gauges become less important in the Terrebonne and Teche-Vermilion river basins, and are generally not important in the Mermentau and Calcasieu-Sabine river basins. Because land breezes are different from sea breezes, data at airports should be only cautiously used in the coastal zone. Fewer wind gauges are needed if the data are to be used in conjunction with a wind-field model. Where data collection is a lower priority, continuous records from a second site within a 60 km radius are sufficient if this second site has similar hydrologic and hydraulic characteristics. Wind speed and direction gauges should be installed at existing real-time stage recording sites to achieve a good spatial distribution.

Maintaining data quality is ensured by establishing a system of quality control that includes not only periodic inspection of stations and maintenance or repair of equipment but also preliminary checking of data by internal consistency checks.

V.4.4 Surface-Water Levels

Stage is a measure of water level surface in a body of water. Stage can be measured discretely or continuously over a period of time. Depending on the measurement device, accuracy limitations will range from 0.3 cm to 3 cm.

Stage measurements can be made by using several different devices. A staff gauge is the simplest of stage measurement devices. Water level measurements are made by visual inspection of a vertical graduated staff. Water level measurements can also be measured with a continuous stage recorder. The water levels are determined by using a tape-float system or pressure transducer. Readings are recorded on a regular time interval on digital recorders, graphic recorders, or electronic data recorders. Electronic data recorders are devices like basic data recorders, where the stage values are stored in memory and downloaded into a computer during field inspections or into data collection platforms that transmit the data via satellite, radio, or telephone on a real-time basis. Stage recorders can be temporary or built to last over a long period of time and under various environmental and climatological conditions.

Where cost is not a major issue and where water level data are a high priority, real-time data collection platforms (DCPs) are recommended as the standard protocol. DCPs have a high equipment and installation cost for the stage recorders but reduce the cost of collecting other variables such as water temperature, dissolved oxygen, and precipitation because the equipment that measures the other variables can also use the DCP. DCPs reduce maintenance costs; maintenance personnel can see when a gauge is not functioning properly and can perform maintenance on a less frequent basis than without the DCP. Because maintenance is performed immediately rather than on a scheduled basis, periods of bad or missing data are reduced.

The measurement of stage over time can be from one reading at a site to whatever interval is required, such as daily, hourly, or less over a determined period. Measurement of stage at one location can be compared to other water levels within a certain range of the gauge in common hydrologic areas. Spatial distribution of water level gauges will depend on the project type and the hydrologic characteristics of the project area.

At many project areas, existing stage recorders or real-time DCPs in the vicinity will suffice. At some locations, an observer may be hired to daily record stage from a staff gauge. Some sites can be monitored continuously for a short time, i.e., 30 to 180 days, to determine the relationship of stage at the project to a nearby permanent location. Other sites can have a staff gauge installed, which would be read during the site visits. These protocols are best suited for projects where collection of water level data is a low priority.

There will be some projects where the level of the water is not as important as the forces of the waves and littoral transport. Directional wave gauges may be necessary to determine these forces. Wave gauges are placed in deep and shallow water near the area of interest. Data are gathered for a 2-to-3 yr period and used to develop a wave model. The wave model predicts the nearshore wave climate based on the deep-water wave gauge data. The model then replaces the shallow-water gauges.

Data quality is maintained by periodic inspection of stations and maintenance and repair of equipment. Internal consistency checks and reviews are employed on all data.

V.4.5 Groundwater Levels

Probably the easiest technique to measure groundwater is to install a shallow piezometer at the same time soil cores are initially taken. The piezometer would be slotted PVC and would need some type of fine gravel pack to minimize siltation, an upper casing, and a protective cap. Height of groundwater could be measured by using a simple ruler from the top of the casing during site visits, or any other data collection event. Piezometer monitoring could be done during site visits or when personnel are in the field for other monitoring. Should continuous monitoring of groundwater levels be necessary, the levels in a well can be monitored through the use of a float-counterweight system (Swenson and Turner 1987; Swarzenski et al. 1991) attached to a data logger.

Quality Control is assured by periodic maintenance of piezometers and replicate ruler measurements.

V.4.6 Surface-Water Salinity and Temperature

Salinity is a measure of dissolved minerals in sea water in units of parts per thousand (ppt). Salinity is typically measured by using either electrical conductivity (or resistivity) or electrical inductance. Salinity is computed using the known relationship between temperature and electrical conductance (or inductance). These instruments can either be internally recording or have a probe for field spot measurements. The accuracy with these types of measurements is about 0.10 ppt. Spot measurements of salinity can also be measured using a refractometer. However, this instrument is only accurate to about 1.0 ppt. Salinity can also be determined in the laboratory (from field-water samples) through the use of an automatic digital chloride titrator. This device works with small sample volumes (less than 1 ml) and can measure salinity with an accuracy of about 0.25 ppt.

There are water level gauges like the Endeco 1159 that also measure temperature and conductivity in addition to stage. Hydrolab H_2O equipment is another gauge that measures all three variables. Both can be used with DCPs. Where water level, conductivity, and water temperature are high priorities, this is the recommended standard protocol. Where salinity is a lower priority, monthly collection is recommended in conjunction with site visits. Salinity can be measured during the site visits by using a field instrument like a YSI 30, which measures water temperature, pH, conductivity, and dissolved oxygen, among other things. Existing data collection platform equipment can also be upgraded to measure and record conductivity and temperature.

The following general guidelines should be employed for all conductivity and temperature measurements. All meters should be calibrated before use, following the manufacturer's guidelines. A log book of the calibration information should be maintained. The meters should be cleaned and properly stored after each use. All personnel should be instructed in the proper calibration, use, and care of the meters. In the case of recording meters, periodic field checks (every 2 weeks to 1 mo) need to be performed on the meters. During these field checks, the proper operation of the equipment should be verified, calibration samples should be collected, and the equipment cleaned.

V.4.7 Discharge

Discharge is the measurement of volume of water passing a given point within a given period of time. Units of measurement for discharge are typically cubic meter per second (m^3/sec). To determine discharge, a measurement of velocity and cross-sectional area is necessary. Velocities are usually measured with mechanical velocity meters, electromagnetic velocity meters, and acoustical velocity meters. Some of these meters can measure only in one direction, while some can measure bi-direction, and others in any direction. The measurement of area is made with physical sounding of depth or by using electronic depth finders. As was the case with the use of salinity meters, the calibration and operation of the flow meters should be verified (according to manufacturer's specifications) before use. During use, the flow meter should be periodically checked to verify proper operation. The personnel using the meter should be trained in the proper operation of the instrument.

Discharge measurements are instantaneous measurements; that is, measured at one point in time. Some projects require that the discharge rate be known over a period of time.

Typically, discharge over a period of time is determined by using a stage-discharge relationship. A series of discharge measurements is made at different stage elevations and a relationship between stage and discharge is determined. Unfortunately, this stage-discharge relationship may not apply to tide-affected areas. Another method to determine continuous discharge is to measure continuous velocity and to develop a relationship between velocity and discharge as was done for the Lake Pontchartrain Tidal Passes by Swenson and Chuang (1983). The recording meters should be serviced on a periodic schedule (2 week to 1 mo). During servicing, the meter should be cleaned and checked for proper operation. A hand-held meter should be used to obtain measurements of the flow at the recording meter site before the recording meter is serviced. These measurements from the hand-held meter can be compared to the data from the recording meter to verify proper operation.

The standard protocol for data collection will vary with project type and location. For example, large-scale uncontrolled diversions will require discharge measurements to be taken from a boat on a routine basis. Conventional measurements should be taken where cross-sectional geometry fluctuates and where the relation between velocity and discharge will vary over time. Frequency and spatial distribution of discharge measurements will also be project dependent. Discharge measurements could be taken during the project visits.

V.4.8 Suspended Sediment

Suspended sediment is expressed in parts per million (ppm) or milligrams of dry sediment per liter (mg/L) of water sediment mixture. Suspended sediment samples can be collected in several ways. In moving water, samples can be collected by using a number of different types of point samplers. Samples are collected at different points in a vertical profile and combined for analysis or analyzed individually. Suspended sediment samples can be collected in low velocities with wide-mouth samplers or by using a pump system. Automatic samplers are also available to provide unattended sampling at the frequency desired.

Where sediment sampling is a high priority, channel measurements taken with a point sampler should be made or an automatic sampler should be installed. Channel measurements generally require a discharge or velocity measurement for correlation. Automatic samplers require implementation of a good quality control system that includes routine visits for maintenance. The frequency of measurements will be project and site dependent. Sampling should be performed a minimum of six times per year. Sampling could be done during the site visits.

Suspended sediment is determined in the laboratory by filtering a known volume of water through a dry, preweighed filter. Suspended sediment filters are rinsed with distilled water to remove any salt effects of the filters. The filter is then dried in a laboratory oven (at 60° C) and reweighed. The total amount of material in suspension is then determined from the weight of material on the filter. Routine laboratory quality control guidelines should be followed with this procedure.

V.4.9 Bathymetry

Bathymetric surveying is the measurement of depths of water bodies. Bathymetry is generally measured from a boat by using positioning equipment and a Fathometer®. This equipment should be calibrated before use, following the manufacturer's guidelines. Range lines are laid out to be surveyed on a routine basis. Positioning is usually recorded in x-y coordinates; depth is recorded in feet. Data can be recorded electronically and even transmitted over telephone hookups. Some shallower water bodies may have to be surveyed by using topographic land surveying techniques. The main consideration in bathymetric surveying is to use proper survey techniques to ensure accurate locations for each depth measurement. In addition the water levels at each site, relative to a fixed datum (or average marsh elevation) must be known during each survey. When the surveys are compared they must all be referenced to the same water level datum.

For projects where this variable is a high priority, bathymetry should be measured once before project implementation and at least once during each 3-yr reporting period. Frequency, methodology, and survey coverage will be project and priority dependent. Spot elevations should be taken annually in conjunction with aerial photography to provide supplemental information.

V.4.10 Topography

Topographic surveying is the measurement of the elevation of land. Topographic surveys can be taken by using three different methods. (1) A surveyor can "walk" an area, recording horizontal location and vertical elevation (see section V.6.2). A survey that uses the water surface as a base and measures elevations with a rod is less expensive than a survey that uses positioning equipment and a Fathometer®. The accuracy of such a survey is about 0.15 m. (2) Surveying with GPS equipment should be used when some smaller error in measurement is acceptable (see section V.6.1). With GPS equipment, the use of range lines to determine location is unnecessary. Data can be recorded electronically. (3) Conventional survey equipment is used when horizontal and vertical accuracy is critical. Range lines are laid out to be surveyed on a routine basis. Positioning is usually recorded in x-y coordinates; elevation is recorded in feet.

For projects where this variable is a high priority, topographic surveys should be taken once before project implementation and at least once during the 3-yr reporting period.

Frequency, methodology, and survey coverage will be project and priority dependent. Spot elevations should be taken annually in conjunction with aerial photography to provide supplemental information. For the other project types, measuring accretion by using soil cores, feldspar marker horizons, and sediment trapping devices is recommended.

For all bathymetric and topographic surveys, personnel should be instructed in the proper calibration, use, and care of equipment. Proper operation of the equipment should be verified during field checks.

V.5 Soil/Sediment Sampling

Bulk Density, Organic Matter, and Percent Water

Bulk density is defined as the total weight of material in a known volume of sample and is given in units of grams per cubic centimeter (g/cm^3). Bulk density includes both the organic and the inorganic fractions. Bulk density may be expressed as either wet bulk density (includes the water in the sample) or as dry bulk density (the sample is allowed to dry). However, since the convention is normally to use dry bulk density, this discussion is confined to that variable. It has been shown (Gosselink and Hatton 1984) that soil density is controlled by the amount of mineral material that infiltrates the organic material framework of the highly organic marsh soils. This organic material framework appears to have a fairly constant ratio of mass to volume. Dry bulk density values generally range from 0.05 g/cm^3 to 1.25 g/cm^3. In highly organic soils, such as those found in coastal marshes, it is more meaningful to express soil nutrients in terms of volume instead of mass (Clarke and Harmon 1967; Mehlich 1972; Delaune et al. 1979; Rainey 1979). Since vegetation roots invade a given volume of soil as opposed to a given mass of soil, plant biomass shows a better relationship to soil nutrients expressed on a per volume basis as opposed to a per mass basis (Delaune et al. 1979).

A core is carefully collected to obtain a known volume with a minimum amount of compaction. The core must also be treated so as to prevent loss of water or matter. Cores can be collected with a small piston core device such as the one developed at the Coastal Ecology Institute (CEI) at Louisiana State University (Swenson 1982), the Hargis corer (Hargis and Twilley 1994) or with a PVC or metal core tube (if chemical analysis is to be run on the samples, be sure to use a core tube made of appropriate material). The CEI piston corer consists of a sharpened core tube with an internal piston (with an O-ring seal). The whole assembly is mounted on a stand. In use, the corer is placed on the marsh surface and the sharpened tube is pushed into the marsh. As the core tube moves downward into the marsh, the piston remains fixed since it is held by the stand. Thus, as a core is taken, suction is created in the tube by the piston, virtually eliminating compaction. The corer is designed to sample the top 11 cm of the marsh surface, and collects a core with a volume of 50±2 cm^3. If a core tube is used (instead of the piston corer), be sure to collect the core in such a manner (by carefully rotating the core tube as it is inserted into the substrate) so as to minimize the compaction. By measuring the distance from the top of the core tube to the sediment surface on both the inside and the outside of the core tube, the compaction can then be calculated by using the total core tube length, as follows:

Depth tube inserted into marsh = (total core tube length) - (outside measurement)

Length of sample = (total core tube length) - (inside measurement)

Compaction = (depth tube inserted into marsh) - (length of sample)

Percent Compaction = (compaction/depth tube inserted into marsh) x 100

Preparation of the samples for return to the laboratory consists of ensuring that the tubes are tightly sealed, the outside of the tubes are clean, well-labeled, and the samples are put on ice for shipment (to avoid evaporation).

The main QC consideration for core collection is proper sample handling and labeling. The sample procedures outlined should be carefully followed. Representativeness and precision will be addressed by the collection of replicate cores at each sample site.

Organic percentage will be determined by the amount of material loss by a dried sample upon ignition at 550°C. The sample will first be dried at ~60° C. The dried sample will then be homogenized (with a mortar and pestle or an electric mill). A subsample (~0.75 g) from the homogenized sample will be used for percent organic analysis.

The field sample (of known volume) is weighed as soon as it is returned to the laboratory. The wet sample weight is recorded, along with the sample container weight. The sample is then allowed to dry in a laboratory oven at 60° C until a constant weight is obtained. The dry sample weight is recorded on the data sheet, and the sample is then homogenized using the mortar and pestle and a laboratory grinder.

The sample is placed into a clean, preweighed and labeled crucible. The crucible with the sample is weighed, then the crucible is placed in a muffle furnace at 500°C for 60 min or until weights are constant. The sample is then removed, allowed to cool in a desiccator, then reweighed. The weight of the crucible and the weight of the crucible plus sample, both before and after combustion, are recorded on the data sheet.

The wet and dry weights are used to compute both the wet and the dry bulk densities and percent water, using the following formulas.

$$\text{Wet Bulk Density} = \frac{\text{Wet Sample Weight}}{\text{Volume of Core}}$$

$$\text{Dry Bulk Density} = \frac{\text{Dry Sample Weight}}{\text{Volume of Core}}$$

$$\text{Percent Water} = \frac{\text{Wet Sample Weight - Dry Sample Weight}}{\text{Dry Sample Weight}} * 100$$

If the piston corer is used, the volume is constant at 50 cc. The crucible plus sample weights before and after ignition (at 550° C for 1 hr) are used, along with the crucible weights, to compute the percent organic matter, using the following formula:

$$\text{Percent Organic Matter} = 1 - \frac{(\text{weight at } 550° \text{ C - crucible weight})}{(\text{weight at } 103° \text{ C - crucible weight})}$$

Data reporting will be done by the laboratory as soon as the samples are analyzed. A report will be sent to the monitoring manager that will document the following:

1. Batch and sample ID information
2. Values of standards
3. Results of QC checks
4. Analysis results
5. Discussions of any problems along with steps taken to address them.

Data validation for this method consists of checking to be sure that all sample containers are properly labeled and that sample numbers and crucible numbers are double checked by laboratory personnel during analysis procedures. In addition, the laboratory personnel must be sure to check the labels on the standards before use.

<u>Groundwater and Soil Salinity</u>

Soil salinities change slowly, and variation will be dampened compared to variation in salinity of the overlying water, which will change with tidal cycle as well as wind direction, seasonal changes to freshwater input, and climatic cycles. Thus, soil salinities can be measured monthly for projects that rank this data collection a high priority, at least within the season when projects are most likely to affect salinity. For example, freshwater diversions are typically operated seasonally when fresh water is available and when biota are most sensitive to high salinity. When soil salinity monitoring is a medium priority, monitoring should be done monthly during times when projects are most likely to affect soil salinity. With those project types where soil salinity monitoring is a low priority, monitoring may be done infrequently or not at all.

Soil salinities can be measured by extracting interstitial water from a surface sediment sample by centrifuge or by using field collection tubes. Vertical salinity profiles will be measured using sampling pipes made from 1.3 cm diameter PVC plumbing pipe. The pipe is cut to the desired length, a PVC point is cemented to the end, and a series of small holes are drilled about 10 cm above the end. In use, the pipes are inserted into the marsh so that the holes are at the desired sampling depth and allowed to stay in place until sufficient sample is collected. The pipes are then withdrawn from the marsh, and the water that collects in the pipe is either measured in the field or placed in vials for subsequent laboratory determination of chlorides (salinity).

To collect a sample, carefully withdraw the tube by gently twisting and pulling, keeping the tubes vertical at all times, otherwise you will spill the sample. Carefully decant the sample from the tube into the prelabeled sample vial, and seal. Make sure that sample vials are tightly capped, labeled properly and are clean. Store in the ice chest. After sampling, rinse out the sampling tubes so that they will be ready for the next sampling site.

The main QA consideration is to ensure that samples are not contaminated from upper layers when the sampling tube is inserted. This is accomplished by covering the top of the tube with your thumb while inserting the tube, then releasing your thumb only after the tube has been inserted to the proper depth. A secondary consideration is to be sure to clean the tubes after sampling and be sure the tubes are empty to ensure that no contamination occurs between sampling sites.

The salinity samples collected will be analyzed in the field using a conductivity probe. The conductivity meter should be used in accordance with manufacturer's specifications. The main QC check is to be sure the conductivity meter is calibrated. This is accomplished by running standards before, during and after sampling. The use of a standard also ensures accurate data. Multiple analysis will be run on ~10% of the samples to check for precision.

<u>Soil Sulfide</u>

A soil water sample is extracted at a predetermined depth using a syringe attached to a stainless steel sampling tube. When collecting the sample, collect ~5 ml up into the syringe, pinch the rubber tubing attaching the syringe to the stainless steel sampling tube, remove the syringe, and expel the water collected in it. Reattach the syringe to the rubber tubing and collect the sample. This procedure lessens the amount of contact with oxygen. The water collected is placed in an antioxidant buffer of equal volume. Usually 5 ml of each (buffer and sample) are used, although 2 ml are possible. The sample container is capped, number recorded, and returned to the laboratory for analysis within 24 hrs. The antioxidant solution must be kept on ice in a tightly sealed bottle to avoid contact with oxygen. A fresh bottle of antioxidant should be opened at each sampling site. The main QC consideration is to avoid introducing oxygen to the soil sample before being placed in an antioxidant buffer. The samples must be analyzed for sulfide concentrations within 72 hours, particularly at low concentrations (<2 ppm). Precision will be addressed in the laboratory analysis by multiple sample readings.

Sulfide laboratory analysis consists of measuring the concentration using a sulfide electrode. The system is calibrated by standards which are prepared by the laboratory for each analysis. Detailed procedures for measurement are contained in the instruction booklet that comes with the sulfide electrode.

The main QC consideration is to be sure that all air bubbles have been removed from the electrodes before use, otherwise, erroneous values will result. It is also important that the same stock antioxidant solution be used in the field for the standard preparation and for sample analysis. Multiple readings will be made on each sample to determine precision. The before-sample run and after- sample run calibration curves will be compared by visual inspection of the mV readings to ensure that there was minimal drift while the samples were being run. The readings for each run should not differ by more than ±0.03 volts (~5%).

Grain Size

There are standard field procedures for soil properties, including grain size (Liu and Evett 1990). Most of these procedures are designed for description of soils as opposed to peats, which will comprise ~90% of our samples. Liu and Evett (1990) observed that estimating particle size components on the basis of dry weight in the field requires considerable experience and that frequent comparisons with laboratory particle-size analysis should be made. Therefore, we will rely upon laboratory analysis, as opposed to field determinations, for grain size. Samples will be collected as "grab samples" using either a stainless steel core tube or scoop.

After all field sampling is completed the samples will be returned to the laboratory for further analysis. Preparation of the samples for return to the laboratory consists of ensuring that the containers are tightly sealed, the outside of the tubes are clean, well-labeled, and the samples are put on ice for shipment. If the sample is to be analyzed for nutrients and contaminants in addition to grain size, it must be handled according to the guidelines discussed in section V.

The main QC consideration for core collection is proper sample handling and labeling. The samples should not be allowed to dry out before the grain size analysis can be completed. Replicate samples will be taken for QC.

A combination of wet sieving and pipette analysis as outlined in Folk (1974) will be used to analyze samples where information at a finer scale than just percent sand, silt, and clay is needed. The silts and clays will be further broken down into subclasses using the pipette analysis. The resulting analysis will give a grain size distribution that ranges from 3 to 9 phi by 1 phi size classes. In the case where only percent sand silt and clay is needed, a simpler hydrometer method (Liu and Evett 1990) can be used.

Section V.1 outlines the general QC procedures to be followed in the laboratory. The following guidelines are specific to this analysis. The pipette method involves measurement by weight changes; it is important to be extremely careful in weighing and be sure to write the weights down in the proper column on the data sheet. It is also imperative to verify the operation of the balance, with standard weights before use. Additionally, all techniques must use the same procedure for removing excess organic matter from samples undergoing grain size analysis.

Soil Redox

Soil redox is measured with an eH electrode. Insert eH electrode carefully in the soil at the desired depth (15 cm). If the soil is unusually hard, then a rod must be used to make a hole first. The probe must be allowed to equilibrate for ~30 min. To make a reading, attach an alligator clip to copper wire (which must be kept dry and not contact wet vegetation) and insert calomel reference electrode into surface water or wet sediment near the eH electrode. The proximity to the platinum electrode does not matter as long as the calomel makes contact with the soil or surface water. Record the reading; there may be some drift (~20 mV). If there are large fluctuations in the reading, double check connections. After sampling, soak electrodes in 30 % hydrogen peroxide solution for ~5 min, rinse, then place in storage container.

QC considerations for eH are (1) be sure that the eH electrodes are checked and calibrated before use; (2) be sure the millivolt meter is operating properly; (3) check the reference electrode operation; (4) be sure to allow the electrodes 30 min to equilibrate before taking readings; (5) be sure to soak electrodes in 30% hydrogen peroxide solution after use to prevent organic layer buildup; and (6) multiple electrodes will be used in each measurement plot, and two sets of readings will be made for each electrode in order to address precision. The potential of the calomel (+244 mV) must be added to the reading.

V.6 Surveying

V.6.1 Global Positioning Systems

Equipment

GPS data will be collected with equipment set to achieve sub-meter accuracy. Real-time differential corrections or post-processing can be conducted on data. Primary systems include a Trimble Pro XL 8-channel unit with TDC1 polycorder and 640 kb memory (with sub-meter accuracy) and Trimble Ag122, real-time differentially corrected receiver, set to achieve sub-meter accuracy. The secondary unit is a Trimble Pathfinder Basic Plus GPS for the rover (field) unit, a single frequency, 6-channel unit with 256 kb memory. The base station, located at NWRC in Lafayette, Louisiana, is a Trimble 4000 ST. This is a single frequency, 8-channel unit with 0.5 kb memory. The base station has been surveyed by treating the Trimble 4000 ST as a rover unit and taking GPS readings at several NGSM benchmarks for 2 hrs and then calculating the coordinates of the Trimble 4000 ST. The base station antenna will be surveyed in FY 95 to confirm these coordinates. A Trimble Navigation Beacon Model XL field unit, which is accurate to 2–5 m after differential correction, is also occasionally used when collecting field data depending on field conditions. Trimble Pfinder software (version 2.3.5) is used with the GPS units to differentially correct the field readings. Equipment setup, operation, and accuracy are conducted according to manufacture's specifications (Pro XL System Operation Manual, September 1994, Part# 24342-00, Revision B).

Base station locations

Base station files are obtained from the NWRC base station. The base station only runs during field data collection. If the NWRC base station is unavailable, base station files will be obtained from the Louisiana State University (LSU), Department of Civil Engineering, or other known base stations or benchmarks (National Geodetic Survey Monuments [NGSM]), which are located throughout the state. In the event of a base station failure while sampling, data will be obtained from one of two community base stations operating in Lafayette, La. (Navigation Electronics, Inc., or John Chance and Associates). Base station locations are at a maximum of 480 km, however, sub-meter accuracy is achieved within 50 km. If location is farther than 480 km, a portable unit with antenna is set up and used in conjunction with a benchmark location near the worksite. If there is not a benchmark within the area, LSU's base station is used.

Survey specifications

(1.) When taking GPS readings, a Trimble Pro XL unit with dual frequency receiver and internal Maxwell chip is used. The Nav Beacon XL is used in conjunction with this unit. Using both achieves sub-meter accuracy within seconds compared to using the old 180 readings that were averaged to get 2–5 m accuracy. Using the Basic Plus, 180 GPS points are taken at the same point and upon returning from the field, corrected with base unit files (4000 ST), and 180 points are averaged to get coordinates for the occupied point. The same point is used and the 180 points are averaged. The Basic Plus can be used with the Nav Beacon to receive 2–5 m accuracy every second in the field. If the Nav Beacon is not used, collect 180 points and differentially correct them with the base station upon return from the field.

(2.) Vegetation data will be recorded on vegetative checksite sheets at each GPS site (appendix B).

(3.) Two photographs are taken at each GPS site (usually a north-south and an east-west view).

(4.) After the GPS files are obtained, they are downloaded into a PC, and the base station files are used to differentially correct them back to the base station. GPS readings from known bench marks will be used to help determine the most accurate method for differential correction of field files. Once the 180 GPS points are differentially corrected, the corrected points are averaged to obtain the final GPS coordinate. Accuracy of the corrected data is usually to within 2–5 m.

(5.) GPS readings and checksite field sheet data shall be maintained in a digital data base, and copies of the digital files shall be transferred to the NWRC Project Manager for inclusion into the CWPPRA Regional GIS Data Base. A copy of the digital data set shall be used in georectification of photographs.

Datum

The datum used in GPS measurements can be a recognized datum, such as NGVD, a local datum related to project or research activities, or an arbitrary datum selected for expediency or convenience. The standard practice is to select a recognized datum. A field reading from this datum is used to check the accuracy of the GPS file readings and to aid in determining the most accurate differential correction procedure to use.

GIS compatibility

All GPS readings and ancillary data (field check site sheets; photographs including latitude and longitude) shall be recorded with necessary information for incorporation into the CWPPRA regional monitoring data base.

Special personnel and training requirements

The skills necessary to conduct mission planning, collect field data, and differentially correct GPS data require an extended knowledge of the theories behind the settings for the unit and options and experience in field deployment. At least one week of formal training (including a field and "lab" component) would be a minimum requirement. The technology related to GPS data collection is rapidly changing and refresher training in GPS data collection is recommended on an annual basis. Basic operation of the GPS equipment would be acceptable if all parameters and settings were adjusted by someone with complete knowledge of the equipment and the trainee only had to take the unit into the field and start/stop it, noting the file name and position on the photograph. A basic operation can be done by someone with less than a half day of training.

Mission Planning

Potential GPS and datum sites are located with aerial photography, and all GPS units are checked to ensure proper functioning prior to field data collection. Standard field equipment (tool box, maps, etc.) are assembled. Additional equipment as required by NWRC safety guidelines (e.g., cellular telephone, life jackets, etc.) are also assembled. Mission planning in terms of scheduling data collection is conducted using Trimble Pfinder software to determine the days and times when the most accurate data can be collected. An almanac is used in ProPlan to coordinate the best time for field work. It approximates the best times to be in the field for a given location based on the location of the 24 satellites in orbit. It is best to use at least a minimum of four satellites and a maximum of twelve. The most accurate data are obtained when the base satellite is at 10° above the horizon and the field (rover) unit mask is set at 15° above the horizon.

V.6.2 Elevational Surveys (ground)

Equipment

Elevational data are collected using appropriate surveying devices (e.g., total station, laser level, surveying rod, etc.) and a generally accepted method such as that described in Moffitt and Bouchard (1975). The equipment must be calibrated and accurate to at least 10 mm in the vertical and 50 mm in the horizontal.

Permanent benchmark locations and descriptions

Permanent benchmark locations and descriptions are obtained from recognized federal (e.g., NOAA, USGS, etc.) or state (e.g., Department of Transportation and Development [DOTD], etc.) agencies. These benchmarks are also identified as first or second order. Permanent benchmarks are always referenced and easily reoccupied. If no permanent benchmarks are present in the immediate vicinity, temporary benchmarks may be established to bridge the gap between the project area and the permanent benchmark.

Survey specifications

1. The first step in collecting elevational data is to set up the leveling device, which is usually done by the "levelman." This is done by spreading the tripod legs so that the tripod head is approximately vertical. The legs should be far enough apart and secured well enough to stablize the level. The instrument is then leveled by centering the bubble on the top of the instrument. The location of this bubble should be checked before and after every reading to ensure that the instrument remains level.

2. A second individual, the "rodman," will rest the survey rod directly on top of the object or location to be surveyed (e.g., marsh surface, benchmark, etc.). These numbers will be recorded by the levelman. It is important that the rodman holds the survey rod in a vertical position. In the coastal zone of Louisiana, this is generally equivalent to holding the rod perpendicular to the marsh surface (see section V.7.1), however, in sloped areas the rod may not be perpendicular to the ground.

3. The numbers read from the rod represent the vertical distance between the level plane and the surface being surveyed. This number can be used to calculate the relative difference in elevation between any given surface and an established benchmark.

4. To eliminate arithmetical mistakes in the reduction of field notes, the final elevation (or the difference in elevation) on each page should be calculated in two ways ("proving the notes"). First by summing the plus (+) and minus (-) readings and second by calculating the difference in elevation between each setup of the level. If these two values are identical, then it is reasonably certain that no arithmetical mistakes were made.

<u>GIS compatibility</u>

All elevational readings and ancillary data (field check sheets, photographs) shall be recorded with the necessary information (latitude, longitude, state plane coordinates) for incorporation into the CWPPRA Regional GIS data base.

<u>Special personnel and training requirement</u>s

Specialized skills necessary to collect accurate elevational data in the field require that personnel be licensed professional surveyors or be trained by and supervised by a licensed professional surveyor.

<u>Mission planning</u>

Mission planning is conducted well in advance to determine transect line locations, sampling intervals, and locations of permanent benchmarks. Sample locations are identified using aerial photography, engineer drawings (bluelines), and any historical or recent survey locations as reference points. Up-to-date benchmark information is obtained prior to sampling, and historical reference points are reoccupied to ensure data set comparability.

V.6.3 Elevational Surveys (aerial)

LiDAR

The FLI-MAP® System brings together the precision of OTF Kinematic GPS and the accuracy of scanning lasers. It is a totally portable system that will not rely on any antennas mounted to the aircraft fuselage, but antennas mounted to a FLI-MAP frame. This frame will hold the GPS antennas and the laser and video cameras. Imagery data will be collected to develop accurate modeling of any terrain surface, as well as planimetric feature mapping of the smallest detail. Its laser produces 10,000 pulses/second with a single return and the laser will incorporate pitch, roll and azimuth at the scan rate and incorporate system time. The horizontal accuracy is 15 - 46 cm (0.5 - 1.5 ft); vertical accuracy is 2 - 10 cm (0.07-0.33 ft); and a 70 - 80 m (230 -262 ft) swath with points falling in a 2 m (6.6 ft) long oval shape will be obtained.

The FLI-MAP® system incorporates an integrated INS/GPS from the industry leading manufacturer, Applanix. The accuracy is 0.05 degrees for pitch and roll and 0.08 degrees for azimuth. The data rate of the attitude measurements is flexible with a maximum rate of 200 Hz. The INS/GPS system provides 3 analog voltages to the laser to capture pitch, roll and azimuth. The system will also record all measurement data to post process the full inertial solution. This system is tolerant to 1-2 minutes of GPS outage while maintaining a fairly high degree of accuracy.

The FLI-MAP® system incorporates multiple rover GPS receivers in the aircraft and one or more ground-reference receivers. Two of the four rover GPS receivers provide the differentially corrected position of the aircraft for real-time pilot navigation. For missions requiring the highest level of accuracy and reliability, multiple ground reference stations are used. All GPS receivers, both rover and ground reference, record the carrier-phase measurements from each satellite. A Vertical Reference Unit (VRU) is used to measure pitch and roll of the laser sensor. The airborne rover receivers and the VRU provide a means for calculating an accurate aircraft azimuth and attitude, as well as a fully redundant and reliable three-dimensional aircraft position.

The scanning laser rangefinder is the heart of the FLI-MAP® system. It is a custom designed "eyesafe at the aperture" reflectorless rangefinder capable of measuring ranges from 12 to 300 meters. The range has been limited to 300 meters at a compromise to the high pulse repetition frequency to achieve the desired data density. The 300 meter maximum range thus coins the term "Near Field" remote sensing. The scanning laser collects up to 8000 range and intensity points per second. The intensity information also provides an active infrared imaging capability. Each record contains timing, laser attitude, laser range and intensity, and data verification/error detection information. The scan rate and scan angle are programmable based upon the data density.

