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QUALITY ASSURANCE PLAN FOR

1991 PILOT STUDY OF

THE ECOLOGICAL CONDITION OF MUNICIPAL WASTEWATER

CONSTRUCTED WETLAND TREATMENT SYSTEMS

by

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CONSTRUCTED WETLAND ECOLOGICAL STUDY

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1.0 INTRODUCTION

The purpose of this quality assurance plan is to detail the methods and procedures to be used in the pilot study of the ecological condition in municipal wastewater constructed wetland treatment systems (hereafter referred to as wetland treatment systems, or WTS). It includes specific procedures for assuring that data are of known, high quality. Background material and description of the general approach are outlined in a separate project work plan.

1.1 Project Overview

Wetland treatment systems are engineered systems designed to simulate natural wetland ecosystem processes for the primary purpose of wastewater treatment (Hammer and Bastian 1989). While current evidence shows that wetland treatment systems can duplicate structural aspects of some natural wetlands, little is known about the replication of wetland functions (Clewell and Lea 1989, Zedler and Weller 1989). Wetland functions are processes or attributes, inherent in many wetlands, that contribute toward a service or benefit that humans consider important. Wetlands usually perform one or more functions, depending upon their type, location, the local geology, topography, and hydrology, and other characteristics of the watershed. Typical wetland functions include: wildlife habitat, recreation, nutrient and pollutant assimilation and retention, detritus and dissolved nutrient and organic matter production, reduction of downstream sedimentation, floodwater retention, and groundwater recharge. With the exception of nutrient removal, wetland functions are normally considered "ancillary", or supplemental in WTS because these systems are usually designed for wastewater treatment and not necessarily for other purposes.

Wetland treatment systems can and do provide various ancillary functions, but concerns exist about potential effects on ecological condition caused by additions of wastewater to these wetlands (Godfrey et al. 1985, U.S. EPA 1984, Mudroch and Capobianco 1979). The ecological condition, or "health" of a wetland refers to its ecosystem viability, sustainability, and ability to serve one or more functions. A "healthy" wetland exhibits structures and functions necessary to sustain itself and is free of most known stressors or problems (Rapport 1989, Schaeffer et al. 1988). Wetland treatment systems have great potential to serve many ancillary functions, but concerns exist about potential effects on ecological condition caused by additions of wastewater to these wetlands. Monitoring the ecological condition of wastewater treatment systems requires development and validation of indicators. Indicators are easily-measured wetland attributes which can be used to assess wetland ecological condition and to identify ecological disfunction. A great deal of research is now underway to develop indicators of ecological condition in wetlands, but most indicators need further testing.

This pilot study will focus on ancillary benefits and ecological processes and their assessment in wetland treatment systems. Six selected wetland treatment systems will be evaluated in July and August 1991. The study is designed to test several indicators for their range, variability and ability to characterize the ecological condition and functioning of wetland treatment systems. In particular, ecological condition will be judged in terms of each wetland's ancillary role as wildlife habitat. The pilot study is an exploratory effort for testing methods, indicators, logistics, and capabilities. It is not intended to provide probability samples which can be related with known confidence to a defined population of constructed wetlands. The data collected should enable us to draw some general conclusions about ecological condition and ancillary benefits of wetland treatment systems (particularly with respect to wildlife habitat values) and the ability of the chosen set of indicators to assess wetland ecological condition. Many of the conclusions drawn from collected data will be speculative and will form the basis for designing a more focussed, quantitative study. Future research efforts could expand on the pilot study by adopting a larger or more homogeneous set of wetland sites, by intensifying sampling, and by refining the list of wetland condition indicators.

1.2 Objectives and Tasks

The objectives of the pilot study are:

- To examine methods and indicators for evaluating the wildlife habitat quality of WTS
- To identify potential gross differences in wildlife habitat indicators between WTS and non-WTS
- To provide baseline data and identify approaches for a more focussed, follow-up project that will provide specific information for developing measures of the wildlife habitat quality of WTS.

Specific tasks for study of selected municipal wastewater constructed wetlands are to:

- utilize the Wetland Evaluation Technique (WET) (Adamus 1987) to evaluate habitat quality and other values of constructed wetlands;
- compile data on selected indicators of wetland condition by: 1) taking measurements at sites and 2) using existing data sets; and
- compare measured indicator values with literature values for natural and created wetlands to get a preliminary idea of the range and variability of the indicators in the six study constructed wetlands relative to the range and variability found in other wetlands.

2.0 PROJECT DESCRIPTION

Six wetland treatment sites were chosen from a list of all free water surface municipal wastewater constructed wetlands operating in the U.S. Sites cover a range of sizes, ages, and geographical locations (Table I). Sites were chosen based on the following criteria:

- location in two different geographical and climatic regions of the country (the arid and semi-arid west and the southeast) and covering a range of sizes
- covering a range of ages but in operation for at least one year
- the existence of some background data on water quality
- permission to use the site
- interest of site operators and other groups in collaboration.

Lynne McAllister and Jane Schuler will travel to all sites in July and August of 1991. To assess ecological condition of the selected wetland sites, two general techniques will be used. First, an evaluation of each wetland's overall value, including its function as wildlife habitat, will be done at each site using the Wetland Evaluation Technique (WET) (Adamus 1987). Second, selected indicators will be measured to evaluate their abilities to assess ecological condition and ancillary benefits of wetland treatment systems. Testing will include determination of indicator variability among wetlands sampled and deviation in indicator values from those measured in natural and created wetlands. Low variability among constructed wetlands and obvious deviations from values obtained for natural and created wetlands would be the expected assessment result for an effective indicator. Data for each indicator will be obtained in one of two ways:

- o collecting data in the field (Table II);

- o using information from existing data sets and records kept for each site (Table III).

Table I. Site information.

Site name	Location	Year built	Size (ha)
Collins	Collins, MS	1987	4.05
Incline Village	Incline Village, NV	1985	365.00
Lakeland	Lakeland, FL	1987	498.00
Orlando	Orlando, FL	1987	486.00
Show Low	Show Low, AZ	1980	284.00
West Jackson	Ocean Springs, MS	1990	21.00

Calculation of descriptive statistics for each indicator will be necessary for data summary, but a qualitative assessment of summary data will be done to determine:

- o indicator range and variability among site sizes, locations, and ages

- o ecosystem function and habitat value of sites

Ecosystem function and habitat value will be judged in terms of abundance and diversity of biota, wetland nutrient assimilation capacity, and physical features of the landscape by comparing indicator values with published data for natural and created wetlands. Qualitative comparisons will be done on wetland data from the same general region of the country. Comparisons to existing data for natural and created wetlands may help identify gross deviations from natural and/or created wetlands of ecological condition of the six study wetland treatment systems if they exist. Because the sample size is small and sites are very different from one another, statistical analyses are inappropriate.

ERL-Duluth is providing a van for travel to all sites. Field data collection will require 4-6 days at each site, depending upon site size, weather, and vegetation density and diversity. Sampling at the western sites will be completed in early July and at the eastern sites in late July and early August. The project schedule chart is shown in Table IV.

Data analysis will include compilation of existing data, creation of a data base for all collected and existing data, data summaries, validation of vegetation specimens, invertebrate enumeration, laboratory analysis of water samples, digitizing aerial photographs for the landscape variables, literature review of existing data for natural and created wetlands, and data comparisons with wetland treatment systems (see Section 9.0 - Data Reduction and Validation). A final report for ERL-Corvallis will be prepared by May 1992.

Table II. Indicators of wetland ecological condition that will be measured during the 1991 pilot study.

Ecological Component	Indicators
Landscape	Wetland area Wetland age Distance of land/water interface in relation to water surface area Ratio of open water area to area covered by vegetation Land use in surrounding upland Distance to other wetlands, major rivers, the coast, traditional use areas (e.g. rookeries), cliffs/bluffs, roads, towns Presence of intervening habitats/corridors, protective buffers Cowardin et al. wetland classification
Vegetation	Species composition and percent coverage Structural diversity (# layers, size classes) Species dominance Presence of exotic species (descriptive)
Invertebrates	Species richness per stratum and per wetland Number of individuals of each species and of each functional group
Toxicity	Whole effluent toxicity tests on inflow and outflow

Table III. List of wetland indicators to be obtained from existing data sets.

Ecological Component	Indicators
Water	pH Dissolved oxygen Biochemical oxygen demand Total suspended solids Ammonia nitrogen Total Kjeldahl nitrogen Total phosphorus Fecal coliform bacteria
Birds	Ecological density (based on use concentration areas) of each species group - waterfowl, wading birds, shorebirds Species richness Relative abundance

Table IV. 1991 pilot study schedule.

	1991 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Initial site char. prelim. contacts, site visit, planning	—	------	---							
Field crew training			---	---						
Site visits										
-Incline Village					*					
-Show Low					*					
-Ocean Springs					*					
-Collins					*					
-Lakeland						*				
-Orlando						*				
Aerial photography			---	---------	-------					
Water sample analysis					----	------				
Data analysis							-------	-------	-------	--

3.0 PROJECT QA ORGANIZATION AND RESPONSIBILITIES

This pilot project is being designed and led by ERL-Corvallis staff; field support and laboratory work will be provided by ERL-Duluth. Names of cooperators are listed in Appendix A. The field component of the study will be carried out by Lynne McAllister, ERL-Corvallis and Jane Schuler, a temporary hire from ERL-Duluth, during July and August 1991. Lynne McAllister will oversee data collection, recording, analysis, and report writing. She will be responsible for quality assurance procedures, quality control data, evaluation of existing data bases, and oversight of the bird survey data. Both members of the field crew have knowledge of wetland ecology and wetland plant identification, as well as extensive work experience in different types of wetlands in various regions of the country.

Existing data bases will be used for some of the chosen indicators (Table III) because many data are more useful and representative of average wetland conditions if collected over a period of time rather than sampled during a very narrow time frame (4-6 days). Because these data have already been collected, ERL-C has made no agreements with cooperators regarding QA/QC of the measurements. The names and locations of people, agencies, and labs that contribute or provide existing data are listed in Appendix A.

Wetland treatment sites that discharge wastewater to a natural water body are required under regulations to sample water regularly for water quality. Water quality data is collected monthly or quarterly at all the eastern sites. Due to arid conditions in the west, enough water evaporates to obviate discharge to a natural body of water, so the western study sites (Show Low and Incline Village) are not required to routinely analyze water to fulfill a discharge permit requirement. Some water quality data, however, is collected at the western sites because it is of interest to site managers or agencies that have interest in the nutrient status in the wetlands (e.g. wildlife agencies). Water quality data is available from site managers. Most laboratories that conduct water analyses for these sites have their own quality assurance programs and documents (See Section 5.4).

Bird surveys are being conducted during 1991 in the six study constructed wetland sites by wildlife biologists from local state and federal agencies and universities who have expert knowledge of avian biology, identification, and survey techniques for birds in their respective regions. Survey results will be available for use in this study. We have made no arrangements with surveyors for QA/QC procedures during bird surveys, nor do the individual surveyors use formal QA/QC guidelines. Quality assurance is incorporated into the survey designs, however, through the selection of stationary survey points, employment of biologists trained in bird identification, and standardizing survey methods and schedules among the six wetlands.

Landscape indicators will be measured from aerial photographs by Lynne McAllister at ERL-Corvallis after the field season. Invertebrate field specimens will be identified and enumerated by personnel at the University of Minnesota-Duluth. Vegetation that cannot be identified by the field crew during sampling will be preserved and identified to species by local experts at universities during the field season or brought back to Duluth or Corvallis for keying by botanists at ERL-C, ERL-D, or nearby university herbarium personnel. Water samples will be sent to ERL-Duluth after collection at each site for whole-effluent toxicity analysis. Lynne McAllister will have responsibility for seeing that these tasks are completed and that data are of sufficient quality.

4.0 OBJECTIVES FOR MEASUREMENT

Four types of data are used during this study: (1) data collected in the field; (2) data derived from maps and aerial photographs; (3) existing data; and (4) laboratory analytical data (whole-effluent toxicity analyses). Laboratory analytical data quality procedures and data quality objectives (DQO's) for the whole-effluent toxicity tests will be based on the ERL-D's Laboratory Quality Assurance Plans and Standard Operating Procedures.

A primary objective of this pilot study is to develop and test environmental indicators for determining and evaluating habitat functions provided by wetlands constructed for waste treatment. Vegetation, water quality, bird use, and landscape data will be collected. Data collected during the study and existing data will be evaluated for (1) its ability to indicate wetland function and (2) its quality in terms of precision, accuracy, completeness, representativeness, and comparability. The study findings will be used to develop data quality objectives for future studies using these procedures. For this study, we will address mainly precision and accuracy.

Data comparability and precision is monitored by periodic QA checks. Checks are conducted for measured parameters requiring specific measurement, estimating, or identification skills. These parameters are invertebrate identification and enumeration, vegetation cover estimation, and plant identification. To accomplish this, replicate samples or determinations are compared at regular intervals in the sampling procedures. For this study, accuracy can be addressed for few measurements because there are usually no standards available for the types of data we will collect in the field. Table V lists data quality objectives for precision and accuracy for all project variables.

The purpose of gathering water quality data was to evaluate the usefulness of water quality variables as indicators and not to use the data in subsequent analyses or to draw conclusions about constructed wetland performance. Standard operating procedures and quality assurance procedures were obtained from the laboratories that measure water parameters from samples collected at the constructed wetland sites. It was decided, however, that a careful inspection of the data and quality assurance procedures was not worthwhile or necessary for pilot study objectives. Criteria for assessing data quality had not been developed, and the process would have been very time-consuming. The relative importance of the data for assessing wetland condition and interpreting results was low. Data were intended to be used for calculating summary statistics and assessing variability regardless of laboratory protocols and measurement consistency among testing labs.

Completeness is checked by comparing the amount of data collected to that which was intended to be collected. We expect to collect at least 80% of the samples stated in the procedures section. Because the wetland environments, weather, and logistical matters on a trip of this scope and length are extremely unpredictable, this is a reasonable estimate for completeness.

Representativeness is not particularly relevant to this study. Use of standard procedures and documentation of decision criteria promote representativeness, although no specific numerical checks are provided. When laying out transects, we will try to include all representative plant communities (or habitats). This will be done by conducting an initial site reconnaissance to identify the major communities. If the three long transects that we propose to sample as a minimum per site do not intersect all of the major communities at least once, shorter transects will be established through communities that were missed. Following routine procedures and documenting exactly what was done will ensure representative samples.

Whenever possible, procedures used will be consistent with standard procedures used in other EPA wetland work (i.e., Federal Interagency Committee for Wetland Delineation 1989, Sherman, et al 1991). This will maintain high comparability between the data collected during the respective studies. Where possible, the expected data quality, based on previous EPA wetland studies, will be used as data quality objectives.

Table V. Data variables, units, sources, and quality objectives. NA=not applicable; NE=not evaluated.

Variable	Units	Source	Precision	Accuracy
Landscape				
wetland area	ha	air photos	90%	NA
land/water interface	meters	air photos	90%	NA
cover/cover interface	meters	air photos	90%	NA
water surface area	ha	air photos	90%	NA
vegetated surface area	ha	air photos	90%	NA
relative coverage of selected types	%	air photos	90%	NA
Vegetation				
species richness	species	field samples	NE	NA
structural diversity	# layers	" "	100%	NA
% coverage by species	%	" "	85%	NA
species dominance	–	calculate	NA	NA
species composition	genus, species	" "	85%	NA
Invertebrates				
species richness	species	field samples	NE	NA
species composition	family, genus	" "	85%	NA
#individuals ea. species	individuals	" "	85%	NA
relative abundance of each functional group	%	calculate	NA	NA
Toxicity				
	% survival	field samples/lab assays	NA	
NA				
whole-effluent	mean reproduction			
Birds				
density	#/wetland area	calculate	NE	NA
species richness	species	bird surveys	NE	NA
relative abundances	no./habitat	bird surveys	NE	NA

Table V, continued

Variable	Units	Source	Precision	Accuracy
Water Quality				
pH	Standard units	existing data sets	NE	NE
Dissolved oxygen	mg/L	"	NE	NE
BOD	"	"	NE	NE
TSS	"	"	NE	NE
NH_3-N	"	"	NE	NE
TKN	"	"	NE	NE
TP	"	"	NE	NE
Fecal Coliforms	#/100 ml	"	NE	NE
WET Functional Analysis	--	field obs, maps, photos, soil surveys	NE	NE

5.0 SAMPLING PROCEDURES

5.1 Introduction

This section documents the procedures for each of the main project activities. For each activity, a brief description, quality assurance considerations, a materials and supplies list, and a detailed procedure are provided. Table V lists each parameter, the data sources, and the measurement units used.

5.1.1 Data handling procedures

The EPA ERL-C Technical and Field Leader is Lynne McAllister. She is responsible for the custody of all data forms. All original data forms are to be preserved. Copies of all data forms that will be used in this study appear in Appendix B.

General considerations in data handling are listed below.

1. Just before leaving the site each day, check each data sheet for legibility and completeness. Check that all data forms are present and in the correct order. In particular, check that headings are complete, e.g., that site name, date, team member's initials, QA status, and any other information is filled in. Data forms should be stored in a dry and clean place.

2. Daily, or as soon as practical, make two copies of all data forms. Check copies for legibility. Send one copy to Richard Olson at ERL-C, who will maintain a file at ERL-C. Keep the original and second copy in separate storage containers with the field crew. This allows for replacement sets in case the originals are destroyed or lost.

3. Maintain a log of all data forms completed and copies sent to the lab. The log can be compared to the field sampling schedule so any missing data can be identified and located.