Due to data formats and processing algorithms, all of the data from each flight is preprocessed to produce three-dimensional positions of the laser returns. The GPS data from the base stations and the primary navigation receivers on the helicopter are reduced to produce vector offsets and then least square techniques are utilized to determine a "best fit".

The contractor conducting the airborne lidar hydrographic survey, J.E. Chance, has developed a powerful software package called FLIP7© to process the FLI-MAP® data. FLIP7 is a Microsoft Windows 95 or NT 4.0 true 32 bit Windows application. This software package merges the helicopter position and attitude information with the LiDAR sensor data and video imagery. FLIP7 provides full CAD (Computer Aided Drafting) capabilities "on top of" the LiDAR data, providing additional capabilities to the operator in extracting valuable information from the FLI-MAP data. FLIP7, along with another Windows application called VcrController, controls the special time code capable VCRs. This allows the user to coordinate the video images with the processed LiDAR data to get a full multi-media presentation of the surveyed area. FLIP7 also provides a means to view and ortho-rectify the video images to gain additional information from the high-resolution images.

V.7 Vertical Accretion

V.7.1 Average Marsh Elevation

Fixed elevation datum is extremely rare in coastal Louisiana because the great accumulation of Holocene sediments continually compact and cause even the most carefully installed markers to subside. Therefore, in most coastal locations the only way to measure elevations is to make the measurements relative to average marsh elevation. Marsh elevation is not only practical to determine but is ecologically valuable because of the relationship between marsh elevation and marsh flooding frequency, and hence, plant stress and mineral sedimentation. Furthermore, the elevation of mean water levels will not change with respect to marsh elevations where the marsh vertical accretion rate is fast enough to counter global sea level rise and local subsidence.

Where traditional benchmarks are unavailable, marsh elevation is defined as 0.0 cm, and the elevation of any other item of interest is measured relative to this datum. Average marsh elevation is most likely to be needed when determining the placement of water level gauges, the elevation of water control structures, and the depth of ponds, but may be needed on other occasions as well. Even where traditional benchmarks exist, the average marsh elevation is needed if average water level (see section V.4.4), average flooding duration, and flooding frequency are to be determined from continuous water level data.

The most important consideration in obtaining repeatable, accurate, and precise estimates is to have a consistent definition of the marsh surface. The definition to be used in all

CWPPRA projects is that the surface is vegetated. If the survey rod (see section V.6.2) is not among living stems and not supported by soil containing living roots, then the rod is not on marsh. It will often be necessary to cut stems in some *Spartina patens* marshes where stem density is extremely high. The importance of placing the rod on soil supported by living roots is most apparent in what are commonly called clumpy marshes: marshes where the vegetation grows in distinct clumps that are higher in elevation than the unvegetated areas between the clumps. The difference in elevation between clumps and unvegetated areas varies widely from marsh to marsh, may vary over time, and may increase as marsh breakup progresses (Nyman et al. n. d.). When determining instrument height, a minimum of 20 elevations (each one separated by 5 m to 10 m) will be used.

In clumpy marshes, the elevation of the unvegetated area is of interest, but as noted, should not be used in defining average marsh elevation. If the marsh is flooded, then water depths (indicated on the survey rod) should be noted when each marsh elevation is made. Surface-water elevation can then be calculated and immediately referenced to a nearby staff gauge. Staff gauges will generally be available for all water control structures and all continuous data collectors, and along shorelines when pond (or lake) depth is being monitored. If the marsh is not flooded, surface-water elevation in ponds (or lakes) can be determined by carefully placing the rod at the water's edge. Generally, 10 measurements of water elevations are sufficient to obtain a precise estimate because still water elevation varies minutely. Surface-water elevation cannot be determined when waves occur.

V.7.2 Determination of Accretion Rates

Sedimentation rates may be lower in stressed marshes as a result of altered hydrologic patterns (Cahoon and Turner 1989; Delaune et al. 1989). The subsequent sediment deprivation may result in water-logged soil, nutrient depletion, and altered plant morphology, if not production (Mendelssohn and McKee 1988). Accretion rates can be measured by one of three methods: Feldspar Marker Horizons; Sediment Erosion Tables; and Radionuclides (^{137}Cs, ^{210}Pb).

<u>Feldspar Marker Horizons</u>

The Feldspar marker horizon is the simplest and consists of placing a layer of feldspar clay on the surface of the marsh. Over time, material is deposited on top of the feldspar, burying the feldspar marker. The depth of material that has accumulated (after some length of time has passed) is determined by collecting a core in the sample plot and measuring the distance from the top of the current marsh surface to the feldspar layer. The sample can be collected by using either a thin-walled core tube or by a cryogenic technique. This involves freezing marsh soil onto a copper tube and the extraction of a small diameter (5 cm) core without compaction (Knaus and Cahoon 1990). The cores can be sliced into 1 cm or larger segments while still frozen. This method is more field intensive than other methods involving coring devices, but the frozen cores allow easier laboratory analysis for bulk density than other standard practices (e.g., U.S. Department of Agriculture, Soil Conservation Service 1984). Alternative coring methods usually involve some compaction of sediment, which can be critical in the evaluation of soil bulk density. A large-diameter (15 cm) core tube can be used to minimize compaction, but it usually has to be dug from the substrate causing considerable disturbance. Such disturbance is not appropriate in areas that are being monitored, i.e., where repeated sampling is required. The core segments should be weighed while wet and then oven-dried before reweighing. The difference in weights indicates the water content of the soil and the weight of the dried segment which, when standardized for the segment volume, provides the dry bulk density. Organic matter content can be similarly determined by loss to ignition.

In using the feldspar marker technique, the sample plot in which the feldspar is to be set put should be at least 50 cm x 50 cm. Enough feldspar should be used to leave a layer at ~5 mm thick. This will require about 5 kg of feldspar. The location of the sample plot must be well marked for future sampling. However, do not place a marker pole directly in the plot since it may interfere with sediment deposition. When placing the feldspar on the surface, broadcast it in a uniform manner so as to obtain an even layer on the marsh surface. After the feldspar has been placed, wet it using a sprinkling can to solidify the layer.

The plots must be well marked so that they can be relocated for subsequent sampling. The plots are resampled after a known time interval (several months to a year later). At this time a core is collected within the plot. This core is later sectioned to determine the thickness of the material deposited on top of the feldspar marker. The thickness of the material provides an estimate of the accretion rate within the plot since the time period over which the material was deposited is known. It is imperative that the core be collected with very little compaction. The recommended technique is the cryogenic sampler as outlined in Knauss (1986).

Sediment Erosion Table

The sedimentation erosion table (SET) technique was originally used for measuring small changes in elevation on tidal flats in the Netherlands (van Erdt 1985) and is presently being used in marsh surface studies in Louisiana and Georgia. A 7.5-cm diameter aluminum pipe is inserted into the marsh surface and represents a datum against which marsh surface elevation is measured. A sedimentation table is placed on the notched pipe during measurement. The distance between the table and the marsh surface is measured by using nine thin aluminum rods. Changes in the distance between the marsh and the table represent changes in the elevation of the marsh surface. For each base the table can be placed in four positions, coinciding with the points of the compass, to give a total of 36 measures of marsh elevation for each plot.

Radionuclides (^{137}CS, ^{210}Pb)

Accretion rates can be measured by using the ^{137}Cs pattern found in soils (DeLaune et al. 1978,1983; Milan et al. 1994). This radioisotope is a residual of bomb fallout, which first appeared in 1954, peaked in the spring 1963, with additional large amounts in 1964, and has declined since with minor fluctuations. The radioisotopic activity of ^{137}Cs deposited with sediments can be used to date subsequent accretion above the 1954 or 1963 horizon, when the initial or maximum isotopic deposition, respectively, occurred. The depth at which the peak ^{137}Cs activity occurs will define the same time period for each of the cores collected. The depth to the 1963 layer can also be used to estimate accretion rates, however, caution must be exercised when making this measurement since compaction occurs when collecting a core, and the error associated with this compaction may be quite large. A 12 cm diameter plastic core is taken at a predetermined plot and returned to the laboratory for analysis where it will be sectioned into 1-cm increments and analyzed using a gamma counter for ^{137}Cs. If the compaction is greater than the allowable QC goal, discard the core and collect another. When a suitable core is obtained, be sure to record the compaction measurements and tube number on data sheets identifying site, date, and times.

Sediment accretion will be measured by counting the ^{137}Cs or ^{210}Pb activity as a function of distance down into the core. This is basically a three-step process: (1) the cores are subsampled into 1-cm sections, (2) the sections are dried, and (3) the radio isotope activity in each section is counted using a Gamma or Alpha counter depending upon the circumstances. The counting system consists of a detector interfaced with a spectrum analyzer. Basically, the system counts the radio isotope activity as a function of energy (in electron volts). The resulting energy spectrum is then analyzed to determine the amount of material of a given isotope that is present in the sample. In addition a subsample is taken from each section for percent organic determination using the method outlined in section V.5. It is anticipated that the counting will be performed by an outside laboratory. The laboratory must have written QC procedures approved by the program manager.

The main QC consideration is to be sure that the proper depth of the subsample from a core is noted and recorded both on the sample dish and on the data sheet. Sample numbers must be tracked carefully since the individual samples will be combined to yield a vertical profile, so the exact location of a sample is important.

The data are expressed as the relative activity (counts/second) per unit weight as a function of distance down the core. These values are used to determine the depth of peak Cs activity. This peak represents the 1963 depositional layer. This data can then be used to estimate the accretion rate, however, the effect of compaction must be taken into consideration since it can be quite high. The accretion rate can be calculated by the following:

accretion (cm/year) = depth to peak (cm) / ([year core collected] - 1963)

Since compaction was measured when the cores were taken, two values for the accretion rate can be calculated; one assuming all of the compaction occurred above the 1963 layer, the other assuming all of the compaction occurred below the 1963 layer. This will yield the range in accretion rate for each core.

V.8 Subsidence

Historical tide-gauge trends can be determined by using data from existing long-term gauges operated by the National Ocean Service and the U.S. Army Corps of Engineers (USACE). In addition, GPS benchmarks and extensometers can be used to monitor subsidence. Their location should be based on an understanding of the framework geology of each basin. Vertical extensometers are used to monitor aquifer compaction caused by withdrawal of groundwater. They consist of a well with a casing installed to a chosen depth. A pipe is placed inside the casing and anchored to the bottom of the casing. If the formation above the base of the casing compacts, the pipe appears to rise above the ground because it is free to move. Nests of three extensometers completed at different depths can be used to determine the amount of shallow compaction (or subsidence) and how it is vertically distributed.

V.9 Marsh Erosion and Soil Creation

Marsh erosion and creation can be defined on both a large scale (whole site) and a small scale (e.g., the edge of a marsh pond). The methodologies for the large-scale type of monitoring fall under the auspices of the habitat mapping group and are discussed in section V.3. The small-scale projects are those which will be carried out as field projects as discussed below.

Small-scale changes in the position of the marsh edge can be determined by one of three techniques:

(1) Repeated surveys of marker stakes (standard beach survey technique);
(2) Repeated measures of the position of the marsh margin in relation to a fixed point within the marsh (Letzsch and Frey 1980).
(3) Repeated establishment of the margin of he marsh using DGPS with sub-meter accuracy.

The survey technique provides information on marsh morphology and is more accurate but requires experienced personnel for surveying. The surveying techniques are discussed in section V.6. The Letzsch and Frey technique requires the insertion of posts at fixed positions in relation to each other and the original marsh edge. Subsequent measurements are made with a tape measure and do not require experienced personnel.

Another method of measuring lateral changes in shoreline positions is to use permanent stakes as a reference from which to measure shoreline position and make measurement over time. A strength of this method is that statistically powerful tests, e.g., repeated measures, result from the comparison of different areas over time. Thus, this method is well suited for comparison of erosion between project marshes and reference marshes, whether the erosion being measured is along large water bodies, navigation channels, or interior erosion resulting from tidal scour. A drawback of this method is that stakes are frequently lost to vandalism (if the area of interest is accessible via boat), fire (if the stakes are made from PVC), or rust (if the stakes are metallic). This method is, therefore, best-suited to interior broken marsh areas where the marsh is too shallow to be accessible without an airboat. Such areas are also unlikely to burn, thus PVC is a suitable material to use in the construction of those permanent stations.

Each station consists of a home stake and 3 direction stakes. All stakes are 1.9 cm PVC pipe inserted vertically into the ground; direction stakes are long enough that 1 m of stake extends above the ground; home stakes are long enough that they extend above marsh vegetation to aid in relocating stations. The home stake is positioned 2–3 m from the shoreline; direction stakes are all exactly 1 m from the home stake. One direction stake is positioned directly between the shoreline and the home stake; this is the center home stake. The other two home stakes are positioned such that they are at right angles to one another and equally distant from the center home stake. A frame constructed of 3.8 cm PVC pipe is used to ensure that all direction stakes are 1 m from the home stake.

All measurements of shoreline position are made relative to the center of the home stake. Measurements are made along a straight line that passes through the home stake and a direction stake, thus, three measurements of shoreline position are made at each station. The frame used for placement of the permanent stakes is needed during all measurements. The frame is slipped over the stakes when measurements are made to ensure that they are along the same line on each sampling date. Additional sections of PVC pipe can be added to the frame until pipe extends out over the shoreline. These sections of pipe are marked every centimeter and the position of the shoreline is recorded. A plumb line or rod with a bubble level should be used to ensure that the proper number is recorded.

It is critical to consistently define shoreline in a manner that is repeatable; thus, water levels cannot be used. The definition to be used in all CWPPRA monitoring is that marsh contains living roots of emergent plant species. Thus, species such as *Eleocharis parvula* cannot be used to define the marsh/ water interface. Perennial species such as *Spartina alterniflora*, *Spartina patens*, and *Panicum hemitomon* define the difference between marsh and pond areas. The position of annual plants such as *Pluchea foetida* or *Echinochloa* spp. also needs to be noted, but their growth may occur in pond areas during drawdowns and other prolonged, low-water levels and is temporary, and therefore does not generally indicate the position of the marsh/water interface.

Data should be collected and recorded so that variation resulting from station, direction, and time period will be accounted for during statistical analyses. It is also important to remember that the difference in shoreline position does not translate directly into the amount of shoreline erosion that occurred because of the geometry of the direction stakes. Measurements made on the left and right direction stakes are more sensitive to changes in shoreline position and must be converted to linear measurements with the relationship:

linear shoreline retreat = measured change * 0.7071

That relationship is based on the trigonometric function of a right triangle: sine = r/y, where = 45 degrees, r = the length of the hypotenuse, and y = length of the vertical leg. It is not necessary to make this conversion until after statistical tests are conducted. Measurements made on the center stake indicate linear change and do not require manipulation.

DGPS shoreline position establishment is a third method for detecting marsh erosion. DGPS data collection methods must take into account time periods between measurements and expected erosion rates on site. Slow erosion rates with close time periods between measurements may cause problems in interpretation of data, due to $\pm$ 1m accuracy of DGPS data.

Data collection will consist of recording data along the shoreline at intervals necessary to accurately define the marsh edge. Points will be collected no farther than10m apart (beaches), and will be obtained at approximately 1.5 m intervals in marshes. Since each reading should be accurate to within 1 m, shoreline position can be defined with 1 reading at each point along the shoreline. However, most shoreline positions will be determined by collecting and averaging a minimum of 20 readings at each point along the shoreline. A best fit line will be drawn connecting all points along the shoreline and comparisons of area changes along the line will be made to determine shoreline change. Data collection equipment and use is consistent with GPS equipment described in section 6.0

V.10 Vegetation Sampling

Species Composition and Relative Abundance

Monitoring of vegetation species composition and relative abundance requires compiling a list of all vegetation species, along with a measure of abundance or dominance, encountered within an area that represents the vegetative community. Relative abundance accurately documents the degree of change within an area by providing a measure of both dominance and evenness of species. It provides an estimate of the number of individuals per species in a given sample area and can be measured by percent cover estimates or stem counts, depending on whether the measurement needs to be relative or absolute, respectively. The precision of cover estimates is limited by the potential of introducing bias from one individual to the next. Therefore, it is recommended that the same individual(s) conduct the monitoring every sampling trip, if at all possible. Ocular estimates and low-level, ground-truthed aerial photography are qualitative techniques that could be used to measure relative abundances. The quantitative technique that could be used is stem counts.

The Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) will be used to identify species compositions and abundances. Rather than use a species-area curve to determine the minimal sample area size, a 4 m^2 sample area (replicate 2 m by 2 m plots) will be used as a standard in all emergent herbaceous vegetation communities. A minimum distance of 5 m will separate the replicate plots. Plots will be established from a differential GPS coordinate using a random azimuth and distance. If the plot location is in open water, the nearest vegetation will be utilized for establishment of the plot. One pole will be established in the southeast corner of the plot, unless otherwise noted; and the plot quadrate will be oriented north/south. The quadrate will be carefully placed on the vegetation, and all vegetation within the quadrate, whether rooted within the plot or not, will be included in the sample. The samples should fulfill the following requirements: the cumulative plot area should be large enough to contain all species, and the habitat should be as uniform and representative as possible.

The Braun-Blanquet method was used by CWPPRA monitoring from 1995-1998 using variable sample area's based on a modified species-area curve approach. No replicates were used but species were identified outside of the plots. Most of the projects used either a 1 m^2 or 4 m^2 sample area. Those projects that used a 1 m^2 sample area size will expand to 4 m^2, with the 1 m^2 embedded within. Replicates will not be established on these projects nor those projects that used 4 m^2 because of budgetary constraints. Species will continue to be identified outside the 2 m x 2 m plot in a 5 m radius from the plot. A 5 m ocular estimate must be calibrated using a 5 m tape measure prior to sampling.

The Braun-Blanquet Cover-Abundance Scale provides absolute values in relation to fixed plot sizes. The scale values (Braun-Blanquet Rank) used are (5) 76-100% cover, (4) 51-75% cover, (3) 26-50% cover, (2) 6-25% cover, (1) 1-5% cover, (+) <1% cover, and (r) solitary. Scale values chosen should not be deviated from for reasons of comparability. Depending upon the types of vegetation, the area could have either a single canopy or multiple canopies. A single canopy plot is one in which all of the vegetation is approximately the same height, with the same general growing form. As one looks down on the plot from above, all vegetation in the plot can be seen; there is no vegetation obscured by overlying vegetation of a different height (or growth form).

In a multiple canopy plot, the vegetation will be of different heights and/or growth forms. The different growth forms in the canopy are identified as tree, shrub, herbaceous and carpet. The result is that when viewed from above, all of the vegetation in the plot cannot be seen. Estimate the cover for the lower canopy, as if the upper canopy vegetation was not present, if possible. Otherwise the upper canopy vegetation must be physically removed (pushing it out of the way) before an estimate of cover of the lower canopy can be obtained. Percent cover (by species) of the sampling quadrate will be estimated ocularly by two observers. The observers will write down their cover values independently and compare. If values differ by more than 5%, this process will be repeated until agreement is reached. Cover estimates will be calibrated using a landscape density chart. Cover will be estimated as a percentage, and cover classes will be assigned during the data analysis phase. On the vegetation sampling data sheet, total cover of the plot (0-100%) will be documented, as well as all growth forms present.

Plant height is also documented for each plot. A minimum of 5 stems from the dominant plant species will be measured (cm) and averaged. The group of stems selected from the dominant plant will be those closest to the southeast corner of the plot. On the vegetation sampling data sheet, average height and dominant plant name will be documented. Even if the plant contains co-dominants, only one species will be measured and documented. It is anticipated that species dominance will change over time.

Qualitative observations are also important in evaluating changes in species composition and abundance over time. During each sampling trip, observations will be recorded regarding whether plants are chloritic, rack or debris on the marsh, herbivory damage, and marsh burning.

Vegetative Plantings

If your project design includes vegetation plantings, then percent survival will be determined in addition to species composition and relative abundance. The general condition of the vegetation plantings will be documented by monitoring a 10% sample of the plantings, provided sufficient budget is available. Each sampling plot will consist of 16 plants, from one or more rows depending on the planting design, with the sampling location determined by a random numbers table based on plant number and marked with a pole. Survival will be determined as a percentage of the number of live plants to the number initially planted after Mendelssohn et al. (1991). Percent cover estimates will be taken from the entire 16 plant plot to determine species composition and relative abundances for all species, including the plantings, using the Braun-Blanquet methodology discussed above.

Hydrophytic Classification

On projects that utilize dredge material for wetland creation such as terracing, there is a need to determine if the plant species that colonize the project area are indeed wetland plants. The vascular plants that colonize the dredge material will be evaluated and classified into a wetland indicator status based on a plant species frequency of occurrence in wetlands. The status will be obtained from the “National List of Plant Species That Occur In Wetlands: Louisiana” (Reed 1988). The five classifications to be used and their prevalence index values are obligate wetland (OBL = 1), facultative wetland (FACW = 2), facultative plants (FAC = 3), facultative upland (FACU = 4), and obligate upland (UPL = 5). Data will be collected using line intercept methodology on transects established across the dredge material. On terracing projects, a minimum of two and a maximum of four transects will be established per terrace (dependent upon length) with samples recorded at one meter intervals. All plants that are in the vertical plane of the line will be identified, assigned a prevalence index number, and averaged for each one meter segment. The number of segments with an average prevalence index value between 1 and 3 on each terrace will be determined and a percentage of the total calculated. A prevalence index of three or less represents a wetland plant community.

<u>Biomass</u>

Standing crop biomass is defined in terms of the accumulated dry weight of plant material at the end of the growing season, but before the peak accumulation has passed. The range of standing crop is from 300 to 1,200 g dry weight m^{2} in the northern Gulf of Mexico (Turner 1976). The clip-plot method (Mueller-Dombois and Ellenberg 1974) should initially be used to obtain aboveground biomass. It would require the clipping of all aboveground matter in established plots, drying it in an oven, and weighing it. Plot size and shape are just as important for obtaining accurate estimates of biomass as they are for the other measures. It is recommended that clip-plots be used until a regression line between plant size and biomass can be developed. This regression could be obtained by counting stems and measuring heights.

Aboveground biomass is harvested from the sampling plots. Remove all standing live and dead culms and litter from the sampling plot using clippers applied within 1 cm of the mud surface. The plant material clipped from each plot is put into labeled plastic bags. In the case of shrubs, they will be identified, counted, and then measured for stem diameter and total height. Shrubs will not be clipped unless they are small seedlings (~15 cm in height). The dead material remaining on the marsh surface after the plot has been clipped will be placed into a separate, labeled bag. This bag of dead material will be placed in the bag with the clipped material, thus the bag serving as a separate sample label should the labels on the outside of the clipped material bag be lost.

Upon return to the laboratory, the samples will be separated (by species) into live culms, dead culms, and litter (material left over on the table after sorting). Plant material is dried at 75°C to constant weight (to the nearest 0.1 g). Individual stem diameters will be measured in the laboratory using digital calipers. These morphological measurements are sometimes a simple substitute for measuring biomass, but because the relationship between morphology and biomass varies in the experimental treatments, morphometric relationships may also be an indicator of plant stress.

The main QC consideration for vegetation harvesting is to ensure proper identification of bags, spacing of the quadrant sides, and separation of vegetation components into live and dead materials. Adequate field notes must be taken in order to fully document the field data collection. If required, species composition and relative abundance should be measured at the same time as biomass by the same individual(s), if at all possible.

Data validation consists of being sure that sample numbers are double checked against the sample numbers listed on the data sheet. This is extremely important since the analysis depends on the weight of a given sample both before and after drying.

Since the vegetation is clipped from plots with a known area, the dry weight will be used to determine the aboveground biomass by the following formula:

Biomass (g m^2) = ([Dry sample weight] - [bag weight]) / plot area (m^2)

The general laboratory QC checks will be used at all times. Particular concerns for the vegetation include that the sorting laboratory will be supplied with a vegetation key in order to ensure proper species identification, and if a species identification is unsure, the sample will be put aside and local experts will be consulted to make the identification.

The minimum sampling frequency for all variables is annually. Within highly diverse fresh marshes, minimum sampling should occur in the spring and fall because of seasonal species changes, which do not occur extensively in brackish and saline marshes.

V.11 Herbivory

Herbivory is the consumption of all or part of a plant by a consumer. It can be calculated directly by a measurement of the plants themselves or indirectly by measuring the intensity of the herbivores in relation to a unit area. The limitations include the ability to determine cause and effect in terms of survival and stress of the plants.

It is suggested that during the project development stage, the evidence of herbivory should be evaluated to determine whether a qualitative or quantitative monitoring approach is necessary. For areas with intensive herbivory, a qualitative approach of looking at the presence or absence of vegetation by ocular estimates and/or low-level photography would suffice if historical vegetative composition is known.

A permanent plot method will be used to evaluate the effects of herbivory, if determined that herbivory exists. All measurements and techniques described above will be evaluated in caged versus uncaged permanent plots in problem or potential problem areas.

It is recommended that the Braun-Blanquet method be used when applicable because it has the broadest application for quantifying shifts in community composition and abundance. All other measurements can be incorporated into the sampling design required for this method in order to be cost and labor efficient. Sample designs will be specific for each project. Random selection of permanent transects or plots would be preferred, and distribution and frequency depend on project area and heterogeneity.

V.12 Submersed Aquatic Vegetation

Three techniques are commonly used by researchers to estimate Submersed Aquatic Vegetation (SAV) cover and relative composition. In many fresh and intermediate areas, water is extremely clear and SAV abundance is high. Cover and relative abundance of SAV can therefore be visually estimated. In more saline areas, turbidity is extremely high and SAV abundance is low. In such areas, frequency of SAV can be estimated from grab samples that are obtained at regularly space intervals on transects by dragging a garden rake as an airboat idles across the pond (Chabreck and Hoffpauir 1962, Nyman and Chabreck 1995). A third technique uses a 1 m^2 aluminum throw trap, which is commonly used to sample aquatic organisms (Kushlan 1981, Rozas and Odum 1987). After the trap is pushed into the sediment, the SAV is harvested (Castellanos 1997) or the water can be pumped out and SAV cover and abundance visually estimated.

Comparing SAV on a coastwide basis is problematic because of extreme variability in water clarity and SAV abundance. There are approximately 722,000 ha of lake and pond habitat in coastal Louisiana, of which 68% is likely turbid waters (Chabreck 1971). Visual estimation is the method of choice because it is extremely quick, accurate, and reproducible. However, the technique cannot be used in turbid waters. Regularly spaced grab samples have been time consuming in clear waters with abundant SAV because the great volume of SAV recovered greatly slows sampling (personal observation). Standardized methodology to compare SAV across the range of conditions encountered in coastal Louisiana do not therefore exist and must be adapted.

The technique that will be used to measure SAV will be a modification of the regularly spaced grab samples used to estimate frequency in Louisiana brackish and saline ponds (Chabreck and Hoffpauir 1962, Nyman and Chabreck 1995). Frequency is a more readily established quantitative measure than either the counting of individuals or the measurement of cover and is often considered a measure of abundance (Mueller-Dombois and Ellenberg 1974:69-80). However, frequency confounds abundance and dispersion because abundant species can have low frequencies if they are restricted to a few dense patches. For this reason and others, the ideal area of a sample is a point (Mueller-Dombois and Ellenberg 1974:69-80). The modified method differs from the previous garden rake method in that the garden rake is dragged on the pond bottom for one-second rather than three-seconds.

Standardizing the sample area demands that airboat speed be as uniform as possible. This requires that the airboat idles into the wind; during strong winds power can be increased as needed. Leaf, bud or root presence are generally required for a plant to be considered present in terrestrial sampling, but SAV is considered present if whole or part of an identifiable plant is returned to the surface by the rake. Another criteria to establish is the number of points sampled in any given pond. The number of points should never fall below 20 (Mueller-Dombois and Ellenberg 1974:69-80); therefore ponds less than 0.25 ha (roughly 0.5 acres) should be excluded from sampling. Accuracy increases with plot number to an unknown limit; therefore, as many points as reasonable will be sampled as the airboat idles across the pond on two transects that roughly divide the pond into thirds. There is likely no benefit of exceeding 100 points per pond. The transects will not be permanent so that their direction and starting point can vary among sample dates with wind direction. The final criteria to set is how

many ponds will be sampled at each study site. It is recommended that three representative bodies of water be sampled. The sample size for statistical analyses is therefore three.
In clear water habitats, cover and abundance should also be estimated visually in each pond and on an additional three, representative ponds. These data would not be applicable coastwide, but would allow smaller differences to be detected when comparing clear water habitats.

V.13 Fisheries Sampling

Juveniles and small adults (generally less than 100 mm total length [TL]) of the fishes and crustaceans should be targeted for sampling. Because the habitats being modified are usually nursery grounds for juvenile stages, the young are more abundant, making population sizes easier to estimate. Moreover, the best methods have been developed to quantitatively sample these small animals. Large juveniles and adults of these target species, if they are present in the area, will be extremely difficult to sample quantitatively. In addition, abundance measures for older juveniles and adults are subject to greater variances and may not reflect habitat value if populations are reduced by local fishing pressure.

The primary variables to be measured for juvenile fishes and crustaceans should be density (number of animals per area of bottom), size, and biomass. Because oysters and other benthic organisms are sedentary, however, different sampling techniques will be required for these species; monitoring for oysters can also include measures of recruitment, growth, and survival. The number of species (species richness) collected within a defined, standardized area should also be recorded. In certain instances, catch in standard gear (such as trawls and seines) may be measured rather than animal density. Catch per standard unit of effort (CPUE) can be useful in assessing relative abundance and species composition, but these data must be interpreted with caution because of the instability in catch efficiency.

Gear catch efficiency is a major issue that must be addressed in the selection of sampling gear. The confounding problem of variables affecting both animal density and gear efficiency can be avoided if the catch efficiency of the sampling gear is very high. Enclosure devices, such as throw traps or drop samplers (Kushlan 1981; Zimmerman et al. 1984), appear to have high catch efficiencies that do not vary substantially in the presence of vegetation (Zimmerman et al. 1986). In addition, recovery efficiency (a major component of catch efficiency) can be easily measured for these samplers through simple tagging procedures after the sampler has been deployed. The area sampled with throw traps is generally smaller than the area sampled with other types of gear such as seines and trawls, but increasing the sample number can generally compensate for this limitation. Drop enclosures are also limited to water depths less than 1–1.8 m, but water depth will probably be shallow for most habitat types to be sampled.

In some limited situations, trawls and seines may be useful in monitoring fishery abundance. These types of gear can be deployed in deeper water, sample larger areas, and provide data that are more comparable with historical data bases. Trawls and seines also have the advantage of being relatively easy to use, and they are more familiar to people conducting monitoring and are often preferred by research agencies. In general use, however, they are often only appropriate for measuring the presence or absence of species in an area. Abundances cannot be accurately measured in habitats where emergent or submerged vegetation is present; thus, comparisons among habitats are not possible. Trawls and seines can provide semiquantitative (moderately stable catch efficiency) abundance samples of nonburrowing animals in nonvegetated habitats. These data can be useful in making comparisons among nonvegetated areas if environmental factors that affect catch efficiency (such as turbidity and bottom type) are examined as potential causes of bias.

Throw traps similar to those described by Kushlan (1981) are recommended as sampling gear, but other gear types such as seines and trawls may be used. All gear types chosen are project-dependent.

Throw nets are typically thrown by one or two persons from the bow of a small boat. Motor noise, boat noise and shadows may bias sampling efforts and should be avoided. Under power, the boat can be positioned for a quiet approach to the selected sampling site, then the motor is turned off and the boat is allowed to drift quietly for some distance toward the site. Alternatively, the boat may be poled or pushed. Once the sampler is thrown, two or more persons should enter the water to check that the bottom ring is set into the substrate to prevent escape of the trapped organisms. Water quality samples and measurements, especially turbidity samples, are then collected before the area is further disturbed. It is also useful to record that the bottom ring was seated, that the bottom was or was not visible at the time the net was thrown, and whether or not rotenone was used. When the use of rotenone is not included in the design, a standard level of effort is necessary in attempting to recover all target species. For example, with a large dip net, six standard sweeps that each fully cover the enclosed area may be sufficient to capture a high percentage of all nekton species. Procedures for sampling with all gear types are described in Steyer and Stewart (1992).

QC checks must be maintained throughout data collection and analysis. Preserved samples should be checked upon return to the laboratory to ensure that each sample contains an adequate amount of preservative and is properly labeled. In some cases, fresh preservative may be needed if the biomass-to-fluid ratio is high. Samples should also be inventoried to confirm that all samples collected in the field have been deposited in the laboratory.

Water quality instruments should be calibrated before each sampling trip and checked again after each trip to ensure accuracy of data. Measurement of salinity, conductivity, temperature and turbidity should be conducted as a minimum during each sampling trip.

Before leaving a sampling site, the field data book should be examined to make sure that all data and samples were collected and logged.

Initial data entry should be verified independently against field and laboratory notebooks. This may be done by entering a data set twice and examining discrepancies, or by direct comparison of input sources with computer printouts.

Prior to analysis of data, preliminary screening should be carried out to identify data entry errors. Minimum and maximum values for each variable should be examined to identify potential errors in the coding process. Suspected errors should be verified by comparison with field or laboratory notebooks. The identification and removal or retention of suspected outliers not resulting from data entry errors is a statistical problem that must be discussed with a statistician.

Density, size, biomass, and number of species will be the primary variables of interest in most projects, and these variables should be summarized by sample, date, area (i.e., project or control), and stratum or habitat type. Environmental variables should also be summarized by sample, date, area (i.e., project or control), and stratum or habitat type.

For most analyses, independent samples will be analyzed in statistical designs that compare fisheries and environmental variables between project and reference areas by strata (if strata are necessary) and seasons. It will be useful to report means, standard errors, ranges and sample sizes for all variables.

V.14 Water Quality Sampling

This discussion applies to both water samples and sediment samples to be collected for the monitoring of nutrients and priority pollutants. Water and bottom material samples should be randomly collected throughout a site for the purposes of characterizing a site. The sampling should be stratified to include any potential contaminant sources. In cases where nutrients and priority pollutants are to be monitored, it is anticipated that a baseline survey would be conducted prior to implementation of a project, with a follow-up study after the project has been implemented.

The goal of sampling is to obtain a sample that is representative of the material being sampled, easily transportable, and can be handled easily in the laboratory. Thus, the sample must contain the same relative proportion of components as the original material sampled and must be handled so that no changes in these proportions occur between sampling and analysis. Sample collection and handling should follow the procedures listed in the Draft Inland Testing Manual (EPA 1994). The main concern of sampling is to ensure that no contamination of the sample occurs during collection and handling. In addition, samples must be collected and stored in the proper type of container for the analysis that is to be conducted. For example, samples that are to be analyzed for trace metals should not come into contact with metal surfaces (except stainless steel), and samples destined for organic analysis should not come in contact with plastic surfaces. Table 4 lists the types of materials appropriate for various analyses. To ensure a representative sample, several subsamples from a larger area can be combined into a single composite sample. Duplicate samples and field blanks should be collected along with the samples.

Table 4. Recommended procedures for sample collection and storage taken from the Draft Inland Testing Manual (EPA 1994).

Analysis	Collection Method	Container Type	Storage Temperature	Holding Time
Metals	Corer/Grab Sampler	Precleaned Polyethylene	<= 4ºc	Hg 28 Days (other 6 mos.)
PCBs	Corer/Grab Sampler	solvent rinsed, glass jar with Teflon® lid liner	<= 4ºc dark	14 Days
Pesticides	Corer/Grab Sampler	solvent rinsed, glass jar with Teflon® lid liner	<= 4ºc dark	14 Days
Aromatic Hydrocarbons	Corer/Grab Sampler	solvent rinsed, glass jar with Teflon® lid liner	<= 4ºc dark	14 Days
TOC	Corer/Grab Sampler	Precleaned Polyethylene	<= 4ºc	14 Days
Nutrients	Corer/Grab Sampler	Precleaned Polyethylene	<= 4ºc	24 Hours

Surface-water samples can be collected using a prewashed sample bottle made of material appropriate to the analysis being performed. The person collecting the sample should wear laboratorygloves to avoid sample contamination. For samples at depth, a remotely operated water sampling device, such as a Niskin Bottle, can be used. Again, the water sampler must be made of material appropriate for the analysis to be performed.

For sediment samples, a gravity (free-fall) coring device (with appropriate liners) is recommended when samples need to be collected at depth. However, a free-fall core can cause compaction of the vertical structure in the sediment. Thus, in cases where the vertical distribution of contaminants within the substrate is important, a vibra-core or piston core should be employed. In cases where only the surficial sediment is being sampled, a grab sample can be collected. The material from which the grab sampler is made should be appropriate for the types of samples being collected.

Nutrient samples need to be chilled to 4°C and treated upon collection and analyzed within seven days according to accepted methods. Trace metal samples need to be fixed at time of collection. Holding times are less critical; however, possibility for sample contamination is much greater. Synthetic organic samples need to be chilled or fixed and chilled at time of collection. Holding times are critical, depending upon class of compounds to be analyzed. Analyses of all water quality samples should be done according to accepted methods, such as those in the Draft Inland Testing Manual (EPA 1994).

Samples should be stored at the temperature listed in table 4. The samples will be turned over to the analytical laboratory for analysis. A chain-of-custody log will be maintained for each sample. This chain-of-custody log should provide the following information:

1. Sample Site
2. Sample Type
3. Collection Procedures
4. Data Collected
5. Environmental Conditions During Collection
6. Name of Individual Collecting the Sample
7. Field Storage Method
8. Laboratory Storage Details

The log is turned over to the analytical laboratory along with the samples. The analytical laboratory signs for the samples, and a copy of the log is kept by the analytical laboratory and the field sampling group. An example of a typical log can be found in appendix B.

As previously discussed, the main concern with sampling is to ensure that no contamination of the samples occurs. Contamination can occur if the sample is allowed to come in contact with inappropriate materials. Cross-contamination between samples can also occur if adequate precautions are not taken. The following general guidelines are to be used. Specific guidelines can be found in the Draft Inland Testing Manual (EPA 1994).

1. All sampling containers and sampling materials are to be made from materials appropriate for the type of sample being collected (table 4).

2. All sampling containers and materials will be cleaned before use. Items should be cleaned with a commercial laboratory cleaner (LIQUINOX®), rinsed with tap water then triple rinsed with distilled water. Some containers may require solvent cleaning and/or acid washing. The Draft Inland Testing Manual should be consulted (EPA 1994).

3. Sampling gear should be sealed in bags (using appropriate materials) in the laboratory prior to sampling. At a field station, the sampling gear can be removed from the bags for sampling. This will ensure no contamination of the sampling gear or containers during transport.

4. A separate set of scoops, spoons, and/or spatulas should be used at each sampling site whenever possible if more than two sites were sampled during the day. After sampling the first site, the scoops and spoons that were used can be placed in a plastic bag for used sampling gear. At the second site, a new set of scoops can be taken out and used. This will

ensure no cross-contamination between sample sites. If two sets of sampling utensils are not available, they should be cleaned between each sampling site.

5. Laboratory gloves should be worn during sampling. A new set of gloves must be used whenever a new site is sampled.

6. As soon as the sample bottles are filled, they should be sealed, cleaned, wiped dry with paper towels and a sample label attached to the bottle (all bottles should also be prelabeled with a unique numeric code). The sample label should contain all pertinent field collection information (date, time, sample site, sample type, and individual collecting sample).

7. After the label is attached to the sample jar (and sealed with clear tape), the samples should be place in the appropriate storage conditions (table 4).

8. A chain-of-custody log is to be maintained for the samples.

9. Field information sheets should be filled out at each sample site. These sheets list the date, the weather conditions, the observers, the sample site (with a sketch map), the techniques used, sample handling procedures, and any other comments (appendix B).

10. Upon return, the samples should be placed in the laboratory cooler and maintained at ~4°C until the samples can be delivered to the analytical laboratory. The samples must be delivered within the holding times specified for a given analysis (table 4).

It is anticipated that water nutrient and priority pollutant analysis will be sent to an outside contract laboratory that specializes in these types of analyses. The performance of the outside laboratory will be assessed by splitting some of the samples and giving the outside laboratory "blind" replicates. In addition, standards will be incorporated with the samples. The standards will not be identified as such to the outside laboratory.

In general, any outside laboratory chosen for the analysis must have a QA/QC Plan in place. Details of the QA/QC Plan, as well as details of specific methods and data on past performance, must be available for scrutiny. If the outside laboratory does not have a QA/QC plan, they must have written documentation of their methods.

In addition, the laboratory must have a person in charge of overall QA/QC who can supply the documentation. This person must also be willing to work with clients to resolve any problems. Results of the laboratory QA/QC program must also be available for review. The laboratory should be run by well-trained personnel who show evidence that they keep up with changing EPA regulations. The laboratory should be familiar with the types of samples being analyzed and should have up-to-date analytical equipment that is properly maintained (as evidenced by maintenance logs and/or a service program).

In addition to the above general considerations, the following more specific guidelines will also be used in laboratory selection.

The detection limits for the analysis being conducted should be low enough to meet the monitoring requirements set for an individual project and determined through the use of dilutions of the lowest standard to discover the first detectable response. In addition, the detection limit should be routinely verified and the verification data should be available.

Equipment should be calibrated using a 5-point calibration curve, which is not forced through zero. The standards used for the calibration curve should be in the same range as the samples being analyzed. The calibration should be routinely assessed during analysis through the use of check standards (every 10 samples). Calibration results as well as the check standard results should be available for inspection. Standard reference material, when used, should have concentrations in the same range as the material being analyzed. In addition, whenever possible the standard reference material should be similar in composition to the materials being analyzed (e.g., marsh sediment, estuarine waters). The accuracy and precision of the analysis, as determined through the use of internal standards and standard reference material, must meet the guidelines specified in table 2. Blanks should be run during the analysis in the sample stream (every 10 samples). The data should be supplied as "nonblank corrected," with the blank information included.

VI. COMPUTER SYSTEM

The CWPPRA regional monitoring data base, located at the Louisiana Department of Natural Resources , Baton Rouge, Louisiana, is designed to efficiently handle the need for data acquisition, organization, and storage of biological, hydrological, climatological, and geographical data. It has been carefully designed to meet the need for optimal storage capacity, multiuser capability, and user friendliness. The primary function of this system is to provide a centralized data base for all information necessary to document the effectiveness of restoration projects and to assist in the day-to-day operation of projects.

VI.1 Computer System Components

VI.1.1 Data Base and Network

The CWPPRA regional monitoring data base uses ORACLE as its relational data base management system. The system is a component of the SONRIS 2000 (Strategic Online Natural Resources Information System) initiative within the LDNR. It is web enabled, so that users within and outside of LDNR can access and utilize the system via a thin client environment. The system server is a IBM Numa-Q which is capable of storing real-time, continuous, and discrete data.

Data base hardware components:

1. Local Processing Facility (IBM Numa-Q)—Stores the digital data sets, runs all necessary software.

2. Ethernet—Allows for the transfer of information between the local processing facility and the various pieces of hardware and software utilizing the TCP/IP protocol.

3. Novell/Windows NT Server Network—allows access to the data base from locations within the Baton Rouge LDNR building. Workstations are networked to electrostatic color plotters, color thermal printers, and LaserJet printers.

4. Tape Backup System—Allows the retrieval of data in the event of data loss. This system is equipped to with 10 DLT tape drives, 388 cartridge library.

5. External Modems—Versilar 8000 w/24 modems provide the means by which files can be imported and exported to and from the data base via remote access

6. SGI O2 and Octane—These machines operate in a UNIX environment and house programs such as CPS-3, GIS, ARC/Info, Oracle, and Erdas, and permit large-scale data analysis functions.

7. Local Macintosh Network—Provides for desktop publishing, processing of GIS data, scanning images, producing slides, and other graphical media.

VI.2 Real-Time Data Acquisition System

The real-time data acquisition system allows LDNR/CRD to actively manage projects. Data collection platforms (DCP's), located throughout the Louisiana coastal zone, transmit data via a geostationary operational environmental satellite to the Wallops Island, Virginia, down link. The data is demodulated there and is transmitted via a domestic satellite to a receive station at the USGS computer center receive station in Baton Rouge, Louisiana. The USGS receive station is designed for continuous operation; however, in the case of a power failure or other incidents which would cause a lapse in data, the Wallops Island down link will automatically retransmit data not received. In the event of a DCP malfunction, a field crew may be dispatched to investigate and repair the DCP that same day, minimizing data loss. When the data reach the USGS computer center, it is quality checked and transmitted via T-1 line to LDNR where the data are stored in the ORACLE data base. Data not transmitted by satellite may also be entered through the PCs and stored in the data base. The simplicity of this setup is beneficial in that we have access to real-time data, automatic data retransmission, and ample access to the data base.

VI.3 Personal Computers

VI.3.1 Desktop

Each employee at LDNR/CRD is supplied with a Dell PC 586 or greater and has access to a networked LaserJet printer. These PCs are operated in a Windows NT environment with word processing done on Corel WordPerfect® 8.0, spreadsheet analyses done on Excel 97 or Lotus 4.01, and statistics are done on PC SAS 6.08. These PCs are networked and can communicate within LDNR/CRD and with the rest of the world via GroupWise 5.x, and Internet Explorer.

VI.3.2 Laptop

Laptop computers (Zenith Z-note , Dell series) are used by Geoscience Specialists to collect data from continuous recorders in the field. These computers are equipped with Windows 95, Excel, GroupWise, WordPerfect® and Internet Explorer.

VI.4 Maintenance Agreements and Upgrades

LDNR/CRD maintains maintenance and service agreements on all hardware and licenses, and on all software applications to ensure that repairs are made quickly and software remains updated.

VII. DATA REVIEW, VERIFICATION, AND ANALYSIS

VII.1 Data Validation, Verification, and Analysis

<u>Routine Procedures</u>

It is crucial that the data collected under the CWPPRA monitoring program be documented throughout its collection, analysis and subsequent storage. The guidelines for data collection and laboratory analysis are listed in the SOPs for each field method (section V).

Data will be entered into the CWPPRA Regional GIS Data Base from field or laboratory data sheets (appendix B) and digital files or directly from electronic dataloggers. Data are entered after all field data have been collected. Each data set will contain header information that describes the data set as well as the variable names on the data set. Data will first be sorted, merged (if needed), and calibration factors will be applied along with any corrections necessary to put the data into proper units for analysis.

Data files are to be saved to disk and a backup copy made as soon as the data from an individual station have been entered. Thus, in the event of a system failure, only data from a single station will have to be reentered.

Final Data Editing Procedures

After the data have been entered, the data files will be printed and the data file contents will be checked against the data sheets to ensure the proper numbers have been entered. Any corrections in data entry will be made at this time. The person verifying and correcting the data will initial and date the printout when verification and corrections are made. Only after the complete data file has been entered and verified will the data set characterization be changed to indicate that it is a final data set ready for analysis.

The data will then be analyzed to produce the following information:

1. Plots of the distribution
2. Lists of the extreme values
3. Frequency tables
4. Tests for normality.

These summary or preliminary type statistics, which will be performed on all of the variables as well as the QC data sets, will be the first analysis performed and will form the basis of the field data reports.

Treatment of outliers and/or suspicious values (values outside of the expected range, table 2) that are detected during the data entry and editing procedures will be flagged in the data set. Thus, during analysis the analysts will know that these are actual measured values as opposed to data entry errors. Outliers will remain in the data set for preliminary analysis but will be addressed in final analysis. Should an outlier be removed during analysis, it will be noted and the statistical reasons for doing so will be given.

VII.2 Data Analysis

General Guidelines for Projects

The actual statistical techniques to be employed for the analysis of the data collected for an individual monitoring project will be developed as part of the project monitoring plan. The general guidelines addressed in section V.1 must be observed in addition to the following:

1. The techniques to be employed must be statistically valid and verified by the biostatistician.

2. All data analysis techniques are to be fully documented.

General Analysis Procedures

The general techniques to be employed include (but are not limited to) the following types of analyses:

1. Data distribution (i.e., cumulative distribution plots, histograms)
2. Univariate statistics (means, standard deviation, etc.)
3. Regression
4. Trend analysis
5. Time series analysis
6. ANOVA
7. Testing of Statistical Assumptions

The exact procedures employed on any given project will be decided upon by the biostatistician assigned to the project.

VII.3 Statistical and Ecological Review

VII.3.1 Program Goals

Periodic statistical and ecological review is required to ensure that individual project monitoring plans are yielding results that allow for the evaluation of project effectiveness. This will be accomplished by periodic reviews of the data being collected and analyzed by a TAG biostatistician and wetland ecologist. These reviews may also involve the use of statisticians and ecologists from the academic community and will also supply an opportunity for modifying the procedures being used to allow for the use of new and/or different approaches. It is a goal of the CWPPRA Monitoring Program to employ state-of-the-art techniques in the statistical and ecological analysis of the data being collected.

VII.3.2 Evaluation of Statistical Techniques Employed

The statistical techniques being employed will also be evaluated on a periodic basis by TAG in conjunction with statisticians from the academic community. These reviews will ensure that all techniques are being properly applied to the data being collected.

This review will also be used to keep an updated timetable of the statistical analysis process for each of the projects. This timetable will list, for each project, the techniques being employed with an indication of the status of the analysis (e.g., complete, in progress, etc.). This timetable will also be used to keep track of any problems that may have developed during the data analysis process.

VII.3.3 Evaluation of Interpretation of Ecological Significance

The determination of statistical significance alone may not necessarily provide a correct ecological interpretation of the monitoring data. For example, a statistically significant difference in salinities may be so small as to have little or no impact on plant communities. Therefore the statistical procedures used and the results of the statistical analyses will be reviewed by the ecologist in light of their ecological interpretations and meaning.

VIII. DOCUMENTATION AND RECORDS

Project management and monitoring require the collection, analysis, and interpretation of environmental data from which project operation, maintenance, and management decisions can be made. Document and record management is critical to attaining the CWPPRA Monitoring Program mission. The following procedures ensure that any document (including all raw or transformed data or information not compiled into a finished report) or report is prepared in a timely fashion, reviewed, approved, used, revised, disseminated, and maintained. All documents and records are maintained for 5 years in accordance with state statutory requirements and then indexed and archived on the 11th floor of the LDNR/CRD building in Baton Rouge.

VIII.1 Data Entry and Editing

<u>Monitoring Manager Responsibilitie</u>s

1. Make two (2) copies of discrete data sheets and continuous recorder calibration sheets. Place originals in common area file and provide one of the copies to the Database Analysis Section (DAS).

2. Load continuous data into Oracle. Enter continuous recorder calibration sheets into Oracle and shift data, if necessary. The acceptance criteria for data drift over a month is 10%. Insure electronic shift conducted properly. Graph shifted specific conductance, raw depth, and temperature data (will graph shifted depth data when Oracle proficient). Review data for gaps and out-of-range or suspicious values and void, if necessary. Any voided data must be explained and initialed in comments box.

3. Shift depth data in Excel or other capable software. Insure electronic shift conducted properly.

4. Insure discrete data sheets entered into Oracle. Check 100% of values for accuracy and completion and make necessary changes; validate data. (Make sure checks are not conducted by same person entering data). If Oracle cannot accept data sheets, insure data entered in appropriate digital format.

5. Generate field trip report in Oracle and send copy to Field Office Supervisor for editorial review and approval. (At discretion of Field Office Supervisor, attached to the field trip report will be summary statistics of continuous depth and salinity data).

6. Provide QA officer packet that includes the following information for each project visited during field trip: a) QA/QC Data Checklist, b) LDNR/CRD Discrete Data Sheets, c) LDNR/CRD Continuous Recorder Calibration Sheets, d) any electronic data files from field trip not accessible in Oracle, and e) field trip report if not accessible in Oracle.

QA Officer Responsibilities

1. Insure that discrete data was entered into Oracle and was verified by the monitoring manager. (If monitoring manager enters data into Oracle, QA officer will perform 100% data verification).

2. Insure electronic shift was conducted properly on continuous data and verify against LDNR/CRD Continuous Recorder Calibration Sheet. Graph shifted specific conductance, raw depth, and temperature data (will graph shifted depth data when Oracle proficient) and review for outliers and suspicious values. Look at transitional periods at the beginning and end of each data record to insure proper continuity. Any questionable data values will be discussed with monitoring manager, and voided if necessary. Decisions regarding changes or voiding of data will be documented in comments section and initialed off by monitoring manager and QA officer.

3. QA/QC Data Checklist is completed by QA officer. Any questions not answered affirmatively are discussed with the monitoring manager. As specific issues are resolved, the QA officer will initial and date in the appropriate location on the QA/QC Data Checklist. When all issues are resolved, the QA officer will initial and date in the bottom right-hand corner indicating that the entire QA/QC Data Checklist has been completed. If any issues are left unresolved, or are to be resolved at a later date, this will be noted in the appropriate comments section. The QA officer will provide the original checklist to the monitoring manager for placement in the monitoring folder. The QA officer will also return datasheets to the monitoring manager.

Instantaneous data from a network of DCPs are input directly into ORACLE through the DRS. An ORACLE report form displays the number of data points successfully transmitted, maxima, minima, mean, times of missing data, and a graphical display of data used to determine the presence of outliers and times of poor data quality. Reports are referenced by DCP serial number and platform number. The reports are reviewed by the geoscience supervisor and any problems are reported to the geoscience manager and corrected. The DCP data are also accessed by USGS by modem. USGS personnel service the equipment in the field and provide LDNR/CRD with field inspection sheets (appendix B). If it is found that the instrument used in the field has drifted between calibrations, the data may be shifted according to algorithms determined by USGS as outlined in Novak (1985). An annual data report is published by USGS that includes all shifted data summaries. The ORACLE report form and annual data reports are periodically inspected by the QA officer.

External data such as that supplied by outside agencies or contractors are supplied in ASCII format on diskette with all fields identified and codes supplied. The monitoring manager for a particular project inspects all data received for completeness and accuracy. All reports summarizing data are kept in both project and monitoring files. Data on diskette is kept by the monitoring manager and a master copy is archived in the CWPPRA Regional GIS Data Base.

VIII.2 Filing

LDNR/CRD monitoring program files are located at the LDNR/CRD building in Baton Rouge and at each of three field offices. These files contain project files, reports, reprints, aerial photography, personnel information and other pertinent monitoring information.

1. Monitoring Plans

Monitoring plans are developed following a standardized format (appendix C). Hard copies of monitoring plans are kept in the monitoring project files. The plans are put into the folders by the monitoring managers and periodically inspected by the geoscience supervisor to ensure adherence to form and the latest updates. Finalized monitoring plans are available on the LDNR/CRD homepage at www.savelawetlands.org.

2. Monitoring Files

Monitoring files are maintained on each project. Each file has six sections: (1) monitoring plan, WVA, permits, operational scheme; (2) chronology of all events/meeting notes and field trip reports; (3) correspondence, phone conversations; (4) scopes of services, budgets; (5) data summary, graphs, tables; and (6) data summary, miscellaneous. These files are maintained by the designated monitoring manager and are reviewed at a minimum of every six months by the geoscience supervisor for completeness.

3. Photography

Aerial photography of project areas is maintained on the 9th floor of the Baton Rouge LDNR/CRD building and at the NWRC office in Lafayette, La. The USGS 7.5-min topographic maps document flight lines of the projects, and digital copies of flightlines are stored in the CWPPRA Regional GIS Data Base. A spreadsheet of projects flown is located with the photographs and is updated annually.

Photographs (35mm) taken of the project areas are stored in the miscellaneous data section of the project monitoring files. A copy of slides or prints is maintained in a filing system alphabetically by project.

4. Reports

Comprehensive Reports

Comprehensive Reports are written by monitoring managers for completed projects every 3 yrs and follow a standard scientific format. Final copies of reports are maintained in an open-file report index and are available on the LDNR/CRD homepage at www.savelawetlands.org.

Field Trip Reports

After each field trip a standard report (appendix C) is filled out by the field trip leader (geoscience specialist) to include auxiliary information such as vegetation appearance, unusual events, etc. These field trip reports are given to the geoscience supervisor for review and comment. Approved field trip reports are filed in the monitoring project files and auxiliary information is incorporated into the ORACLE data base. Project file folders are reviewed at 6-mo intervals by the geoscience supervisors for completeness, and any missing reports are replaced.

5. Data

The CWPPRA Regional GIS Data Base was designed to include enough space for at least 1 yr of data from all stations in the system now and for those planned in the future. The system is also capable of holding a shifted data set of equal space. Data must be archived every year after the original, and shifted data sets are inspected by the monitoring manager and approved by the geoscience supervisor.

VIII.3 Tracking

VIII.3.1 Project Time Lines

Monitoring responsibility spreadsheets identifying monitoring and management personnel as well as construction and monitoring plan status are updated continuously via networked computers. These forms include the TAG Responsibility Tracking Sheet and the Project Monitoring Responsibility Sheet (appendix C). These sheets keep all active participants in the CWPPRA Monitoring Program informed on all project time lines.

VIII.3.2 Field and Laboratory Samples

The labelling scheme for field and laboratory samples is determined by the project monitoring manager, geoscience supervisor and TAG prior to field sampling initiation. Field sample tracking sheets are filled out by the project monitoring manager and signed by any subsequent personnel transporting the samples to an approved laboratory.

VIII.3.3 Data and Records

Data and record tracking is an important aspect of information control and utilization. The term *tracking* in this section refers to the compilation and organization of data and records in a format that identifies its contents and location in order to make the data and records easily accessible to users.

Proper data and record tracking entails collecting all information relative to a particular project and organizing this material to enable users to locate and utilize the findings. Management strategy includes a filing system for all records and gives directions as to where other information relating to the project can be found. All number streams are compiled in spreadsheet files with corresponding reports generated from this information. The tracking system will allow the user to follow data from its raw form through spreadsheets, analysis and reports.

1. Hard Copy

   All data, documents, and records kept in the project files or the monitoring project files will be labelled upon entry into the file and tracked. Tracking codes will include basin, project number, type of file, file section, and document number. A cross-referenced file in Professional File or Pro-cite will be maintained by the Biological Monitoring Section Office Coordinator and periodically inspected by the geoscience supervisors and program manager.

2. Electronic

   All monitoring data will be stored on a magnetic medium. They will initially be stored on diskette and will later be copied into the CWPPRA Regional GIS Data Base and archived to tape. All data sets in spreadsheets will be identified by project (basin and project number), the type of data, and dates. A master file containing the names and locations of all data files will be maintained by the geoscience supervisor and will be inspected by the geoscience program manager.

IX. QUALITY ASSESSMENT

Success of the CWPPRA Monitoring Program will be determined at three basic levels: (1) sampling success, (2) project success, and (3) program success. Sampling success involves both measurement quality, which is discussed in section IV.4 and data quality which is discussed in sections IV.2, IV.3, and IX.1. Project success will be determined by reviewing measured data at periodic intervals to determine if the project is meeting its original goals and objectives. Statistical and ecological reviews of results, as discussed in section VII.3 will assist in the evaluation of success. Program success will be determined by the accomplishment of deliverables as discussed in section I.1.6 and by maintaining a high standard of quality throughout all program elements as discussed in the QMP.

IX.1 Data Quality

Data quality is the responsibility of all personnel involved in the monitoring program to ensure that all data collected are valid. Assurance of good quality data is necessary to determine whether project goals and objectives are met, to compare data among projects, and to assist in the design of future projects. Data quality will be ensured by management overview and audits throughout the process of data entry, transfer, reporting, and evaluation.

Data download and storage generally follow the guidelines established in general automated laboratory procedures (GALP) (EPA 1990). The Geoscience Supervisor oversees all data download and storage activities and facilities. This individual will ensure that the SOP for Computer System (section VI) will be followed and implemented correctly. Other daily, monthly, and periodic audits of data (discrete, continuous, and instantaneous) have been outlined in Documentation and Records (section VIII).

When it is determined by the geoscience supervisor, geoscience manager that data do not meet expected standards (sections III and IV), then corrective action must be taken. The Geoscience Program Supervisor has the authority to suspend or stop work upon notification by the appropriate assessment personnel. In the case of health/safety matters, the assessment personnel have the authority to suspend work. The Geoscience Supervisor will identify whether the problem is a personnel, equipment, data entry, data storage, data retrieval, or analysis error and devise a corrective action plan with the Geoscience Manager for immediate implementation. The Geoscience Supervisor will notify the Geoscience Program Manager and will monitor the identified problem and the corrective measure taken to ensure that the problems are resolved. The Geoscience Program Manager will be notified when the problem has been corrected.

IX.1.1 Field Data Quality

Since field data from projects are the basis for decision making, it is very important to ensure that documents related to field work are of high quality and are audited. To assure that all data collected in the monitoring process are valid and comparable, the Geoscience

Manager and Supervisors are responsible for standardizing methods of data collection and handling. The SOPs (section V) are strictly adhered to and all monitoring personnel are trained in the procedures.

All geoscience specialists are accountable for data collected and generated for each of their respective projects. They are responsible for inspecting the boat, vehicle, and equipment checklists and calibration sheets prior to every field trip. Should any boat, vehicle, or equipment failure occur, it is brought to the attention of the geoscience supervisor and documented in the written field trip report. Following each field investigation, all data must be reviewed by the geoscience specialist and QA officer for completeness and validity. Monthly meetings are held between the geoscience specialists and geoscience supervisors to discuss any problems or concerns and to provide additional training, if necessary. Overall adherence to protocol and accepted procedures as outlined in the SOPs for field measurements (section V) is audited by the QA officer and the geoscience supervisor. Any deviations from SOP procedures are corrected at the time of the occurrence or brought to the attention of the geoscience manager.

IX.1.2 Laboratory Data Quality

LDNR/CRD contracts out all laboratory analyses other than routine analyses. Scopes of services for necessary analyses are prepared by the monitoring manager and approved by the geoscience manager. The monitoring manager audits the work completed under the contract to ensure consistency with standards and procedures outlined in section IV.4 and fills out a Performance Evaluation for every laboratory contract. This form assesses quality, quantity, and timeliness of work completed. The QA officer reviews quality assurance guidelines provided by the contract laboratory to ensure compliance with SOPs.

IX.2 Personnel Quality

LDNR/CRD and NWRC assure personnel quality through minimum requirements for employment, training, and performance appraisals. Specific education and experience criteria are required for personnel to participate in the monitoring program (appendix A). These requirements establish the necessary knowledge base, and training provides the specific guidance mandatory for implementation of the program.

Training will be provided to all personnel as needed to perform to the quality standards described in this QMP (section II.2). Necessary training will be evaluated by geoscience supervisors and the QA auditor.

Annual performance evaluations are conducted on all personnel to provide an indicator of job knowledge, technical skills and ability, performance of duties, communication skills, interpersonal skills, and management skills and abilities. Areas that need improvement and specific training or skills are identified to assist in the quality improvement process.

If it is determined by the geoscience supervisor, geoscience manager, assistant administrator, administrator, and assistant secretary of LDNR/CRD that there is a failure to perform adequately by LDNR/CRD personnel, corrective action may be taken following Civil Service Rules, chapter 12 (Department of Civil Service n.d.).

IX.3 Program Quality

A program audit is conducted annually by the QA Manager to ensure adequate staff and facilities to perform necessary program obligations. Reports on general management issues will be kept by the QA Manager. Annual performance reviews and supervisor-project managers monthly meeting reviews kept by the geoscience supervisors will be evaluated as part of this audit. An independent, professionally recognized wetland ecologist contracted from the academic community will verify whether management decisions made by TAG and the program manager advance the goals of the Monitoring Program. A technical and management audit is conducted periodically by the TAG contract wetland ecologist. This audit will not only identify problem areas, but also any notworthy practices. The contract wetland ecologist may conduct an interim review of problem areas to ensure that problems have been resolved. Monitoring plans, field collection methods, data handling and analysis methods, and project monitoring reports will be reviewed and an audit report will be prepared (appendix C). The Geoscience Program Supervisor has the authority to suspend or stop work upon notification of audit results. Appropriate actions will be taken to alleviate any problem areas identified in the program and technical audits.

IX.4 Management Systems and Peer Review

Multiple QA and QC checks are performed at all phases of program implementation, as addressed in each section of this QMP, to prevent and/or detect quality problems. Since most activities are monitored by at least two hierarchical levels of supervision, problems are identified quickly and corrective action is employed promptly. CWPPRA Management is constantly informed of the quality process and has made a commitment to quality improvement activities. CWPPRA Management is fully aware that restoration science is a new field and that many avenues exist for improving monitoring technologies and the associated quality system. Evaluation of such technologies is encouraged as part of the quality improvement process. It is further understood that peer review is an essential component of this program, which leads to the development of better products and services.

IX.4.1 Quality Improvement Responsibilities

The specific quality improvement responsibilities of appropriate components within the CWPPRA Monitoring Program (figure 3) are addressed below.

IX.4.1(1) LDNR/CRD

LDNR/CRD will be responsible for planning, implementing and evaluating the effectiveness of all quality improvement activities associated with monitoring plan development, data collection and storage, statistical analyses, quality control criteria, data interpretation, and report generation. Assessments of their activities will be conducted through audits, performance evaluations, peer reviews, and technical reviews. The QA Manager has the responsibility for informing the CWPPRA management hierarchy on the assessment process.

IX.4.1(2) NWRC

NWRC will be responsible for planning, implementing and evaluating the effectiveness of all quality improvement activities associated with habitat mapping and GIS analysis (geographic information systems support) and other related monitoring as deemed appropriate by LDNR/CRD for each project. The QA Manager has the responsibility for informing the CWPPRA management hierarchy on the assessment process.

IX.4.1(3) Contracts

The wetland ecologist will assess quality assurance and data interpretation, whereas the contract biostatistician will assess statistical inferences and conclusions to ensure statistical validity. These contracts will assist LDNR/CRD in an assessment of the quality improvement process.

IX.4.1(4) CWPPRA Management

The Planning and Evaluation Subcommittee (P&E) is the recipient of all monitoring information as developed by LDNR/CRD, NWRC, TAG, MWG, and contracts and cooperative agreements. All monitoring activities and findings regarding the quality improvement process are addressed to the P&E Subcommittee and have line management authority to address the CWPPRA Technical Committee and Task Force.

X. INFORMATION EXCHANGE

The CWPPRA Monitoring Program will be generating a tremendous amount of data and information. The program ensures that information gathered is made available to the general public as well as governmental agencies and the research community (customers), as part of the Freedom of Information Act of 1966.

LDNR/CRD and NWRC are committed to reporting information in a timely fashion, that is, in an organized and understandable format. Sources of information include, but are not limited to: graphical outputs; GIS maps; verified and validated data; monitoring plans; and project and comprehensive program reports. All information is available on the LDNR/CRD homepage and CWPPRA homepage at www.savelawetlands.org orwww.lacoast.gov. respectively.

Customers will submit a written request for information outside that provided on the internet to LDNR/CRD or NWRC and these requests will be documented and catalogued in order to understand customer needs. When a specific request from a customer is received, it is processed to provide the customer, to the extent practicable, with the requested product. In most cases, the products and information being produced as part of the monitoring program that are available on the internet should be adequate. It will not be possible to produce "custom" products for each request. Customers, however, will have access to data used to produce the standard products and can re-format and/or reanalyze the data to fit their particular needs.

A mechanism is currently being developed for user access requirements that will ensure data integrity, security, and confidentiality. All data and information requests must be in writing and addressed to Louisiana Department of Natural Resources, Coastal RestorationDivision, P. O. Box 94396, Baton Rouge, Louisiana, 70804-9396.