5.1.2 Entering Data on Data Forms

There are three major sources of data entry errors: (1) Misplaced entries; (2) illegible entries; and (3) incorrect entries. Procedures to minimize such errors are presented below.

Data forms:

1. Take time to ensure the data is being recorded in the correct row and column. When recording numerical data on a matrix form it is easy to lose one's place.

2. Verify which sampling point is being sampled each time a move is made.

3. If data must be entered in a non-standard location on the form, document what you did and why it was done. On the form write the information nearby or write a number, circle it, then, at the bottom of the page or in the margin, repeat the circled number, write the correct data, and initial the entry.

4. Some forms may be similar in appearance, so make sure that you are using the correct one.

5. Never enter data from more than one transect on the same data form.

Avoiding Illegible Entries:

1. Use a black pen. Never use pencil. Black pen makes better copies.

2. Write carefully and don't rush.

3. Use a clipboard and an additional clip to hold the paper down if windy.

4. Use the following rules for writing numbers:

   -Leave the tops of 4's open.
   -Close the tops of all 9's.
   -Cross all 7's.
   -Make certain one can distinguish between 5's, 8's, and 2's.

5. After entering a data set, stop and examine the data sheets for legibility and completeness.

During this project, one person may call out data and another record it. Before writing data down the recorder should repeat it to verify accuracy. Verify the spelling of plant names. Watch for numerical transpositions.

5.1.3 Correcting Errors in Entries

Never erase. Draw a line through mistakes, write the correct information neatly nearby and initial the entry. If there isn't enough room to write the correct information, write a number and circle it. At the bottom of the page or in the margin, repeat the circled number, write the correct data, and initial the entry.

5.1.4 Solving problems encountered

If data is missing or illegible, Lynne should attempt to rectify the problem before leaving the site. If the problem cannot be corrected, she should fully document the situation on the appropriate data form(s). If the problem involves a significant quantity of data, Richard Olson (Project Officer, ERL-C) should be contacted to determine what corrective action should be taken.

5.2 Landscape Indicators

Landscape indicators often provide a more integrated assessment of wetland condition than the more highly variable indicator measurements obtained during field sampling. They can provide measures of habitat values. Table V lists the landscape indicators to be measured during this study, the data sources, and units of measurement.

5.2.1 QA Considerations

Appendix C lists aerial photographers who have been contracted through EPA to conduct color infrared aerial photography of each site. Photo quality has been maximized by contracting experienced and reputable air photo companies and by providing the same photo specification request to all companies for photography to be done in each region.

The procedures used for acquiring landscape indicators consist of measurements of length and area using a digitizer. Although quantitative, the areas and lengths measured relate to mapped or photographed environmental conditions which must be qualitatively estimated. The major quality assurance measures related to these procedures are precision, completeness, and comparability. Precision will be checked by replicate measurements of the same variable. Completeness and comparability will be enhanced through the use of standard procedures.

5.2.2 Material and supplies list

* large scale aerial photographs
* digitizer/arc-info system
* planimeter
* stereoscope
* data sheets
* pencils
* calculator
* ruler

5.2.3 Specific procedures

Photographs of each site will be overlapped to match land features appropriately and layed out on a large digitizing board. A Mantech employee will complete the digitizing of wetland area, land/water interface, cover type interface, water surface area, wetland area, and areas of vegetation zones using an electronic digitizer connected to the ARC/INFO geographic information system software on the VAX computer. Standard procedures for digitizing follow the ArcInfo Users Guide (ESRI 1989). Personnel performing this job will have experience with digitizing and the ARC/INFO system. In addition to measurements taken for landscape indicators, the use of ArcInfo will facilitate the production of accurate base maps for each site, which will be useful for designing future research at these sites and for noting long-term changes in vegetation patterns.

The Cowardin et al. (1979) wetland classification will be used to define wetland type for each site. At large sites that are composed of several wetland types, the percentage of each type will be estimated. The Cowardin classification, developed by the U.S. Fish and Wildlife Service is intended to describe ecological taxa, arrange them in a system useful to resource managers, furnish units for mapping, and provide uniformity of concepts and terms. Wetlands are defined by plants (hydrophytes), soils (hydric soils), and frequency of flooding. Ecologically related areas of deep water, traditionally not considered wetlands, are included in the classification as deepwater habitats. The classification is based on a hierarchy of classification levels: system, subsystem, class, subclass, dominance type and modifiers. No additional data will be required for classifying wetlands. Wetland classification will be included in the general site information in a field notebook.

5.3 Selection of Sampling Locations Within Site

5.3.1 Site Stratification

Each wetland will be stratified by vegetation communities present and by wetland cell. The farther away from the source of wastewater entry, the greater the cell number. Very often wetland treatment systems are planted so that each cell contains monospecific stands of vegetation. The species planted - usually Typha and Scirpus are those found to be most efficient in promoting nutrient assimilation. These species are usually capable of translocating large quantities of oxygen to their root zones for use by bacteria and other organisms that can process nutrients. If vegetation within a single cell is of mixed types, stratification will be done for vegetation type as well as cell. Each community will be sampled separately. This provides better sample representativeness and more accurate characterization of the various habitats within the site. Vegetation stratifications will be: 1) emergent - Typha; 2) emergent - Scirpus; 3) emergent - other dominant, or mixed; 4) submergent; 5) floating-leaved; 6) scrub/shrub; and 7) forested.

5.3.1.1 QA Considerations

This procedure is qualitative in nature so data quality is increased by consistently following standard procedures and careful documentation of what was decided and why.

5.3.1.2 Equipment and Supply List

* Graph paper
* Pencils
* Any documentation of wetland vegetation available
* Copy of a site base map
* Aerial photos or habitat maps of the site

5.3.1.3 Specific Procedures

1. Tour the site to determine the location and extent of various plant communities.

2. Distinguish vegetation communities based on structure (i.e., forested, scrub/shrub, emergent, etc.) and dominant species for emergent classes.

3. Draw the predominant communities on a base map of the site.

4. Label each community with a letter code. This code will precede all the data and sample identification codes for measurements and samples collected from that area.

5.3.2 Transect Establishment

Establishing the transects for sampling vegetation is one of the first procedures performed at each site. Although specific procedures are provided for establishing transect locations, the process requires a good deal of professional judgement.

Transects will be placed to represent wetland processes and vegetation communities. First, they should be placed parallel the gradient of wastewater treatment (i.e. running from the influent toward the effluent control structures). This will in effect be a stratification by wetland cell. This will allow an analysis of the influence of wastewater constituents (nutrients, pH, oxygen level) on vegetation and macroinvertebrate composition. Second, transects should be placed through the major vegetation types in each cell. We will attempt to include all plant community types present in the wetland within transects, which may require relocation of some transect lines or the establishment of more transects. The number and length of individual transects and number of sample plots along transects will be determined using several criteria: 1) wetland area; 2) accessibility (may be limited by dense vegetation, deep water, unstable substrates); and 3) configuration and size of vegetation communities. A minimum of three transects will be established in each wetland, beginning from a base line at the influent end of the wetland when possible and continuing toward the effluent end. Spacing of sampling plots along transects will depend on the length of the transect and the size of the wetland. We will sample at least 40 plots (quadrats) per wetland and will attempt to maintain a uniform sampling intensity among wetlands.

5.3.2.1 QA Considerations

The location of transects within the wetland affects the representativeness of the samples and data collected. To ensure high levels of comparability among field personnel, follow established procedures throughout the project. Good documentation of the rationale for choosing a given location helps with later data interpretation.

5.3.2.2 Equipment and Supply List

- 100-m all weather measuring tape (Ben Meadows #122608 or equivalent)
- 5-lb. Hammer
- Stakes
- Nylon Straps to bind wooden stakes for carrying
- Red and yellow flagging

5.3.2.3 Specific Procedures

1. Lynne McAllister is responsible for determining transect locations.

2. Personnel should always walk on the left side (the side on the left when walking away from the starting point) of vegetation transects to avoid trampling vegetation in sampling plots.

3. The number of transects used and their lengths may vary from site to site depending on the wetland's size, shape, and vegetation distribution. Lynne should clearly document in a field notebook (Appendix B) what was done in each case.

4. Mark transect ends with stakes and flags. Use the following system to avoid lost or bad data due to misidentification of transect and plot numbers.

   - Indicate the beginning of each transect with yellow flagging attached to the stake at plot "0". Plot "0" is located at the beginning of the transect at 0.0 m on the meter tape.

   - Indicate the end of each transect with yellow flagging attached to the stake at the last plot in the transect.

   - Write the transect number on the stake or on the flagging to assist with later identification.

5.4 Water Quality (Existing data sets)

The suitability of each site's water quality data will be evaluated based upon the existence of standard QA/QC procedures for water collection and laboratory analyses used at laboratories that analyze each site's water samples. However, no detailed assessment of the adequacy of these procedures will be done. QA/QC documents were sent to Mantech from each laboratory and can be obtained from Lynne McAllister.

The water quality data set for this study will be created from existing site data for the last full year for which it was collected. The western sites do not have discharge permits and therefore are not required to take regular water samples. They do, however, take some measurements for their own records, and there have been periods of more intensive sampling for which data is available. Water quality measurements available for each site are listed in Table VI. A year of data for each water quality indicator will be copied from data printouts, provided by each site manager into a data base at ERL-C. Average values for each parameter in Table III will then be calculated. Data quality for this data set will be judged based variances, presence of outliers, and extent of missing data. Before including outliers in calculations, we will contact respective labs for potential explanations. If they cannot provide explanation, we will delete the outliers from the data base.

Table VI. Water quality measurements available from each site.

P=partial data set; C=complete data set; NS=not sampled; *=for phase I only; +=for effluent only; #=as total phosphate.

Site	Measurement								
	pH	DO	BOD	TSS	NH3	NH3-N	TKN	TP	Fecal coliforms
Orlando, FL	P	C	C	C	NS	C	C	C	C
Lakeland, FL	C	C	C	C	C	NS	C	C	NS
West Jackson, MS	C	C	C	C	NS	C	C*	NS	C
Collins, MS	C	C	C	C	NS	C	NS	P#	C+
Show Low, AZ	C	C	C	P	NS	NS	C	C#	P
Incline Village, NV	NS	C	P	NS	NS	P	NS	P#	C

5.5 Whole Effluent Toxicity Tests

5.5.1 Introduction

Grab water samples will be collected at the inflow and outflow of each wetland and sent to Duluth for 7-day chronic whole effluent toxicity tests on Ceriodaphnia dubia. Whole effluent toxicity tests using water from both the inflow and outflow of the wetlands can provide information on harmful substances that might be present in the wetlands. Although toxic substances have rarely been documented, it is of interest to check for them to ensure that wildlife are not being attracted to threatening environments.

5.5.2 QA Considerations

We will have no formal QA for collection of grab samples. QA considerations will be fulfilled to the extent possible by following routine procedures, proper labelling, and consistency in collection techniques.

5.5.3 Materials and supplies list

* 2 1-gallon pre-labelled cubitainers
* 1-2 qt. plastic pitchers
* plastic ladel
* cooler
* dry ice
* data sheets

5.5.4 Specific procedures

Collection will be done on a Monday or Wednesday night, cooled overnight, and mailed to Duluth as soon as possible Tuesday or Thursday morning. The Duluth lab will run tests starting on Wednesdays or Fridays. Holding time for these samples is only 36 hours. Samples must be kept at 4° C until they arrive at ERL-Duluth. Deb Taylor and Cindy Hagley at ERL-Duluth will send supplies of dry ice to the site contacts (see Appendix A) for pick-up by the field crew. The field crew will have a portable freezer that can be kept in a hotel room so that dry ice can be kept frozen. Plastic coolers will be purchased by the field crew as needed during the season. Use the following procedure to standardize collection of water samples in the field. Lab procedures are outlined in Section 8.1.

1. Collect grab samples at the inflow and outflow of the wetland by dipping water out of the inflow and outflow pools with a small (1-2 qt) nalgene containers. First, rinse the container with a sample of the water that will be collected. Pour dipped samples into a pre-labelled 1-gallon cubitainer, which has also been rinsed with site water prior to filling. Let the cubitainer overflow with about 1/4 its volume so that there is no headspace at the top. Collect 1 1-gallon cubitainer at the inflow and 1 at the outflow.

2. If water can be collected as it comes out of the inflow and outflow structures, simply let it fall directly into the cubitainer. Document on the water collection log (Form H, Appendix D) whether this method or the intermediate container method was used to fill the cubitainer. If water is very shallow and use of a pitcher to collect the grab sample results in sediments entering the container, use a ladel to scoop the water. Avoid potential contamination of the final sample with sediments, stones, macroscopic algae, or other vegetation.

3. Tightly cap the cubitainer and place in an ice-packed cooler. Refrigerate as soon as possible.

4. Coolers must be packaged in a box for shipping. The length plus the girth of the package must be less than 130" in order for Federal Express to guarantee overnight shipping. Just before packaging, take the temperature of each water sample and write it on the water collection log. Include a copy of the water collection log in the box. Mail packages to ERL-Duluth:

Teresa J. Norberg-King
U.S. EPA
6201 Congdon Blvd.
Duluth, MN 55804

5. Call Teresa Norberg-King at ERL-Duluth 1 or 2 days before collecting water samples to confirm the date that water samples will arrive in Duluth so that she can set up laboratory apparatus to conduct toxicity assays as soon as the water arrives. (A tentative schedule of shipping dates will be set up with Teresa before departing from Duluth in July).

5.6 Vegetation Sampling

Wetland vegetation is an indicator of wetland condition and type. Wildlife depends on vegetation communities food and shelter. Understanding the plant communities within a wetland is essential to evaluating potential habitat values.

Four separate, but related, vegetation sampling activities will be performed at each site: (1) vegetation inventory; (2) percent species cover; (3) plant community structure; and (4) specimen collection and preservation. The vegetation inventory will be a general reconnaissance of the site, including identification and description of the major plant communities. Cover measurements estimate the percent cover of all species located within the quadrats (sampling plots) located along the vegetation transects. Plant community structure characterizes the vegetation on the basis of layers (i.e., trees, scrub/shrub, emergent/floating, submerged, and bare). Specimen collection and preservation will involve collecting and preserving samples of each species for later validation.

5.6.1 QA Considerations

Comparability, accuracy, precision, and completeness are the major areas of concern for QA in vegetation sampling and will be checked for each variable. Replicate vegetation estimates provide an indicator of estimating precision. Accurate vegetation identification is ensured by concurrent and post field work specimen validation and replicate sampling. Completeness is enhanced through the careful use of standard procedures and data recording methodologies.

5.6.2 Equipment and Supply List

* Vegetation Forms
* Pens
* Stakes
* Plant Presses with blotters and ventilators
* Newspapers for plant pressing
* One gallon Ziplock or paper Bags
* 1-m^2 Quadrat
* Twine
* Regional Flora
* Trowel
* Hand Lenses
* 6 centimeter ruler
* Flagging

5.6.3 Specific Procedures

5.6.3.1 Vegetation Inventory Procedures

On arriving at the site, conduct a reconnaissance to determine the general nature of the vegetation and to identify appropriate locations for transects. Photograph and identify the major plant communities (e.g. emergent - Typha dominant, scrub/shrub, submergent, etc.) and roughly mark their boundaries on the site sketch map. Photographs of vegetation patterns, unusual plants, and the general vegetative composition will be taken using standard photographic procedures (See "Supporting Data" procedure, section 5.14.4). A sufficient number of photos should be taken to characterize all the major habitats, vegetation communities, and unusual conditions present in each wetland.

5.6.3.2 Cover Estimation and Structural Diversity

Vegetation will be sampled using quadrats at sample plots located at pre-determined meter marks along transects that are established according to guidelines in Section 5.3. A sample plot will be delineated by 1-3 quadrat sizes along transects depending upon the vegetation type present. Vegetation cover procedures consist of recording the estimated percentage of each sampling plot covered by each species' undisturbed canopy. The measurements are general and no effort should be made to adjust for discontinuities in the canopy of species with open habits. For example, do not account for small openings in the canopy in a patch of vegetation when estimating cover. Because species can overlap each other, the sum of cover percentages will often exceed 100%.

1. Complete the heading on each data form (Form F, Appendix B), recording site, date, recorder's name, transect number, sample plot number, and meter mark along the transect. Take the time to do this before starting to record data. Don't record data from more than one transect on one data form. If more than one form is required to complete a transect, repeat the species names in the same order on each form.

2. If vegetation is generally herbaceous, use the 1-m^2 quadrat. Place the quadrat along the transect as illustrated in Figure 1.

3. If vegetation contains large scrub/shrub establish a 5.0-m^2 quadrat. Do this by extending the short sides of the 1-meter quadrat another 2.8 meters as illustrated in Fig. 1. Stake the corners and mark quadrat boundaries by running twine around all stakes.

4. If vegetation contains trees, establish a 10-m radius circle for a sampling plot. Measure 10 m along the transect from the meter mark at the pre-chosen sampling point location and 10 m in both directions perpendicular to the transect line. Visually determine which trees are within the circular plot formed by connecting with an arc all endpoints of the 10-m radius measurements. If it questionable whether some trees are within the 10-m radius boundaries, run a meter tape from the sampling point along the transect to each tree in question.