XII. DEFINITIONS

LIST OF ACRONYMS

ANOVA	analysis of variance
ATV	all-terrain vehicle
CEI	Coastal Ecology Institute
CPUE	catch per standard unit of effort
CV	coefficient of variation
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
DAPS	data automatic processing system
DCP	data collection platforms
DOTD	Department of Transportation and Development (Louisiana)
DRS	DOMSAT Receive Station
GALP	general automated laboratory procedures
GIS	Geographic Information System
GOES	geostationary operational environmental satellite
GPS	Global Positioning Systems
LAC	Louisiana Administrative Codes
LAN	local area network
LDNR/CRD	Louisiana Department of Natural Resources/Coastal Restoration Division
LSU	Louisiana State University
LRS	Louisiana Revised Statutes
LUMCON	Louisiana Universities Marine Consortium
MWG	Monitoring Work Group
NBS/SSC	National Biological Service/Southern Science Center
NGSM	National Geodetic Survey Monuments
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetlands Inventory
PC	personal computer
P&E	Planning and Evaluation (Subcommittee)
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RDBMS	relational data base management system
RSD	relative standard deviation
SAB	Spatial Analysis Branch

SET	sedimentation erosion table
SOP	standard operating procedure
TAG	Technical Advisory Group
TL	total length
TM	thematic mapper
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
WVA	wetland value assessment

Units Definitions

Prefix	Symbol	Units
pico	p	10^{-12}
nano	n	10^{-9}
micro	M	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Conversion Table

multiply English Units by		to obtain metric units
inch (in)	25.4	millimeter (mm)
cubic inch (in^3)	16.39	cubic centimeter (cm^3)
square inch (in^2)	6.452	square cm (cm^2)
foot (ft)	0.3048	meter (m)
square foot (ft^2)	0.0929	square meter (m^2)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
mile (mi)	1.609	kilometers (km)
nautical mile	1.853	kilometers (km)
square mile (mi^2)	2.59	square kilometer (km^2)
mile per hour (mi/h)	1.609	kilometer per hour (km/h)
acre	0.4047	hectare (ha)
acre-foot (acre-ft)	1233	cubic meter (m^3)
fluid ounce (fl oz)	0.02957	liter (L)
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^3)
pounds (lb)	453.59	grams (g)
knots (knots)	51.48	cm per second (cm/s)

Temperature Conversion

Degrees Fahrenheit = 1.8 * (degrees Celsius + 32)

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APPENDIX A

Job Description and Requirements

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JOB DESCRIPTIONS AND REQUIREMENTS
LDNR/CRD BIOLOGICAL MONITORING AND
USGS NATIONAL WETLANDS RESEARCH CENTER STAFF

NATURAL RESOURCES GEOSCIENCE PROGRAM MANAGER

The Natural Resources Geoscience Program Manager's responsibilities involve a diverse array of technically oriented functions within the LDNR/CRD Biological Monitoring Section. The major role of this position is to successfully manage and administer the following objectives: monitoring of coastal restoration projects, development of new wetland restoration and enhancement techniques; development of a data base management system; quality assurance; statistical analysis; preparation of reports and public presentations; and interagency coordination. Work involves the supervision of project monitoring and subordinate Natural Resource Geoscience Program Supervisor positions. It further involves independent decision making and requires extensive knowledge regarding Louisiana's coastal area; report writing; computer operation; statistical analysis; public relations; and interagency coordination. The incumbent travels extensively throughout the state. These responsibilities are described in greater detail below.

35% The incumbent is responsible for managing the Biological Monitoring Section. This involves preparation of the section's annual goals and responsibilities and an evaluation of the timetables, budgets, staffing, contracts and resources necessary to meet responsibilities. Manages monitoring contracts and develops tracking systems for completion of responsibilities. Supervises subordinate Natural Resources Geoscience Program Supervisors and delegates management authority to appropriate staff to ensure completion of directed responsibilities. Reviews and evaluates staff productivity and develops management techniques to increase efficiency.

25% The incumbent is responsible for managing the monitoring efforts of LDNR/CRD that are directed towards various interagency efforts, such as the Coastal Wetlands Planning, Protection, and Restoration Program, Coastal Wetlands Conservation Plan, and Barrier Island Restoration Feasibility Study. This involves serving as a departmental representative on various Technical Advisory Groups and Monitoring Work Groups and directing subordinate personnel on activities that support these interagency efforts.

25% Responsible for managing the collection, analysis, quality assurance, and interpretation of data that will assist in a determination of restoration project effectiveness. The incumbent develops the work procedures and operational plans to manage this data so that it is technically valid and useful. The incumbent utilizes the latest environmental data acquisition technology and computer-aided data management procedures and is responsible for managing a data base of project-related information to accurately document project effectiveness. The incumbent will develop management options and recommendations based on the interpretation of data. Information will be synthesized into reports regarding the overall project effectiveness for use by the private sector and public agencies.

10% The incumbent manages the development of a coast-wide monitoring strategy that establishes standard operating procedures, quality management and assurance plans, and criteria for program assessment. Strategies will be employed for evaluating spatial and temporal data on project, basin and coast-wide scales, and objective methods for selection of management alternatives will be developed based on environmental characteristics and appropriate cost/benefit and risk analysis models.

5% The incumbent is responsible for attending meetings to develop input on various restoration projects, plans and programs proposed throughout the state whether or not implemented by LDNR/CRD. Many of these proposed projects require technical input from the Division before their implementation, and LDNR/CRD is the mandated lead agency for these types of projects. This would include constant liaison with legislators, state and federal officials, engineers, contractors, consultants, and the public concerning these proposed projects, plans and programs.

Minimum requirements: A baccalaureate degree with at least eighteen semester hours in any one or a combination of the following fields: biological sciences, environmental sciences, wildlife and fisheries sciences, ecology, or forestry plus seven years of professional level geoscience work. Two years of the required experience must have been at a supervisory level. Graduate training with at least six semester hours per thirty in any of the qualifying fields may be substituted for a maximum of two years of the required general experience on the basis of fifteen semester hours for six months of experience.

NATURAL RESOURCES GEOSCIENCE PROGRAM SUPERVISOR

The Natural Resources Geoscience Program Supervisor 's responsibilities involve a diverse array of technically oriented functions within the LDNR/CRD Biological Monitoring Section. The major role of this position is to supervise in the successful accomplishment of the following objectives: development of detailed monitoring plans for coastal restoration projects; monitoring of coastal restoration projects; development of new wetland restoration and enhancement techniques; data base management and statistical analysis; report writing; preparation and delivery of public presentations; and interagency coordination. Work involves project monitoring, supervision of subordinate Natural Resources Geoscience Specialists, independent decision making, and requires extensive knowledge regarding Louisiana's coastal area; boat handling and maintenance; environmental data collection and equipment maintenance; report writing; computer (personal and mainframe) operation; statistical analysis; public relations; and interagency coordination. The incumbent travels extensively throughout the state. Field work under difficult conditions is necessary at times. These responsibilities are described in greater detail below.

40% Responsible for supervising the monitoring management of coastal restoration projects that utilize techniques such as freshwater and sediment diversions; hydrologic restoration; marsh management; barrier island restoration; beneficial use of dredged material; sediment/nutrient trapping; shoreline protection; and vegetative planting. This involves preparation or review of project folders; monitoring plans and contract specifications; participation at various meetings and field trips; assistance in acquiring necessary permits; and preparation of other paperwork; making inquiries regarding materials and equipment; availability and cost; and supervision of subordinates and contract management.

25% The incumbent will supervise the collection and analysis of data regarding wetland restoration projects implemented by LDNR/CRD. This monitoring work involves boat handling; site reconnaissance; qualitative and quantitative data collection of biological, hydrological, and climatological data; utilization of various environmental instruments; analysis of samples collected in the field; and interpretation ofdata. The incumbent will develop and supervise reports regarding the overall effectiveness and environmental ramifications of the projects monitored for use by the private sector and public agencies. The incumbent will ensure that the reports are accurate and of the highest quality.

15% The incumbent will develop a statewide monitoring strategy that utilizes an ecosystem level approach. The incumbent will establish monitoring priorities for restoration projects and be responsible for the development and implementation of standardized methodologies for the collection, analysis and management of data.

10% The incumbent will supervise the management and analysis of data regarding wetland restoration projects implemented by LDNR/CRD. The incumbent will utilize the latest environmental data acquisition technology and computer-aided data management procedures and is responsible for developing a data base of project-related information to accurately document project effectiveness. The incumbent will employ sound experimental designs and utilize appropriate statistical analysis programs to ensure that data collected is statistically defensible.

10% The incumbent prepares procedural documents for office and field monitoring activities. The incumbent will provide training to lower-level Geoscience Specialists regarding sampling methods, safety procedures and quality assurance procedures. The incumbent must operate and maintain specialized monitoring equipment, possess navigational skills, have theability to read maps, quad sheets and aerial photography, and understand quality assurance criteria.

Minimum requirements: A baccalaureate degree with at least eighteen semester hours in any one or a combination of the following fields: biological sciences, environmental sciences, wildlife and fisheries sciences, ecology, or forestry plus five years of professional level geoscience work. Graduate training with at least six semester hours per thirty in any of the qualifying fields may be substituted for a maximum of two years of the required experience on the basis of fifteen semester hours for six months of experience.

NATURAL RESOURCES GEOSCIENCE SPECIALIST 3

The responsibilities of the Natural Resources Geoscience Specialist 3 (NRGS 3) involve a diverse array of technically oriented functions. This position is within the LDNR/CRD Biological Monitoring Section. The major role of this position is the successful accomplishment of the following objectives: development of detailed monitoring plans for coastal restoration projects; monitoring of coastal restoration projects; development of new wetland restoration and enhancement techniques; data base management and statistical analysis; report writing; preparation and delivery of public presentations; interagency coordination; and administrative support. Work involves a tremendous amount of responsibility and independent decision making, and requires extensive knowledge regarding Louisiana's coastal area. Specialized skills include: boat handling and maintenance; environmental data collection and equipment maintenance; report writing; computer operation; statistical analysis; public relations; and interagency coordination. The incumbent travels extensively throughout the coastal parishes. Field work may involve overnight stays and working under difficult conditions. More specific duties and responsibilities are described in detail below.

The incumbent of this position provides senior technical assistance to Natural Resources Geoscience Specialists in the collection, management, and analysis of data collected on wetland restoration projects and provides administrative assistance to the Natural Resources Geoscience Program Manager.

55% The incumbent is responsible for providing senior technical guidance to all staff that monitor coastal restoration projects such as freshwater diversions, sediment diversions, marsh management, hydrologic restoration, beneficial use of dredged material, sediment/nutrient trapping, shoreline stabilization, and vegetative restoration. Monitoring will determine project effects on vegetative growth and productivity, wildlife and fisheries productivity, water quality and sediment accretion. Senior technical guidance includes co-management of the collection, analysis, quality assurance and interpretation of data that will assist in a determination of the effectiveness of wetland restoration projects. The specific monitoring work includes site reconnaissance to determine project feasibility, pre- and post-construction data collection, data quality control and assessment, and data compilation and analysis. All of these activities require a knowledge of environmental field instrumentations, sample analysis techniques, data base management and biological data interpretation.

15% The incumbent assists in the development of an objective method for the selection of site-specific management alternatives that evaluates available restoration techniques based on environmental characteristics and appropriate cost/benefit and risk analysis models. The incumbent then assists in design of restoration projects based on biological and socioeconomic information. The incumbent will develop detailed monitoring plans that are unique and site-specific to each restoration project, and will determine the appropriate design, equipment, labor and transportation for the successful implementation of those plans. This will require innovative thinking and knowledge of state-of-the-art monitoring techniques. The incumbent will also utilize monitoring data to evaluate existing management schemes in order to determine if operational adjustments are necessary. The incumbent will also assist in the development of a statewide monitoring strategy that establishes monitoring priorities for restoration projects.

15% The incumbent is responsible for preparation of contract specifications, purchase requisitions, participation at various meetings and field trips, providing assistance in acquiring necessary permits, and making inquiries regarding materials and equipment availability and costs. The incumbent processes and performs detailed technical review of project documents such as: historical data reports, environmental assessments, feasibility reports, and permits. The incumbent also monitors contracts to assure that contract schedules and deliverables are in accordance with contract terms. This work consists of but is not limited to directing and supervising consulting firms selected by and under contract with LDNR/CRD to perform specific tasks necessary to achieve project objectives.

5% The incumbent utilizes the latest environmental data acquisition technology and computer-aided data management procedures and is responsible for developing a data inventory of project-related information to accurately document project effectiveness. Once the data is analyzed and interpreted, it is synthesized into reports regarding the overall effectiveness and environmental ramifications of the projects for use by the private sector and public agencies.

5% The incumbent prepares guidance documents for field monitoring and provides training to lower-level Geoscience Specialists regarding sampling methods and safety procedures. The incumbent must operate and maintain specialized monitoring equipment, possess navigational skills, and have the ability to read maps, quad sheets and aerial photography.

5% The incumbent will review technical literature and attend seminars and workshops to maintain familiarity with improved and innovative techniques. The incumbent will assess data compiled from statewide monitoring, special studies and other agencies to determine coastal conditions and to document changes or trends. The incumbent will conduct scientific evaluations of existing conditions of river, coastal and other natural resources, and prepare maps, technical literature and reports for dissemination to the legislature, environmental groups and other interested parties.

Minimum requirements: A baccalaureate degree with at least eighteen semester hours in any one or a combination of the following fields: biological sciences, environmental sciences, wildlife and fisheries sciences, ecology, or forestry plus four years of professional level geoscience work which includes administrative experience. Graduate training with at least six semester hours per thirty in any of the qualifying fields may be substituted for a maximum of two years of the required experience on the basis of fifteen semester hours for six months of experience.

NATURAL RESOURCES GEOSCIENCE SPECIALIST 2

The responsibilities of the Natural Resources Geoscience Specialist 2 (NRGS 2) involve a diverse array of technically oriented functions. This position is within the LDNR/CRD Biological Monitoring Section and may be downgraded to a Natural Resources Geoscience Specialist 1 for training purposes. The major role of this position is the successful accomplishment of the following objectives: development of detailed monitoring plans for coastal restoration projects; monitoring of coastal restoration projects; development of new wetland restoration and enhancement techniques; data base management and statistical analysis; report writing and preparation; delivery of public presentations; and interagency coordination. Work involves a tremendous amount of responsibility and independent decision making, and requires extensive knowledge regarding Louisiana's coastal area. Specialized skills include: boat handling and maintenance; environmental data collection and equipment maintenance; report writing; computer operation; statistical analysis; public relations; and interagency coordination. The incumbent travels extensively throughout the coastal parishes. Field work may involve overnight stays and working under difficult conditions. More specific duties and responsibilities are described in detail below.

55% The incumbent is responsible for the monitoring of coastal restoration projects such as freshwater diversions; sediment diversions; marsh management; hydrologic restoration; beneficial use of dredged material; sediment/nutrient trapping; shoreline stabilization; and vegetative restoration. Monitoring will determine project effects on vegetative growth and productivity, wildlife and fisheries productivity, water quality, and sediment accretion. Monitoring responsibilities include collection, management, and analysis of data to determine the effectiveness of wetland restoration projects. The specific monitoring work includes site reconnaissance to determine project feasibility, pre- and post-construction data collection, data quality control and assessment, and data compilation and analysis. All of these activities require a knowledge of environmental field instrumentations, sample analysis techniques, data base management and biological data interpretation.

20% The incumbent is responsible for assisting in the preparation of scopes of work, purchase requisitions, permit applications, contract specifications, and contract management. The incumbent conducts technical reviews of project documents such as: historical data reports, environmental assessments, feasibility reports, and permits.

10% The incumbent assists in the development of an objective method for the selection of site-specific management alternatives that evaluates available restoration techniques based on environmental characteristics and appropriate cost/benefit and risk analysis models. The incumbent will develop detailed monitoring plans that are unique and site-specific to each restoration project, and will determine the appropriate design, equipment, labor and transportation for the successful implementation of those plans. The incumbent will utilize monitoring data to assist in evaluation of existing management schemes in order to determine if operational adjustments are necessary.

10% The incumbent utilizes the latest environmental data acquisition technology and computer-aided data management procedures, and is responsible for developing a data inventory of project-related information to accurately document project effectiveness. Once the data are analyzed and interpreted, they are synthesized into reports regarding the overall effectiveness and environmental ramifications of the projects for use by the private sector and public agencies.

5% The incumbent will review technical literature and attend seminars and workshops to maintain familiarity with improved and innovative techniques. The incumbent will assess data compiled from statewide monitoring, special studies and other agencies to determine coastal conditions and to document changes or trends. The incumbent will conduct scientific evaluations of existing conditions of river, coastal and other natural resources, and prepare maps, technical literature and reports for dissemination to the legislature, environmental groups and other interested parties.

Minimum requirements: A baccalaureate degree with at least eighteen semester hours in any one or a combination of the following fields: biological sciences, environmental sciences, wildlife and fisheries sciences, ecology, forestry, physical geography, statistics, oceanography or agronomy plus two years of professional level experience in the qualifying fields.

Graduate training with at least six semester hours per thirty in any of the qualifying fields will substitute for a maximum of one year of the required experience on the basis of fifteen semester hours for six months of experience.

A graduate degree in qualifying fields will substitute for all of the required experience.

OFFICE COORDINATOR 1

The incumbent of this position performs highly responsible administrative support work in assisting the two Geoscience Managers over the Biological Monitoring Section (BMS) and the Database Analysis Section (DAS) of the Coastal Restoration Division (CRD), Office of Coastal Restoration and Management (OCRM), Department of Natural Resources (DNR), in coordinating the day-to-day activities of the Division. The incumbent operates a micro-computer in a Microsoft Windows environment, using software applications which include (but are not limited to): WordPerfect, Lotus 1-2-3, Excel, Oracle, Professional File, OrgPlus, Harvard Graphics, Procomm Plus (for modem operations), Netscape, and GroupWise (for e-mail operations).

30% The incumbent performs routine programming for electronic computer equipment and software and assists in developing new procedures for implementing and tracking programmatic activities (budgets, contracts, personnel, purchasing, monitoring plan development, monitoring data collection, reports development, information exchange, etc.). The incumbent establishes and maintains complex spreadsheets and other electronic files for identifying, recording and classifying stored data; modifies existing files to accommodate new or different information; extracts, assembles and merges stored information to create new documents; and links these files in a complex array such that they are available on the network for user integration by the field offices.

20% The incumbent designs, creates, and edits programmatic training and implementation documents that are used by the professional staff. The incumbent will type and electronically revise a wide variety of complex documents which are often technical, scientific or statistical in nature requiring knowledge of special vocabulary and symbols to ensure accuracy in spelling. The incumbent is responsible for compilation of statistics and preparation of routine annual and quarterly reports regarding the deliverables of the monitoring program.

15% The incumbent will type and revise correspondence, memoranda, briefs, reports, contracts, charts, statistical tables, graphs and other documents from recorded, rough, or finalized copy and proof typing results for typographical errors, spelling, punctuation and format accuracy from the 31 professionals and from members on an interagency technical advisory group. The incumbent is therefore responsible for a large amount of interagency coordination.

5% The incumbent is responsible for screening all correspondence. This includes receiving and routing mail to the appropriate personnel for disposition. The incumbent is responsible for answering telephone inquiries and preparing correspondence concerning information or assistance requests for the general public with regard to office policies and procedures.

5% The incumbent serves as the data and information distribution center for monitoring deliverables to federal, state, local, public and private entities. The incumbent is responsible for ensuring quality control of outgoing materials and correspondence to assure accuracy, consistency and conformance with departmental standards and procedures. The incumbent is also responsible for establishing office record keeping systems and procedures for these out-products.

5% The incumbent is responsible for the preparation of time sheets and payroll records for the BMS and DAS and the submission of those records to the Federal Assistance Section Office Coordinator 1 and Office of Management and Finance, respectively, for processing. The incumbent is responsible for independently preparing and submitting and/or encoding on the computer payroll records for the BMS and DAS (20 permanent positions, 11 job appointments, and 1-6 students).

5% The incumbent is responsible for expressing independent judgement, without prior approval, in coordinating the scheduling of important appointments for the professional staff at the Baton Rouge office and Thibodaux field office; arranging trip itineraries for official business trips and assuring that scheduling and materials are in order as required by unit personnel. This includes coordinating and overseeing travel arrangements for all professional staff at the Baton Rouge office and Thibodaux field office, including hotel accommodations, air travel, car rentals, etc. Prepares travel vouchers for all personnel in unit.

5% The incumbent performs support activities such as maintaining files and central records; monitoring office supply inventory and requisitioning office supplies as needed, tracking requisitions; and printing and duplication services. The incumbent also maintains a contract log of all pending and active monitoring contracts (approximately 10-20 per year) for the Program Manager in order to insure that all deliverable timetables are met.

5% The incumbent is a member of a Oracle database development and implementation Team that is testing CRD’s Project Tracking System and the Biological Monitoring Database System. The incumbent will train both technical and non-technical staff members in the BMS and DAS in the use of the Project Tracking System. The incumbent will be responsible for maintaining and ensuring the accuracy of the data entered into the Project Tracking System and the Biological Monitoring Database System by BMS and DAS staff members.

5% The incumbent supervises student workers. Such supervision includes implementing work procedures and making work assignments, including making recommendations for revising procedures to improve the unit's operations. Three functional student work units are supervised to implement the following assignments: 1) spreadsheet entry of biological reports and reprints; 2) correspondence filing and distribution; and 3) maintenance of vehicles, boats and biological equipment.

Minimum requirements: Ability to type at least 40 words per minute plus three years of experience in which clerical work was a major duty.

ECOLOGIST

The incumbent serves as an ecologist in a multidisciplinary group of specialists comprising the Spatial Analysis Branch of the USGS/NWRC. The major role of this position is to serve as the project manager for the CWPPRA monitoring activities. Additionally the incumbent's duties include project management on interagency projects; the preparation of interagency agreements, task orders, and requests for proposals; and collaboration with other USGS/NWRC scientists in the development and analysis of research projects and proposals.

35% Project manager - Work Unit 422, "Habitat Mapping and GIS Analysis for CWPPRA Monitoring Activities". Primary duties include the coordination of USGS/NWRC CWPPRA monitoring activities within the Spatial Analysis Branch (aerial photography acquisition, photointerpretation and GIS analysis) and with other agencies, primarily LDNR/CRD. Responsibilities include the authority as account manager for acquisitions and budget planning.

25% Project manager for reimbursable cooperative efforts including Status and Trends project for Barataria-Terrebonne National Estuary Program and the Breeding Bird Atlas with the Louisiana Department of Wildlife and Fisheries.

10% Develops study plans and requests for proposals for contracts from within and outside the Service. Preparation of interagency agreements and task orders.

10% Maintains close liaison and working relations with the scientific community relative to wetlands ecology, including professional personnel in other research laboratories, universities, and other agencies to minimize the potential for duplication of effort, to maximize achievement of common objectives, and to ensure that current wetland restoration techniques are made available to Service programs.

10% Maintains currency in the fields of optimal sampling, experimental design, statistical analyses, and biometrics relative to wetlands ecology. Maintains currency in the sampling methodology and analyses of parameters important to coastal restoration monitoring in such areas as hydrology, vegetation, and habitat mapping.

10% Designs and manages projects and studies, and works independently to provide a greater understanding of the effects of environmental perturbations in coastal areas, with emphasis on wetlands.

Minimum requirements: An advanced degree (Ph.D. or equivalent doctoral degree) or 1 year of specialized experience at least equivalent to the GS-11 level in biology or related field of science underlying ecological research, with undergraduate training that includes at least 30 semester hours in basic and applied biological sciences. These hours must have included at least 9 semester hours in ecology, and 12 semester hours in physical and mathematical sciences.

SUPERVISORY GEOGRAPHER

The incumbent is supervisor of the mapping section of the USGS/NWRC as well as a work unit project leader. Responsibilities of this position include the acquisition of aerial photography, the photointerpretation of wetland and upland habitats for present and historical time periods, and the cartographic representation of the photointerpretation on base maps. Project management and coordination activities include: coordination of aerial photo acquisition; providing supervision and technical assistance to photointerpreters and cartographers whose activities include managing and converting data bases; photointerpretation, preparation of maps and atlases; and technical support for GPS, laser-leveling techniques, GIS, cartographic projects, and extensive fieldwork. Independent research focuses on the areas of determination of mapping and photographic accuracy and the use of GPS in base map development and other relevant topics. Also, is responsible for QA/QC within the mapping area.

50% Manage mapping projects, evaluating CWPPRA, EMAP regional mapping, CBRA photo interpretation, and wetland and upland flight mapping.

10% Develops study plans and requests for proposals for contracts from within and outside the USGS/NWRC. Preparation of interagency agreements and task orders.

5% Maintains close liaison and working relations with the scientific community relative to wetlands ecology, including professional personnel in other research laboratories, universities, and other agencies to minimize the potential for duplication of effort, to maximize achievement of common objectives, and to ensure that current wetland restoration techniques are made available to USGS/NWRC and outside programs.

10% Designs and manages projects and studies, and works independently to provide a greater understanding of the effects of environmental perturbations in coastal areas, with emphasis on wetlands.

25% Technical assistance and consulting.

Minimum requirements: A bachelor's degree in geography, or related physical or social science such as geology, meteorology, economics, statistics, sociology, anthropology, political science, history, cartography, computer science, urban studies, or planning that included at least 24 semester hours in geography or related fields. Two years of the required experience must have been at a supervisory level. Also applicable is a combination of education and experience— courses equivalent to a major in geography or related field that included at least 24 semester hours in geography or related fields, as shown above, plus appropriate experience or additional education. Candidates must also have had 1 year of specialized experience equivalent to the GS-11 level, or Ph.D. or equivalent doctoral degree.

CARTOGRAPHER

The incumbent of this position provides support for mapping and aerial photographic acquisition for CWPPRA monitoring for the USGS/NWRC. The major duties of this position include CWPPRA project boundary file transfers, planning aerial photographic flight lines, map and photography archiving, indexing, quality control, field work related to the establishment of ground control and GPS, and graphics production.

25% The incumbent obtains digital copies of finalized boundary maps for each CWPPRA project site and imports the boundary files into appropriate software for flight line planning. The digital flight line files are kept in a computerized data base and a copy is transferred to the aerial photographic contractor for photo acquisition. The aerial photographic contractor returns digital files of completed photo acquisition. The incumbent incorporates any changes into the data base and transmits a copy to the main CWPPRA data base in Baton Rouge. The incumbent also maintains a computerized data base of all photography acquired. The incumbent shall maintain logs of all hard copy maps and tables of aerial photography acquired.

10% The incumbent performs map and photographic archiving for the USGS/NWRC, produces copies of maps for archives and for distribution, and distributes all completed map and aerial photography products associated with CWPPRA sites for USGS/NWRC. The incumbent develops and maintains a computerized data base system for map and photographic archives using data base software packages.

50% The incumbent participates in fieldwork to establish aerial targets and georeferenced mapping coordinates. This includes using GPS to georeference map targets; acquiring materials for aerial targets; the placement of targets in the field; maintenance of GPS base station and the acquisition of base station data; post-processing of GPS data; providing computerized GPS data to appropriate persons for photographic rectification; and transmittal of a file copy to the main CWPPRA data base. The incumbent prepares all field equipment for each field trip, inventories all field equipment after fieldtrips, cleans or maintains all field equipment as per manufacturer's instructions, and stores equipment, boats, and motors.

10% The incumbent performs quality control on data preparation and map review for map production work completed within the mapping section. The incumbent reviews hard copy tables of all digitized data produced for completeness, illegal labels, and conversion errors in polygons and acreage. The incumbent investigates existing errors in the mapping and digital processing and provides annotated maps for the corrections to be made.

5% The incumbent uses various software to produce graphs, tables, maps, or other materials needed by the supervisory geographer to aid in the development of presentations and/or publications worked on in the mapping area.

Minimum requirements: A bachelor's degree (or equivalent work experience), and a minimum of one year direct experience in map production, manual or automated. This individual shall be capable of communicating mapping concepts and interpreting requirements for successful project completion.

CARTOGRAPHER (PHOTOINTERPRETER)

The responsibilities of the photointerpreter involve a number of technically oriented functions. The position is in the mapping section the Spatial Analysis Branch of the USGS/NWRC. The major role of this position is the consistent and accurate photointerpretation of wetland and upland habitats from varying scale of aerial photography. Specialized skills include the use of stereoscope, a zoom transfer scope, a computer, GIS software, GPS and software, and laser leveler.

35% The incumbent produces 1:12,000- or 1:24,000-scale habitat maps using a stereoscope and a ZTS (zoom transfer scope). The maps will be produced from interpreted aerial photography of 1:24,000 or 1:12,000 scale.

10% The incumbent organizes and participates in field work to perform activities in the field for ground truthing maps for quality control, including cruising roadside habitats, site checks, filling out checksheets, taking photographs of each site, and annotating maps and aerial photographs for corrections, additions, and deletions.

5% The incumbent works with the GIS specialist in the production of accurate, detailed and current base maps from digitally scanned aerial photography or aerial videography for projects within the mapping section. This will include the scanning of the photography, acquisition of GPS or mapped positional locations, mosaicking photography, softcopy rectification of images, and plotting acceptable products for use by cartographers as base maps.

50% The incumbent provides support and manages other projects in the mapping section including seagrass mapping, Hurricane Andrew change detection, GPS surveying, and cartographic production.

Minimum requirements: A bachelor's degree (or equivalent work experience) and at least two years of experience in photointerpretation and remote sensing applications. This individual shall have the ability to interpret remote sensing data obtained from a variety of sources (e.g., aerial photography, satellite imagery, etc.) and be familiar with classification system design and implementation.

GEOGRAPHER (GIS SPECIALIST)

The incumbent is a member of the Spatial Analysis Branch in the USGS/NWRC with specialized skills including the use of a Unix workstation with the following GIS/RS software packages: ERDAS, PCI, ARC/Info and other packages as necessary. Duties include but are not limited to:

30% Operates the USGS/NWRC geographic information system (GIS) software, ARC/Info, with minimal supervision. Develops methodologies designed to analyze complex spatial models using the vector and raster functionalities of the GIS software.

25% Produces high-quality cartographic output products using the USGS/NWRC software and spatial data components. Product standards will be developed and adhered to by incumbent. Cartographic map components, such as bar scales and logos, will be correctly developed and standardized and used for all cartographic products.

20% Organizes and manages the spatial data bases and maintains a data dictionary containing pertinent information about the data. Develops a graphical library interface of the USGS/NWRC spatial data. The library will serve as a catalog of spatial data as well as a way to browse and access data.

15% Produces easy-to-use interfaces using the ARC/Info Arc Macro Language module and UNIX programming tools to provide access, modeling, and analyses of spatial data byresearchers and others not familiar with intricate command systems and functionality of GIS.

10% Provides training to USGS/NWRC staff regarding the use and application of GIS, specifically ARC/Info by developing training material and conducting training courses.

Minimumrequirements: A bachelor's degree (or equivalent work experience) and a minimum of two years experience in systems analysisand programming. Experience shall include one year of directing and supervising GIS software development activities for specialized applications. Specialized knowldedge is required of the principles, practices, methods, and techniques of GIS technology, as well as the proven ability to direct and advise otherprogrammers in solving complex programming problems. This individual shall be capable of programming major code units and have experience using a variety of computers, operating systems, and GIS applications software packages.

CONTRACT WETLAND ECOLOGIST (TAG)

This contract shall provide for a contracting party (ecologist) to perform the following tasks in support of the CWPPRA monitoring effort.

65% Assist TAG in the development of project-specific monitoring plans that may include but is not limited to:

1. evaluating historical ecological data and literature;
2. identifying goals and objectives and variables to be measured;
3. determining null hypotheses and statistical testing;
4. field investigations to determine heterogeneity of project area, potential control areas, and access to sampling stations; and
5. determining sampling design.

10% Provide management oversight to maximize the success of quality assurance/quality control activities under the CWPPRA monitoring program, which may include but is not limited to:

1. reviewing documentation procedures related to monitoring plan design, sampling, data analysis, and reporting;
2. reviewing implementation of standardized monitoring methodologies;
3. reviewing implementation of standardized training program;
4. reviewing selection of appropriate facilities and equipment; and
5. verifying and evaluating data for accuracy, precision, completeness, and representativeness.

25% Have the lead role in interpreting the results of data analyses and detecting trends in the ecological condition, which should include but is not limited to preparing narratives addressing:

1. project-specific results;
2. results by project type; and
3. basin-level (cumulative) effects of projects.

Minimumrequirements: A graduate degree plus five years of professional level experience in natural resources management or a related field of science underlyingecological research. Specialty must be demonstrated in the field of wetland ecology.

CONTRACT BIOSTATISTICIAN (TAG)

This contract shall provide for a contracting party (biostatistician) to perform the following tasks in support of the CWPPRA monitoring effort.

80% Assist TAG in the development of project-specific monitoring plans, which may include but is not limited to:

1. evaluating experimental designs, data analysis and the interpretation of statistical tests;
2. developing sampling and analytical protocols;
3. preparing statistics and graphics; and
4. providing recommendations that will ensure that the analyses, inferences, and conclusions drawn are valid and based on logic, scientific reasoning, and current statistical theory.

20% The contracting party shall support the ecologist and other TAG members in interpreting the results of data analysesand detecting statisticallysignificanttrends in the ecological condition, which should include but is not limited to preparing narratives addressing:

1. project-specific results;
2. results by project type; and
3. basin-level (cumulative) effects of projects.

Minimum requirements: A graduate degree and five years of professional level experience in statistical research, statistical computations, or the compilation of statistical data. Specialty must be demonstrated in the field of biostatistics.

APPENDIX B

Forms and Data Sheets

Boat Number:__________________

CHECK LIST FOR BOAT EQUIPMENT

- ☐ Check for all items below:
- ☐ Trailer lights working & not broken
- ☐ Grease trailer
- ☐ Grease motor
- ☐ Trailer light hook-up
- ☐ Bearing buddy covers
- ☐ Tie down straps in good condition
- ☐ Boat tied in front properly
- ☐ Air pressure in tires
- ☐ Winch connected properly
- ☐ Oil tank full
- ☐ Gas tank full (extra 2 gallon tank also)
- ☐ Safety chains intact
- ☐ Spare tire
- ☐ Running lights work
- ☐ All equipment (field instruments, life jackets, etc.) out of boat
- ☐ Boat, motor, and trailer are clean
- ☐ Flush motor with fresh water
- ☐ List of needed repairs on chalkboard and in maintenance book

BLACK BOX

- ☐ 3 Spark plugs
- ☐ Manual pullrope for motor
- ☐ Owner's manual
- ☐ Spare nuts, O-rings, and cotter pins for motor (in little bag)
- ☐ Tools
  - ☐ Flathead screwdriver
  - ☐ Phillips screwdriver
  - ☐ Diagonal cutting pliers
  - ☐ Channel lock pliers
  - ☐ Crescent wrench
  - ☐ Pliers
  - ☐ Needle nose pliers
  - ☐ Spark plug wrenches
  - ☐ Pocket knife
- ☐ Flare kit
- ☐ First aid kit
- ☐ 2 spare boat plugs
- ☐ Q-beam
- ☐ Q-beam adapter
- ☐ Roll black tape
- ☐ Roll duct tape
- ☐ Spare prop
- ☐ WD-40
- ☐ Raid wasp spray
- ☐ Insect spray
- ☐ Fire extinguisher
- ☐ Rear running light
- ☐ Key for motor

BOAT

- ☐ Spare gas tank (2 gallon)
- ☐ 1 gallon oil
- ☐ 12 gallon gas tank
- ☐ Black storage box
- ☐ 12 volt battery
- ☐ 2 push poles
- ☐ 1 paddle
- ☐ 2 boat plugs
- ☐ 2 bungee cords

COMMENTS

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SAMPLE CUSTODY LOG

PART A: TO BE FILLED OUT BY PERSONNEL COLLECTING,
STORING, AND SHIPPING SAMPLES TO ANALYTICAL LABORATORY

SAMPLE SITE:____

SAMPLE TYPE:____

SAMPLE NUMBERS:

__________ __________ __________ __________

__________ __________ __________ __________

__________ __________ __________ __________

DATE AND TIME COLLECTED:________________________________

SAMPLING TECHNIQUE:____________________________________

COLLECTED BY:______________________ OF ________________________

STORAGE:____

DATE AND TIME PLACED IN STORAGE:__________________________

STORAGE TEMPERATURE:______________CENTIGRADE

PLACED IN STORAGE BY:_________________ OF ______________________

DATE AND TIME REMOVED
FROM STORAGE FOR SHIPPING:______________________________

REMOVED BY:_____________________ OF __________________________

TEMPERATURE (PRIOR TO SEALING):______________CENTIGRADE

PART B: TO BE FILLED OUT BY PERSONNEL
RECEIVING SAMPLES AT ANALYTICAL LABORATORY

DATE AND TIME PACKAGE RECEIVED:__________________________

RECEIVED BY:________________________ OF ______________________

SHIPPING CONTAINER TEMPERATURE
(UPON OPENING):_____________________CENTIGRADE

DATE AND TIME PLACED IN STORAGE:__________________________

STORAGE TEMPERATURE:________________CENTIGRADE

PLACED IN STORAGE BY:________________ OF ______________________

F:\USERS\BMS_DAS\REPORTS\QMP 2000\QMP Appendices\Sample Custody Log.wpd

WETLAND PHOTOS DATA SHEETS

CHECK SITE NO.____________________ PHOTO NO._______________ DATE____/_____/______

REPORTED BY: Name____________________ (Title)__________________(Agency)______________

OTHER FIELD PARTY MEMBERS:____

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1. Location: 1:100,000 Map____

   LONGITUDE AND LATITUDE (if available)____

   STATE________________________________ COUNTY________________________________

   TOWN________________________________ USGS QUAD*____________________________

   WATERSHED__________________________ ECOREGION______________________________

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2. PRELIMINARY WETLAND CLASSIFICATION ACCORDING TO USFWS SYSTEM (1979) AS INTERPRETED FROM AERIAL PHOTOGRAPHY:

Site No.	A	B
Subsystem		
Class		
Subclass		
Water Regime		
Special Modifiers		

3. Description of Wetland Plant Community as Interpreted from Aerial Photography and Ancillary Sources.

Site No.	A	B
Soil Type from Soil Survey		
Photo Signature for Predominant Plants		
Photo Signature for Dominant Canopy Plants		

C Please attach copy of portion of quad showing location of subject field sites. Also attach ground photos of site to back of sheet.

F:\USERS\BMS_DAS\REPORTS\QMP 2000\QMP Appendices\Wetland Photos Data Sheet.wpd

Check Site No._______________ Photo No._____________ Date and Time_____________________

1. Location U.S.G.S. Quad____________________ LAT./LONG. (G.P.S.)_____________

2. IN-FIELD WETLAND CLASSIFICATION ACCORDING TO USFWS SYSTEMS (1979) (see NWI legend on separate sheet)

Site No.	A	B
Subsystem		
Class		
Subclass		
Water Regime		
Special Modifiers		

4. Description of Wetland Plants from Ground Observations

Site No.	A	B
Soil Type Observed in Field	Organic Sandy Loamy Clay	Organic Sandy Loamy Clay
Additional Comments About Soils		
Predominant Plants Observed in Field		
Dominant Canopy Plants Observed in the Field		
Predominant Mid-Canopy Plants Observed in the Field		
Predominant Ground Plants Observed in the Field		
Significant Indicator Plants		

A	Checklist of Important Field Observations	B
	Standing Water Present	
	Estimated Depth of Water	
	Saturation to Surface Only	
	Depth to Water Table	
	Tidal Influence	
	High Tide Presently	
	Low Tide Presently	
	Water Marks on Steps	
	Silt or Sand on Leaves	
	Debris Washing In	
	Hummocky Surface	
	Deep Stream Entrenchment	
	No Stream Entrenchment	
	Buttressed Trees	
	Roots Exposed on Surface	
	Areas of Peat Build-Up	
	Water Stained Leaves	
	Stream Channelization	
	Major Ditches in Area	
	Small Ditches at Site	
	Silvicultural Bedding Evident at Site	
	Evidence of Farming	
	Evidence of Grazing	
	Dumping of Trash in Area	
	Area Impounded	
	Evidence of Spoil at Site	
	Other Manmade Impacts	

Soil Observations		
Site	A	B
Soil Type		
Munsell: Matrix Hue, Croma and Depth		
Oxidized Rhizospheres		

MAP HISTORY - LARGE SCALE PRODUCTION

I. Production Control

1:100.000__________________________ Region_______________________________

Received___________________________ Origin________________________________

Quads 15/7.5________________________ Photos_______________________________

Transferred_________________________ Distribution___________________________

Comments/Special Instructions____

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Signature

MAP HISTORY - LARGE SCALE PRODUCTION

Production Control

1:100.000__________________________ Region_______________________________

Received___________________________ Origin________________________________

Quads 15/7.5________________________ Photos_______________________________

Transferred_________________________ Distribution___________________________

Comments/Special Instructions____

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Signature

II. Photo Interpretation and P.I. Tie Diagram

1:100.000__________________________ Region______________________________

Received___________________________ Started______________________________

Quads 15/7.5________________________ Photos______________________________

Date Completed______________________ PI. Hours____________________________

Personnel___________________________ ____________________________________

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Comments/Special Instructions____

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Signature

P. I.
TYING DIAGRAM

Map Name: ______________________________

Comments: ______________________________

III. USFWS - P.I. QC

Received_____________________________ Sttarted___________________________

Completed____________________________ Total Hrs.________________________

Personnel____________________________ Photos____________________________

Comments/Special Instructions ____

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Signature

IV. SCANNED PHOTOGRAPHY

Base Maps 15/7.5____

Date Received____________________ Projected Start Date____________________

Started__________________________ Projected Completion____________________

Completed________________________ Projected Hours_________________________

Total Hours______________________

Personnel________________________

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Comments/Special Instructions ____

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Signature

V. SCANNED PHOTOGRAPHY/QC

Base Maps 15/7.5____

Date Received____________________ Projected Start Date______________________

Started__________________________ Projected Completion_____________________

Completed_______________________ Projected Hours__________________________

Total Hours______________________

Personnel_______________________

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Comments/Special Instructions ____

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Signature

Section No.______________________
Revision No.______________________
Date______________________
Page__________ of __________

VI. Large Scale P.I. Review

Received____________________ Started______________________

Completed____________________ Total Hours______________________

Personnel____________________ ______________________

Comments/Special Instructions______________________________________

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Signature

VII. ZTS Corrections

Received____________________ Started______________________

Completed____________________ Total Hours______________________

Personnel____________________ ______________________

Comments/Special Instructions______________________________________

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Signature

VIII. SCANNED PHOTOGRAPHY/QC

Received______________________ Started______________________________

Completed______________________ Total Hours____________________________

Personnel______________________ ___________________________________

Comments/Special Instructions____

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Signature

IX. Large Scale Reprographics

Date Submitted to Reprographics____

Reprographics Completed________________ Hours__________________________

Shipping Date_________________________ Total Hours______________________

File Comments____

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Signature

LDNR/CRD Discrete Hydrologic Data Sheet

Sheet ___ of ___

Date ______________________ Project ______________________ Personnel ______________________ Agency ______________________

Instrument ______________________ Serial No. ______________________ Instrument ______________________ Serial No. ______________________

Station	CST Time (24 hr)	Staff Gauge (ft)	Depth (ft)		Temp (C)	Sp. Cond. (µS/cm)	Salinity (ppt)	D.O. (mg/L)	pH	Secchi (ft)	Other		Notes
											Parameter	Value	
				Bottom									
				Surface									
				Bottom									
				Surface									
				Bottom									
				Surface									
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Continuous Recorder Calibration Sheet

Project & Name | Station | Location | Date & CSTime

Constant Recorder | Serial Number | Dirty Battery Volts | Sonde Date &Time

Calibration Instrument | Serial Number

Collected By | Agency

Download Filename | File Size

Log Successful | Marsh Elevation (NAVD)

Dirty Reading	Temp (C)	SpCond (uS/cm)	Salinity (ppt)	Depth (ft)	Depth Out of Water	SpCond Difference
Constant Recorder						
Calibration Instrument						% Difference

Clean Reading	Temp (C)	SpCond (uS/cm)	Salinity (ppt)	Depth (ft)	Depth Out of Water	SpCond Difference
Constant Recorder						
Calibration Instrument						% Difference

Staff Gauge

Sensor Elevation (NAVD)

Water Level on Rod (ft)

Water Level (NAVD)

Staff Gauge (NAVD)

Staff Gauge - Water Level

Water Level Difference

% Difference

Water Level

Mark to Sensor Distance

Shift using Dirty Depth out of Water

Shift using Depth Difference

SHIFT

Calibration Required

Calibration Accepted

Comments .....

Standard (uS/cm)

DEPLOYMENT

Station | Location | Date & CSTime (*MM-DD-YY HH:MM*)

Constant Recorder | Serial Number | Battery Volts | Battery Changed

Deploy Filename | Duration days | Interval minutes

Notes .....

Calibration Formulas

Formula for % difference of SpCond:

% diff. of SpCond = [(SpCond (Sonde) – SpCond calibration instrument) ÷ SpCond calibration intrument] x 100

[(1990 – 1956) ÷ 1956] x 100= 1.7%

Formula for % difference in Water Level:

% diff. of WL = [(dirty WL reading – clean WL reading) ÷ clean WL reading] x 100

[(2.15 – 2.17) ÷ 2.17]**l** x 100 = 0.92%

U.S. GEOLOGICAL SURVEY, WRD
INSPECTION SHEET FOR DCP SITES

DATE ______________ INSPECTED BY ______________
STATION NAME ______________
STATION NUMBER ______________

DCP READINGS

Serial # ______________

		BEFORE CLEANING Watch Time ______	AFTER CLEANING Watch Time ______
CD	PARAMETER	READING	READING
1	STAGE		
2	CONDUCT. (conv)		
3	VELOCITY		
4	TEMPERATURE		
5	PRECIPITATION		
6	WIND SPEED		
7	WIND DIRECTION		
8	BATTERY VOLTAGE		

HYDROLAB READING

Hydrolab # ______________ Last Lab Calibration ______________

FIELD CONDUCTANCE CALIBRATION

Standard	Temp of Standard	Init. Reading	Adj. Reading

FIELD READINGS

Parameter	Reading	Parameter	Reading
Temperature		Diss. Oxygen	
Conductance		pH	
	DEPTH		

OTHER CHECKS

Tape Down Measurements			Instruments checked/ cleaned	
Reference Point	=		Pressure Transducer	
Tape Down + 1.0	=		Diss. Oxygen Probe	
Water Surface	=		Temperature Probe	
Inside Gage	=		pH Probe	
Outer Gage	=		Raingage	
Checks w/ DCP	=	s yes s no	# of test tips	
			Conduct Probe	
			depth of probe	

REMARKS: ______________

CONDUCTANCE CONVERSION (before cleaning)

DSP conductance reading = ((______________)/4 * 50000)/16 =________________.

CONDUCTANCE CONVERSION (after cleaning)

DSP conductance reading = ((______________)/4 * 50000)/16 =________________.

Shoreline Marker Data Sheet

Project: ____________________ Personnel: ____________________ Date: ____________

Station	Measurement (ft)		
	1 - Left	2 - Center	3 - Right

Sediment Erosion Table Data Sheet

Project: ____________________ Station: ____________________ Group: __________

GPS Coordinates: ____

Personnel: ____________________ Date: ____________________ Time: __________

Measured By: ____________________ Adjusted By: ____________________

	Compass Heading			
Pin No.	North	South	East	West
1				
2				
3				
4				
5				
6				
7				
8				
9				

Comments:

Accretion Measurement Data Sheet

Feldspar Cryogenic Coring Technique

Project: ____________________________________ Date: ____________________________

Personnel: __________________________________ Measurer of Cores: ________________

			Cryo-Core		Accretion Measurements (mm)							
Station	Group	Time	X-Coor.	Y-Coor.								

Notes:

Vegetation Sampling Data Sheet

Modified Braun-Blanquet Technique

Sample Type: _____Stratified _____Random _____Transect NATURAL _____ PLANTED _____

Project: ___________________________________ Station: _____________________ Group: _______________

Personnel: ___________________________________ Plot Size: _____________________ Date: _______________

Station Coordinates: ______________________________

Plant Community Type: _____Freshwater _____Intermediate _____Brackish _____Saline _____Cypress-Tupelo Swamp

_____Other (describe) ____

Percent Cover: Total Cover _____% Tree _____% Shrub _____% Herbaceous _____% Carpet _____%

Average Height: Dominant Height _____(m) Tree _____(m) Shrub _____(cm) Herbaceous _____(cm) Carpet _____(cm)

Species List

Scientific Name	Common Name	Species Code	% Cover	B-B Rank	IN / OUT	# Planted / # Alive	Wetland Indicator Status

B-B Rank: (5) 76-100%, (4) 51-75%, (3) 26-50%, (2) 6-25%, (1) 1-5%, (+) <1%, (r) Solitary

Wetland Indicator Status: OBL = 1, FACW = 2, FAC = 3, FACU = 4, UPL = 5

Comments:

Planted Vegetation Plot Percent Cover Estimation Data Sheet

Species List	% Cover for each Species in each Plot								Total cover
Scientific Name	1	2	3	4	5	6	7	8	
									0
									0
									0
									0
									0
									0
									0
									0
									0
									0
									0
									0
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									0
									0
									0
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									0
									0
									0
									0
									0
									0
					Total cover in the plot				0

INSTRUCTIONS

On the reverse side of this sheet; fill in the top of the sheet, fill in the column, # Planted\ # Alive.

Divide the 16 plant plot into 8 2-plant subplots. Record species and cover values for each subplot using SOP's. Totals can be calculated when the data is entered in the office

In the Office, tranfer Species and total cover values to the reverse side. Fill in common name, species code, B-B rank, and wetland indicator status.

Submersed Aquatic Vegetation (SAV) Transect Data Sheet

Modified Rake Technique

Project: Personnel: Pond Center GPS Coordinates:

Station (pond): Group:

No. of Samples: Date: Sheet of

Species Abbreviations

A = Alga (A1=alga1, etc)
Ca = Cabomba carolinianum
Ch = Chara (Ch1 = sp.1, etc.)
Ce = Ceratophyllum demersum
E = Eleocharis (E1 = sp.1, etc.)

M = Myriophyllum spicatum
Na = Najas guadalupensis
Ne = Nelumbo lutea
O = Ottelia alismatoides
P = Potamogeton (P1= sp.1, etc)

R = Ruppia maritima
V = Vallisneria americana
Z = Zannichellia palustris
_ = ________________
_ = ________________

Sample No.	Species Present	Depth (ft)	Water Temp (C)	Sp. Cond. (uS)	Salinity (ppt)	Sample No.	Species Present	Depth (ft)	Water Temp(C)	Sp. Cond. (uS)	Salinity (ppt)
1						21					
2						22					
3						23					
4						24					
5						25					
6						26					
7						27					
8						28					
9						29					
10						30					
11						31					
12						32					
13						33					
14						34					
15						35					
16						36					
17						37					
18						38					
19						39					
20						40					

Notes:

Fisheries Sampling Data Sheet

Station________________ Date________________ Time________________

Project________________ Group________________ Personnel________________

Sample Type: Drop Sample / Throw Trap

Site Location: Project Area / Reference Area

Habitat Type: Marsh SAV Unvegetated # of Jars________

Weather

Cloud Cover_____% Wind: Direction_____ Velocity_____mph
Other____

Hydrography

Salinity_____ppt Distance to Edge(Center)_____ft
Temperature_____°C Bottom D.O._____ppm
Sample Water Depth: _____ft
Turbidity _____ftu

Vegetation

Species__________________________________Stem#________Dry Weight________gr
Species__________________________________Stem#________Dry Weight________gr
Species__________________________________Stem#________Dry Weight________gr
Species__________________________________Stem#________Dry Weight________gr

Core Sample Taken? YES / NO %Cover of SAV______%

Notes

____
____
____
____
____
____
____

QA/QC DATA CHECKLIST

11/8/00

Project Number: | Date discrete data collected: | QA officer:

Monitoring Manager: | Time period for continuous data: | Date approved:

#		Question	QA Officer's Initials and Date
1	Y / N COMMENTS:	Was a field trip report generated ?	
2	Y / N COMMENTS:	Were all data entered on datasheets and calibration sheets correctly? (i.e., data entered in correct columns all information entered in correct units)	
3	Y / N COMMENTS:	Were discrete data entered correctly into Oracle? Were any data missing	
4	Y / N COMMENTS:	Were continuous recorder calibration sheets entered correctly into Oracle?	
5	Y / N COMMENTS:	Were continuous data entered correctly into Oracle? Were any data missing	
6	Y / N COMMENTS:	Were specific conductance data shifted for biofouling? If not, list station # and recorder id #	
7	Y / N COMMENTS:	Were water level data shifted for biofouling? If not, list station # and recorder id #	
8	Y / N COMMENTS:	Were all water level data converted to a known elevational datum? (Outside of Oracle	
9	Y / N COMMENTS:	Were data graphed?	
10	Y / N COMMENTS:	Was there a normal transition between the last datum record and the present datum record	
11	Y / N COMMENTS:	If different recorders were deployed than retrieved, was this updated in Oracle Recorder Deploymen	

Final QA Officer's Initials and Date

APPENDIX C

Reports and Data Formats

MONITORING PLAN

PROJECT NO. XX-XX NAME

ORIGINAL DATE:
REVISED DATE:

> Top margin 1"; Bottom margin 1"; Left margin 1"; Right margin 1"; Font is Times New Roman, 12 point.

Preface

> Most monitoring plans will not have this section. However, some may.

> One blank line between date and Preface.
> One blank line after Preface.
> Notice that Preface and all other section headings are underlined.

Project Description

> 1. Location, ecological setting, land loss/gain, historical data.
> 2. Important ecological characteristics relevant to project components.
> 3. Project purpose.
> 4. Project features.
> 5. One blank line after Project Description.

> If there is a bullet list of project features, indent to position 1.5"

Project Objectives

> 1. Indent to position 2.0"
> 2. Project Objective(s) is/are something worked toward or aspired to.
> 3. These are obtained directly from the project plan and feasibility analysis. Focus on primary objectives, not secondary.
> 4. One blank line after Project Objective(s).

1.

2.

Specific Goals

1. Indent to position 2.0"
2. Specific Goal(s) is/are what one intends to do or acheive.
3. These are obtained directly from the project plan and feasibility analysis.
4. One blank line after Specific Goal(s).

1.

2.

Additional Monitoring Needs (if applicable) will appear here if required by permitting, if secondary objectives need to be addressed, or if additional project component(s) are to be phased in..

Reference Area

1. Explain the criteria used to select the site.
2. Identify sites that were evaluated.
3. Describe the site selected relative to the criteria.
4. Identify limitations of the reference area.
5. Describe generally what monitoring elements will be evaluated in the reference area and what type of sampling (paired, proportional, etc.).

Monitoring Limitations

Include this section if needed.

Monitoring Elements

With each element identify: data collection method(s), number of stations, frequency of sampling, reference for methodology or historical information source.

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

1.

2.

Anticipated Statistical Analyses and Hypotheses

Numbers should correspond with the monitoring elements.
Include the statements “If we fail to reject the null hypothesis, we will investigate for negative effects.” and/or “Ancillary data will be used when available.” when appropriate.

1.

Goal:

Hypothesis:

H_0:

H_a:

Notes

1. Implementation: Start Construction:
   End Construction:

2. Federal Sponsor Point of Contact:

3. DNR Project Manager:
   DNR Monitoring Manager:
   DNR DAS Assistant:

4. Monitoring budget and reporting requirements

5. References:

For References format, see BMS_DAS/Reports/Templates/Reference.TEM.

LA Department of Natural Resources	Coastal Restoration Division	P.O. Box 94396 Baton Rouge, LA 70804-9396

FIELD TRIP REPORT

PROJECT(S):

LOCATION:

PURPOSE:

CRD INVESTIGATORS:

DATE:

CONDITIONS:

COMMENTS:

QMP AUDIT REPORT
CWPPRA MONITORING PROGRAM

Date:
Project Name and Number:
Monitoring Manager:
Monitoring Crew:

Vessel:
Auditor:

TASK	Not Applicable	Satisfactory	Unsatisfactory	Comments
Trip Checkout				
Launch Checkout				
Equipment Checkout				
Calibration Techniques				
Navigational Plans				
Travel to Site				
Safety				
Vessel Operation				
Navigational Use				
Control of Crew				
Site Locations				
Ability to Locate Site				
Anchoring				

TASK	Not Applicable	Satisfactory	Unsatisfactory	Comments
Deployment of Data Collection Equipment				
Proper Deployment				
Proper Use				
Proper Calibration				
Proper Completion of Data Sheet				
Sampling				
Collection of Organisms				
Identification of Organisms				
Measurement of Organisms				
Processing of Organisms				
Storage of Samples				
Sample Processing and Shipment				
Sample Transfer				
Sample Processing				
Sample Shipment				
Use of Sample Custody				

TASK	Not Applicable	Satisfactory	Unsatisfactory	Comments
<u>Data Processing</u>				
Downloading of Data				
Correction of Data				
Data Entry				
Data Transfer				
Communications				

NOTES:

<u>OVERALL</u>

1999/2000 TAG RESPONSIBILITIES TRACKING SHEET

Project Number	Project Name	Monitoring Manager	Agency	Approximate Meeting Date	Time Expenditures (hrs. ea.) Ecologist & Biostatistician	Time Expenditures (hrs.) Monitoring Managers	Assigned Ecologist & Biostatistician	Suspense date for forwarding Preliminary Plan/Info to TAG/MWG	Date Preliminary Plan/Info actually forwarded to TAG/MWG	Date Final Plan Forwarded for Review by P&E/MWG	Date Final Approved Plan Disseminated to P&E
BA-03c	Naomi Outfall	Boshart	NRCS	24-Feb-99	28	59	Sasser, Pal	03-Feb-99	04-Feb-99	21-May-99	16-Jun-99
BA-26	Barataria WW East	Boshart	NRCS	24-Feb-99	18	51	Sasser, Pal	03-Feb-99	04-Feb-99	21-May-99	16-Jun-99
MR-09	Delta-wide Crevasses	Troutman	NMFS	02-Mar-99	24	51	Sasser, Pal	11-Feb-99	08-Feb-99	23-Mar-99	10-May-99
C/S-23	Replace Hog Island	Miller	USFW	30-Mar-99	28	59	Nyman, Pal	09-Mar-99	10-Mar-99	11-May-99	17-Jun-99
TE-31	Flotant Marsh Fencing	Young	NRCS	29-Jun-99	18	51	Nyman, Pal	08-Jun-99	15-Jun-99	pending deauthorization	
TV-14	Marsh Island Hydrologic Restoration	Mallach	USACE	24-Aug-99	28	59	Nyman,Pal	03-Aug-99	05-Aug-99	03-Sep-99	21-Jan-00
TE-10	Grand Bayou Diversion	Rapp	USFW	22-Sep-99	28	59	Sasser, Pal	01-Sep-99	03-Sep-99	18-Apr-00	23-May-00
CS-27	Black Bayou Hydrological Restoration	Mallach	NMFS	23-Sep-99	28	59	Nyman, Pal	02-Sep-99	07-Sep-99	07-Feb-00	31-Mar-00
BS-03a	Caernarvon Diversion Outfall	Snedden	NRCS	02-Feb-00	28	59	Sasser, Pal	12-Jan-00	14-Jan-00	16-Feb-00	
ME-11	Humble Canal	Thibodeaux	NRCS	25-Apr-00	28	59	Nyman, Pal	04-Apr-00	07-Apr-00	19-Sep-00	31-Oct-00
BA-22	HR of Bayou L'Ours Ridge	Curole	NRCS	22-Jun-00	28	59	Nyman,Pal	01-Jun-00	01-Jun-00		
TV-16	Cheniere Au Tigre Demo	Barrilleaux	NRCS	24-Oct-00	18	51	Nyman,Pal	03-Oct-00			
BA-28	Grand Terre Planting	Lear	NMFS	30-Jan-01	24	51	Sasser, Pal	09-Jan-01			
TE-37	New Cut Dune/Marsh Restoration	Hubbell	EPA	30-Jan-01	24	51	Sasser, Pal	09-Jan-01			
PO-27	Chandeleurs Island Restoration	Sealy	NMFS	31-Jan-01	24	51	Sasser, Pal	10-Jan-01			
BA-27	Barataria Land Bridge (Ph 1)	Troutman	NRCS	27-Feb-01	28	59	Sasser, Pal	06-Feb-01			
PO-24	Hopedale Hydrologic Restoration	Sealy	NMFS	27-Feb-01	28	59	Sasser, Pal	06-Feb-01			
BA-24	Siphon at Myrtle Grove	TBA	NMFS	27-Mar-01	28	59	Sasser, Pal	06-Mar-01			
TE-32	Lake Boudreaux Basin Introduction - Alt. B	Hubbell	USFWS	27-Mar-01	28	59	Nyman, Pal	06-Mar-01			
PO-28	LaBranche Wetlands Terracing/Plantings	Kay	NMFS	29-Mar-01	28	59	Sasser, Pal	08-Mar-01			

Distribution: DNR proj mgrs, mon mgrs, M.Floyd, N. Clark,S. Hawes, J.Johnston, B.Jones, R. Boe, J. Foret, A. Nyman, R. Paille, N. Pal, T. Landers, C.Steyer, C. Sasser, J. Visser, T. Podany, S. Creed, J. Peckham

1997/1998 TAG RESPONSIBILITIES TRACKING SHEET

Project Number	Project Name	Monitoring Manager	Agency	Approximate Meeting Date	Time Expenditures (hrs. ea.) Ecologist & Biostatistician	Time Expenditures (hrs.) Monitoring Managers	Assigned Ecologist & Biostatistician	Assigned SAG Representative	Suspense date for forwarding Preliminary Plan/Info to TAG/MWG	Date Preliminary Plan/Info actually forwarded to TAG/MWG	Date Final Plan Forwarded for Review by P&E/MWG	Date Final Approved Plan Disseminated to P&E
TE-29	Racoon Island Breakwaters	Townson	NRCS	29-Jan-97	20	59	Nyman, Pal	Stone	08-Jan	01/08/97	03/04/97	04/07/97
C/S-09	Brown Lake	Weifenbach	NRCS	29-Jan-97	28	59	Nyman, Pal	Swenson	08-Jan	01/08/97	03/11/97	04/14/97
C/S-24	Perry Ridge	Thibodeaux	NRCS	28-May-97	18	43	Nyman, Pal	Nelson	07-May	05/06/97	06/04/97	07/03/97
MR-08	Beneficial Use of Hopper Dredged	Troutman	USACE	28-May-97	20	59	Nyman, Pal	Autin	07-May	05/06/97	06/03/97	06/26/97
C/S-26	Compost (Demo)	Castellanos	EPA	23-Sep-97	24	51	Nyman, Pal	Schaffer	02-Sep	09/05/97	03/18/98	08/13/98
BA-23	Barataria WW West	O'Neil	NRCS	20-Nov-97	18	49	Nyman, Pal	TBA	30-Oct	10/30/97	12/09/97	01/06/98
TE-27	Whiskey Island Restoration	Townson	EPA	29-Jan-98	18	43	Nyman, Pal	Stone	08-Jan	01/12/98	07/23/98	08/13/98
TE-25	East Timbalier Island Restoration	Borron	NMFS	29-Jan-98	18	43	Nyman, Pal	Stone	08-Jan	01/12/98	07/23/98	08/13/98
TE-30	East Timbalier Sed. Restor. (Phase II)	Borron	NMFS	29-Jan-98	18	43	Nyman, Pal	Stone	08-Jan	01/12/98	07/23/98	08/13/98
PO-22	Bayou Chevee	Holbrook	USACE	25-Mar-98	24	51	Nyman, Pal	Turner	04-Mar	02/27/98	04/21/98	05/06/98
CW-7	Nutria Harvest Wetland Restor. Demo	O'Neil	NMFS	25-Mar-98	18	43	Nyman, Pal	TBA	04-Mar	03/09/98	03/27/98	06/05/98
CS-25	Plowed Terrace (DEMO)	Miller	NRCS	29-Apr-98	20	59	Nyman,Pal	Proffitt	01-Apr	04/07/98	07/23/98	08/13/98
CS-11b	Sweet Lake/Willow Lake Hyd. Rest.	Vincent	NRCS	29-Apr-98	28	59	Nyman,Pal	Shaffer	01-Apr	04/07/98	07/23/98	08/13/98
TV-12	Little Vermillion Bay	Courville	NMFS	26-Aug-98	12	49	Nyman,Pal	Shaffer	05-Aug	08/06/98	10/01/98	11/16/98
TE-36	Thin Mat Floating Marsh (DEMO)	Young	NRCS	08-Sep-98	18	43	Sasser,Pal	Winston	17-Aug	08/14/98	12/30/98	03/11/99
TV-13a	Oaks/Avery Canals Hydro Restoration	Castellanos	NRCS	02-Dec-98	28	59	Nyman,Pal	Proffitt	09-Nov	11/16/98	02/01/99	3/19/99

Distribution: DNR proj mgrs, mon mgrs, M.Floyd, H.Gaudet, N. Clark, S. Hawes, J.Johnston, B.Jones, R. Boe, T. McTigue, A. Nyman, R. Paille, N.Pal, J. Peckham, C.Steyer, C. Sasser, J. Visser, S. Mathies

1996/1997 TAG RESPONSIBILITIES TRACKING SHEET

Project Number	Project Name	Monitoring Manager	Agency	Approximate Meeting Date	Time Expenditures (hrs. ea.) Ecologist & Biostatistician	Time Expenditures (hrs.) Monitoring Managers	Assigned Ecologist & Biostatistician	Assigned SAG Representative	Suspense date for forwarding Preliminary Plan/Info to TAG/MWG	Date Preliminary Plan/Info actually forwarded to TAG/MWG	Date Final Plan Forwarded for Review by P&E/MWG	Date Final Approved Plan Disseminated to P&E
TE-28	Brady Canal Hydrologic Restoration	Cheramie	NRCS	31-Jan-96	24	59	Nyman, Pal	Swenson	10-Jan	01/10/96	07/02/96	08/13/96
BA-15	Lake Salvador Shore Protection (Demo)	Alonzo	NMFS	28-Feb-96	16	51	Nyman, Pal	Stone	07-Feb	02/06/96	07/26/96	09/20/96
CS-17	Cameron Creole Watershed	Weifenbach	USFW	29-Feb-96	28	59	Sasser, Sun	Proffitt	08- Feb	01/31/96	05/31/96	06/25/96
PO-06	Fritchie Marsh	Holbrook	NRCS	25-Apr-96	28	59	Nyman, Sun	Pezold	04-Apr	04/01/96	06/04/96	07/02/96
MR-06	Channel Armor Gap Crevasse	Kelley	USACE	26-Jun-96	20	59	Sasser, Pal	White	05-Jun	06/06/96	08/22/96	11/25/96
MR-07	Pass-a-Loutre Crevasse	Kelley	USACE	26-Jun-96	20	59	Sasser, Pal	White	05-Jun	06/06/96	08/22/96	11/25/96
C/S-21	Highway 384	Vincent	NRCS	27-Jun-96	28	51	Sasser, Pal	Swenson	06-Jun	06/06/96	09/24/96	12/23/96
BA-02	GIWW to Clovelly	Alonzo	NRCS	28-Aug-96	28	59	Sasser, Pal	Swenson	07-Aug	08/08/96	11/08/96	02/28/97
ME-13	Freshwater Bayou Bank Stabilization	Vincent	NRCS	21-Nov-96	16	43	Sasser, Pal	Nelson	01-Nov	11/07/96	01/06/97	02/12/97