5. For each species present, write the genus and species names on Form F. Indicate the vegetation layer for each species by entering the layer code in the appropriate box. Layer codes are:

   S=submerged
   E=emergent/floating-leaved
   B=Scrub/shrub (bush)
   T=forested (tree)

6. Establish pseudonyms for plants which can't be identified in the field. The following codes will be used for unknown plants:

   UE=unknown emergent
   US=unknown submergent
   UF=Unknown floating-leaved
   UB=unknown bush (scrub/shrub)
   UT=unknown tree

After each code, assign a number, starting with the first specimen in each of the above categories at a particular site (e.g. UE1, US2, etc.). Use this letter-number code for the duration of plant sampling at a particular site. Start a new code and numbering system for each site.

7. Record the name or unknown code for all species found within the quadrat and estimate percent cover by estimating vegetation cover as close as possible to the following categories: 1%, 5%, 10%, 20%, 35%, 50%, 65%, 90%, 99%, or 100%. Percent cover for structural type can be calculated by adding percentages across all species within each structural type.

NOTE: Include canopy of all vegetation that falls within the quadrat even if the plant is rooted outside of the quadrat.

8. Count the number of structural types recorded on the data sheet as a measure of structural diversity.

9. Collect specimens of all unknown plants at every site. Preserve specimens as described in Section 5.7.3.3.

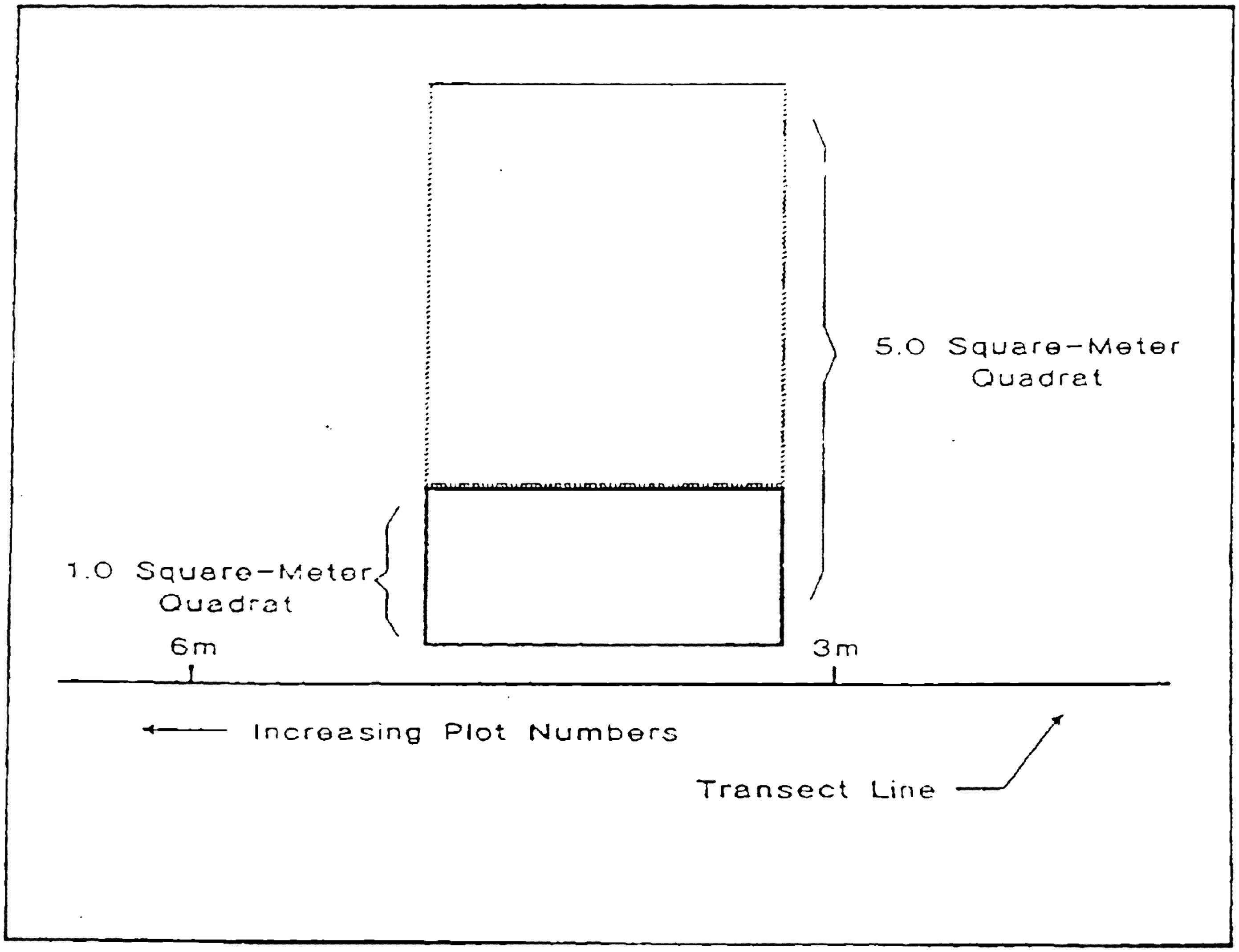

Figure 1. Quadrat placement along transect.

5.7.3.3 Specimen Collection and Preservation

This procedure involves collecting all unknown plant taxa observed during the project located in the sampling plots. Plants will be labeled, pressed, and used for species validation. Standard procedures for plant collection and preservation are used. The process is briefly outlined below and in more detail in University of California (1975).

Collection

1. It is unlikely that rare plants will be present in these constructed wetlands. However, the field crew should check with the site managers or local botanists (See section 13.1.1) whether rare plants may be encountered on site and find out what they look like so that collection can be avoided.

2. Plants should be collected in flower or fruit, if possible.

3. Collect enough plant material to ensure adequate foliage, roots, and rhizomes for identification.

4. If the specimen is small, collect the entire plant, including roots and rhizomes.

5. If the specimen is large, collect some of the root, part of the stem with leaves, and part of the inflorescence.

6. If the plant is woody, collect some twigs with leaves and fruit.

Preservation

1. Use standard (12 X 18 inch) plant pressing frames, numbered 1,2,3, etc.

2. Clean the dirt off the plants before pressing.

3. Remove dead leaves and other unwanted parts.

4. Lay the plants flat and avoid overlapping.

5. Bend long plants sharply so they fit within the frame. Don't curve or twist the stems.

6. Pad areas around thick stems so no air pockets remain.

7. Attach a tag to the stem of each plant with the following information: unknown specimen code, date, site, transect, and plot number.

8. Insert plants between folded layers of newspaper. Sandwich the newsprint between layers of blotter material and separate with corrugated cardboard. The corrugations should be parallel to the shorter dimension (12 in.) for better air circulation. Place the stack of plants, blotters and cardboard in the press. Use two adjustable straps to hold the pressed plants firmly.

9. Record the following plant collection information on Form G (Appendix B): press number, unknown specimen code, site, plot number, cell number, transect number, meter mark, date collected, soil conditions, associated plant species, local conditions (moisture or water level, slope, etc.)

10. Change newspapers and blotters in the presses as necessary (daily to every few days) until specimens are dry. Check that all samples are adequately labelled.

5.7 Bird Data

5.7.1 Introduction

Birds are very visible and are relatively east to identify and survey over a large area. They are therefore appropriate candidates as indicators of vertebrate diversity. The bird data will be treated as an existing data set. Survey methods were submitted by local biologists who are doing bird surveys. There is some degree of uniformity among survey designs. Copies of proposals are available from Lynne McAllister.

5.7.2 QA Considerations

When using existing data, we have limits on control over quality assurance. There is no QA that is standardized among surveyors, and surveyors have not included QA considerations in their plans that were provided for review by the Constructed Wetlands team. Accuracy and completeness will be maximized through selection of data collected by highly qualified and experienced ornithologists. Each bird surveyor has been contacted prior to their surveys so that survey design can be standardized as much as possible while maintaining the original objectives of the surveying organization. Surveys being conducted are based on commonly used survey methods, which will assure some degree of comparability to existing data bases. Bird counts will be done by the same person for each survey, which will help insure precision among surveys. Because there will be only one surveyor per survey, however, precision among observers will not be evaluated.

5.7.3 Materials and Supplies - not applicable

5.7.4 Specific Procedures

Ground surveys will be conducted at the Collins, Ocean Springs, Show Low, and Incline Village sites. Timed counts of the number of individuals of all species seen from pre-established points along the wetland shorelines will provide an estimate or relative abundance of birds in each area (habitat and cell). Aerial surveys will be carried out at the Incline Village, Orlando, and Lakeland sites. Surveyors will fly at low altitude (200-500'), making one pass along pre-established flight lines through the wetland. They will count the number of each species and note the locations of bird concentrations within the wetland. Copies of data forms will be sent by each surveyor to ERL-Corvallis where results will be transcribed onto data sheets (Form M, Appendix B) and entered into a file in a data base.

5.8 Invertebrates

5.8.1 Introduction

Aquatic invertebrates form an important link in the overall functioning of wetland systems. The presence/absence of certain species and overall densities of invertebrates can provide information about bird prey availability, nutrient levels, and how well the wetland is performing certain functions.

The Timed-Qualitative Sampling Method (TQSM) has been used extensively in South Carolina and Florida to satisfy National Pollution Discharge Elimination System requirements and in wetlands success criteria applications. The TQSM has recently become better known as the Timed-Quantitative Sampling Method and it has become more widely accepted as a result of its being considered "quantitative" rather than "qualitative". The primary objective when using this method is to obtain a representative, or relative, number of specimens of every species present at the sampling locality at the time of sampling. As long as the primary objective is met, standard tests and indices and enumeration techniques can be used.

Invertebrates will be collected using a semi-quantitative technique. Various methods of collection will be used in the major habitats within a site in order to obtain a sample that is representative of invertebrate abundance and species richness at the site. The collection period will be timed. The time spent in each area will be based on the number of individuals and species diversity in net samples. Each collector will keep track of the time they spend in each area. Specimens will be preserved in ethyl alcohol. Glass collection jars (approximately 250-ml) will be labeled for site, cell, and the habitat where invertebrates were collected (different jars will be used for each habitat). Habitat categories are:

- o forested
- o emergent/floating
- o submergent
- o shrub/scrub
- o open water

Samples will be mailed to Duluth where they will be identified to genus and counted by genus and functional group for each wetland and for each cell/habitat combination within the wetland from which they were collected. Functional groups are: shredders, scrapers, collectors, and predators (Vannote et al. 1980). The distribution of individuals among functional groups can provide information on the community structure, biological and chemical processes occurring in a wetland, abiotic processes external to the water body, and the trophic condition and pollution status. Some species might indicate eutrophic conditions or low oxygen levels (Adamus and Brandt 1990).

This method will sample mainly the aquatic forms of invertebrates whose longest life stage is in the water. It should allow us to collect a diversity of aquatic invertebrates in a relatively short time and with minimal effort. Information acquired will contribute toward an initial overall characterization of the invertebrate communities in each wetland and will provide a good first assessment of species abundance and richness.

5.8.1 QA Considerations

Representativeness, completeness, and accuracy are the major QA considerations involved with invertebrate sampling. Representativeness depends on the selection of sampling locations and is enhanced by standard selection criteria. Completeness is achieved by careful sample handling and labelling. Comparability is achieved through the use of well documented standard procedures. Count accuracy is accomplished by partial replicate counting.

5.8.2 Equipment and Supply List

- #30 mesh rectangular kick nets
- bucket with net bottom for rinsing
- white enamel pans
- forceps
- ethyl alcohol (95% dilution)
- glass collection bottles - 250 ml
- stick-on labels
- waterproof markers, pencils
- waterproof labels

5.8.3 Specific Procedures

Sampling techniques will be semi-quantitative. Collection techniques will be qualitative but searches will be timed so that the number of individuals collected will be per unit time.

1. Search for invertebrates by:

    a. using kick nets along bare or rocky substrate, along bank areas with emergent vegetation, within emergent, shrub, and forested vegetation in the wetland interior, and around or under any other kind of substrate such as fallen logs, rubble, or other debris that invertebrates might use as substrate to attach or to seek shelter.

    b. scraping rocks and other substrates to obtain attached insect forms (e.g. species of scrapers).

2. After taking several sweeps with a kick net in the same habitat, dump the contents into a bucket with mesh in the bottom, and rinse the sample with water to eliminate all muds and other fine particulates.

3. Pour the sample into a white enamel tray, pick out invertebrates with hands or forceps, and place into 95% ethyl alcohol preservative in pre-labelled glass jars. Labels should include site, date, cell #, habitat type, and jar number. In addition, write this information in pencil on a prepared waterproof paper label and place it inside the jar.

4. Each jar should contain invertebrates from only one cell and one habitat type within that cell.

5. When jars are 2/3 full, begin filling a new jar if necessary to collect all invertebrates from each cell/habitat type present in the wetland. For multiple jars, make sure all labels are the same, with the exception of the jar number.

6. Record the following information on the invertebrate data form (Form C, Appendix B): date, site, collector, previous and present weather, cell #, habitat type, amount of time spent sampling in that habitat, number of jars used, and comments.

7. Not all wetland cell/habitat combinations need be sampled. In large wetlands or wetlands where several adjacent cells support similar vegetation communities, the field crew will select a subsample of cells and habitats to sample. The decision criteria used to make this judgement are listed below:

    a. The habitat should be one of the major communities present throughout the wetland.

    b. If several adjacent cells contain the same vegetation assemblage, either include all in the same sample or take the sample from only one of the cells and assume it is representative of the others.

    c. If cells with similar vegetation assemblages are separated by more than one or two cells (use judgement for this decision) sample each separately.

8. Two crew members will sample each cell/habitat simultaneously. Effort can be divided between the two members by dividing areas to be sampled in half. Each person will record separately the amount of time they sample in each cell/habitat. The time includes sweep netting, straining, and bottling samples. The two times will be added together to derive the total person-hours of effort for each cell/habitat combination. The total amount of time spent sampling all cell/habitat combinations selected can then be calculated by adding all the individual times.

9. Samples will be stored in a cool place until sampling for a particular site is completed. Samples will be shipped on ice to Duluth with a copy of the invertebrate sample log (Form D, Appendix B). Specimens will be identified to species by ERL-Duluth personnel or by Jane Schuler on a Fall 1991 position extension. Identification data will be recorded on Form E (Appendix B). During storage, both in the field and lab, samples will be checked twice per week for evaporation and discoloration of alcohol. If the ethyl alcohol has developed a brownish tint, it will be carefully drained, and new preservative will be added to completely cover all specimens in the jar.

5.9 Wetland Functional Analysis (WET)

5.9.1 Introduction

The Wetland Evaluation Technique (WET) (Adamus et al. 1987) is a rapid assessment of wetland functions and values such as wildlife habitat, erosion control, floodwater retention, nutrient assimilation, and groundwater recharge. Background on the method is given in a separate Workplan for this project. Lynne McAllister will receive field training from Paul Adamus in May 1991 before commencing pilot study field work. She will then train the temporary hire during training in late July in Duluth. Both crew members will conduct separate assessments so that precision can be evaluated.

The technique requires that a sequence of questions be answered about the wetland being assessed. Answers to questions will be marked on the WET data forms (Appendix E). After returning to Corvallis, the information will be entered into the WET computer program which calculates high, moderate, or low qualitative probability ratings for each wetland value in terms of social significance, effectiveness, and opportunity.

The purpose of conducting this assessment is to make a cursory assessment of several wetland functions, including wildlife habitat. Thus, it is a separate type of analysis than the indicator evaluation. Results can provide a general idea of wetland ecological condition and can be compared to results of field indicator sampling. Qualitative comparisons might help evaluate the effectiveness of the WET technique for assessing wildlife habitat values in wetland treatment systems.

5.9.2 Equipment and Supplies List

* WET data forms
* notebook
* topo maps
* soil surveys
* air photos, if available
* binoculars
* NWI maps, if available
* pencils/pens

5.9.3 Specific Procedures

Follow procedures and questionnaire in the WET Manual (Adamus et al. 1987).

5.10 Field Training

Prior to beginning field work in July 1991, Lynne McAllister and Jane Schuler will travel to Duluth MN to pack equipment and receive field training. Deborah Taylor at the Duluth Laboratory, who has experience in wetland sampling, will demonstrate equipment use, sampling techniques, sample handling and storage, and sample packing. Training will be done in a wetland near Minneapolis, MN where Deborah is currently conducting a research project. At this time, we will also go through a run of all sampling that we will do on each constructed wetland during July and August. This exercise will reveal any major problems in sampling techniques, sample transport and processing and equipment needs that we may have overlooked. Steps can then be taken to remedy problems before leaving Duluth.

5.11 Sample Labeling

Information on labeling is covered under the sampling procedure for each measurement variable in Sections 5.5 (whole effluent tests), 5.6 (vegetation), and 5.8 (invertebrates).

5.12 Sample Handling

Information for this section is covered under the sampling procedure for each measurement variable in Sections 5.5 (whole effluent tests), 5.6 (vegetation), and 5.8 (invertebrates).

5.13 Supporting Data

Supporting data augments the quantitative components of this project by providing a general picture of each wetland. It is divided into two major groups:

1. Sketch Maps
2. Photography

5.13.1 QA Considerations

Mapping QA is based on the use of standard procedures and on the correction of "closure" errors where appropriate. Make certain the compass is in calibration before use (See "Calibration").

5.13.2 Equipment and Supply List

- Brunton Pocket Compass (360° azimuth)
- Florescent Flagging
- 100-m Measuring Tape
- 35-mm Camera with 50-mm
- lens
- ASA 100, 35-mm Ektachrome slide film
- Pens
- Graph Paper
- 360° Protractor
- Blank Paper
- Metric Ruler with
- Pencils
- Erasers

5.13.3 Sketch Maps

Sketch maps are available for all sites (Appendix F). If additional or more accurate information is desired on site layout and vegetation type distribution, the sketch mapping techniques detailed in Appendix D will be used. Lynne McAllister will determine whether the need for detailed maps outweighs the time required to construct them. In most cases, available sketch maps and air photos that will be taken during summer and fall 1991 will suffice. Some of the mapping techniques in Appendix D will be useful for placing site features and sampling locations on existing sketch maps.