Distribution: DNR project mgrs, monitoring mgrs, TAG members, H.Gaudet, R. Greco, M.Hester, J.Johnston, B.Jones, D.Lindstedt, A. Nyman, N. Pal, T.Podany, E.Proffitt, D.Reed, L.Rouse,G.Shaffer,C.Steyer,G.Stone, E.Swenson, D.White, L.Wilson, J.Winston

1994/1995 TAG RESPONSIBILITIES TRACKING SHEET

Project Number	Project Name	Monitoring Manager	Agency	Approximate Meeting Date	Time Expenditures (hrs. ea.) Ecologist & Biostatistician	Time Expenditures (hrs.) Monitoring Managers	Assigned Ecologist & Biostatistician	Assigned SAG Representative	Suspense date for forwarding Preliminary Plan/Info to TAG/MWG	Date Preliminary Plan/Info actually forwarded to TAG/MWG	Date Final Plan Forwarded for Review by P&E/MWG	Date Final Approved Plan Disseminated to P&E
CS-19	West Hackberry Plantings	Vincent	NRCS	24-Jan	18	43	Sasser, Pal		NA	06-Apr	05/26/94	06/22/94
PO-17	Bayou La Branche	Steller	USACE	18-Apr	18	43	Sasser, Pal		NA	06-Apr	04/21/94	05/16/94
ME-8	Dewitt-Rollover Plantings	Vincent	NRCS	18-Apr	18	43	Sasser, Pal		NA	06-Apr	05/17/94	09/12/94
ME-9	Cameron Prairie Refuge	Miller	USFWS	08-Jun	18	43	Sasser, Zhou		NA	26-May	06/13/94	07/11/94
TE-20	Eastern Isles Dernieres Phase 0	Raynie	EPA	08-Jun	18	52	Sasser, Zhou		NA	26-May	07/20/94	09/12/94
XTE-41	Eastern Isles Dernieres Phase 1	Raynie	EPA	08-Jun	18	52	Sasser, Zhou		NA	26-May	07/20/94	09/12/94
TV-09	Boston Canal	Weifenbach	NRCS	27-Jul	18	43	Sasser, Zhou		NA	05-Jul	08/09/94	09/12/94
TE-18	Timbalier Island	Raynie	NRCS	27-Jul	12	43	Sasser, Zhou		NA	05-Jul	08/04/94	06/05/95
CS-18	Sabine Refuge	Vincent	USFWS	27-Jul	18	43	Sasser, Zhou		NA	05-Jul	08/23/94	09/21/94
TE-19	Lower Bayou La Cache	Raynie	NMFS	31-Aug	28	59	Sasser, Zhou		NA	24-Aug	09/12/94	11/20/94
TV-03	Vermilion River Cutoff	Thibodeaux	USACE	01-Sep	12	43	Nyman, Pal		NA	24-Aug	09/21/94	11/01/94
ME-04	Freshwater Bayou Phase I	Vincent	NRCS	01-Sep	12	43	Nyman, Pal		NA	24-Aug	04/10/96	02/01/95
TE-22	Point au Fer	Raynie	NMFS	01-Sep	20	51	Nyman, Pal		NA	24-Aug	09/12/94	11/23/94
CS-20	East Mud Lake	Holbrook	NRCS	28-Sep	28	59	Sasser, Zhou		07-Sep	12-Sep	04/05/95	05/16/95
ME-12	SW Shore White Lake	Miller	NRCS	29-Sep	20	51	Nyman, Pal		08-Sep	12-Sep	12/19/94	02/21/95
BA-20	Jonathan Davis	Haywood	NRCS	30-Nov	28	59	Sasser, Pal		09-Nov	07-Nov	03/29/95	07/12/95
TV-04	Cote Blanche Hydrologic	Thibodeaux	NRCS	01-Dec	28	59	Nyman, Pal		10-Nov	16-Nov	04/04/95	07/17/95
PO-20	Red Mud Demo (Modified)	Raynie	EPA	26-Jan-95	28	78	Nyman, Pal		05-Jan	01/09/95	03/06/95	06/20/95
PO-16	Bayou Sauvage Phase 1	Holbrook	USFW	02-Feb-95	18	43	Sasser, Pal		12-Jan	01/17/95	03/23/95	06/20/95
PO-18	Bayou Sauvage Phase 2	Holbrook	USFW	02-Feb-95	18	43	Sasser, Pal		12-Jan	01/17/95	03/23/95	06/20/95
C/S-22	Clear Marais	Miller	USACE	01-Mar-95	16	43	Nyman, Pal		08-Feb	02/08/95	03/07/95	06/05/95
BA-19	Barataria Bay Waterway	Carriere	USACE	01-Mar-95	18	49	Nyman, Pal		08-Feb	02/13/95	03/13/95	06/06/95
AT-02	Atchafalaya Sediment	Bourgeois	NMFS	25-May-95	18	49	Sasser, Sun	Rouse	04-May	05/04/95	10/30/95	07/15/96
AT-03	Big Island Mining	Bourgeois	NMFS	25-May-95	18	49	Sasser, Sun	Rouse	04-May	05/04/95	10/30/95	07/15/96
TE-26	Lake Chapeau Marsh Creation	Cheramie	NMFS	27-Jul-95	28	59	Nyman, Sun	Rouse	06-Jul	07/13/95	1/31/96	07/02/96
TE-23	West Bell Pass	Alonzo	USACE	31-Aug-95	18	49	Sasser, Sun	White	10-Aug	08/10/95	12/28/95	04/26/96
TE-17	Falgout Canal Planting	Bourgeois	NRCS	28-Sep-95	16	47	Nyman, Sun	Proffitt	07-Sep	09/11/95	05/08/96	06/25/96
ME-04	Freshwater Bayou Phase II	Vincent	NRCS	07-Dec-95	24	59	Nyman, Sun	Swenson	16-Nov	11/15/95	04/10/96	05/01/96

Project Monitoring Responsibilities

Project Number	Project Name	Priority List	Monitoring Manager (MM)	MM Supervisor	Project Manager	DAS Assistant	NWRC Assistant	Basin	Agency	Project Type	Construction Date (month-day-year) Start	End	Monitoring Plan Completion Date	Aerial Photography Acquisition Latest Date (flight #)	Progress Report Due Date (report #)	Comprehensive Report Due Date (report #)	Close-Out Report Due Date
CWPPRA PROJECTS																	
BA-02	GIWW to Clovelly Wetlands	1	Rapp	Lee	Boddie	Armbruster	Clark	BA	NRCS	HR	05/06/99	8/01/00*	02/28/97	12/20/96 (2)			
C/S-17	Cameron/Creole Watershed	1	Weifenbach	Libersat	Menard	L. Aucoin	Creed	C/S	USFW	HR	11/01/96	02/01/97	06/25/96	11/01/93 (1)	02/01/03 (2)	02/01/01 (1)	
PO-16	Bayou Sauvage Phase 1	1	Sealy	Troutman	Boddie	Wallace	MacInnes	PO	USFW	HR	08/01/95	05/01/96	06/20/95	12/20/96 (2)	05/04/98 (3)	05/01/01 (1)	
C/S-18	Sabine Refuge Protection	1	Barrilleaux	Libersat	Guidry	L. Aucoin	Creed	CS	USFW	SP	12/01/94	01/27/95	09/21/94	01/11/97 (2)	01/27/97 (4)	01/27/01 (2)	
TE-18	Timbalier Island Plantings	1	Lear	Lee	Bahlinger	Armbruster	Clark	TE	NRCS	VP	04/01/95	07/02/96	06/05/95	11/08/97 (2)	07/02/00 (6)	07/02/02 (1)	07/07/02
TE-17	Falgout Canal Plantings	1	Hubbell	Lee	Bahlinger	Armbruster	Clark	TE	NRCS	VP	12/23/96	05/12/97	06/25/96	11/08/97(2)		05/12/99 (1)	05/12/99
C/S-19	West Hackberry Plantings	1	Miller	Libersat	S. Aucoin	L. Aucoin	Creed	C/S	NRCS	VP	11/01/93	12/15/94	6/22/94	11/23/97(2)	06/16/97 (4)	12/15/00 (2)	
ME-08	Dewitt-Rollover Plantings	1	Vincent	Libersat	S. Aucoin	L. Aucoin	Creed	ME	NRCS	VP	07/01/94	08/01/94	09/12/94	11/01/93 (1)	08/01/95 (1)	11/24/96 (1)	11/24/96
MR-03	West Bay Sediment Diversion	1	Troutman	Troutman	Hodnett	Wallace	MacInnes	MR	COE	SD	ON HOLD						
BA-19	Barataria Bay WW Wetl. Creation	1	Curole	Lee	Saxton	Armbruster	Clark	BA	COE	DM	08/30/96	11/11/96	06/06/95	12/19/94 (1)	11/16/97 (2)	11/11/99 (1)	
TE-19	Lower Bayou La Cache	1	Hubbell	Lee	Long	Armbruster	Clark	TE	NMFS	MM	deauthorized						
PO-17	Bayou La Branche Wetland	1	TBA	Troutman	Cook	Wallace	MacInnes	PO	COE	DM	11/02/93	04/07/94	05/16/94	11/17/97 (4)	04/06/99 (5)	04/06/02 (2)	
ME-09	Cameron Prairie Refuge Protection	1	Barrilleaux	Libersat	Guidry	L. Aucoin	Creed	ME	USFW	SP	01/31/94	08/03/94	07/11/94	01/11/97 (2)	06/13/97 (3)	08/04/01 (1)	
T/V-03	Vermilion River Cutoff	1	Thibodeaux	Libersat	Juneau	L. Aucoin	Creed	T/V	COE	SP	01/01/96	02/16/96	11/01/94	11/01/93 (1)	02/20/97 (2)	02/01/00 (1)	
TE-20	Eastern Isles Dernieres Restoration	1	Curole	Lee	Long	Armbruster	Clark	TE	EPA	BI	01/15/98	05/01/99	07/23/98	11/08/97(2)	06/01/00 (1)	06/01/04 (1)	
AT-02	Atchafalaya Sediment Delivery	2	Rapp	Lee	Cook	Armbruster	Clark	AT	NMFS	DM	02/01/98	03/28/98	07/15/96	11/24/97(2)	03/28/03 (2)	03/28/01 (1)	
ME-04	Freshwater Bayou	2	Vincent	Libersat	Guidry	L. Aucoin	Creed	ME	NRCS	HR	10/10/94	10/01/98	05/01/96	01/11/97 (2)	10/01/99 (5)	10/01/01 (1)	
PO-18	Bayou Sauvage Phase 2	2	Sealy	Troutman	Boddie	Wallace	MacInnes	PO	USFW	HR	03/30/96	06/01/97	06/20/95	12/20/96 (2)	06/01/98 (1)	06/01/01 (1)	
C/S-22	Clear Marais	2	Miller	Libersat	Guidry	L. Aucoin	Creed	C/S	COE	SP	11/01/96	03/20/97	06/05/95	11/07/94 (1)	03/20/98 (1)	03/20/01 (1)	
BS-03a	Caernarvon Diversion Outfall Man.	2	Snedden	Troutman	Buchtel	Wallace	MacInnes	BS	NRCS	FD	01/01/01*	08/01/01*	*04/01/00	*10/26/00 (1)			
C/S-20	Mud Lake East	2	Weifenbach	Libersat	Broussard	L. Aucoin	Creed	C/S	NRCS	MM	01/01/96	05/01/96	05/16/95	12/26/94 (1)	05/01/01 (5)	05/01/02 (2)	
BA-20	Jonathan Davis Wetland	2	TBA	Troutman	Saxton	Wallace	MacInnes	BA	NRCS	HR	06/15/98	09/15/00*	07/12/95	11/17/97(2)			
TE-22	Point Au Fer	2	Rapp	Lee	Thibodeaux	Armbruster	Clark	TE	NMFS	SP	10/10/95	05/08/97	11/23/94	11/24/97(2)	05/08/98 (1)	05/08/01 (1)	
AT-03	Big Island Mining	2	Rapp	Lee	Cook	Armbruster	Clark	AT	NMFS	DM	03/11/98	09/20/98	07/15/96	11/24/97(2)	09/20/00 (1)	09/20/03 (1)	
C/S-21	Highway 384	2	Vincent	Libersat	Broussard	L. Aucoin	Creed	C/S	NRCS	MM	10/01/99	02/01/00	12/23/96	01/11/97 (1)	02/01/01 (1)	02/01/03 (1)	
PO-06	Fritchie Marsh	2	TBA	Troutman	Hodnett	Wallace	MacInnes	PO	NRCS	HR	11/01/00*	03/01/01*	07/02/96	*10/26/00 (2)			
T/V-09	Boston Canal Bank	2	Thibodeaux	Libersat	Guidry	L. Aucoin	Creed	T/V	NRCS	SP	10/01/94	09/01/95	09/12/94	11/24/97(2)	09/01/97 (4)	09/01/02 (2)	
C/S-09	Brown Lake Marsh Management	2	Castellanos	Libersat	Broussard	L. Aucoin	Creed	C/S	NRCS	MM	03/01/01*	08/01/01*	04/07/97	11/23/97 (1)			
TE-23	West Bell Pass	2	Curole	Lee	Saxton	Armbruster	Clark	TE	COE	DM	02/01/98	11/01/98	04/26/96	11/08/97(2)		03/01/02 (1)	
TE-24	Eastern Isles Dernieres	2	Curole	Lee	Long	Armbruster	Clark	TE	EPA	DM	01/19/98	05/01/99	07/23/98	11/08/97(2)	06/01/00 (1)	06/01/04 (1)	
PO-19	MRGO Back Dike Marsh Protection	3	TBA	Troutman	Saxton	Wallace	MacInnes	PO	COE	MM	no monitoring						
BA-04c	West Point a la Hache Outfall Man.	3	Boshart	Troutman	Hodnett	Wallace	MacInnes	BA	NRCS	HR	11/01/02*	07/01/03*	*05/01/01	11/10/93 (1)			
MR-06	Channel Armor Gap Crevasse	3	TBA	Troutman	Cretini	Wallace	MacInnes	MR	COE	FD	09/15/97	12/15/97	11/25/96	01/09/96 (1)	12/15/99 (1)	12/15/01 (1)	
T/V-04	Cote Blanche Hydrologic Restoration	3	Thibodeaux	Libersat	Juneau	L. Aucoin	Creed	T/V	NRCS	HR	03/01/98	01/20/99	07/17/95	01/11/97 (1)	01/20/00 (1)	11/01/01 (1)	
C/S-04a	Cameron/Creole Maintenance	3	Weifenbach	Libersat	Menard	L. Aucoin	Creed	C/S	NRCS	HR	no monitoring						
BA-21	B. Perot and B. Rigolets Marsh Rest.	3	TBA	Troutman	Burkholder	Wallace	MacInnes	BA	NMFS	MC	deauthorized						
MR-07	Pass-a-Loutre Crevasse	3	TBA	Troutman	TBA	Wallace	MacInnes	MR	COE	SD	deauthorized						
TE-25	East Timbalier Island Restoration	3	Hubbell	Lee	Burkholder	Armbruster	Clark	TE	NMFS	BI	04/01/99	01/12/00	08/13/98	11/08/97 (1)	01/12/01 (1)		
C/S-23	Hog Island, Replace, W. Cove, HQ	3	Miller	Libersat	Menard	L. Aucoin	Creed	C/S	USFW	MM	02/01/00*	01/01/01*	06/17/99	*10/26/00 (1)			
BS-04a	White's Ditch Outfall Management	3	Snedden	Troutman	Clark	Wallace	MacInnes	BS	NRCS	HR	deauthorized						
TE-26	Lake Chapeau Marsh Creation	3	Lear	Lee	Burkholder	Armbruster	Clark	TE	NMFS	HR	09/20/98	08/05/99	07/02/96	11/24/97(2)	08/5/00 (1)	08/5/02 (1)	
TE-27	Whiskey Island Restoration	3	Hubbell	Lee	Long	Armbruster	Clark	TE	EPA	BI	01/01/98	05/01/99	07/23/98	11/08/97 (1)	06/31/00 (1)	06/31/04 (1)	

Project Monitoring Responsibilities

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TE-28	Brady Canal Hydrologic Restoration	3	Folse	Lee	Allen	Armbruster	Clark	TE	NRCS	HR	06/21/99	07/10/00	08/13/96	*10/26/00 (1)	07/10/01 (1)		
PO-09a	Violet Freshwater Distrib. (no pumps)	3	Snedden	Troutman	Buchtel	Wallace	MacInnes	PO	NRCS	HR	deauthorized	06/01/02	01/01/01				
BA-15	Lake Salvador Shore Protect. (DEMO)	3	Curole	Lee	Bahlinger	Armbruster	Clark	BA	NMFS	SP	06/30/97	10/01/97	09/20/96	12/18/97(2)	10/01/01 (2)	10/01/02 (1)	
ME-12	SW Shore White Lake Protect (DEMO)	3	Libersat	Libersat	Guidry	L. Aucoin	Creed	ME	NRCS	SP	06/04/96	06/07/96	02/21/95	12/26/94 (1)	06/07/97 (2)	06/07/98 (1)	06/07/98
PO-20	Red Mud Demo (Modified)	3	TBA	Troutman	Cook	L. Aucoin	Creed	PO	EPA	MC	pend.deauth.						
PO-21	Eden Isles East Marsh Restoration	4	Sealy	Troutman	Llewellyn	Wallace	MacInnes	PO	NMFS	HR	deauthorized						
BA-22	Hydrologic Rest. of Bayou L'ours Ridge	4	Curole	Lee	Saxton	Armbruster	Clark	BA	NRCS	HR	NO DATE						
TE-30	E. Timbalier Sediment Rest. (Phase 2)	4	Hubbell	Lee	Burkholder	Armbruster	Clark	TE	NMFS	BI	04/01/99	01/12/00	08/13/98	11/08/97 (1)	01/12/01 (1)		
BS-07	Grand Bay Crevasse	4	Snedden	Troutman	Cretini	Wallace	MacInnes	BS	COE	SD	deauthorized						
C/S-24	Perry Ridge Shore Protection (HALF)	4	Barrilleaux	Libersat	Guidry	L. Aucoin	Creed	C/S	NRCS	SP	10/01/98	02/01/99	07/03/97	11/23/97 (1)	02/01/01 (1)	02/01/02 (1)	
BA-23	Barataria Waterway Shore Prot. (West)	4	Sealy	Troutman	Saxton	Wallace	MacInnes	BA	NRCS	SP	06/01/00*	11/01/00*	01/06/98	11/17/97 (1)			
C/S-25	Plowed Terraces (DEMO)	4	Castellanos	Libersat	Juneau	L. Aucoin	Creed	C/S	NRCS	TE	07/01/00	08/23/00	08/13/98	02/19/96 (1)			
MR-08	Ben. use of Hopper Dredge Mat. (DEMO)	4	TBA	Troutman	Boddie	Wallace	MacInnes	MR	COE	DM	deauthorized						
TE-31	Flotant Marsh Fencing (DEMO)	4	Lear	Lee	Bahlinger	Armbruster	Clark	TE	NRCS	SNT	deauthorized						
C/S-26	Compost (DEMO)	4	Castellanos	Libersat	Juneau	L. Aucoin	Creed	C/S	EPA	MC	04/01/01*	07/01/01*	08/13/98	01/11/97 (1)			
BA-24	Siphon at Myrtle Grove (Phase 1)	5	TBA	Troutman	Cretini	Wallace	MacInnes	BA	NMFS	FD	06/01/01*	01/01/03*	*11/01/00	*09/26/01			
BA-03c	Naomi Outfall Management	5	Boshart	Troutman	Hodnett	Wallace	MacInnes	BA	NRCS	FD	02/01/01*	07/01/01*	06/13/99	*10/26/00 (1)			
T/V-12	Little Vermillion Bay Sediment Trap.	5	Castellanos	Libersat	Menard	L. Aucoin	Creed	TV	NMFS	SNT	05/15/99	09/01/99	*11/16/98	*10/26/00 (1)	09/01/00 (1)		
TE-10	Grand Bayou/GIWW FW Diversion	5	Rapp	Lee	Andrus	Armbruster	Clark	TE	USFWS	FD	12/1/00*	1/31/01*	05/23/00				
BA-25	Bayou Lafourche Siphon/Phase	5	Folse	Lee	Llewellyn	Armbruster	Clark	BA	EPA	FD	NO DATE						
C/S-11b	Sweet Lake/Willow Lake Shore. Prot.	5	Mallach	Libersat	Broussard	L. Aucoin	Creed	CS	NRCS	SP	11/01/99*	08/01/01*	08/13/98	*10/26/00 (1)			
PO-22	Marsh Creation at Bayou Chevee	5	Sealy	Troutman	Burkholder	Wallace	MacInnes	PO	COE	SP	08/01/00*	03/01/01*	05/06/98	11/17/97 (1)			
ME-13	Freshwater Bayou Bank Stabil.	5	Vincent	Libersat	Guidry	L. Aucoin	Creed	ME	NRCS	SP	03/01/98	06/01/98	02/12/97	12/19/96 (1)	06/01/99 (1)	06/01/04 (1)	
TE-29	Racoon Isl. Breakwaters (Demo)	5	Folse	Lee	Burkholder	Armbruster	Clark	TE	NRCS	SP	04/24/97	07/15/97	04/14/97	11/08/97(1)	06/15/98 (1)	06/15/02 (1)	
CS-27	Black Bayou Hydraulic Restoration	6	Mallach	Libersat	Juneau	L. Aucoin	Creed	CS	NMFS	HR	12/01/00*	08/01/01*	03/31/00	*10/26/00 (1)			
TE-33	Bayou Boeuf Pump Station, Incr. 1	6	Folse	Lee	Burkholder	Armbruster	Clark	TE	EPA	HR	deauthorized						
MR-09	Delta-Wide Crevasses	6	TBA	Troutman	Bahlinger	Wallace	MacInnes	MR	NMFS	SD	06/25/99	07/14/99	05/10/99	*10/26/00 (1)	07/15/00 (1)	07/15/03 (1)	
TV-14	Marsh Island Hydrologic Rest.	6	Mallach	Libersat	Juneau	L. Aucoin	Creed	TV	USACE	HR	10/01/01*	04/01/02*	01/21/00	*09/26/00			
TE-34	Penchant Basin Plan wo/Shoreline	6	Lear	Lee	Burkholder	Armbruster	Clark	TE	NRCS	HR	NO DATE						
TV-15	Sediment Trapping at the Jaws	6	Mallach	Libersat	Menard	L. Aucoin	Creed	TV	NMFS	SNT	04/01/01*	08/01/01*	*12/01/00	*09/26/00			
TV-13a	Oaks/Avery Canals Hydro. Rest. Incr 1	6	Castellanos	Libersat	Juneau	L. Aucoin	Creed	TV	NRCS	HR	04/01/01*	08/01/01*	03/19/99	*09/26/00			
TE-32	Lake Boudreaux Basin FW Intro-Alt. B	6	Hubbell	Lee	Cook-Boddie	Armbruster	Clark	TE	USFWS	HR/FD	NO DATE						
BA-26	Barataria Bay WW Bank Protect. East	6	Boshart	Troutman	Hodnett	Wallace	MacInnes	BA	NRCS	SP	02/01/01*	07/01/01*	06/13/99	*09/26/00			
TE-35	Marsh Creation E. of Atchaf. R -Avoca	6	Hubbell	Lee	Burkholder	Armbruster	Clark	CW	USACE	MC	deauthorized						
MR-10	Dustpan/Cutterhead Dredging (Demo)	6	TBA	Troutman	Boddie	Wallace	MacInnes	MR	USACE	DM	NO DATE						
LA-02	Nutria Harvest for Wetland Rest.(Demo)	6	Snedden	Troutman	Brodnax	Wallace	MacInnes	CW	USFWS		11/01/98	11/01/03*	06/05/98			11/01/99 (2)	
TV-16	Chenier Au Tigre Shoreline Demo	6	Barrilleaux	Libersat	Menard	L. Aucoin	Creed	TV	NRCS	SP	02/01/01*	05/01/01*					
BA-27	Barataria Land Bridge (Ph1)	7	TBA	Troutman	Boddie	Wallace	MacInnes	BA	NRCS	SP	03/01/01*	10/01/01*	11/01/00*				
BA-28	Grand Terre Vegetative Planting	7	Lear	Lee	Bahlinger	Armbruster	Clark	BA	NMFS	VP	04/01/00						
TE-36	Thin Mat Floating Marsh (Demo)	7	Lear	Lee	Brodnax	Armbruster	Clark	TE	NRCS	MC	12/01/99	05/12/00	03/11/99		05/12/01 (1)	05/12/02 (1)	
ME-14	Pecan Island Terracing	7	Thibodeaux	Libersat	Guidry	L. Aucoin	Creed	ME	NMFS	TE	06/01/01*	10/01/01*					
PO-24	Hopedale Hydrologic Restoration	8	Sealy	Troutman	Hodnett	Wallace	MacInnes	PO	NMFS	HR	03/01/01*	09/01/01*	*11/01/00	*10/01/00			
ME-11	Humble Canal Hydrologic Restoration	8	Thibodeaux	Libersat	Guidry	L. Aucoin	Creed	ME	NRCS	HR	02/01/01*	06/01/01*					

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CS-28	Sabine Refuge Marsh Creation (revised) Ph 1	8	Castellanos	Libersat	Menard	L. Aucoin	Creed	CS	COE	MC	NO DATE						
PO-25	Bayou Bienvenue Pumping Station/Terracing	8	Sealy	Troutman	Thibodeaux	Wallace	MacInnes	PO	NMFS	HR	NO DATE						
BA-27b	Barataria Land Bridge Shoreline Protection Ph 2 Inc 1	8	TBA	Troutman	Boddie	Wallace	MacInnes	BA	NRCS	SP	03/01/01*	10/01/01*	08/01/00*				
TV-17	Lake Portage Land Bridge Ph 1	8	Mallach	Libersat	Menard	L. Aucoin	Creed	TV	EPA	SP	NO DATE						
BS-09	Upper Oak River Freshwater Introduction Siphon Ph 1	8	Snedden	Troutman	Hodnett	Wallace	MacInnes	BS	NRCS	FD	NO DATE						
PO-26	Opportunistic Use of Bonnet Carre Spillway	9	Troutman	Troutman	Llewellyn	Wallace	MacInnes	PO	COE	FD	NO DATE						
PO-27	Chandeleur Islands Restoration	9	Sealy	Troutman	Grandy	Wallace	MacInnes	PO	NMFS	VP	NO DATE						
ME-06	FW Introduction South of Hwy. 82	9	Weifenbach	Libersat	Llewellyn	L. Aucoin	Creed	ME	USFWS	FD/HR	NO DATE						
TE-39	South Lake Decade/Atchafalaya Freshwater Intro.	9	Folse	Lee	Buchtel	Armbruster	Clark	TE	NRCS	FD/SD	NO DATE						
TV-18	Four-Mile Cut/Little Vermilion Bay HR	9	Thibodeaux	Libersat	Grandy	L. Aucoin	Creed	TV	NMFS	TE	NO DATE						
AT-04	Castille Pass Sediment Delivery	9	Rapp	Lee	Grandy	Armbruster	Clark	AT	NMFS	SD	NO DATE						
CS-16	Black Bayou Bypass Culverts	9	Vincent	Libersat	Buchtel	L. Aucoin	Creed	CS	NRCS	HR	NO DATE						
CS-30	GIWW Bank Stabilization (Perry Ridge to Texas)	9	Barrilleaux	Libersat	Buchtel	L. Aucoin	Creed	CS	NRCS	SP/TE/V	NO DATE						
PO-28	LaBranche Wetlands Terracing/Plantings	9	TBA	Troutman	Grandy	Wallace	MacInnes	PO	NMFS	SP/TE/V	NO DATE						
TV-11b	Freshwater Bayou Canal HR/SP - Belle Isle to Lock	9	Vincent	Libersat	Llewellyn	L. Aucoin	Creed	TV	COE	SP/HR	NO DATE						
ME-17	Little Pecan Bayou Control Structure	9	Weifenbach	Libersat	Buchtel	L. Aucoin	Creed	ME	NRCS	HR	NO DATE						
BA-29	Marsh Creation South of Leeville	9	Curole	Lee	Llewellyn	Armbruster	Clark	BA	EPA	MC	NO DATE						
BA-30	East/West Grand Terre Islands Restoration	9	Folse	Lee	Grandy	Armbruster	Clark	BA	NMFS	BI	NO DATE						
TE-40	Timbalier Island Dune/Marsh Restoration	9	Hubbell	Lee	Llewellyn	Armbruster	Clark	TE	EPA	BI	NO DATE						
BA-27c	Barataria Basin Landbridge Shore Protection Ph.3	9	TBA	Troutman	Buchtel	Wallace	MacInnes	BA	NRCS	SP	06/01/01*	09/01/02*	08/01/00*				
TE-37	New Cut Dune/Marsh Restoration	9	Hubbell	Lee	Llewellyn	Armbruster	Clark	TE	EPA	BI	04/01/01*	10/01/01*	03/30/01*				
TV-19	Weeks Bay/Commercial Canal/GIWW SP	9	Barrilleaux	Libersat	Llewellyn	L. Aucoin	Creed	TV	NRCS	SP/HR	NO DATE						
TE-41	Mandalay Bank Protection (Demo)	9	Lear	Lee	Llewellyn	Armbruster	Clark	TE	USFWS	SP	NO DATE						
MR-11	Periodic Introduction of Sediment and Nutrients at Sele	9	TBA	Troutman	Llewellyn	Wallace	MacInnes	MR	COE	SD	NO DATE						
FEDERAL PROJECTS																	
BS-08	Caernarvon		Snedden	Troutman	Buchtel	Wallace	MacInnes	BS	DNR	FD	01/12/88	02/28/91	11/01/87	02/14/94 (2)		08/28/00 (2)	
BA-01	Davis Pond		Snedden	Troutman	Fruge	Wallace	MacInnes	BA	DNR	FD	11/04/96	01/01/01	03/29/96	11/12/93 (1)			
PO-04	Bonnet Carre		Snedden	Troutman	Buchtel	Wallace	MacInnes	PO	LDWF	FD	NO DATE						
STATE PROJECTS																	
BA-03	Naomi Diversion		Boshart	Troutman	Hodnett	Wallace	Jones	BA	DNR	FD	04/04/91	10/15/92	08/01/92	11/21/93 (1)	03/18/96 (2)	10/15/02 (2)	
BA-04	West Pt. a la Hache		Boshart	Troutman	Hodnett	Wallace	Jones	BA	DNR	FD	01/28/91	04/15/92	03/01/92	01/26/99 (2)	05/27/96 (2)	04/15/01 (2)	
BA-05b	Queen Bess		Curole	Lee	Bahlinger	Armbruster	Clark	BA	DNR	DM	08/01/90	10/01/90	04/01/91	11/01/96 (2)	03/11/96 (2)		03/11/96
BA-05c	Baie de Chactas		Curole	Lee	Bahlinger	Armbruster	Clark	BA	DNR	SP	08/31/90	11/02/90	08/01/90	11/10/93 (1)	04/01/97 (2)		04/01/97
BA-16	Segnette		Horne	Troutman	Boddie	Wallace	Jones	BA	DNR	SP	07/01/94	09/01/94	04/05/93	04/14/95 (1)	02/05/96 (2)		02/05/96
BS-06	Lake Lery Hydrologic Restoration		Snedden	Troutman	Cretini	Wallace	Jones	BS	DNR	FD	no monitoring						
Cal/Sab	Blind Lake		Vincent	Libersat	Steyer	L. Aucoin	MacInnes	C/S	DNR	SP	07/01/89	09/01/89	06/01/89	10/19/92 (1)	07/17/96 (1)		03/01/98
Cal/Sab	Sabine Terraces		Vincent	Libersat	Steyer	L. Aucoin	MacInnes	C/S	DNR	TE	07/01/90	07/30/90	10/01/89	01/12/95 (2)	05/06/93 (1)		01/30/98
C/S-01	Holly Beach		Weifenbach	Libersat	Blanchard	L. Aucoin	MacInnes	C/S	DNR	SP	08/17/92	05/12/94	09/01/90	05/07/92 (2)	05/12/99 (3)		
C/S-02	Rycade Canal		Miller	Libersat	Broussard, G.	L. Aucoin	MacInnes	C/S	DNR	MM	11/02/93	07/01/94	10/06/93	10/19/92 (1)	07/01/98 (2)	07/01/00 (2)	
C/S-04a1	Cameron/Creole Automation		Weifenbach	Libersat	Broussard, G.	L. Aucoin	MacInnes	C/S	DNR	HR	NO DATE						
ME-01a	Pecan Island		Miller	Libersat	Broussard, G.	L. Aucoin	MacInnes	ME	DNR	FD	11/19/91	05/22/92	12/21/93	12/10/92 (1)	04/28/97 (2)		04/28/97
MR-01	Small Sediment Diversion		TBA	Troutman	Boddie	Wallace	Jones	MR	DNR	SD	01/01/92	09/11/93	08/31/92	01/09/96 (2)	05/15/96 (2)		05/15/96
PO-01	Violet Siphon		Snedden	Troutman	Cook	Wallace	Jones	PO	DNR	FD	10/01/91	05/01/92	10/18/93	10/26/93 (1)	03/08/96 (2)		03/08/96