5.13.4 Photography

A photographic record is used to visually record site characteristics. It can be used to verify data later in the study. In addition, it is a method for tracking changes in the wetland over time.

General Guidelines:

The following procedure is followed when taking photographs.

1. To standardize photographs, use a good quality, 35-mm camera equipped with ASA 100, 35-mm Ektachrome slide film and a normal 50-mm lens.

2. Label each roll of film by photographing a completed Form I (Appendix B) in the first frame, if it is a new roll, or in the first frame taken on a site.

   In addition, identify each roll with a "roll number code". The code contains two parts. The first part is the roll number. Rolls are numbered consecutively for each camera used. The second part is the photographer's initials.

   For example, if Jane Doe is taking vegetation photographs on the 14th roll of film used in that camera, the code would be 14JD.

3. Document each picture by number and topic on the appropriate photo log (Form J, Appendix B).

4. Check camera battery frequently. Carry a spare.

5. Never let the camera or film sit in the sun. Extra film can be stored in a sealed plastic bag in a cooler with plant or water samples if the weather is hot.

The primary types of photographs taken at each site are vegetation photos and general site photos. Each is described below. In addition, photos may be taken of other types of samples (water, invertebrates) to document collection methods used and to help characterize samples

Vegetation Photos:

The purpose is to document the vegetation observed. Include photos of the vegetation surrounding the site, unusual or rare plants, unknowns or plants hard to identify, overviews of the vegetation on the site, any obvious pattern in the distribution of the plants. Document the photos taken in the photo log by recording location, date, dominant habitat type, growth form of the specimen, associated species, hydrologic conditions where the plant was collected, and any other noteworthy information. Cross reference each entry in the photo log (Form J) by including a sign in all photos indicating location (site, cell, transect no., and plot number, if applicable) and date when the specimen was collected.

General Site Photos:

Take a panoramic landscape sequence from a central location or high elevation in the wetland. Photograph major wetland features such as open water areas, water channels, inlets, and outlets. Take pictures looking along all transects from each end. Document the photos taken in the photo log, being sure to identify photos of transects by transect number.

6.0 SAMPLE HANDLING AND CUSTODY

Samples can be damaged through improper handling and lost if custodial responsibilities are not clearly established and followed. This section outlines procedures for ensuring that field samples and data are delivered safely to the lab.

Lynne McAllister has custodial responsibility for all samples collected during the study until they are delivered to the Duluth lab. Each sample collected will be recorded in a Sample Custody Log (Appendix B), which includes the sample type, number, date collected, and date custody was transferred. In addition the water collection log (Form H) and the invertebrate sample log (Form D) will be filled out in part and sent with the samples to Duluth.

Laboratory personnel will take custody of the water and invertebrate samples and sign Forms D and H at the time of receipt of the samples. The Lab is then responsible for sample handling and safety. Samples may not be discarded until authorized in writing by ERL-C.

General considerations in sample handling are listed below:

1. All sample containers must be clean prior to use in the field.

2. Discard defective containers and lids.

3. As soon as each sample is collected, close the lid firmly, and label the container.

4. Call the Duluth lab the day samples are mailed so that personnel there know when to expect samples and can prepare laboratory apparatus.

5. To ship water and invertebrate samples to ERL-Duluth, pack in an insulated plastic cooler with adequate dry ice to keep them cool until they can be transferred to laboratory refrigeration (invertebrate samples will not need refrigeration). Take the temperature of the water samples just before packaging and record on Form H; have the receiving party at Duluth record the temperature on Form H when the shipments are received. Temperature of the water samples should be maintained as close to 4° C as possible. Temperature and holding time are not critical for invertebrate samples.

7. Complete the Sample Custody Log and Forms D and H. Copies of forms D and H will be kept with the samples from the time they are collected until they are discarded. Original copies of the forms are kept in the site packet with the field crew. A second copy will be sent to ERL-Corvallis at the time of shipping to Duluth.

8. Plant presses containing specimens should be stored in a dry, well ventilated environment if possible. Keep them in a moderately heated room if conditions in alternative storage areas are cold or humid.

9. Keep invertebrate samples in a cool area until they are sent to Duluth. Check sample storage containers periodically for leaks. Change ethyl alcohol in containers as necessary.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 Laboratory

Calibration procedures and frequency for lab analysis of water and toxicity tests are outlined in the National Effluent Toxicity Assessment Center's standard operating procedures (EPA 1988).

7.2 Field

Magnetic Compass

Prior to field work, and at each study site, the magnetic declination setting on the compass should be checked and recalibrated if required. Magnetic declination is the difference in direction between the true and magnetic north poles. Local declination can be determined from a recently (within the past ten years) issued US Geological Survey topographic map for the area. The legend contains a true north arrow and a magnetic north arrow and indicates the difference in degrees.

The compass has a calibration pin located under the glass face, opposite the cover hinge. On the rim of the compass rosette is a compass scale, marked in degrees. Turn the adjustment screw, which is located on the side of the case, until the pin lines up with the correct declination on the scale. Check the compass by comparing the relationship between magnetic north (the compass needle direction) and true north, 0° on the compass rosette, with the north rays on the topographic map.

8.0 ANALYTICAL PROCEDURES

8.1 Whole effluent toxicity tests

Teresa Norberg-King at ERL-Duluth will receive all samples sent from the field. She will log in samples as they arrive and will be responsible for analyzing them in the correct time frame. ERL-Duluth has its own data sheets for reporting results. Samples are tracked in the Duluth lab by a log-in number. Tests will be 7-day chronic tests with renewal of Ceriodaphnia twice during the test. In addition, survival will be read at 48 hours to obtain an acute test result. The number of female adults and the number of young produced after each of the periods will be recorded. The test will follow a standard format for effluent testing (EPA method no. EPA/600/4-89/001, Short term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters for Freshwater Organisms). Whole effluent toxicity tests will be run according to the National Effluent Toxicity Assessment Center's Standard Operating Procedures, 1988 with the following modifications to the standard dilution technique:

1. A board will be set up for effluent tests each time samples are sent from the field sites. The board will include 100% concentrations of influent and effluent samples and a control consisting of the culturing water. For the pilot study, we are interested in whether there are any signs of toxicity, so we will start with assays using only 100% concentration.

2. Acute tests will be done using Ceriodaphnia as the test organism because it is more sensitive to toxics than is the fathead minnow. Ten Ceriodaphnia will be placed in each of the three treatments. The number of surviving Ceriodaphnia in each chamber will be recorded at 48 hours for the acute result and after 7 days for the chronic result.

9.0 DATA REDUCTION, VALIDATION

Data that will be entered into computer files for further summary and reduction (i.e. measurements that require replicate sampling) is listed in Table VII. All other data will be tabulated by hand (i.e. no averages or further reduction is necessary). Each type of data in Table VII will be collected within the sampling hierarchies shown in Figure 2. Data collected will be used when necessary to calculate other indicators listed in Tables II and III.

Field data will be recorded on prepared data sheets (Appendix B) for parameters that will be sampled by ERL staff in summer 1991. At the end of each day (or the beginning of the next day) data sheets will be photocopied at the site manager's office or facility. One copy will stored in a secure place and kept with the field crew until arrival back in Corvallis. The second copy will be mailed to Corvallis when all work is completed at each site.

Field data and raw data from existing databases will be entered into a personal computer in fall 1991 at ERL-C. All data except those from the WET analysis will be copied from original data sheets into SAS (or other data base) data sets for manipulation and calculation of summary statistics. Lynne McAllister will check every record of data entered with the original data sheets and correct as necessary. Data sets and two backups will be kept on floppy disks. Lynne McAllister will be responsible for all data entry and validation, data base management, and summary analyses. The PC-SAS software package will be used for data analyses.

Vegetation structural diversity and percent coverage of each species will be calculated as an average or all sample plots per transect and per wetland site. A species list will be made for each site with the percentage of sample plots in which each species was seen. After obtaining cover estimates for each sample plot, species will be ranked in descending order of percent cover. The species whose cover estimates total the first 50% of cover will be considered dominants. If additional species with cover estimates of 20% or more are ranked below the species comprising the first 50% on the list, they will also be considered dominants.

Avian species richness will be calculated for the whole season by totalling the number of species observed during any visit. Values will be derived for each cell or vegetation strata (ecological unit) in each site and for the whole site. The ubiquity of each species will be evaluated by calculating the percentage of observation points at which each species was seen. For aerial surveys, this will be based on the percentage of cells in which each was seen. Relative abundance is based on the assumption that the sample represents a constant but unknown proportion of the population (Bull 1981) and is useful when determination of the actual density is not practical because of factors such as visibility or bird mobility. Relative abundance will be considered the number of birds of each species per unit of effort, which is defined by a timed point count or timed aerial survey.

Summary statistics will include mean, standard deviation, min/max, and range. Water quality data from the most recent full year in which it was collected will be included in the data base. Vegetation data will be summarized for the whole wetland and for each separate vegetation stratum or cell (e.g. emergent, forested, shrub/scrub, bare). Similarly, invertebrate counts will be summarized for each trap as well as for all traps combined. Bird data will be summarized for each ecological zone (point count or wetland cell) on each visit and over the entire survey period (May through November). Toxicity tests will not need summarizing. Results of the WET analysis will be entered into the WET computer program for analysis. For each wetland, the program gives qualitative probability ratings of high, medium, or low for wetland functions and values in terms of 1) social significance, 2) effectiveness, and 3) opportunity. Wildlife habitat is among the various functions and values that WET assesses.

Data summaries will be calculated for strata, transect, and site. For comparison to other published data, we eventually want to say something specific about the site as a whole because it is likely that most comparison data will not be reported per strata or transect. Therefore, data will be summarized for a whole site. For judging wetland function, however, and to get a better idea of ecological processes and influences on biota, it will be more appropriate to report results by strata (vegetation type, cell).

Statistical tests will not be used. Summary data will be used for assessing range and variability of indicator values, for making comparisons with data from natural and created wetlands, and for judging the effectiveness of indicators in characterizing wetland function and ecological condition.

Table VII. Data that will be included in data base for summary and reduction.

Ecological Component	Data
Vegetation	species and percent coverage per quadrat number of structural types per quadrat species dominance per quadrat
Invertebrates	number of each species per site and habitat within site functional group of each species number of individuals of each species per cell/habitat sampled
Water Quality	1 year's data for each wetland's influent and effluent measurements for: pH, dissolved oxygen, BOD, total suspended solids, ammonia nitrogen total Kjeldahl nitrogen, total phosphorus, fecal coliform bacteria
Birds	number of species detected per strata and per survey number of individuals of each species detected per strata and per survey

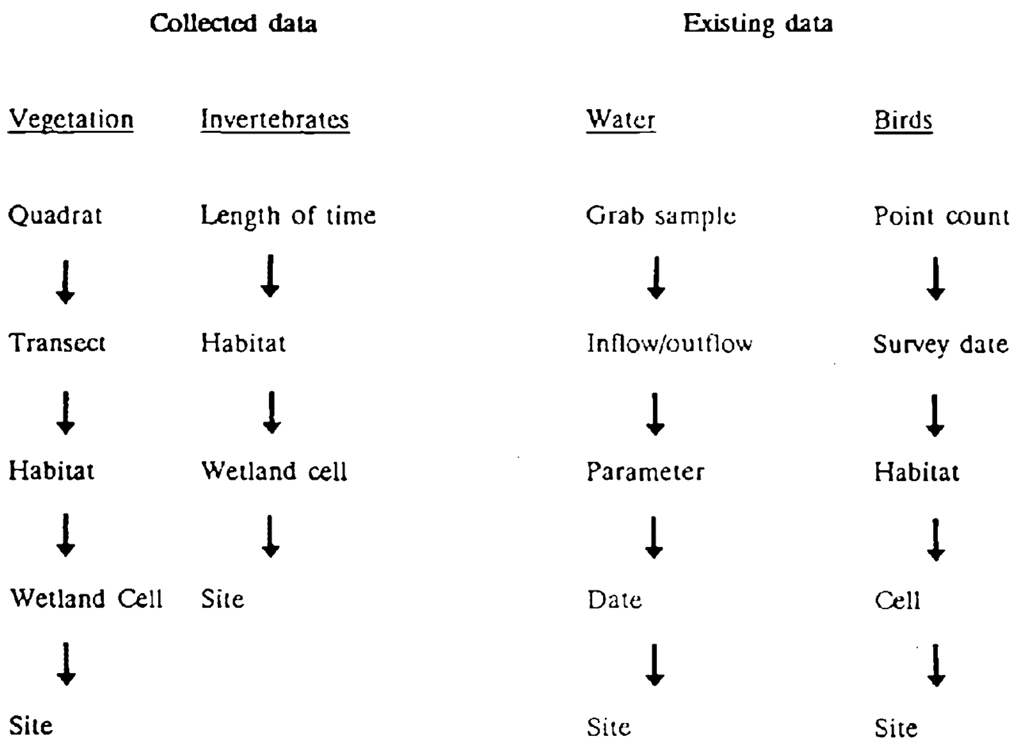

Figure 2. Data reduction scheme.

10.0 INTERNAL QUALITY CONTROL CHECKS

We will not use quality control checks for assessing water quality data. Quality control in the field will be done by following routine procedures for checking accuracy and precision between the two field personnel. Specific procedures are included in Section 13.0, Routine Procedures used to Assess Data Precision, Accuracy, and Completeness.

11.0 PERFORMANCE AND SYSTEM AUDITS

The Environmental Research Laboratory-Corvallis QA staff perform technical systems audits of all extramural projects prior to or concurrent with data collection to:

- familiarize project staff with EPA QA requirements and procedures,

- evaluate the implementation of the QA activities specified in the QA project plan, and

- provide assistance in attaining the objective to collect data of known and documented quality.

One or two of the six pilot study sites will be visited by ERL-Corvallis QA staff for a technical systems audit during the July/August 1991 sampling season. Lynne McAllister will oversee the data collection and will be in contact with cooperators about their responsibilities and activities. Internal audits will be done during field data collection and are included in Section 13.0, "Routine Procedures Used to Maintain QA Objectives" and in Section 10.0, "Internal Quality Control Checks".

12.0 PREVENTATIVE MAINTENANCE

Preventative maintenance at laboratories measuring water quality was not assessed. Preventative maintenance for whole effluent toxicity testing is covered by standard operating procedures outlined in the National Effluent Toxicity Assessment Center's standard operating procedures and the Environmental Research Laboratory -Duluth Quality Assurance Plans and Standard Operating Procedures (EPA 1988).

Standard field equipment, such as measuring tapes, buckets, quadrats, nets, waders, and hip boots will be rinsed and checked daily for breakage or damage. Simple repairs will be done as necessary or equipment will be replaced if possible.

12.1 Compass

At each site, before using the compass, check for damage, e.g., loose hinges, broken glass. The needle should move freely and smoothly when the compass is held level. Check that the compass is adjusted for the correct magnetic declination for the study area (see Section 10.0 "Calibration Procedures".

12.2 Plant presses

Because of very humid conditions in the eastern U.S., blotters and newsprint around all plant specimens will be changed daily, even for samples that appeared completely dry at any point, and samples will be checked for thorough and proper labeling. Incomplete or lost labeling will be corrected by checking the cross reference in the unknown plant log (Form G, Appendix C) and filling in any incomplete labels in plant presses.

13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Periodic quality control checks are performed to ensure that quality assurance objectives are maintained. These checks are performed on field, lab, and ERL-C procedures. This section discusses the checks and process for making corrective actions.

13.1 Field Work

Due to the high environmental variability between study sites, QC data will be collected at each site. At each site, standard field procedures are followed, but team members exchange jobs and duplicate a portion of the sampling and data collection. This procedure allows quantitative assessment of sampling **comparability** between team members for vegetation and landscape measurements. Ultimately, this information will be used to make a statement on the reproducibility of information gathered using the techniques employed in this study.

13.1.1 Specific Procedures

WET Analysis--

All WET assessments will be fully completed. Information will be obtained through personal communication with site managers and local people familiar with each region, through site visits, and by studying soil surveys, USGS topo maps, and aerial photos. The two members of the field crew (Lynne McAllister and Jane Schuler) will conduct separate WET analyses. During this time there will be no interaction or discussion between the two people. Precision will be evaluated by calculating the percentage of questions answered the same by both people per wetland. These percentages will be averaged for all six wetlands.

Vegetation--

1. Two field team members start sampling the same transect. One member (A) samples vegetation plot number one and the data is recorded on the data form for the site. The other team member (B) samples plot number two and this data is recorded on a data form marked "remeasurement". After sampling these plots the team members switch locations and re-sample the plots **without moving the sampling frames.** Repeat this "switching" for plots three and four. All of team member B's data is recorded as "remeasurement" and A's as "non-remeasurement", or regular site data.

2. After the first four quadrats are sampled, continue sampling the remaining quadrats without collecting remeasurement data.

3. Team members should not exchange comments on the vegetation of re-sampled plots while conducting remeasurement sampling until each person has their estimates.

4. If team members differ in their percent coverage estimates of vegetation by more than one increment (see Section 5.6.3.2), each person will relate their reasons for the estimate they gave, and they will reach an agreement on the "correct" estimate.