10/04/00

Project Monitoring Responsibilities

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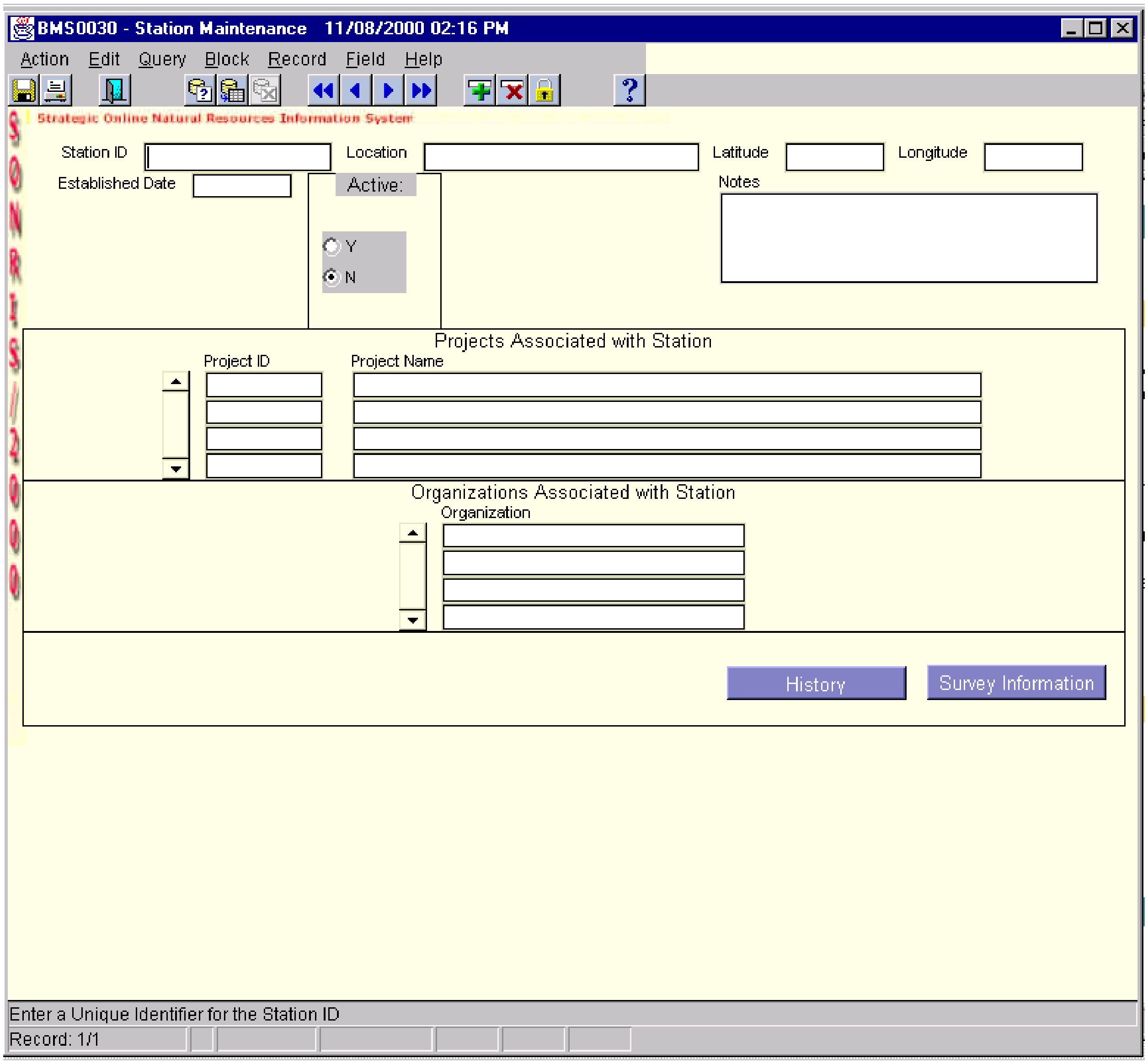
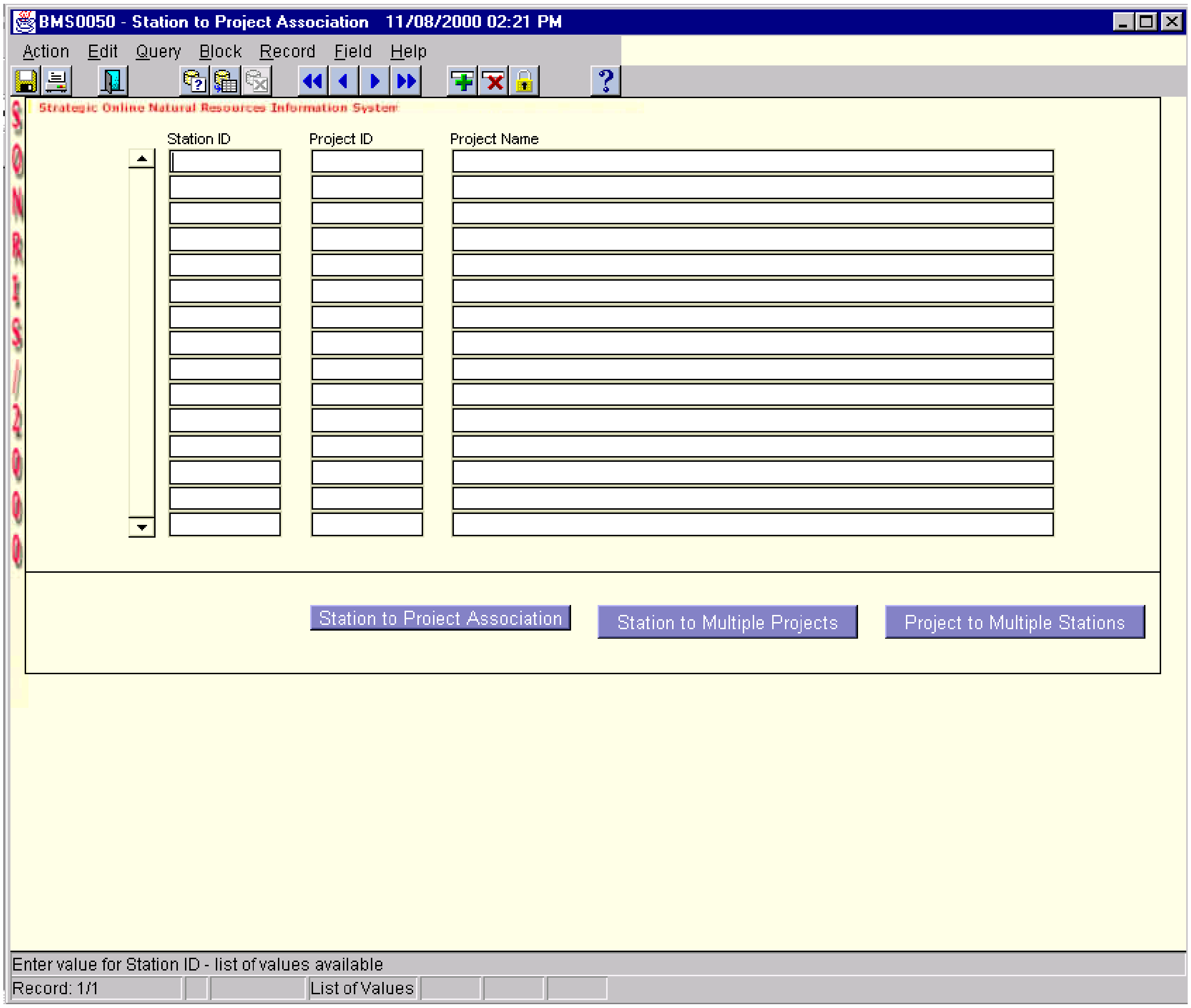
PO-02c	Bayou Chevee		Sealy	Troutman	Boddie	Wallace	Jones	PO	DNR	SP	01/01/91	05/01/94	10/20/92	04/01/92 (1)	06/10/96 (2)		06/10/96
PO-03b	La Branche Shoreline		TBA	Troutman	Cook	Wallace	Jones	PO	DNR	SP	no monitoring						
PO-08	Central Wetlands		Snedden	Troutman	Cook	Wallace	Jones	PO	DNR	FD	08/10/91	05/15/92	08/01/92	10/26/93 (1)	02/22/96 (2)		02/22/96
PO-10	Turtle Cove		Snedden	Troutman	Bahlinger	Wallace	Jones	PO	DNR	SP	09/20/93	07/26/94	10/01/94	11/01/94 (1)	01/27/97 (3)	09/14/99 (1)	09/14/99
TE-01	Montegut Wetland		Hubbell	Lee	Thibodeaux	Armbruster	Clark	TE	DNR	MM	05/17/93	11/17/93	10/01/92	11/09/91 (1)	07/15/96 (2)	05/01/97 (1)	05/01/97
TE-02	Falgout Canal Protection		Folse	Lee	Thibodeaux	Armbruster	Clark	TE	DNR	MM	07/31/92	04/02/93	04/01/93	10/16/91 (1)	05/25/96 (2)	05/01/00 (2)	
TE-03	Bayou La Cache Wetland		Hubbell	Lee	Thibodeaux	Armbruster	Clark	TE	DNR	MM	01/01/96	10/23/96	07/01/93	10/13/92 (1)	10/23/97 (2)	10/23/99 (1)	
TE-07b	Lower Petit Caillou		Hubbell	Lee	Long	Armbruster	Clark	TE	DNR	HR	06/01/95	09/01/95	03/01/94	11/01/94 (1)	07/23/96 (2)		07/23/96
TE-14	Point Farm Refuge Plantings		Folse	Lee	Bahlinger	Armbruster	Clark	TE	DNR	VP	02/01/93	02/01/94	08/01/93	None	02/05/96 (2)		02/05/96
T/V-02a	Hammock Lake		Thibodeaux	Libersat	Bahlinger	L. Aucoin	MacInnes	T/V	DNR	SP	08/01/90	09/30/90	08/01/90	12/10/92 (1)	12/19/96 (1)		12/19/96
T/V-02b	Yellow Bayou		Thibodeaux	Libersat	Underwood	L. Aucoin	MacInnes	T/V	DNR	SP	10/01/91	10/31/91	07/01/91	12/10/92 (1)	12/04/96 (1)		12/04/96
T/V-06	Marsh Island Control Structure		Thibodeaux	Libersat	Broussard, G.	L. Aucoin	MacInnes	T/V	DNR	MM	03/01/93	09/06/93	08/01/93	08/25/94 (1)	03/28/97 (3)		03/28/97
T/V-11	Freshwater Bayou Bank Protection		Miller	Libersat	Guidry	L. Aucoin	MacInnes	T/V	DNR	SP	11/01/93	02/02/94	07/01/93	12/10/90 (1)	06/26/96 (1)		06/26/96
T/V-13	Oaks Canal/Vermilion Bay Shore		Castellanos	Libersat	Thibodeaux	L. Aucoin	MacInnes	TV	DNR	SP	NO DATE						
ON-HOLD STATE PROJECTS																	
BA-06	US 90 to GIWW		Rapp	Lee	Radford	Armbruster	Clark	BA	DNR	HR	ON HOLD						
BA-07	Couba Island		Snedden	Troutman	Burkholder	Wallace	Jones	BA	DNR	SP	ON HOLD						
BA-08	Lake Cataouatche		Curole	Lee	Boddie	Armbruster	Clark	BA	DNR	SP	ON HOLD						
BA-09	Salvador WMA Gulf Canal		Curole	Lee	Boddie	Armbruster	Clark	BA	DNR	SP/VP	ON HOLD						
BA-10	Davis Pond Outfall		Snedden	Troutman	Radford	Wallace	Jones	BA	DNR	FD	ON HOLD						
BA-11	Tiger/Red Pass		TBA	Troutman	Boddie	Wallace	Jones	BA	DNR	FD	ON HOLD						
BA-12	Grand/Spanish Pass		TBA	Troutman	Boddie	Wallace	Jones	BA	DNR	FD	ON HOLD						
BA-13	Hero Canal		Boshart	Troutman	Boddie	Wallace	Jones	BA	DNR	FD	ON HOLD						
BA-14	Little Lake		Boshart	Troutman	Boddie	Wallace	Jones	BA	DNR	MM	ON HOLD						
BA-17	City Price		Boshart	Troutman	Boddie	Wallace	Jones	BA	DNR	FD	ON HOLD						
BS-01	Bohemia		Boshart	Troutman	Cook	Wallace	Jones	BS	DNR	FD	ON HOLD						
BS-01b	Bohemia Outfall		Boshart	Troutman	Cook	Wallace	Jones	BS	DNR	FD	ON HOLD						
BS-03b	Caernarvon Outfall St. Bernard		Snedden	Troutman	Boddie	Wallace	Jones	BS	DNR	FD	ON HOLD						
BS-05	Bayou LaMoque Outfall Manage.		Snedden	Troutman	Radford	Wallace	Jones	BS	DNR	FD	ON HOLD						
C/S-04b	Cameron Creole FW Intro.		Weifenbach	Libersat	Guidry	L. Aucoin	MacInnes	C/S	DNR	FD	ON HOLD						
C/S-05	Sabine Freshwater Introduction		Castellanos	Libersat	Guidry	L. Aucoin	MacInnes	C/S	DNR	FD	ON HOLD						
C/S-06	Black Lake South		Miller	Libersat	Broussard, G.	L. Aucoin	MacInnes	C/S	DNR	VP	ON HOLD						
C/S-07	Black Lake West Shore Protect.		Miller	Libersat	Broussard, G.	L. Aucoin	MacInnes	C/S	DNR	SP/VP	ON HOLD						
C/S-08	Black Lake North Marsh		Miller	Libersat	Broussard, G.	L. Aucoin	MacInnes	C/S	DNR	MM	ON HOLD						
C/S-10	Grand Lake Ridge Marsh		Miller	Libersat	Guidry	L. Aucoin	MacInnes	C/S	DNR	MM	ON HOLD						
C/S-12	Black Bayou Marsh management		Miller	Libersat	Guidry	L. Aucoin	MacInnes	C/S	DNR	MM	ON HOLD						
C/S-13	Back Ridge Freshwater		Weifenbach	Libersat	Guidry	L. Aucoin	MacInnes	C/S	DNR	FD	ON HOLD						
C/S-14	Tripod Bayou Control Structure		Weifenbach	Libersat	Broussard, G	L. Aucoin	MacInnes	C/S	DNR	HR	ON HOLD						
C/S-15	Boudreaux/Broussard Marsh		Weifenbach	Libersat	Guidry	L. Aucoin	MacInnes	C/S	DNR	SNT	ON HOLD						
C/S-16	Black Bayou Culverts		Miller	Libersat	Broussard, G.	L. Aucoin	MacInnes	C/S	DNR	HR	ON HOLD						
ME-02	Hog Bayou Wetland		Miller	Libersat	Guidry	L. Aucoin	MacInnes	ME	DNR	MM	ON HOLD						
ME-05	White Lake Shore Protection		Miller	Libersat	Broussard, G.	L. Aucoin	MacInnes	ME	DNR	SP	ON HOLD						
ME-06	Big Burn Marsh Management		Vincent	Libersat	S. Aucoin	L. Aucoin	MacInnes	ME	DNR	MM	ON HOLD						

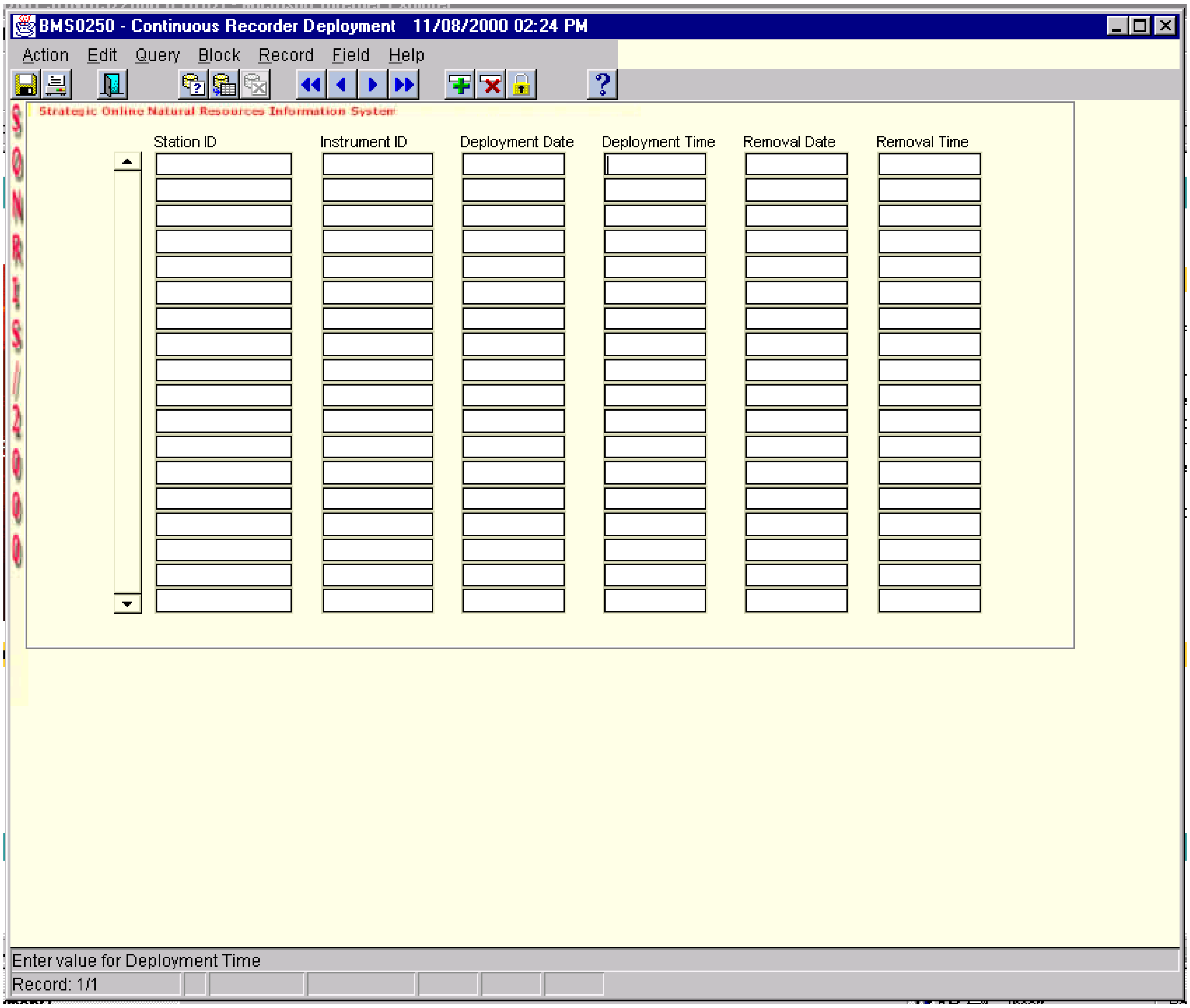
10/04/00

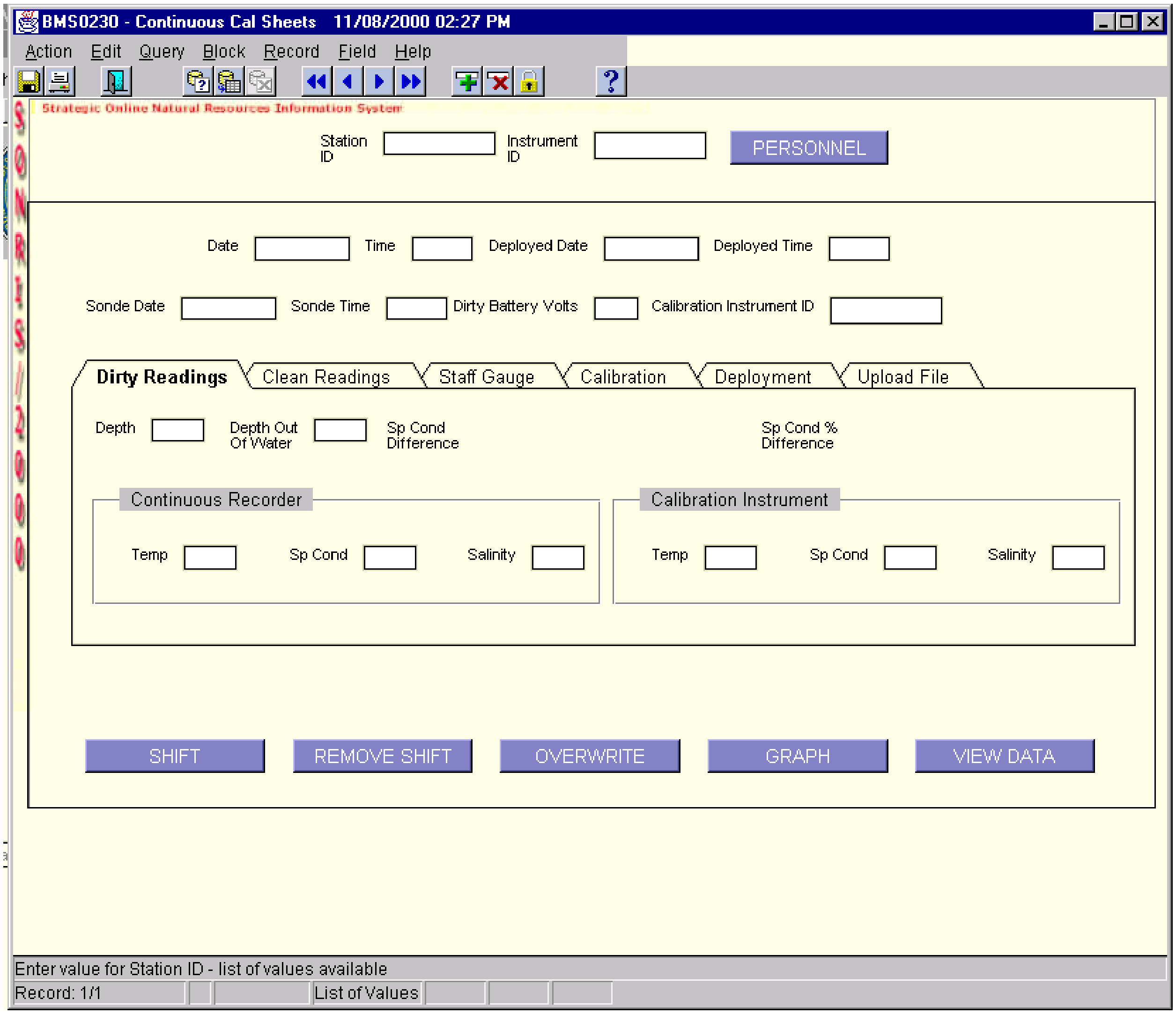
Project Monitoring Responsibilities

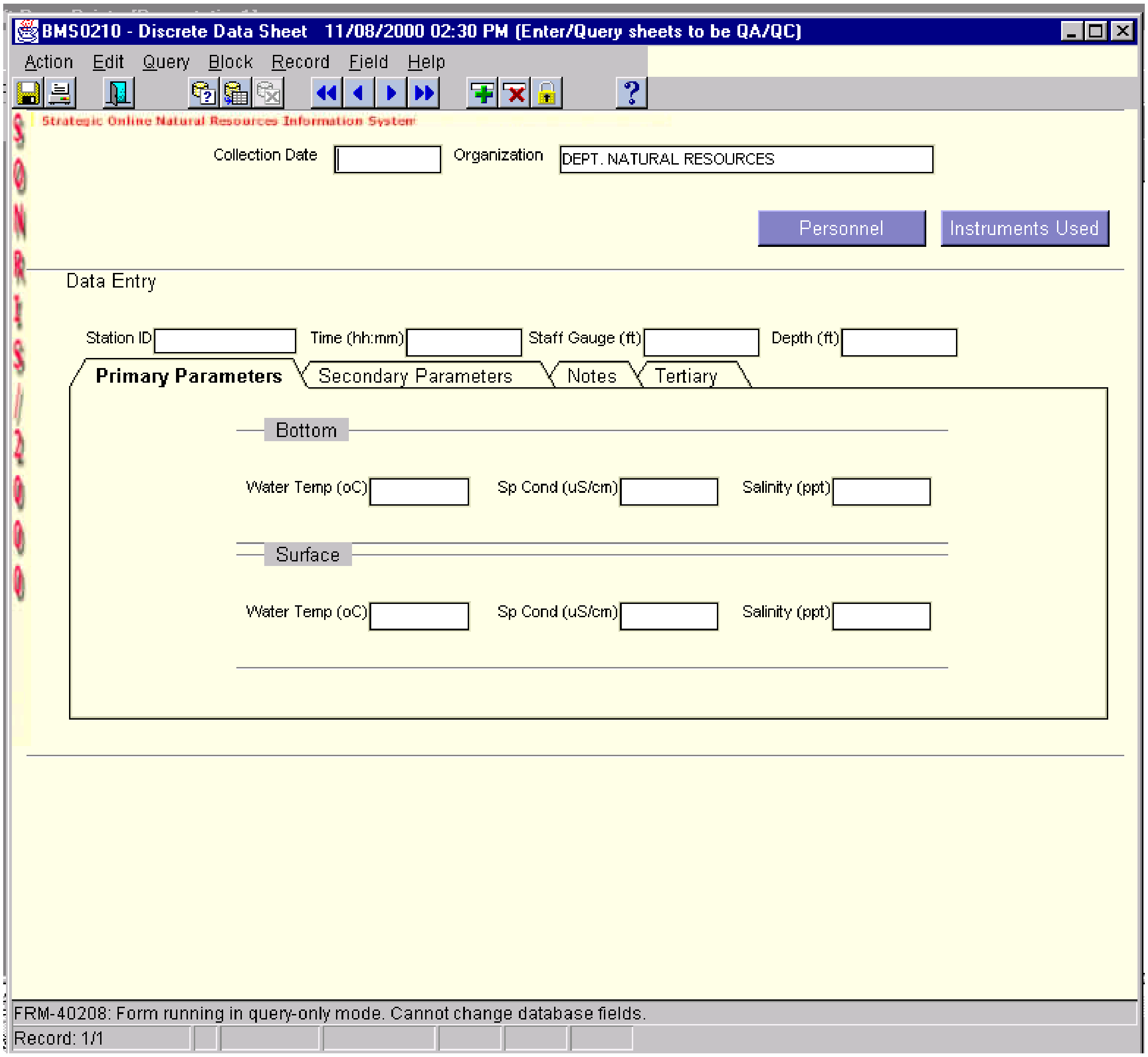
Project Number	Project Name	Priority List	Monitoring Manager (MM)	MM Supervisor	Project Manager	DAS Assistant	NWRC Assistant	Basin	Agency	Project Type	Construction Date (month-day-year) Start	End	Monitoring Plan Completion Date	Aerial Photography Acquisition Latest Date (flight #)	Progress Report Due Date (report #)	Comprehensive Report Due Date (report #)	Close-Out Report Due Date
ME-07	Deep Lake Marsh Protection		Vincent	Libersat	Broussard, G.	L. Aucoin	MacInnes	ME	DNR	SNT	ON HOLD						
ME-10	Sawmill Canal		Vincent	Libersat	Broussard, G.	L. Aucoin	MacInnes	ME	DNR	HR	ON HOLD						
ME-11	Humble Canal		Vincent	Libersat	Thibodeaux	L. Aucoin	MacInnes	ME	DNR	HR	ON HOLD						
MR-02	Pass-a-Loutre Sediment Fence		TBA	Troutman	Radford	Wallace	Jones	MR	DNR	SNT	ON HOLD						
MR-04	Tiger Pass Creation		Horne	Troutman	Boddie	Wallace	Jones	MR	DNR	DM	ON HOLD						
MR-05	Pass-a-Loutre Sediment Mining		TBA	Troutman	Radford	Wallace	Jones	MR	DNR	SD	ON HOLD						
PO-03	LaBranche Wetland		TBA	Troutman	Cook	Wallace	Jones	PO	DNR	MM	ON HOLD						
PO-07	North Shore		Sealy	Troutman	Gammill	Wallace	Jones	PO	DNR	SNT	ON HOLD						
PO-11	Cutoff Bayou		Sealy	Troutman	Gammill	Wallace	Jones	PO	DNR	HR	ON HOLD						
PO-12	West LaBranche Wetland		TBA	Troutman	Gammill	Wallace	Jones	PO	DNR	MM	ON HOLD						
PO-13	Tangipahoa/Pontchartrain		Sealy	Troutman	Cook	Wallace	Jones	PO	DNR	SP	ON HOLD						

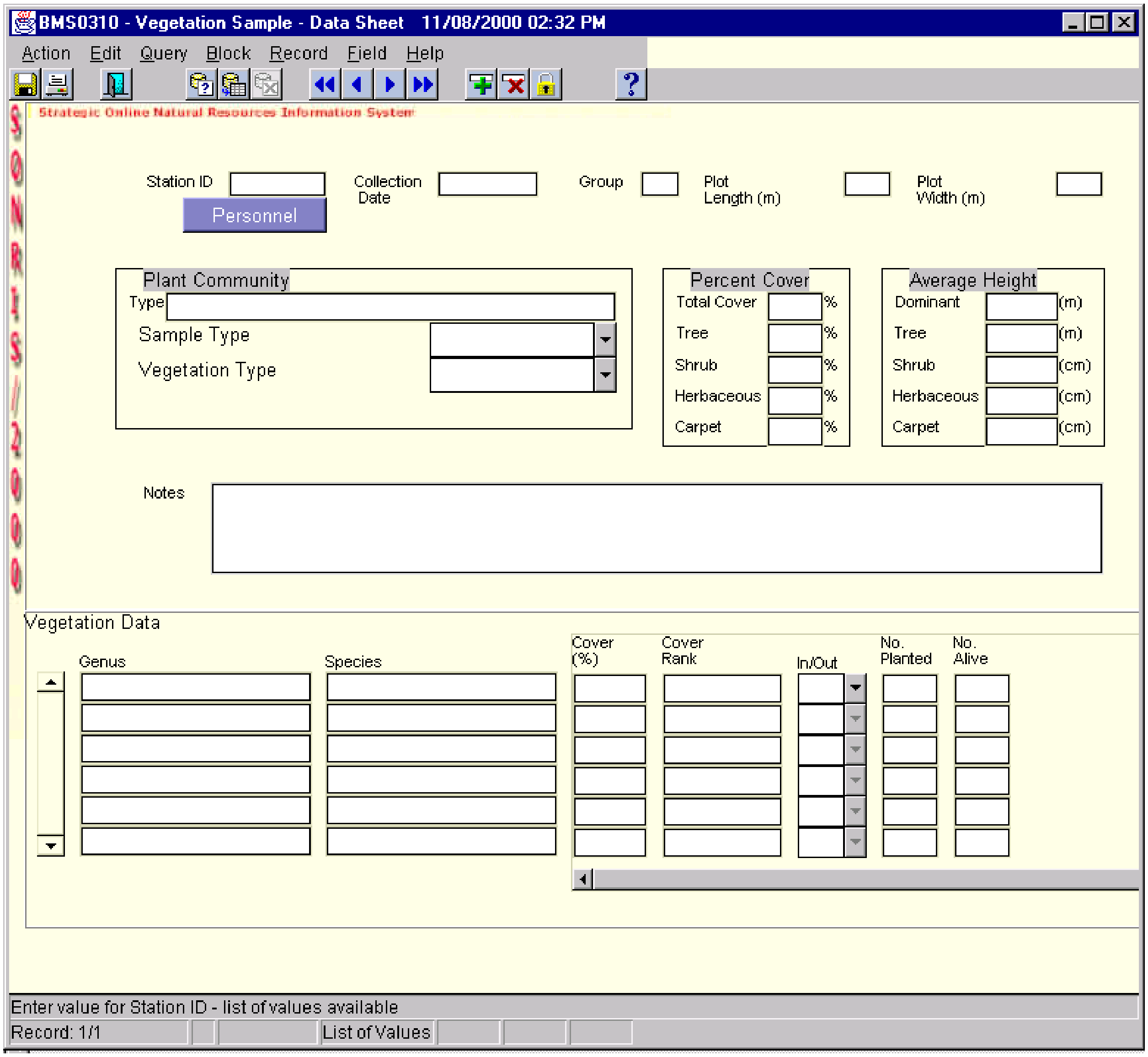

BMS0030 - Station Maintenance 11/08/2000 02:16 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Station ID
Location
Latitude
Longitude
Established Date
Active:
Y
N
Notes
Projects Associated with Station
Project ID
Project Name
Organizations Associated with Station
Organization
History
Survey Information
Enter a Unique Identifier for the Station ID
Record: 1/1