4. To ensure accurate plant identification, all plant specimens are validated by the team botanists or other qualified persons during and after the field season. Validations during the field season will be made,

if possible, at nearby universities or with biologists working near the site:

Jean Wooten, botanist at University of Southern Mississippi in Hattiesburg - approx. 40 miles from Collins. She can help identify specimens collected at the Ocean Springs and Collins sites.

CH2M Hill - Consultants in Gainesville who will be sampling at the Ocean Springs site at the same time we are there. They may also be able to help with samples from the Florida sites.

Bill Dunning, Carson City (Phone: 702-267-3965)

Terry Meyer at the Show Low site

Post Buckley, environmental consulting firm in Orlando - Jim Burney, the site overseer, works at the Orlando site all summer and is familiar with vegetation (Phone.407-647-7275).

Copies of the validated vegetation data sheets will then be used for data analysis.

13.2 Laboratory Measurements

Invertebrates--

Data quality will be evaluated for species identification and total count of each species per habitat and per wetland. Personnel at ERL-Duluth will identify to species the invertebrates collected and will record functional group for each and the number of individuals collected in each cell/habitat combination in each wetland. Invertebrates will be identified using standard invertebrate keys (e.g. Merritt and Cummins 1984). Remeasurement samples (every tenth sample analyzed at ERL-Duluth) from each wetland will be reidentified and recounted by a second person. All individuals in each container will be identified to check that all individuals that the first evaluator identified belong to the same species. Record replicate data on the same type of data sheet used for the procedure and write "remeasurement sheet" on the top of the form.

Water Toxicity Tests--

Details of the testing procedure are included in the National Effluent Toxicity Assessment Center's Standard Operating Procedures. Quality control is achieved through the use of ten replicate organisms per treatment (influent, effluent and a control) and the use of a control containing water used to culture the organisms. No other remeasurement will be done during tests. QA will also be assessed by determining whether the assumptions of the tests were met during lab analysis and by following standard operating procedures outlined by ERL-Duluth.

Landscape measurements--

Ten percent of all landscape measurements for each site which require the use of a digitizer or planimeter will be replicated by Lynne McAllister or a second geographer. Replicated data will be checked against original data and the relative percent difference calculated (see Section 13.3.1). Record the replicate data on the same type of data sheet generally used for the procedure and write "remeasurement sheet" on the top of the form.

13.3 ERL-C Data Quality Assessment Procedures

QC data will be sent by the field crew and ERL-D to ERL-C for evaluation. Several procedures are used to determine whether data quality objectives are met and to establish actual project performance. This section details general data quality assessment procedures then applies them to specific activities. Examples are used to clarify procedures.

13.3.1 General Procedures

Two calculations are frequently used in assessing data quality: **Relative Percent Difference** and **Coefficient of Variation.** These calculations help to compare data sets with one or more reference data sets.

Relative Percent Difference (RPD) is used to compare two values such as the results of lab analysis of replicate samples. Compute the RPD by subtracting one value from the other and recording the result as an absolute value. Divide this number by the mean of the two values and multiply by 100.

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

Coefficient of Variation (CoV) is used to compare three or more values. CoV is computed by dividing the standard deviation (sd) by the data mean and multiplying by 100 to obtain a percentage.

13.3.2 Specific Procedures

Landscape data--

Relative percent difference will be calculated for the two measurements. The mean of the RPDs for each site will be calculated immediately after each replicate data set is made. The results can then be checked right away and required changes to procedures can be made if data quality does not meet the DQOs (Table V). Precision will be evaluated based on whether the RPD meets the objectives specified for each variable in Table V.

Record the replicate data on the same type of data sheet, and write "remeasurement sheet" on the top of the form. When all data is collected, compute the RPD for the entire study and include this information in the final data quality report.

Vegetation--

The following procedures are used to determine **comparability** between field team members. This also provides an estimate of precision.

Vegetation Cover Estimates:

There are two components to the vegetation cover estimates. One is the actual cover estimate for each species and the other is the number of species observed. The following procedures are used to determine comparability between field team members. This also provides an estimate of precision.

Percent cover precision is computed by calculating the mean difference between team members for each jointly recorded species. For each species jointly recorded along each transect, sum the cover percentages of each species for each team member. Calculate the mean difference between the two sums. Determine cover precision for the site by calculating the mean comparability (precision) for all species.

Example: Precision for a given species.

Cover Estimates - Botanist One

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Equisetum	5	20	0	50	30

Cover Estimates - Botanist Two

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Equisetum	5	30	5	60	40

Calculations:

The sum of cover estimates are:

Botanist One = 105
Botanist Two = 140

The means of cover estimates are:

Botanist One = 21
Botanist Two = 28

The mean difference is 7%

To compute cover comparability (precision) for the site, calculate the mean of the mean difference for all species. If four species were jointly recorded at the site:

	Species #1	Species #2	Species #3	Species #4
Mean Difference	7%	8%	6%	10%

The sum is 31. Divide by 4 (the number of species) to get the comparability for the site, which is 8%.

Plant recognition comparability examines the number of species both team members jointly observed and identified during the QA check.

Example:

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Jointly recorded species-	8	5	11	9	11
Total of species observed-	12	7	11	12	12
Precision ratio	0.67	0.71	1.00	0.75	0.92

To compute the precision for the site, sum the ratios for each plot, divide by five (the number of plots), then multiply by 100:

$$(4.05/5) \text{ X } 100 = 81\%$$

Invertebrates

Invertebrates will be identified at least to the genus level and to the species level when possible. The number of individuals of each taxon collected at each sampling location will be recorded. To accomplish this, empty the contents of a sample container into a sorting dish. Use forceps to remove large pieces of unwanted material, taking care not to also remove small invertebrates. Then remove the invertebrate specimens, one at a time, and record the numbers of each taxon found in the container. QA checks are accomplished by returning the contents of every tenth sample container to the dish. Then, a second individual identifies and re-counts the contents. Record the QA data on a separate data sheet marked "remeasurement". The QA checks result in two indexes of comparability between the two team members. One is a index for the "count" and the other an index for taxonomic identification.

Invertebrate count comparability (precision) between personnel is computed by calculating the percent relative difference (PRD) between individual team members for each jointly recorded taxon then subtracting this from 100. Compute the PRD by subtracting one person's count from the other's and recording the result as an absolute value. Divide this number by the mean of the two values, and multiply by 100. Subtract the product from 100.

$$\text{Comparability Index} = 100 - \left(\frac{100\,(|A - B|)}{(A + B)/2}\right)$$

Example: Comparability for a given species.

Count "A" = 25
Count "B" = 28

$$\text{Comparability Index} = 100 - \left(\frac{100\,(|25-28|)}{(25+28)/2}\right) = 88.7\%$$

Determine the "count" comparability for the whole specimen container by calculating the mean comparability for each species.

Example: Comparability for the sample container.

	Species #1	Species #2	Species #3	Species #4
Comparability Index	72%	84%	78%	92%

The sum is 324. Divide by 4 (the number of taxons) to get the comparability index for the sample container, 81%.

Invertebrate identification comparability represents the number of taxons both team members jointly observed and identified during the QA check. Compute this by calculating the ratio of invertebrate taxons jointly observed by total taxons observed and multiplying this by 100.

$$\text{Comparability} = \frac{\text{Jointly observed}}{\text{Total observed}} \times 100$$

Example:

Six different taxons were recorded by the two team members together. Of these, 5 were jointly recorded by both team members.

Total observed = 6

Jointly recorded = 5

$$\text{Comparability} = \frac{5}{6} \times 100 = 83.3\%$$

To compute"count" and "identification" comparability indexes for the study, sum all the QA sample container comparability results, divide by the number of sample containers re-checked for QA, and multiply by 100. Useful information can be obtained from calculating the "count" comparability for each taxon for the whole study. The feasibility of calculating this index depends on the taxonomic similarity among the sites studied.

Although no minimum acceptable value has been set for the study, the values should be equal to or greater than those shown in Table V. The results of this study will help to establish standards for later studies.

14.0 CORRECTIVE ACTIONS

Remeasurement data will be evaluated in the field and the field crew will reconsider methods, procedures, etc. Lynne and the other crew member will communicate regularly about the efficiency and techniques of sampling, and will take corrective actions when necessary. All changes that are made of the original QA Plan will be documented in detail.

15.0 QUALITY ASSURANCE REPORTS (TO MANAGEMENT)

The project will include a final report only; there will be no interim reports to management. The QC data to be collected throughout the study are discussed in Section 13.0 (Specific Routing Procedures used to Assess Data...). The final report, to be completed at the end of May 1992, will summarize QC data and evaluation of QA procedures.

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APPENDIX A LIST OF COOPERATORS AND DATA COLLECTORS

Cooperators (field and laboratory support)

1. Field support
   Cindy Hagley
   EPA, ERL-Duluth
   6201 Congdon Blvd.
   Duluth, MN 55804
   8-780-5755

2. Laboratory support
   Bill Sanville
   EPA, ERL-Duluth
   6201 Congdon Blvd.
   Duluth, MN 55804
   8-780-5723

Data providers - existing data sets

A. Water quality

1. Bob Hamill - Collins, MS site
   Soil Conservation Service
   601 7th Street
   P.O. Box 487
   Collins, MS 39428
   601-765-4445

   Water Lab: Culpepper Lab, Jackson, MS

2. Don Richey - Incline Village, NV site
   Incline Village General Improvement District
   893 Southwood Blvd.
   P.O. Drawer P
   Incline Village, NV 89451
   702-832-1242

   Water Lab: General Improvement District Lab, Incline Village, NV

3. Dave Hill - Lakeland, FL site
   Wastewater Operations, City of Lakeland
   1825 Glendale Street
   Lakeland, FL 33803
   813-686-0319

   Water Lab: City of Lakeland Wastewater Treatment Lab, Lakeland, FL

4. Alan Oyler - Orlando, FL site
   Bureau of Wastewater
   Environmental Services Department, City of Orlando

5100 L.B. McLeod Road
Orlando, FL 32811
407-246-2213

Water Lab: Bureau of Wastewater Lab, City of Orlando, FL

5. Mel Wilhelm/Terry Meyer - Show Low, AZ site
U.S. Forest Service
Lakeside Ranger District
RR 3 Box B50
Lakeside, AZ 85929
602-368-5111

Water Lab: Western Technology, Flagstaff, AZ

6. Donald Scharr - West Jackson, MS site
Mississippi Gulf Coast Regional Wastewater Authority
3103 Frederic Street
Pascagoula, MS 39567
601-762-0119

Water Lab: Mississippi Gulf Coast Regional Wastewater Authority Lab, Pascagoula, MS

B. Bird surveys

1. Florida sites (Orlando, Lakeland)
Peter Frederick
Department of Wildlife and Range Sciences
118 Newins-Ziegler Hall
University of Florida
Gainesville, FL 32611-0304
904-392-4851/392-1040

2. Mississippi sites (Collins, West Jackson)
Frank Moore
Department of Biological Sciences
University of Southern Mississippi
Southern Station, Box 5018
Hattiesburg, MS 39406-5018
601-266-4929/266-4394

3. Arizona site (Show Low)
Mel Wilhelm/Terry Meyer
U.S. Forest Service
Lakeside Ranger District
RR3 Box B50
Lakeside, AZ 85929
602-368-5111

4. Nevada site (Incline Village)

Rich Heap
Nevada Department of Wildlife - Region 1 Headquarters
380 West B Street
Fallon, NV 89406

APPENDIX B DATA FORMS AND LOGS

List of data forms to be used during 1991 field season:

Form	Description
C	Invertebrate field data sheet
D	Invertebrate Sample Log
E	Invertebrate identification
F	Vegetation Field Sheet
G	Unknown Plant Log
H	Water Collection Log
I	Photo ID Sheet
J	Photo Log

List of notebooks/logs:

1. Field - general site information, wildlife species seen, surrounding land use, unusual observations, rationale for transect placement, distance between quadrats, number of quadrats sampled, Cowardin et al. wetland classification ...

2. Sample Custody Log - list of samples sent to Duluth, including type of sample, identification number, date collected, and date sent.

3. Log of all data forms completed, copied, and sent to ERL-Corvallis.

Form C. Invertebrate Field Data Sheet

Site: ____________________

Date: ____________________

Previous & Present Weather: ____________________

Collector: ____________________

*Habitat type

Level I
- F = forested
- E = emergent /floating
- S = submergent
- C = scrub/shrub
- B = bare

Level II
- S = sediment substrate
- R = rock or plant substrate
- O = other

Cell #	Habitat Type*	# Jars	Amt. of Time	Comments

General comments/observations:

Label on jar: ____ Site ____ ____ Cell ____ Hab ____ type ____ Jar #

Form E. Invert ID

Site: ______________________

Date: ______________________

Identifier: ______________________

Remeasurement: Y/N

	Cell #										
	Habitat										
Species	Functional Group	Count/Sp.#									

General Comments:

Form D. Invertebrate Sample Log

Date Sent: ______________________________

Date received in Duluth: ___________________________

Received by: _____________________________

Sample ID#	Date Collected	# Jars	Dates sample checked	Dates alcohol changed or added	Specimen Condition (Good, Fair, Poor)	Observer initials

Form F: Vegetation Field Sheet

Page ___ of ___

Site: ______________________________

Date: ______________________________

Recorder: ______________________________

Transect #: ______________________________

Length: ______________________________

QA Sheet: Y/N

Put transect, plot & collec. code (e.g. UE-2) in plant collection bag.

		Plot #															
		Cell #															
		strata type															
		Meter Mark															
		Quad Size															
Species	+ Collected Y/N	Veg layer S,E,B, or T															

General Comments/Observations:

Veg layers: S = Submerged
E = Emergent
B = bush (scrub/shrub)
T = tree (forested)

*Quad Size

1 = $1m^2$
5 = $5m^2$
10 = 10m radius

Collect & label unknowns

UE = unk emergent
US = unk submergent
UF = unk floating-leaved
UB = unk bush (scrub/shrub)
UT = unk tree (forested)

% Cover categories:

1,5,10,20,35,50,65,80,90
99,100

Strata Types:

ET = emergent-Typha
ES = emergent-Scirpus
EO = emergent-Other, or mixed
SB = submerged
FL = floating-leaved
SS = scrub/shrub
FO = forested

Form G. Plant Log - for collected unknowns

Label plants in presses w/ site, date, transect, plot & unknown code.

Site	Date	Transect #	Plot #	Cell #	Meter Mark	Press #	Unknown Code	Assoc. Species	Soil Condition	Other Comments

Form H. Water Collection Log

Site: ______________________________

Samples received by: ______________________________

Processed by: ______________________________

* Code = site & water source

Sites	Source
I = Incline Village	I = influent
S = Show Low	E = effluent
C = Collins	
O = Ocean Springs	
L = Lakeland	
R = Orlando	

	Collected				Received		
Sample Code*	Method	Date	Time	Temp. when sent	Date	Time	Temp.

Date:

Site Code:

Photographer:

Film Roll Code:

Form J. Photo Record: (1 sheet/roll of film) Pg.____ of____
for veg, & site photos (whole transects, buffers, disturbance, cells, overall veg. patterns, other features).

Site: ____________________
Date: ____________________
Film ID#*: (eg. 100-36-1) ____________________
Type of film: ____________________
# of exposures: ____________________

Photo Description (include sample codes)	Frame #	Photographer

Film ID:
1S0 # _____ _____ _____
exp _____ _____
roll # _____ _____

Write this code on a label & put in the film cannister. When film is developed, write the code on the processing stub.

APPENDIX C AERIAL PHOTOGRAPHERS

1. Florida sites

   Kucera South
   Dick Connors
   3550 Drain Field Road
   Lakeland, FL 33811
   813-646-9661

2. Mississippi sites

   Harris Aerial Surveys
   Lynn Harris
   P.O. Box 246
   Midway, AR 72651
   501-481-5884

3. Show Low site

   Keeney Aerial Mapping
   Ellis Hyde, Vice President
   1130 W. Fillmore
   Phoenix, AZ 85007
   602-340-1877

4. Incline Village site

   American Aerial Survey, Inc.
   6249 Freeport Blvd.
   Executive Airport
   Sacramento, CA 95822
   916-422-0770

APPENDIX D SKETCH MAP PROCEDURES

Each wetland studied may be mapped to provide a spatial picture of the site for use during data analysis later in the project. Sketch mapping techniques provide a quick and reasonably accurate wetland map. This type of map shows the general planimetric shape of the wetland, but is not intended to be precisely scaled. The maps shows major site features such as open water, banks, and landmarks. In addition, sampling transects and other sampling points are indicated.

Copies of existing base maps for the site may be used. Use the mapping procedures below to locate and place site features and sampling locations on the map.

Determining Distance by Striding:

Striding is a method for estimating surface distances by walking with a measured stride and counting the steps. During training, field team members (Lynne McAllister and a temporary hire) determine the length of their individual strides by repeatedly walking a known distance and counting the number of steps taken. The procedure is to:

1. Mark off a 100-m course.

2. Wearing normal field clothing and shoes, walk the course four times with an easy stride, counting the strides. **Strides are counted on one foot, i.e., each time the left foot is placed.**

3. If the number of strides required to walk the course varies by more than one, practice taking uniform stride and repeat step #2.

4. After variation has been reduced to less than one stride per 100 m, calculate the average length of a stride by dividing the number of strides taken to complete the course four times into four times the length of the course.

5. Record the result for use during mapping.

Making Field Measurements:

First, determine what will be used as the wetland perimeter. Tie flagging at "corners" on the wetland perimeter.

Corners represent changes in direction in the wetland boundary. The finished map will show the wetland as a polygon. When mapped, the flagging will be represented by the points of the polygon.

Perform the following tasks:

1. Assemble a clipboard, Brunton compass, several copies of Map Datasheets, and a blank sketch map.

2. Check the declination setting on the compass (See Calibration Section).

3. Start at a convenient "corner" on the wetland perimeter. Make a dot on the sketch map to indicate your location and label it with an "A". Draw an arrow on the map indicating "north".

4. Use the compass to sight the next flagged point on the wetland perimeter, this will be station "B".

Mark the estimated location of "B" on data form with a "B". Record the compass reading from "A" to "B" on form.

5. Stride in a straight line to station "B" and record the number of strides taken. **NOTE: Make certain stride length is written on the form.**

6. Take a "backsight" compass reading from station "B" to station "A" and record.

7. Check to see if an error has been made in sighting the relationship between stations "A" and "B" by adding the compass reading obtained in steps #4 and #6 above. They should total $360^\circ \pm 5^\circ$. If not, repeat steps #4 and #6 until the criteria is met.

8. Continue this process from station to station around the perimeter. As each segment of wetland is measured, record compass bearings and number of strides on data form and draw a rough map.

9. At convenient points along the perimeter, take compass readings to the end-points of the vegetation transects and other sampling points. Record the compass readings on the data form and sketch the position of the transects on the map. Take readings on each end-point of each transect from at least two stations.

10. Record the locations of major site features such as open water, trees, water courses, patches of monotypic vegetation, and fences on data form and on the map.

11. If the space between two stations cannot be crossed due to water, unstable substrate or other obstructions, use triangulation to compute the distance.

    Locate a convenient area where both stations can be seen. Using a meter tape, establish two points which are a known distance apart (at least 30 m) and record the distance on the data form. Take compass readings to each station from each end of the measured distance. These readings can be used to calculate the unknown distance later.

12. If the site is unusually difficult to traverse due to obstructions or unstable substrate, all survey stations and site features can be determined with triangulation (See #11 above).

13. After all stations and site features are recorded, examine the sketch map and document anything which will help complete the final map. Check that data is recorded for all map stations and that entries on the data forms are legible.

Finishing the Map:

The maps are finished as time permits. Two processes are involved: map sketching and correcting for closure errors.

1. Assemble graph paper, pencils, erasers, a ruler with markings in centimeters, and a 360° protractor.

2. Examine the map data sheet and estimate the appropriate scale to use so that the map will fit on a sheet of paper. This takes some practice, if the scale is too large, the map won't fit on the paper. If too small, the map will be too small to contain the details.

3. Establish "north" and indicate on the map with an arrow.

4. Mark the approximate location of station "A" on the graph paper.

5. Lightly draw a line, i.e., a ray, from station "A" to station "B", using the protractor to follow the compass bearing recorded on the data sheet. Check to see that this line is correctly drawn using the "backsight" data.

6. Calculate the distance from station "A" to station "B" by multiplying the "number of strides" information on data form by the length of stride. Determine the length of a line to use on the map by converting the actual distance from "A" to "B" to the equivalent based on the scale chosen for the map. Use the cm scale on the ruler to create a line of the appropriate length on the graph paper from station "A" to "B". Lightly label station "B" on the map.

7. Continue this procedure from station to station until the entire perimeter is mapped. The final leg should connect the last station back to station "A". If it doesn't connect there is a "closure" error.

   If there is a closure error, double check the computations and compass bearings. If no obvious reason is found for the error see "Correcting Closure Error" below.

8. Finally, erase unwanted lines and marks, and darken the lines if necessary to make a good xerox copy. Draw in the site features and label the map with the site number, location, date sampled, date drawn, and the mapper's name. Also, indicate the map scale, e.g., Scale: 1 cm = 8 m. See Figure 14 for an example of a finished map.

Correcting for Closure Error:

1. Measure the perimeter of the sketch, noting distances between points. Draw a line to represent the perimeter of this plot and mark each point on it, keeping the relative scale.

   Example: A to B = 4 cm; B to C = 4 cm; C to D = 5 cm;
   D to A' = 7 cm; Perimeter = 20 cm.

   The line does not have to be 20 cm long. It can be reduced as long as the reduction of all distances between points is kept to scale.

2. Measure the width of the gap and draw a line its length up from A' on the line.

3. Measure the bearing of the ray from A to A'.

4. Complete the triangle by drawing a line from A to the top of the line representing the width of the gap. This line will be the length of the perimeter of the adjusted plot.

5. Draw lines up from each point on the first perimeter to the adjusted perimeter.

6. Measure the lengths of each ray extending up from the points on the line. Then draw each ray in its corresponding place on the figure with the angle from north of the ray connecting A to A'.

7. Finally, draw in the adjusted plot, starting at A, going to points 1, 2, & 3, and back to A. The "gap" should now be closed.

This method of error correction should be used only if the closure error is very large. If the error is small, either leave the gap open or adjust the plot from your memory of what the perimeter of the wetland looked like and triangulation. The purpose of these maps does not require extreme precision.

APPENDIX E WETLAND EVALUATION TECHNIQUE DATA FORMS

INSTRUCTIONS FOR FORM A: SITE DOCUMENTATION

Form A must be completed for all evaluations. Form A documents general information about the wetland being evaluated. It serves as a useful reference throughout the evaluation procedure and as documentation of the evaluation following its completion. It is suggested that Form A be completed as one of the preparatory tasks (see Section 2.8). Instructions for completing Form A are as follows:

Complete Part 1 of Form A by filling in each of the blanks with the requested information.

Complete Part 2 of Form A by sketching a map, or attaching a copy of the topographic map. Include in the sketch, or on the map (if it is not already indicated), the additional information itemized in Part 2 of Form A.

In addition, determine the size of each of the following areas and record your answers in Part 2 of Form A.

(1) The AA acreage
(2) The IA acreage (if applicable)
(3) The watershed acreage of the AA
(4) The wetland acreage within the AA (AA acreage minus deepwater acreage)
(5) The wetland acreage within the watershed of the closest service area (watershed acreage minus upland and deepwater acreage)
(6) The wetland/deepwater acreage within the watershed of the closest service area

FORM A: SITE DOCUMENTATION (Page 1 of 2)

Part 1 - Background Information

Evaluation Site: ______________________ Date: __________

Site Location (Section, Range, and Township): ______________________

Has the evaluator taken a training course in WET Version 2.0? __________

Agencies/Experts Contacted: ______________________

Circle the assessment levels to be completed? SS-1 SS-2 E/O-1&2 E/O-3 HS

Is the wetland tidal or nontidal? If the wetland is nontidal, indicate the month(s) that represent wet, dry, and average conditions, or if only average annual condition will be used, give rationale. Also, indicate if the previous 12 months of precipitation has been above, below, or near normal.

____

____

Is this evaluation an estimate of past conditions or a prediction of future conditions? (If answer is yes, explain nature and source of predictive data.)

____

____

Will alternative ratings be used to evaluate any of the functions or values (if yes, explain)? ______________________

____

____

Part 2 - Identification and Delineation of Evaluation Areas

Sketch a map on the following page, or attach a suitable map (photocopy of topgraphic map) that shows the following information:

-- Boundaries of the AA, IA, and IZ, and the location of service areas.
-- Watershed boundaries of AA, and service areas.
-- Extent of surface water in the AA during the wet and dry seasons.
-- Open water (channels and pools) within and adjacent to the AA.
-- Normal direction of channel or tidal flow
-- Normal direction of wind-driven waves or current.
-- Impact area(s).
-- Scale of distance and north compass direction.

Explain the procedures used to identify or delineate the AA, IA, IZ, service areas, and the watersheds of these areas if they differed from the guidelines outlined in Section 2.7. ______________________

____

____

-- Continued --

FORM A: SITE DOCUMENTATION (Page 2 of 2)

Part 2 (Cont.)

Estimate the extent of the following areas:

Assessment Area = ______ acres
Impact Area = _______ acres (only if applicable)
Watershed of AA = ______ acres/______ miles^2 (acres x 0.0016 = miles)
Wetlands in AA = ______ acres
Wetlands in the watershed of closest service area = ______ acres
Wetlands and deepwater in the watershed of closest service area =______ acres

How were locality and region defined for this evaluation? ____________________
____
____
____
____

Sketch of Evaluation Areas (or attach map):

INSTRUCTIONS FOR FORM B

Record your answers to the social significance and effectiveness and opportunity questions on Form B. There are four possible answers on this form. They include the letters "Y" for a "yes" answer, "N" for a "no" answer, "U" for an "unknown" answer, and "I" if the question is inappropriate to a particular situation (i.e., a question dealing with tide is inappropriate when evaluating nontidal wetlands).

In all cases, Form B indicates the appropriate answer options for each question. For instance, appropriate answers for a level 1 assesment of social significance (Questions 1-31) are "Y," "N," "U," and, in some cases, "I." On Form B note that the "I" is only given as an option when it is appropriate. For effectiveness and opportunity assessment level 1 (Questions 1-27), "U" is never an appropriate answer; therefore, it never appears on Form B as an option. Answers to each question must be selected from the options shown on Form B.

During the effectiveness and opportunity evaluation certain questions must be answered for the three seasonal contexts addressed by WET. For these questions, three subcolumns with headings of "X," "W," and "D" are provided for answering the question in terms of seasonal context. Unless it was determined in Task 4 to use the average annual condition for the evaluation, answer questions for all three seasonal conditions using the following guidelines:

(1) Average ($\bar{X}$):

- (a) Hydrology: intermediate between average annual wettest and driest condition.
- (b) Vegetation: maximum annual standing crop.
- (c) Tidal: the average daily high tide condition.

(2) Wet (W):

- (a) Hydrology: wettest time of an average year.
- (b) Vegetation: midpoint of the growing season
- (c) Tidal: the average monthly high tide condition (spring tide).

(3) Dry (D):

- (a) Hydrology: driest time of an average years.
- (b) Vegetation: dormant time of the year.
- (c) Tidal: the daily midtide condition.

Some effectiveness and opportunity questions are broken into two or more alphabetic and/or numeric subsections. Alphabetic subsections are designed to have a single "Y" answer. For example, in Question 10 only one of the choices (10A-10F) will be answered "Y" while the remaining choices should be answered "N." Numeric subsections, on the other hand, are designed so that more that one "Y" answer is possible. For example, in Question 42.1 one or more of the choices (42.1.1-42.1.3) may have a "Y" answer.

FORM B: EVALUATION ANSWER SHEET

Evaluation Site: ______________________________

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 1

3.1.1 "Red Flags"

Comments/Assumptions

s1. Y N U
s2. Y N U
s3. Y N U
s4. Y N U
s5. Y N U
s6. Y N U

3.1.2 On-site Social Significance

Comments/Assumptions

s7. Y N U I
s8. Y N U I

3.1.3 Off-site Social Significance

Comments

s9. Y N U I
s10. Y N U
s11. Y N U
s12. Y N U
s13. Y N U
s14. Y N U
s15. Y N U I
s16. Y N U I
s17. Y N U I
s18. Y N U I
s19. Y N U
s20. Y N U

Comments

s21. Y N U
s22. Y N U I
s23. Y N U
s24. Y N U
s25. Y N U
s26. Y N U
s27. Y N U
s28. Y N U
s29. Y N U
s30. Y N U
s31. Y N U

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 2

Context Region (Circle one)
Standard Density Circle
Locality
Hydrologic Unit

Question #

Comments/Assumptions

1 Y N
2 Y N
3 Y N
4 Y N

Evaluation Site: ______________________________

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 1 (OFFICE)

	WETLAND CONDITION			COMMENTS/ASSUMPTIONS
Q.#	X̄	W	D	
1.1	Y N			
1.2	Y N			
1.3	Y N			
2.1.1	Y N			
2.1.2	Y N			
2.1.3	Y N			
2.2.1	Y N I			
2.2.2	Y N I			
3.1	Y N			
3.2	Y N			
3.3	Y N			
4.1	Y N			
4.2A	Y N			
4.2B	Y N			
4.2C	Y N			
4.2D	Y N			
5.1.1		Y N		
5.1.2		Y N		
5.2		Y N		
6.1	Y N			
6.2	Y N			
7	Y N I			
8.1	Y N			
8.2	Y N			
8.3	Y N			
8.4	Y N			
9.1		Y N		
9.2		Y N I		
9.3		Y N I		
10A	Y N			
10B	Y N			
10C	Y N			
10D	Y N			
10E	Y N			
10F	Y N			

Evaluation Site: ______________________________

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$		W		D	
11	Y	N	Y	N	Y	N
12A	Y	N	Y	N	Y	N
12Aa	Y	N	Y	N	Y	N
12Ab	Y	N	Y	N	Y	N
12Ac	Y	N	Y	N	Y	N
12Ad	Y	N	Y	N	Y	N
12Ae	Y	N	Y	N	Y	N
12B	Y	N	Y	N	Y	N
12Ba	Y	N	Y	N	Y	N
12Bb	Y	N	Y	N	Y	N
12Bc	Y	N	Y	N	Y	N
12Bd	Y	N	Y	N	Y	N
12Be	Y	N	Y	N	Y	N
12C	Y	N	Y	N	Y	N
12Ca	Y	N	Y	N	Y	N
12Cb	Y	N	Y	N	Y	N
12Cc	Y	N	Y	N	Y	N
12Cd	Y	N	Y	N	Y	N
12D	Y	N	Y	N	Y	N
12Da	Y	N	Y	N	Y	N
12Db	Y	N	Y	N	Y	N
12E	Y	N	Y	N	Y	N
13A	Y	N	Y	N	Y	N
13Aa	Y	N	Y	N	Y	N
13Ab	Y	N	Y	N	Y	N
13Ac	Y	N	Y	N	Y	N
13Ad	Y	N	Y	N	Y	N
13Ae	Y	N	Y	N	Y	N
13B	Y	N	Y	N	Y	N
13Ba	Y	N	Y	N	Y	N
13Bb	Y	N	Y	N	Y	N
13Bc	Y	N	Y	N	Y	N
13Bd	Y	N	Y	N	Y	N
13Be	Y	N	Y	N	Y	N
13C	Y	N	Y	N	Y	N
13Ca	Y	N	Y	N	Y	N
13Cb	Y	N	Y	N	Y	N
13Cc	Y	N	Y	N	Y	N
13Cd	Y	N	Y	N	Y	N
13D	Y	N	Y	N	Y	N
13Da	Y	N	Y	N	Y	N
13Db	Y	N	Y	N	Y	N
13E	Y	N	Y	N	Y	N

Evaluation Site: ______________________________

WETLAND CONDITION | COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$			W		D	
14.1	Y	N		Y	N	Y	N
14.2	Y	N		Y	N	Y	N
15.1A	Y	N	I				
15.1B	Y	N	I				
15.1C	Y	N	I				
15.2	Y	N	I				
16A	Y	N		Y	N	Y	N
16B	Y	N		Y	N	Y	N
16C	Y	N		Y	N	Y	N
17	Y	N					
18	Y	N	I				
19.1A	Y	N	I				
19.1B	Y	N	I				
19.2	Y	N	I				
19.3	Y	N	I				
20.1	Y	N	I				
20.2	Y	N	I				
21A	Y	N					
21B	Y	N					
21C	Y	N					
21D	Y	N					
21E	Y	N					
22.1.1	Y	N					
22.1.2	Y	N	I				
22.2	Y	N					
22.3	Y	N	I				
23	Y	N					
24.1	Y	N	I				
24.2	Y	N	I				
24.3	Y	N	I				
24.4	Y	N	I				
24.5	Y	N					
25.1	Y	N					
25.2A	Y	N	I				
25.2B	Y	N	I				
25.3	Y	N					

Evaluation Site: ______________________________

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
		WETLAND CONDITION		
26.1	Y N			
26.2	Y N I			
26.3	Y N I			
27.1	Y N			
27.2	Y N I			
27.3	Y N I			

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 2 (FIELD)

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
		WETLAND CONDITION		
28	Y N			
29.1	Y N			
29.2	Y N			
30.	Y N	Y N	Y N	
31.1	Y N	Y N	Y N	
31.2	Y N	Y N	Y N	
31.3	Y N	Y N	Y N	
31.4	Y N I	Y N I	Y N I	
31.5	Y N	Y N	Y N	
31.6A	Y N	Y N	Y N	
31.6B	Y N	Y N	Y N	
31.6C	Y N	Y N	Y N	
31.6D	Y N	Y N	Y N	
31.6E	Y N	Y N	Y N	
32A	Y N			
32B	Y N			
32C	Y N			
32D	Y N			
32E	Y N			
32F	Y N			
32G	Y N			
32H	Y N			
32I	Y N			
32J	Y N			
32K	Y N			

FORM B (Cont.)

Evaluation Site: ______________________________

Q.#	$\bar{X}$			W			D		COMMENTS/ASSUMPTIONS
33A	Y	N							
33B	Y	N							
33C	Y	N							
33D	Y	N							
33E	Y	N							
33F	Y	N							
33G	Y	N							
33H	Y	N							
33I	Y	N							
33J	Y	N							
33K	Y	N							
34.1	Y	N							
34.2	Y	N							
34.3.1	Y	N							
34.3.2	Y	N	I						
35.1	Y	N	I						
35.2	Y	N	I						
36.1.1	Y	N		Y	N		Y	N	
36.1.2	Y	N		Y	N		Y	N	
36.2.1	Y	N		Y	N		Y	N	
36.2.2	Y	N		Y	N		Y	N	
36.2.3	Y	N		Y	N		Y	N	
37	Y	N							
38.1	Y	N							
38.2	Y	N							
38.3	Y	N							
38.4	Y	N							
38.5	Y	N							
38.6	Y	N							
38.7	Y	N							
38.8	Y	N	I						
39	Y	N							
40.1	Y	N	I						
40.2	Y	N	I						
41.1				Y	N	I			
41.2				Y	N	I			

WETLAND CONDITION

FORM B (Cont.)