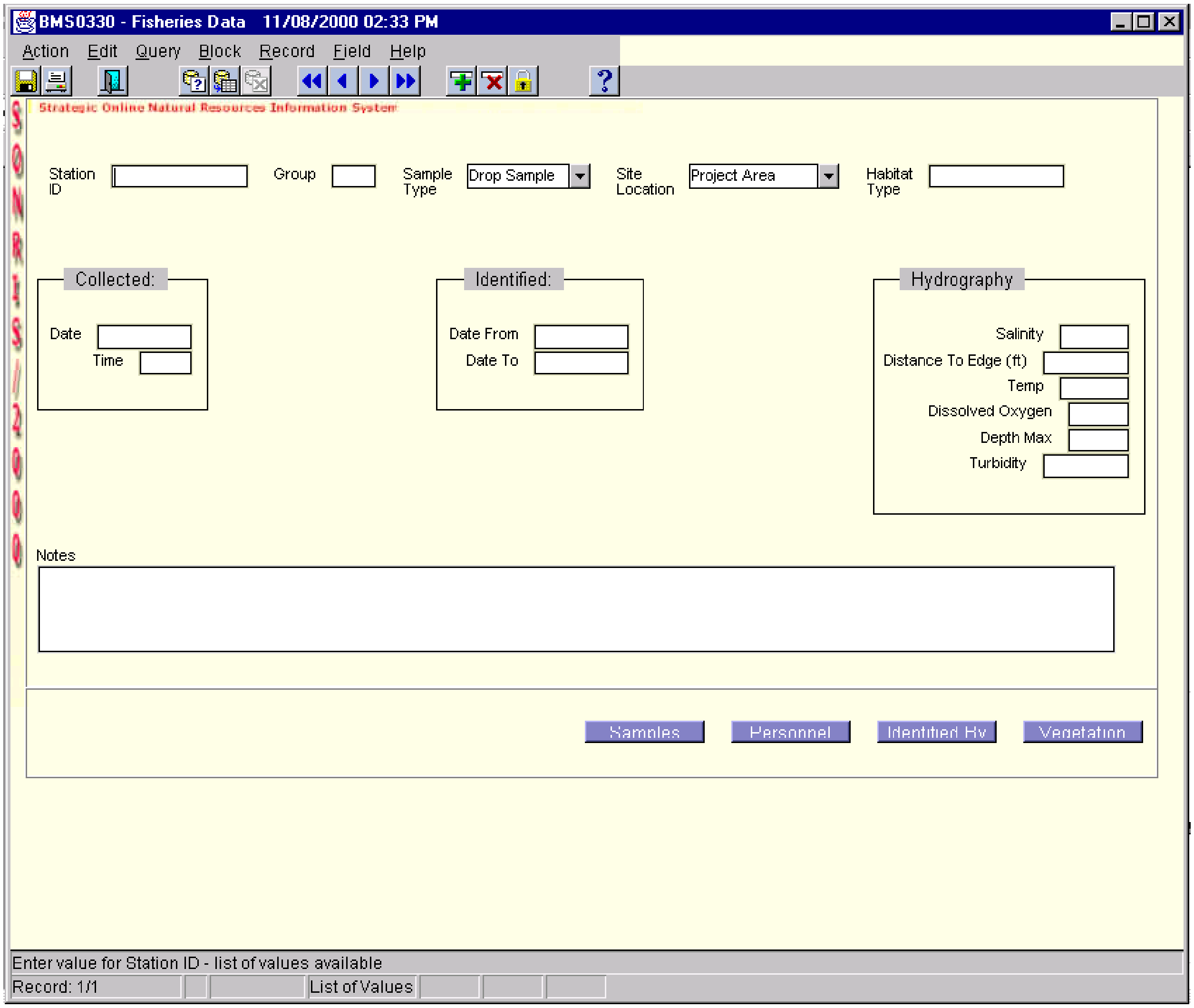

BMS0050 - Station to Project Association 11/08/2000 02:21 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Station ID
Project ID
Project Name
Station to Project Association
Station to Multiple Projects
Project to Multiple Stations
Enter value for Station ID - list of values available
Record: 1/1
List of Values

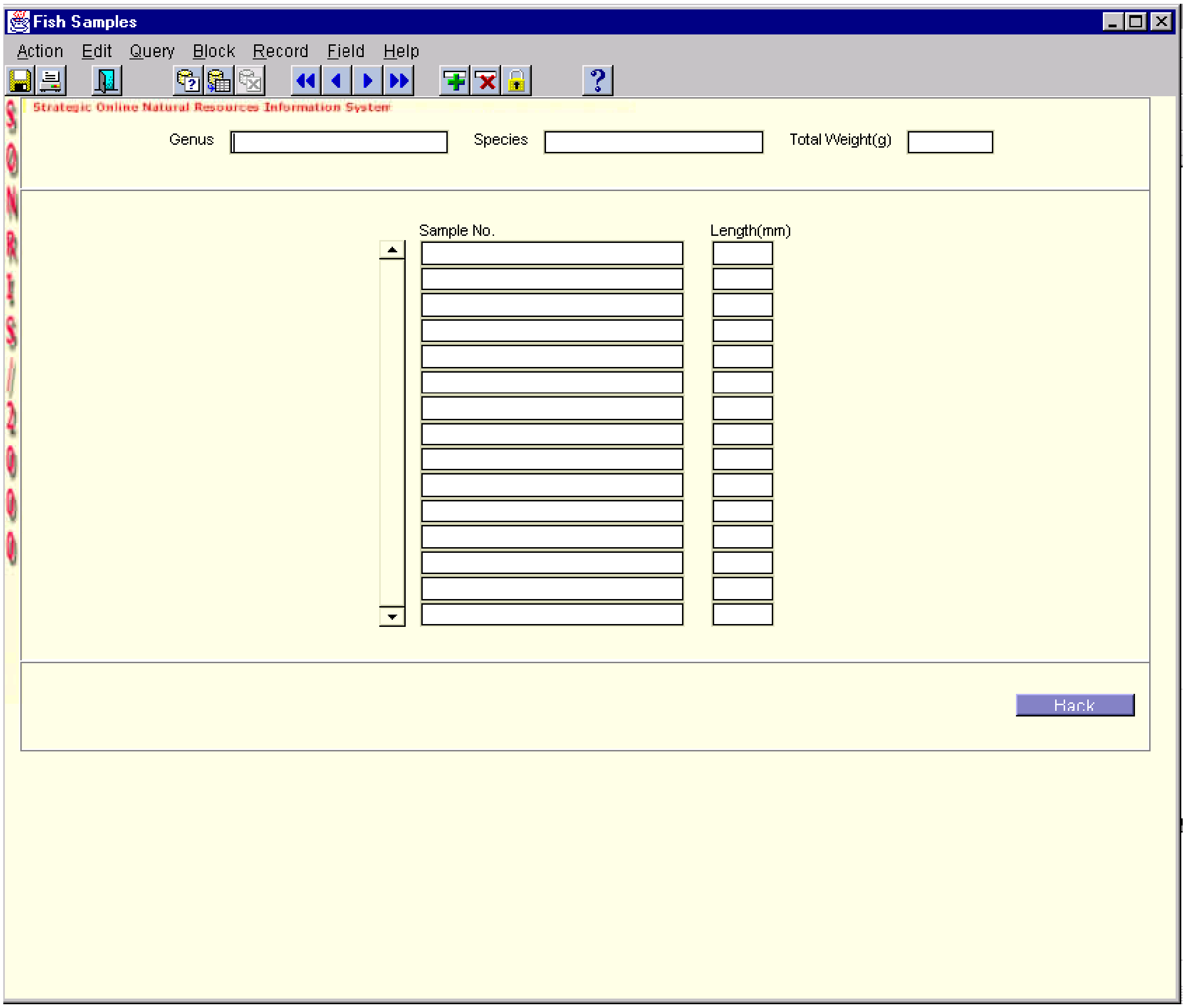

BMS0250 - Continuous Recorder Deployment 11/08/2000 02:24 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Station ID
Instrument ID
Deployment Date
Deployment Time
Removal Date
Removal Time
Enter value for Deployment Time
Record: 1/1

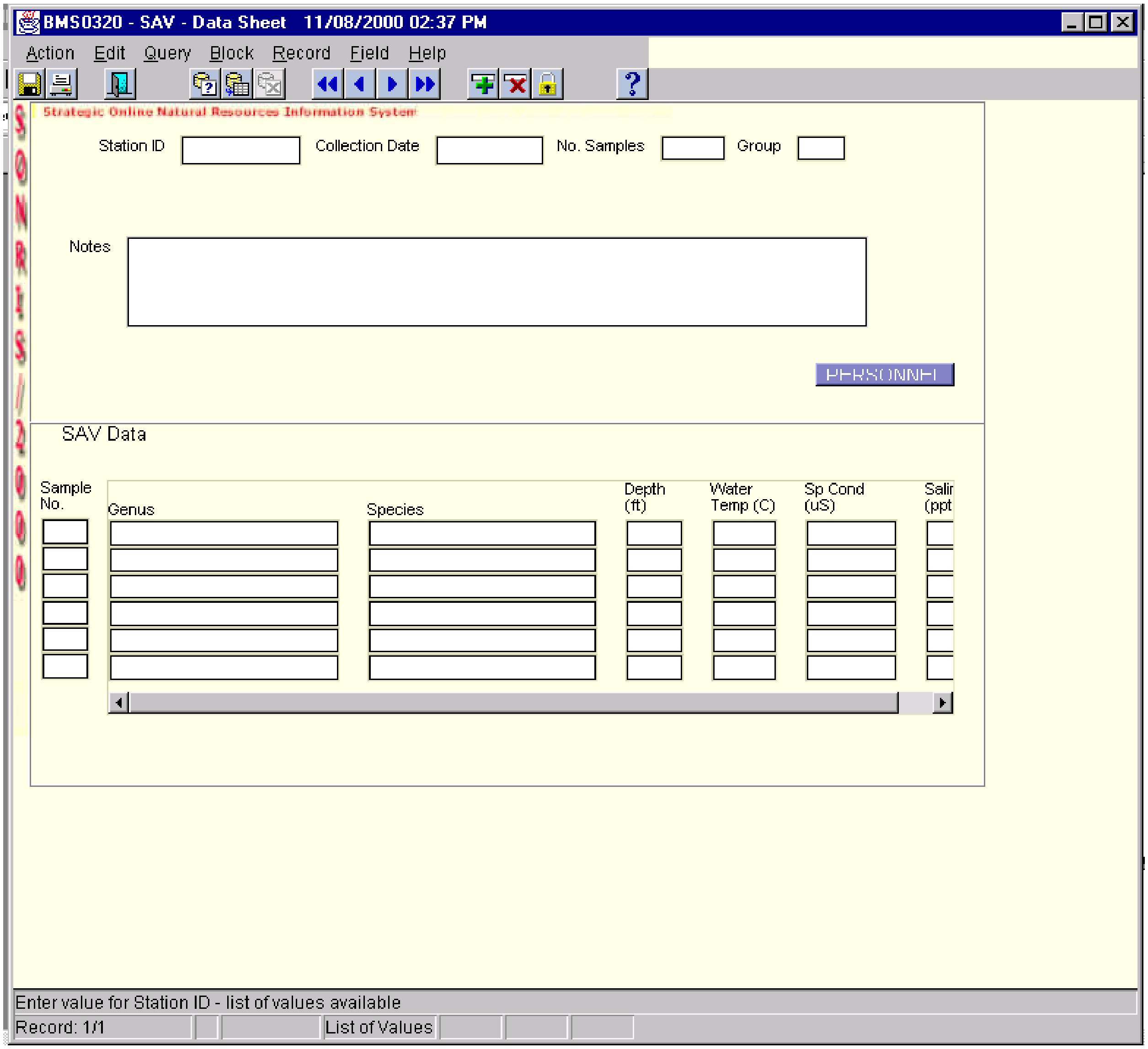

BMS0230 - Continuous Cal Sheets 11/08/2000 02:27 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
Station ID
Instrument ID
PERSONNEL
Date
Time
Deployed Date
Deployed Time
Sonde Date
Sonde Time
Dirty Battery Volts
Calibration Instrument ID
Dirty Readings
Clean Readings
Staff Gauge
Calibration
Deployment
Upload File
Depth
Depth Out Of Water
Sp Cond Difference
Sp Cond % Difference
Continuous Recorder
Temp
Sp Cond
Salinity
Calibration Instrument
Temp
Sp Cond
Salinity
SHIFT
REMOVE SHIFT
OVERWRITE
GRAPH
VIEW DATA
Enter value for Station ID - list of values available
Record: 1/1
List of Values

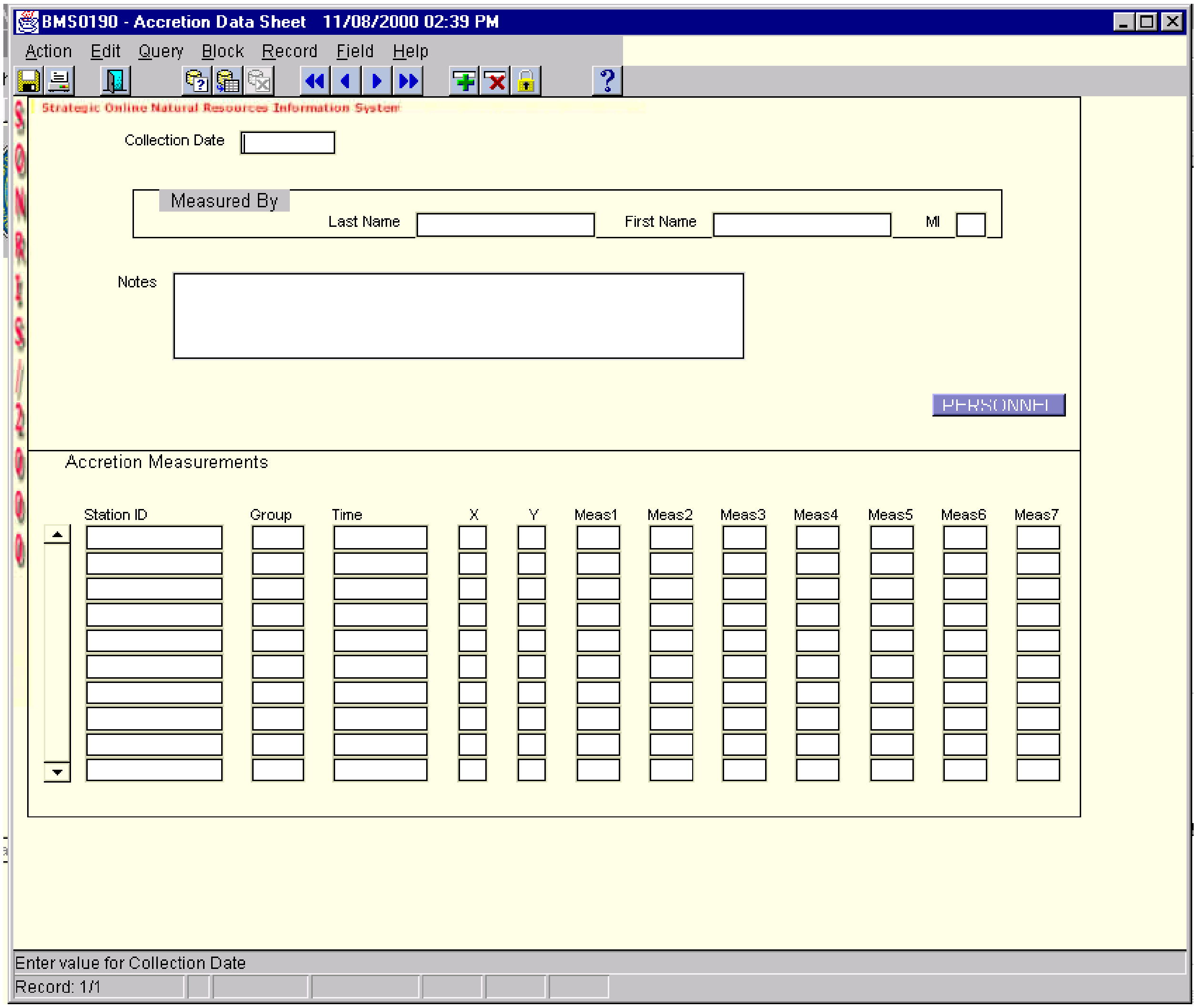

BMS0210 - Discrete Data Sheet 11/08/2000 02:30 PM (Enter/Query sheets to be QA/QC)
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Collection Date
Organization
DEPT. NATURAL RESOURCES
Personnel
Instruments Used
Data Entry
Station ID
Time (hh:mm)
Staff Gauge (ft)
Depth (ft)
Primary Parameters
Secondary Parameters
Notes
Tertiary
Bottom
Water Temp (oC)
Sp Cond (uS/cm)
Salinity (ppt)
Surface
Water Temp (oC)
Sp Cond (uS/cm)
Salinity (ppt)
FRM-40208: Form running in query-only mode. Cannot change database fields.
Record: 1/1

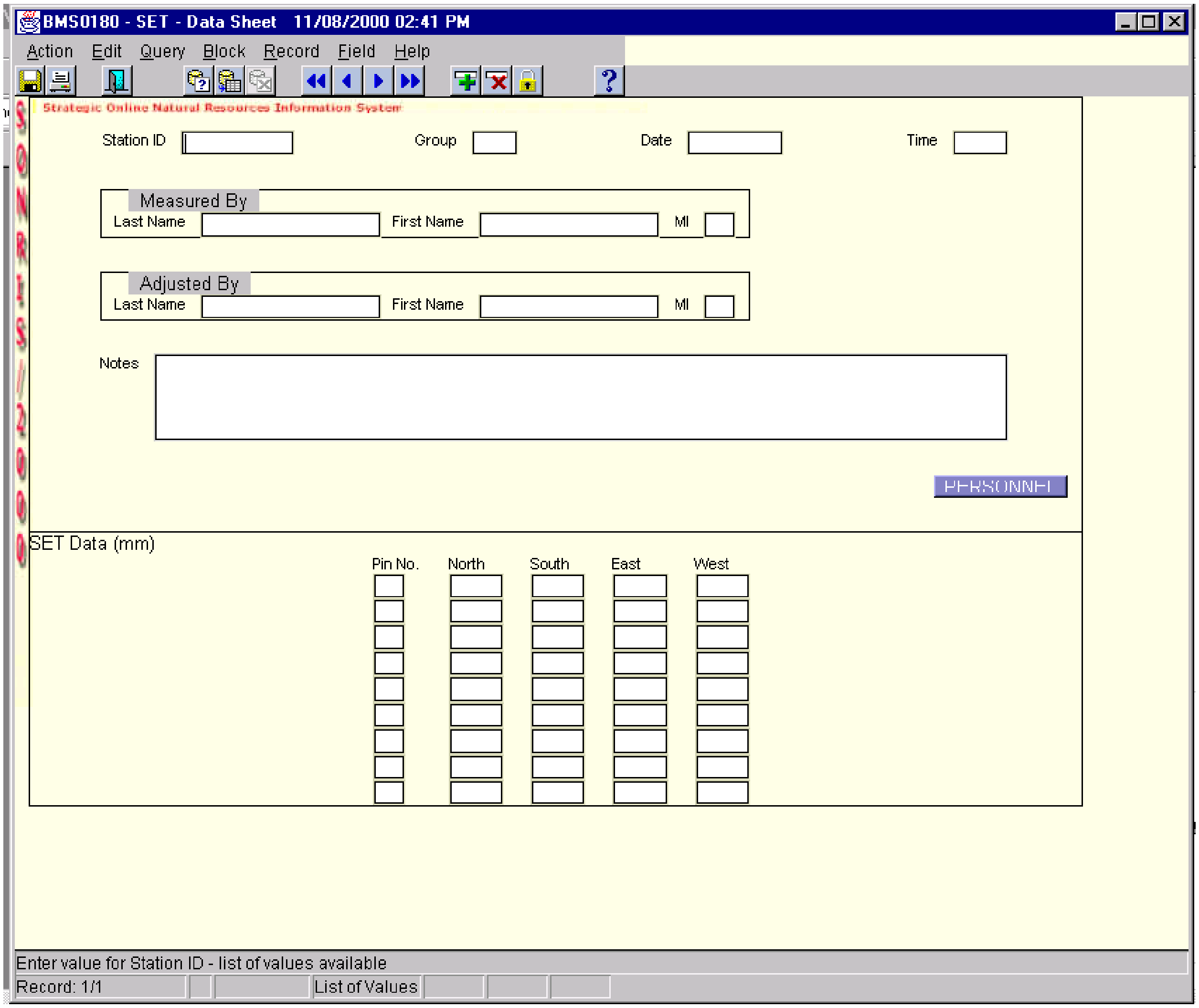

BMS0310 - Vegetation Sample - Data Sheet 11/08/2000 02:32 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Station ID
Personnel
Collection Date
Group
Plot Length (m)
Plot Width (m)
Plant Community
Type
Sample Type
Vegetation Type
Percent Cover
Total Cover
Tree
Shrub
Herbaceous
Carpet
Average Height
Dominant
Tree
Shrub
Herbaceous
Carpet
Notes
Vegetation Data
Genus
Species
Cover (%)
Cover Rank
In/Out
No. Planted
No. Alive
Enter value for Station ID - list of values available
Record: 1/1
List of Values

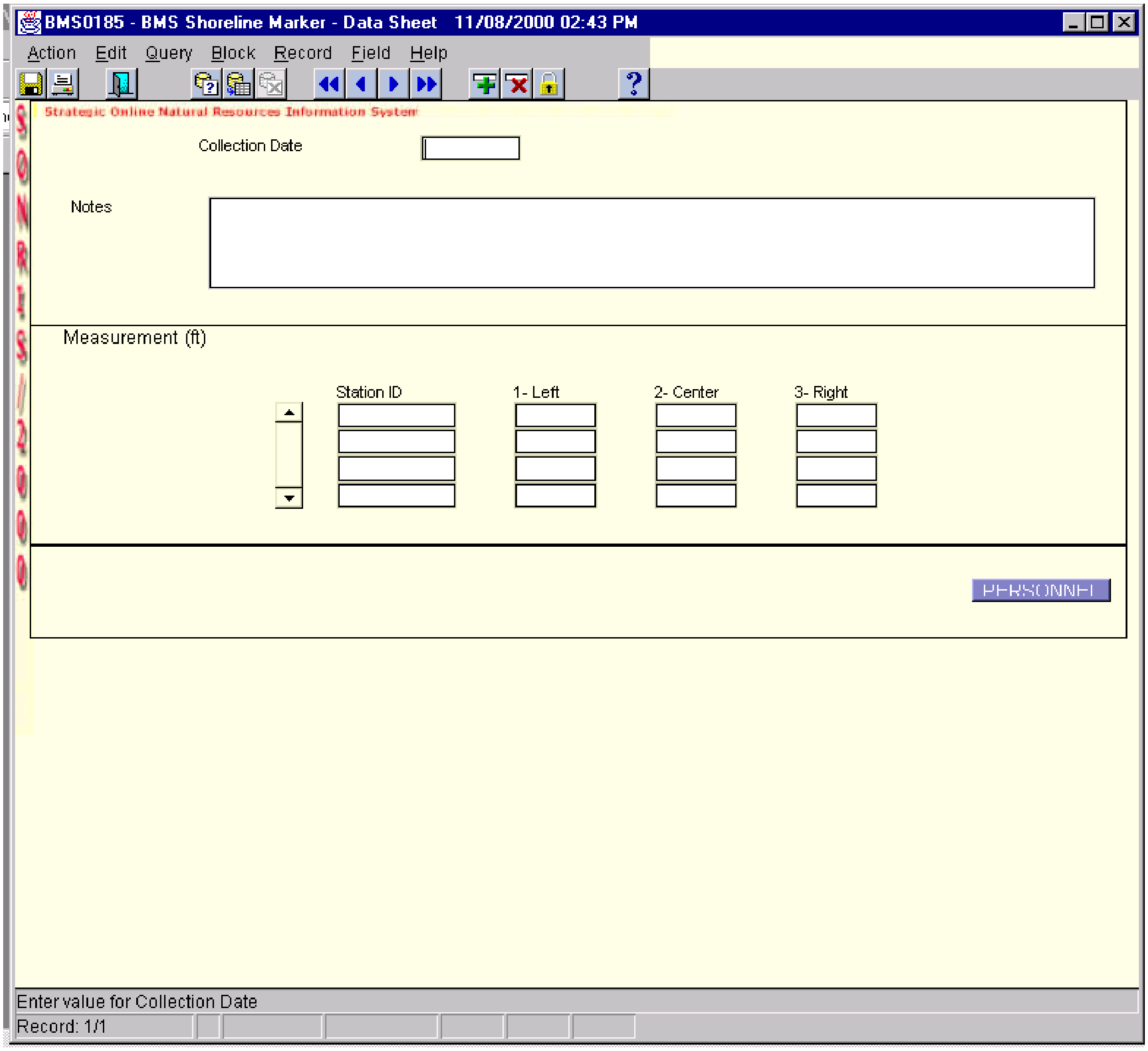

BMS0330 - Fisheries Data 11/08/2000 02:33 PM
Action Edit Query Block Record Field Help
SONRIS/2000
Strategic Online Natural Resources Information System
Station ID
Group
Sample Type
Drop Sample
Site Location
Project Area
Habitat Type
Collected:
Date
Time
Identified:
Date From
Date To
Hydrography
Salinity
Distance To Edge (ft)
Temp
Dissolved Oxygen
Depth Max
Turbidity
Notes
Samples
Personnel
Identified By
Vegetation
Enter value for Station ID - list of values available
Record: 1/1
List of Values

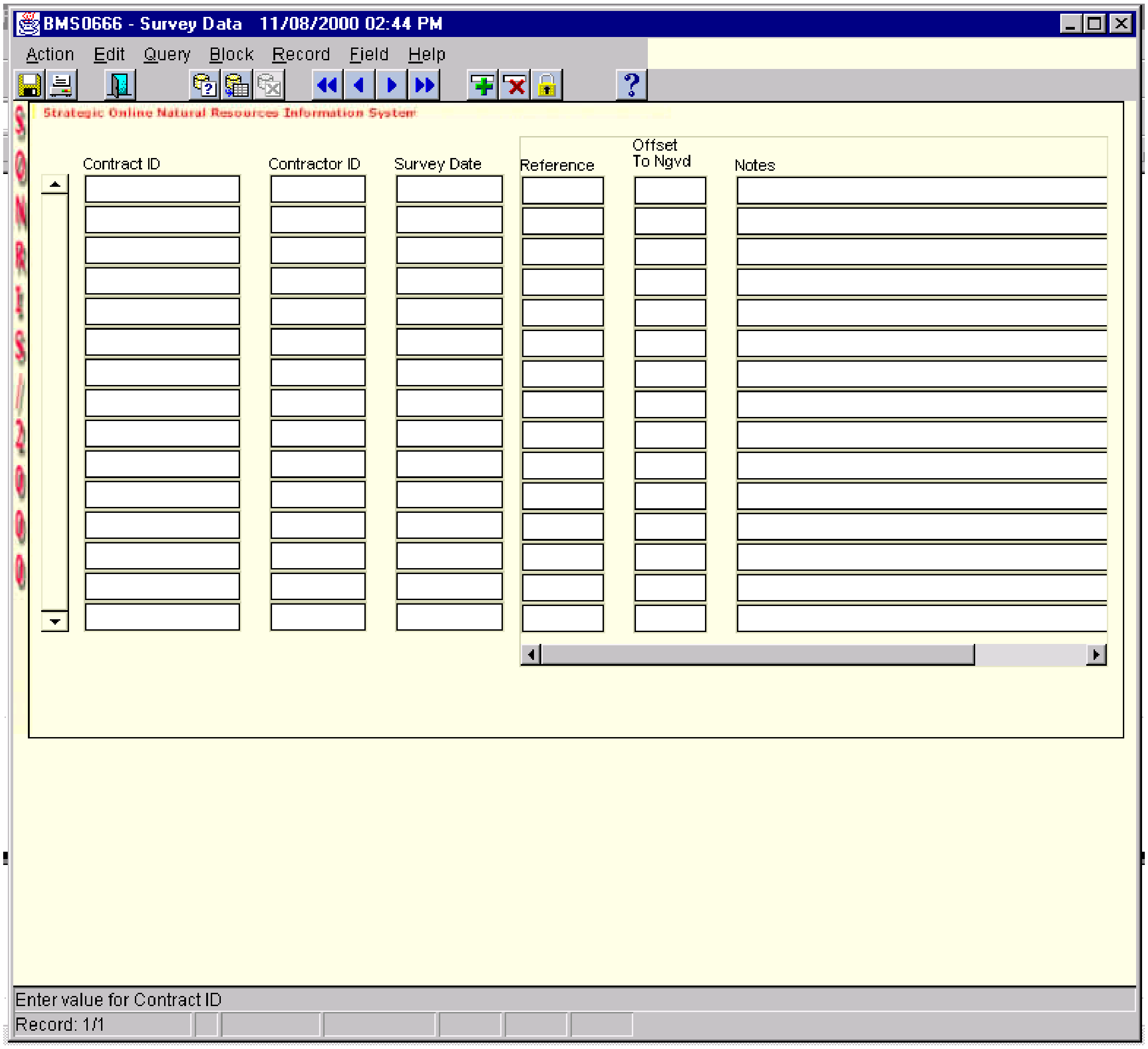

Fish Samples
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Genus
Species
Total Weight(g)
Sample No.
Length(mm)

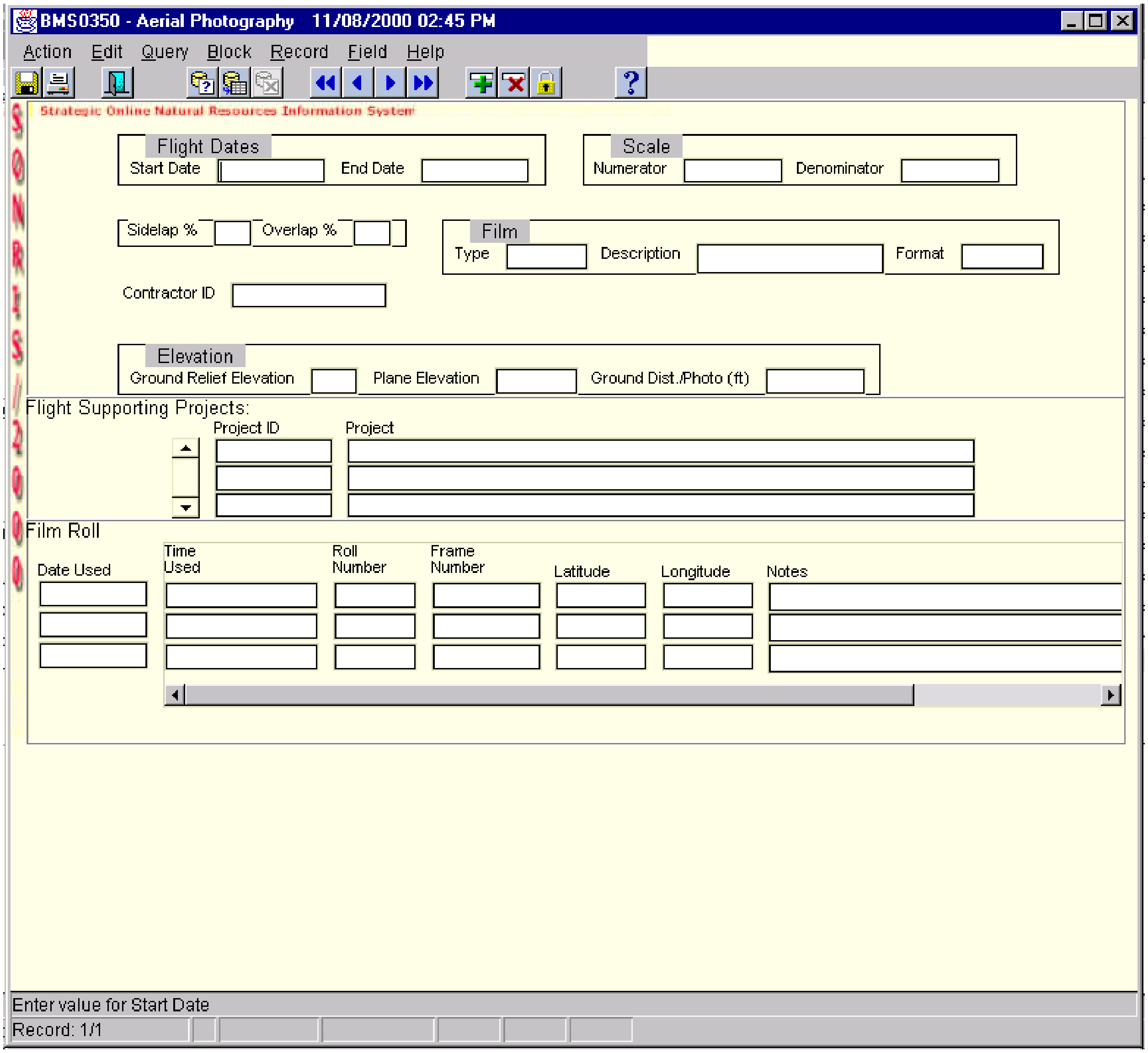

BMS0320 - SAV - Data Sheet 11/08/2000 02:37 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Station ID
Collection Date
No. Samples
Group
Notes
PERSONNEL
SAV Data
Sample No.
Genus
Species
Depth (ft)
Water Temp (C)
Sp Cond (uS)
Salir (ppt
Enter value for Station ID - list of values available
Record: 1/1
List of Values


BMS0190 - Accretion Data Sheet 11/08/2000 02:39 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Collection Date
Measured By
Last Name
First Name
MI
Notes
PERSONNEL
Accretion Measurements
Station ID
Group
Time
X
Y
Meas1
Meas2
Meas3
Meas4
Meas5
Meas6
Meas7
Enter value for Collection Date
Record: 1/1


BMS0180 - SET - Data Sheet 11/08/2000 02:41 PM
Action Edit Query Block Record Field Help
Station ID
Group
Date
Time
Measured By
Last Name
First Name
MI
Adjusted By
Last Name
First Name
MI
Notes
PERSONNEL
SET Data (mm)
Pin No.
North
South
East
West
Enter value for Station ID - list of values available
Record: 1/1
List of Values


BMS0185 - BMS Shoreline Marker - Data Sheet 11/08/2000 02:43 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Collection Date
Notes
Measurement (ft)
Station ID
1- Left
2- Center
3- Right
PERSONNEL
Enter value for Collection Date
Record: 1/1


BMS0666 - Survey Data 11/08/2000 02:44 PM
Action Edit Query Block Record Field Help
Strategic Online Natural Resources Information System
SONRIS/2000
Contract ID
Contractor ID
Survey Date
Reference
Offset To Ngvd
Notes
Enter value for Contract ID
Record: 1/1


BMS0350 - Aerial Photography 11/08/2000 02:45 PM
Action Edit Query Block Record Field Help
SONRIS/2000
Strategic Online Natural Resources Information System
Flight Dates
Start Date
End Date
Scale
Numerator
Denominator
Sidelap %
Overlap %
Film
Type
Description
Format
Contractor ID
Elevation
Ground Relief Elevation
Plane Elevation
Ground Dist./Photo (ft)
Flight Supporting Projects:
Project ID
Project
Film Roll
Date Used
Time Used
Roll Number
Frame Number
Latitude
Longitude
Notes
Enter value for Start Date
Record: 1/1