Evaluation Site: ______________________________

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$			W			D		
42.1.1	Y	N	I	Y	N	I	Y	N	I
42.1.2	Y	N	I	Y	N	I	Y	N	I
42.1.3	Y	N	I	Y	N	I	Y	N	I
42.2.1	Y	N	I	Y	N	I	Y	N	I
42.2.2	Y	N	I	Y	N	I	Y	N	I
42.2.3	Y	N	I	Y	N	I	Y	N	I
43A	Y	N		Y	N		Y	N	
43B	Y	N		Y	N		Y	N	
43C	Y	N		Y	N		Y	N	
43D	Y	N		Y	N		Y	N	
43E	Y	N		Y	N		Y	N	
43F	Y	N		Y	N		Y	N	
43G	Y	N		Y	N		Y	N	
43H	Y	N		Y	N		Y	N	
43I	Y	N		Y	N		Y	N	
44A	Y	N		Y	N		Y	N	
44B	Y	N		Y	N		Y	N	
44C	Y	N		Y	N		Y	N	
44D	Y	N		Y	N		Y	N	
44E	Y	N		Y	N		Y	N	
44F	Y	N		Y	N		Y	N	
44G	Y	N		Y	N		Y	N	
44H	Y	N		Y	N		Y	N	
44I	Y	N		Y	N		Y	N	
45A	Y	N							
45B	Y	N							
45C	Y	N							
45D	Y	N							
45E	Y	N							
45F	Y	N							
45G	Y	N							
46A	Y	N		Y	N		Y	N	
46B	Y	N		Y	N		Y	N	
46C	Y	N		Y	N		Y	N	
47A	Y	N							
47B	Y	N							
47C	Y	N							

Evaluation Site: ____________________

WETLAND CONDITION | COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$			W			D		
48A	Y	N	I	Y	N	I	Y	N	I
48B	Y	N	I	Y	N	I	Y	N	I
48C	Y	N	I	Y	N	I	Y	N	I
48D	Y	N	I	Y	N	I	Y	N	I
48E	Y	N	I	Y	N	I	Y	N	I
48F	Y	N	I	Y	N	I	Y	N	I
49.1.1	Y	N	I	Y	N	I	Y	N	I
49.1.2	Y	N	I	Y	N	I	Y	N	I
49.2	Y	N	I	Y	N	I	Y	N	I
49.3	Y	N	I	Y	N	I	Y	N	I
50.	Y	N		Y	N		Y	N	

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 3 (DETAILED DATA)

WETLAND CONDITION | COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$				W			D		
51.1	Y	N	U							
51.2	Y	N	U							
52.1	Y	N	I	U						
52.2	Y	N	I	U						
53.1	Y	N	I	U						
53.2	Y	N	I	U						
54	Y	N	U		Y	N	U	Y	N	U
55.1	Y	N	U							
55.2	Y	N	U							
55.3	Y	N	U							
55.4	Y	N	U							
56.1	Y	N	I	U						
56.2	Y	N	I	U						
57.1	Y	N	U							
57.2	Y	N	U							
58.	Y	N	U							

FORM B (Cont.)

Evaluation Site: ________________________________

WETLAND CONDITION				COMMENTS/ASSUMPTIONS
Q.#	$\bar{X}$	W	D	
59.1	Y N I U			
59.2	Y N I U			
60	Y N U			
61	Y N I U			
62	Y N U			
63.1	Y N I U			
63.2	Y N I U			
64		Y N I U		

INSTRUCTIONS FOR FORM C: SUPPLEMENTARY OBSERVATIONS

Form C is used to document the observation of fish and wildlife species by the evaluator(s) during the field visit to the AA site. The observations documented in Form C are only used during the habitat suitability evaluation procedure, therefore, it is not necessary to fill out Form C unless habitat suitability evaluations are anticipated.

Record observations of fish and waterfowl species groups, as well as individual fish and bird species while at the AA site. In addition, record observations of recreational and consumptive activities occurring at the AA site.

FORM C: SUPPLEMENTARY OBSERVATIONS

Evaluation Site: ______________________________

Indicate the species, species groups, and activities that are actually observed, reliably reported, or known to occur at the AA on a regular basis.

FISH SPECIES GROUPS*	OBSERVED/REPORTED
1. Warmwater Group	Y or N
2. Coldwater Group	Y or N
3. Northern Lake Group	Y or N
4. Coldwater Riverine Group	Y or N

FISH SPECIES	OBSERVED/REPORTED
______________	Y or N
______________	Y or N
______________	Y or N

WATERFOWL SPECIES GROUPS**	OBSERVED/REPORTED		
	NESTING	MIGRATING	WINTERING
1. Prairie Dabblers	Y or N	Y or N	Y or N
2. Black Duck	Y or N	Y or N	Y or N
3. Wood Duck	Y or N	Y or N	Y or N
4. Common and Red-Breasted Mergansers	Y or N	Y or N	Y or N
5. Hooded Merganser	Y or N	Y or N	Y or N
6. Canvasback, Redhead, Ruddy Duck	Y or N	Y or N	Y or N
7. Ring-necked Duck	Y or N	Y or N	Y or N
8. Greater and Lesser Scaup	Y or N	Y or N	Y or N
9. Common Goldeneye	Y or N	Y or N	Y or N
10. Bufflehead	Y or N	Y or N	Y or N
11. Whistling Ducks	Y or N	Y or N	Y or N
12. Inland Geese	Y or N	Y or N	Y or N
13. Tundra Swan	Y or N	Y or N	Y or N
14. Brant	Y or N	Y or N	Y or N

BIRD SPECIES	OBSERVED/REPORTED
______________	Y or N
______________	Y or N
______________	Y or N

RECREATIONAL ACTIVITIES

Hiking	Sailing	Snowmobiling	Research
Birdwatching	Power Boating	Skiing	Educational Fieldtrips
Photography	Canoeing	Snowshoeing	Horseback Riding
Swimming	Kayaking	Ice Skating	

CONSUMPTIVE ACTIVITIES

Agriculture	Fur Harvesting	Commercial/Sport Fishing	Peat Harvesting
Hunting	Timber Harvest	Natural Food Gathering	Water Supply

* Fish species groups are explained on page 138

** Waterfowl species groups are explained on page 1647

INSTRUCTIONS FOR FORM D: EVALUATION SUMMARY SHEET

Form D documents the results of the evaluation. Record probability ratings for functions in terms of social significance and/or effectiveness and opportunity evaluation in the appropriate row and column. An "*" on Form D indicates that WET does not evaluate the function in terms of social significance or effectiveness and opportunity.

Record probability ratings for any habitat suitability evaluations that were conducted in the appropriate row and column.

At the bottom of the Form indicate:

(1) The levels of assessment completed for the evaluation
(2) Whether that particular Form D is for an AA or IA
(3) Identify evidence suggesting contrary probablity ratings
(4) Identify alternative sources of information used to assign a probability rating
(5) If possible identify wetland loss rates for the locality or region in terms of wetland type, acreage, and time frame.

FORM D: EVALUATION SUMMARY SHEET

Evaluation Site: ______________________________

Wetland Functions and Values

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge			*
Ground Water Discharge			*
Floodflow Alteration			
Sediment Stabilization			*
Sediment/Toxicant Retention			
Nutrient Removal/Transform.			
Production Export	*		*
Wildlife Diversity/Abundance**		*	*
Breeding	*		*
Migration	*		*
Wintering	*		*
Aquatic Diversity/Abundance			*
Uniqueness/Heritage		*	*
Recreation		*	*

Habitat Suitability Evaluation

Fish Species Groups:

__________ Group ___ __________ Group ___ __________ Group ___

Waterfowl Species Groups:

	Breeding	Migration	Wintering
Group ________	___	___	___
Group ________	___	___	___
Group ________	___	___	___
Group ________	___	___	___

Fish, Invertebrate, and Bird Species:

________	___	________	___	________	___
________	___	________	___	________	___
________	___	________	___	________	___
________	___	________	___	________	___

Levels of assessment completed: S-1 S-2 E/O-1 E/O-2 E/O-3 HS
Evaluation is for the: AA IA (Note: if the evaluation is for an IA, documentation of the AA evaluation must be presented with this evaluation).
Is there any evidence that suggests ratings contrary to the above (explain)?

____

Were alternative sources used for any of the ratings above (explain)? ________

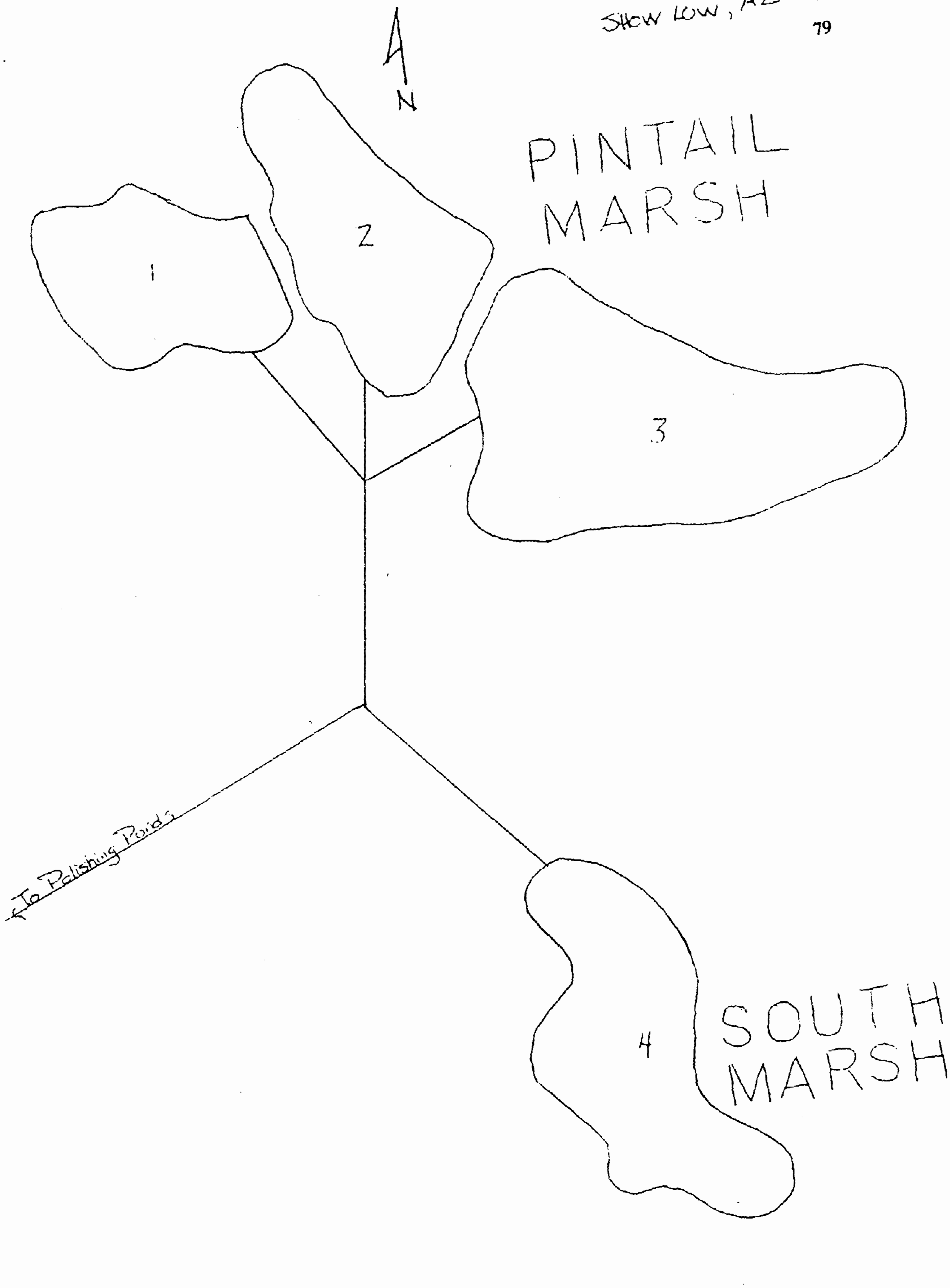
____

The loss rate for ________________ (identify locality/region) between 19__ and 19__ for ________________ (identify wetland type) was __________ (acres/year or % loss).

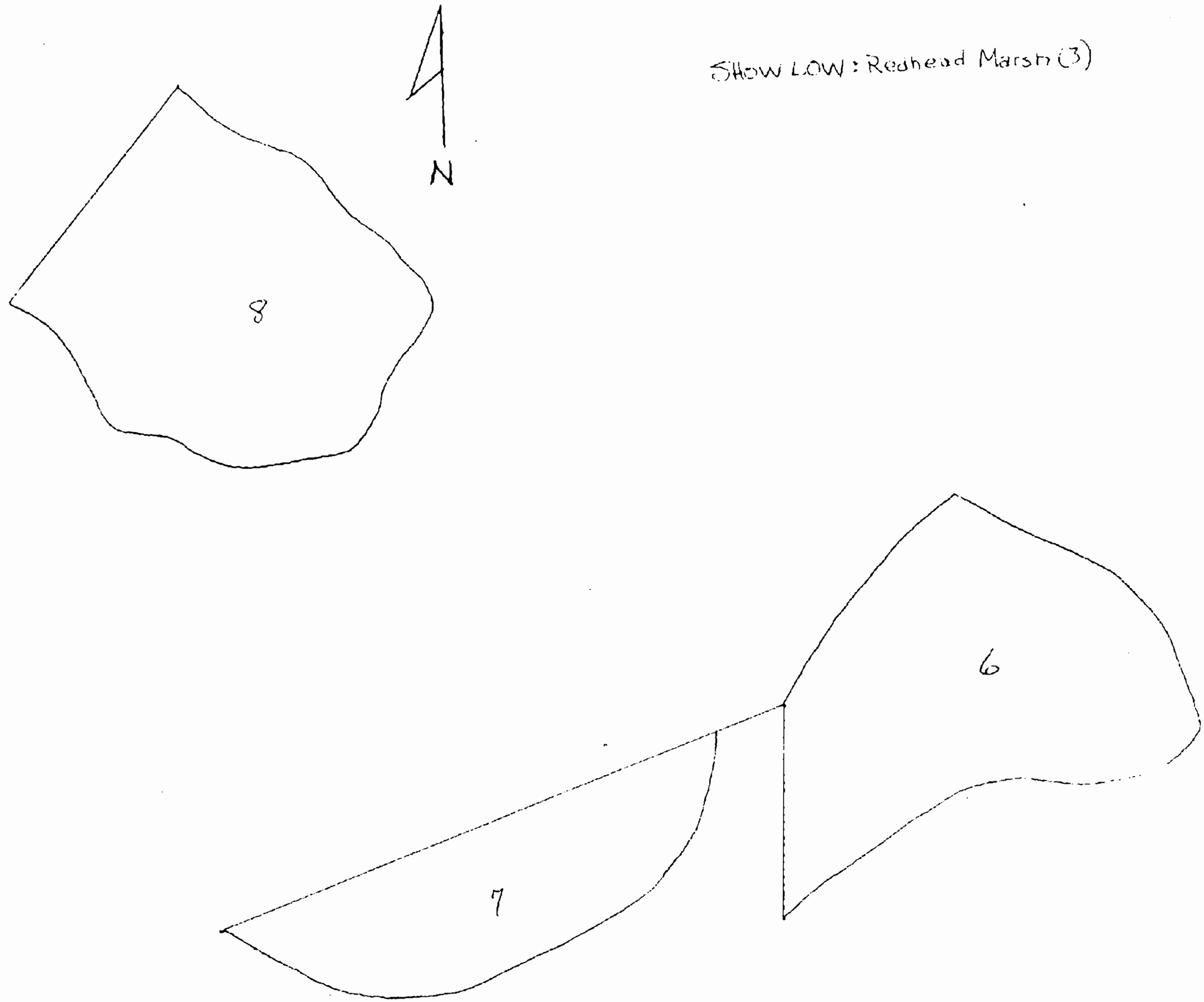
* WET does not evaluate this function or value in these terms.
** Wildlife Diversity/Abundance assesses only wetland-dependent birds. Other wildlife (e.g., game mammals) should be evaluated using other methods.

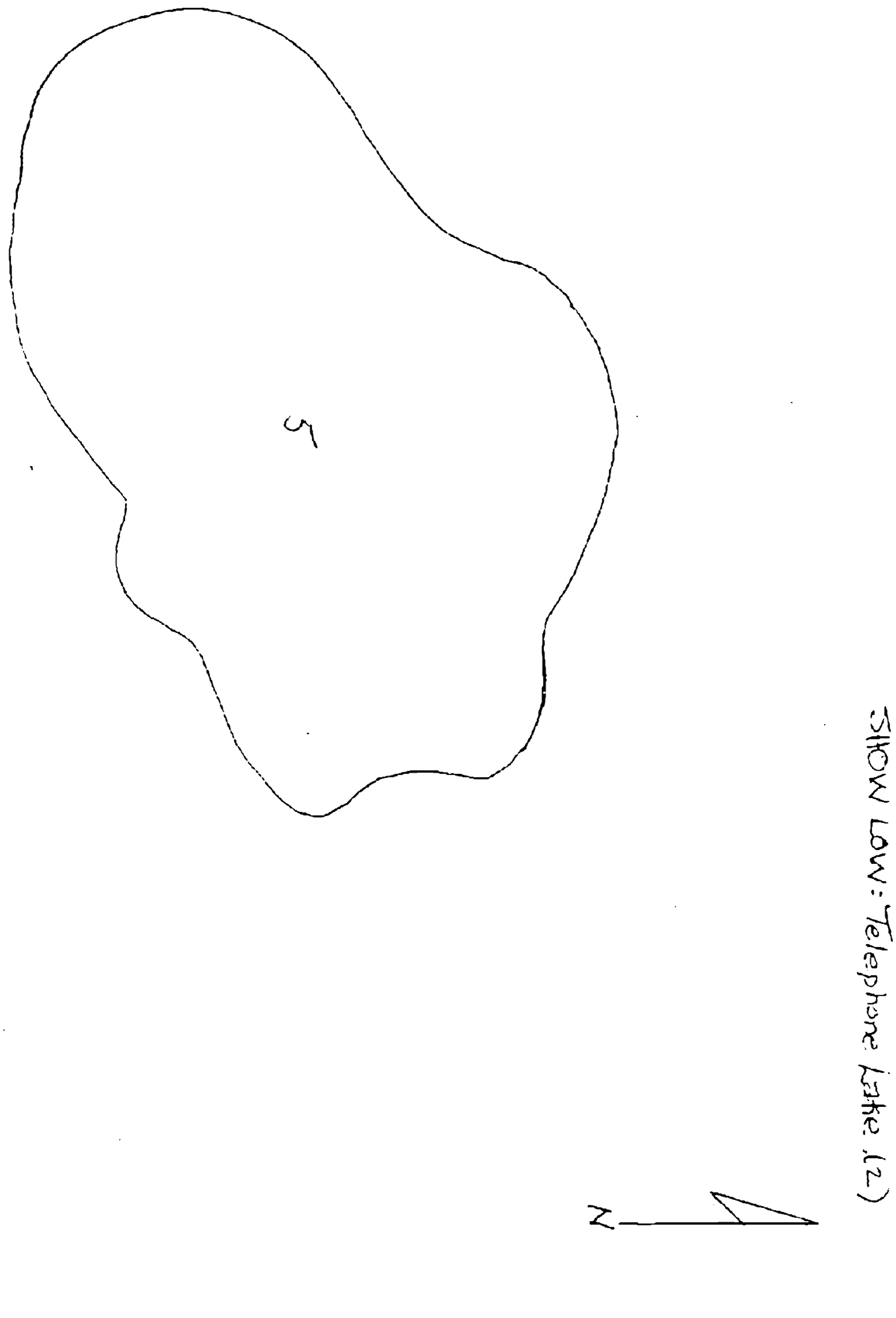
APPENDIX F SITE MAPS

Show Low, Az (i)

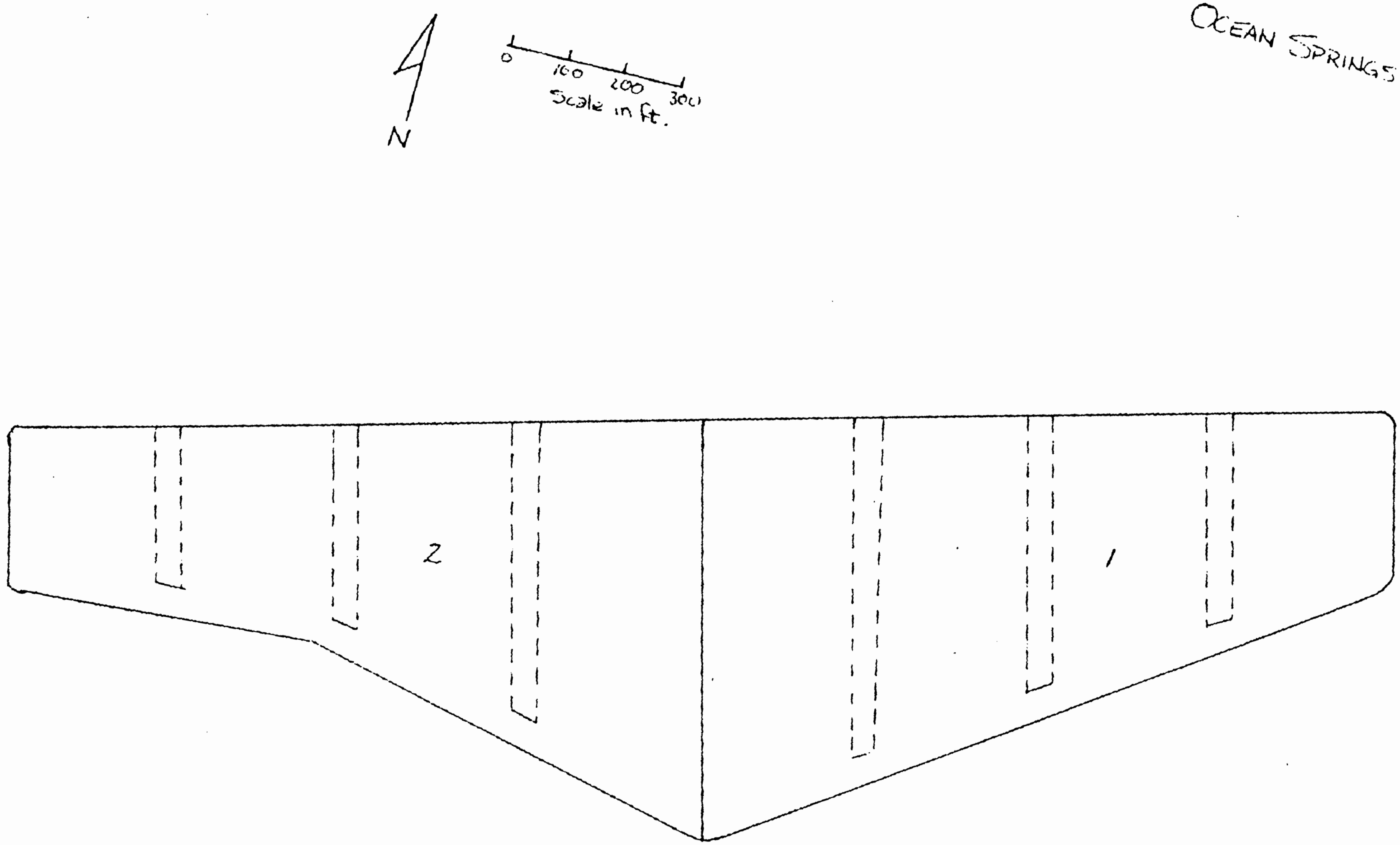


SHOW LOW: Redhead Marsh (3)

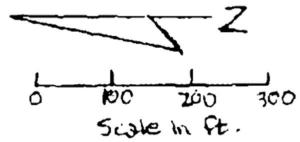


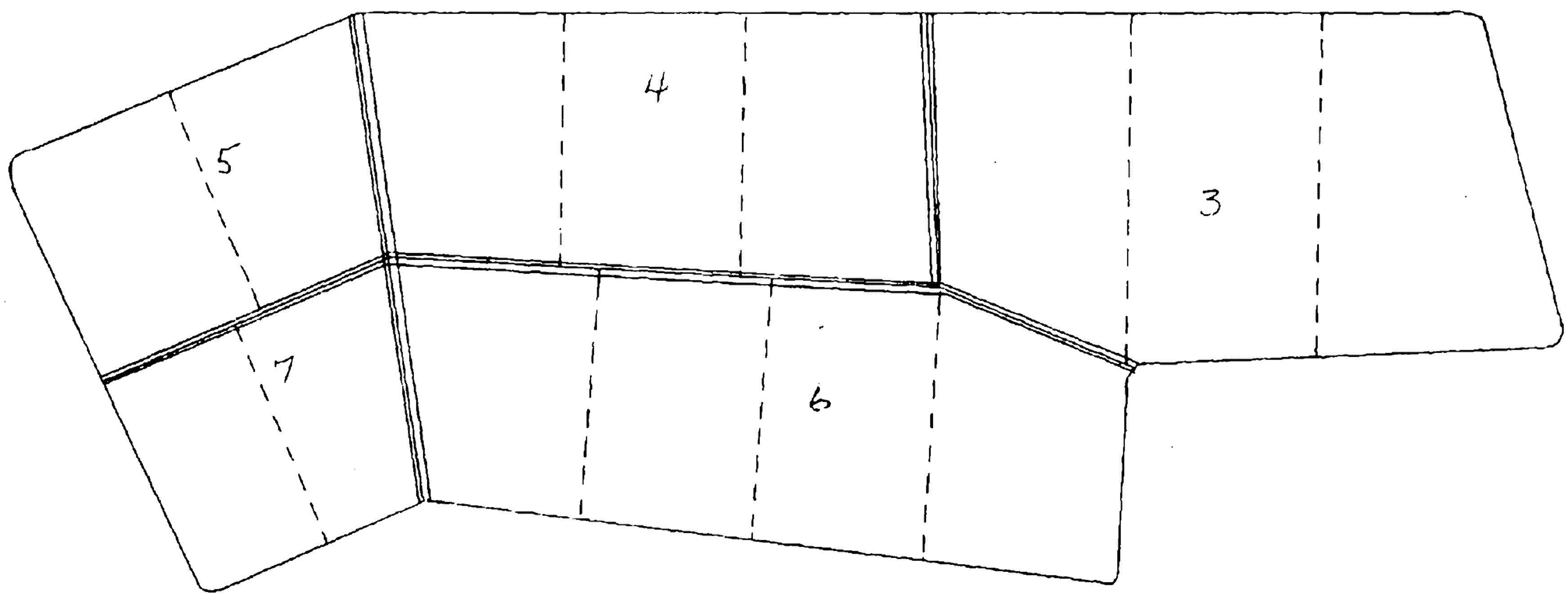

5
SHOW LOW: Telephone Lake (2)
N

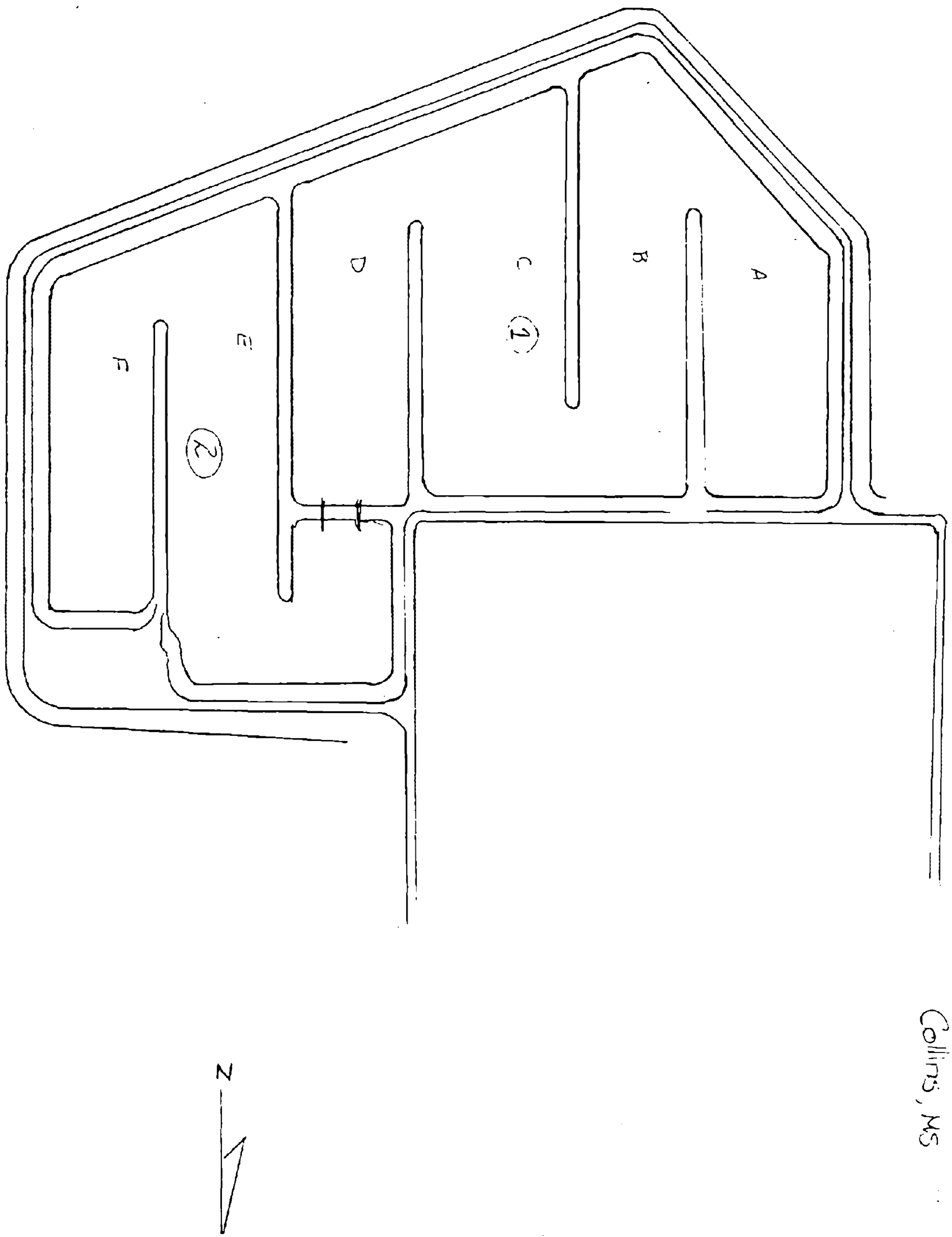
Ocean Springs: Phase I

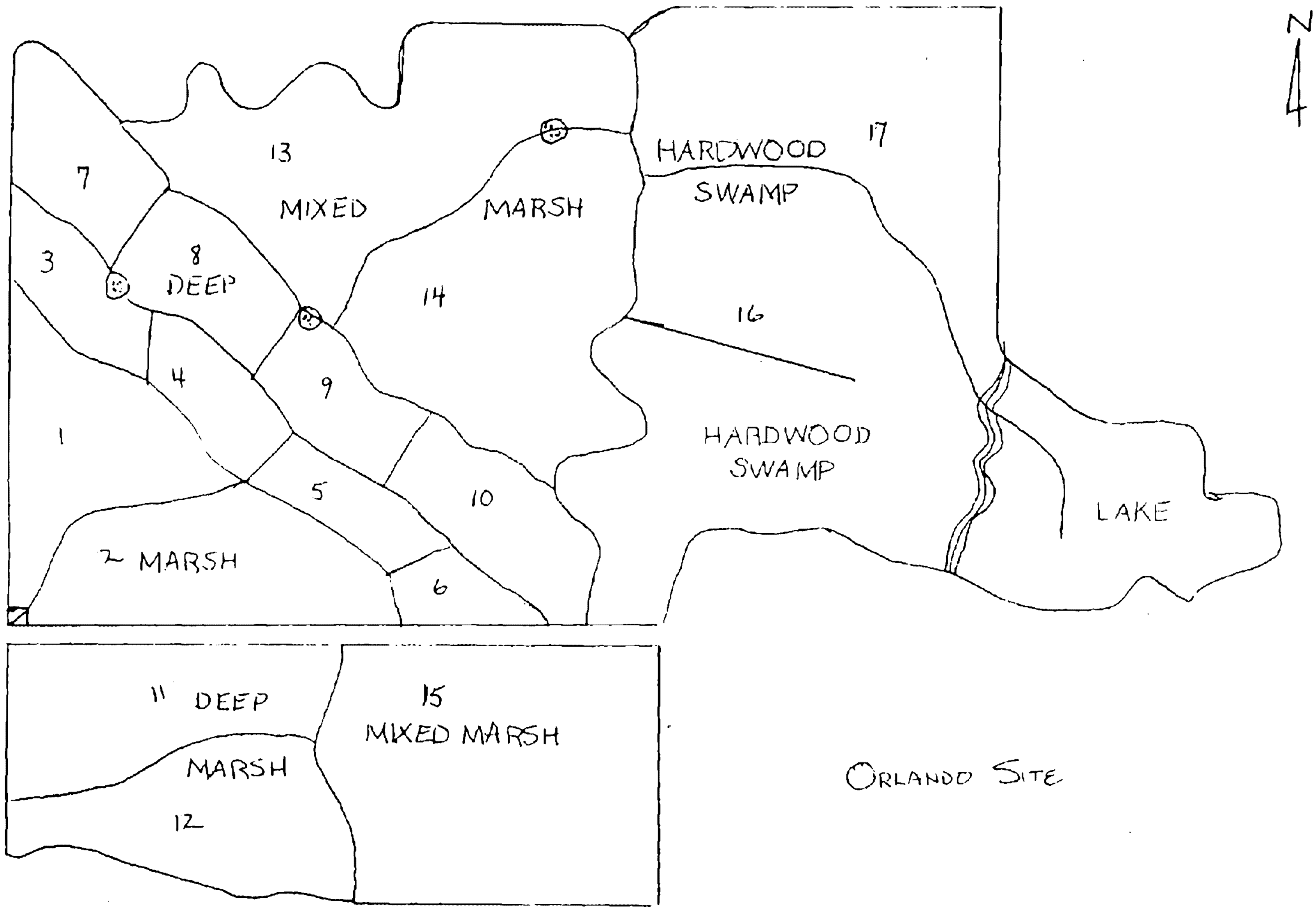


Ocean Springs: Phase II

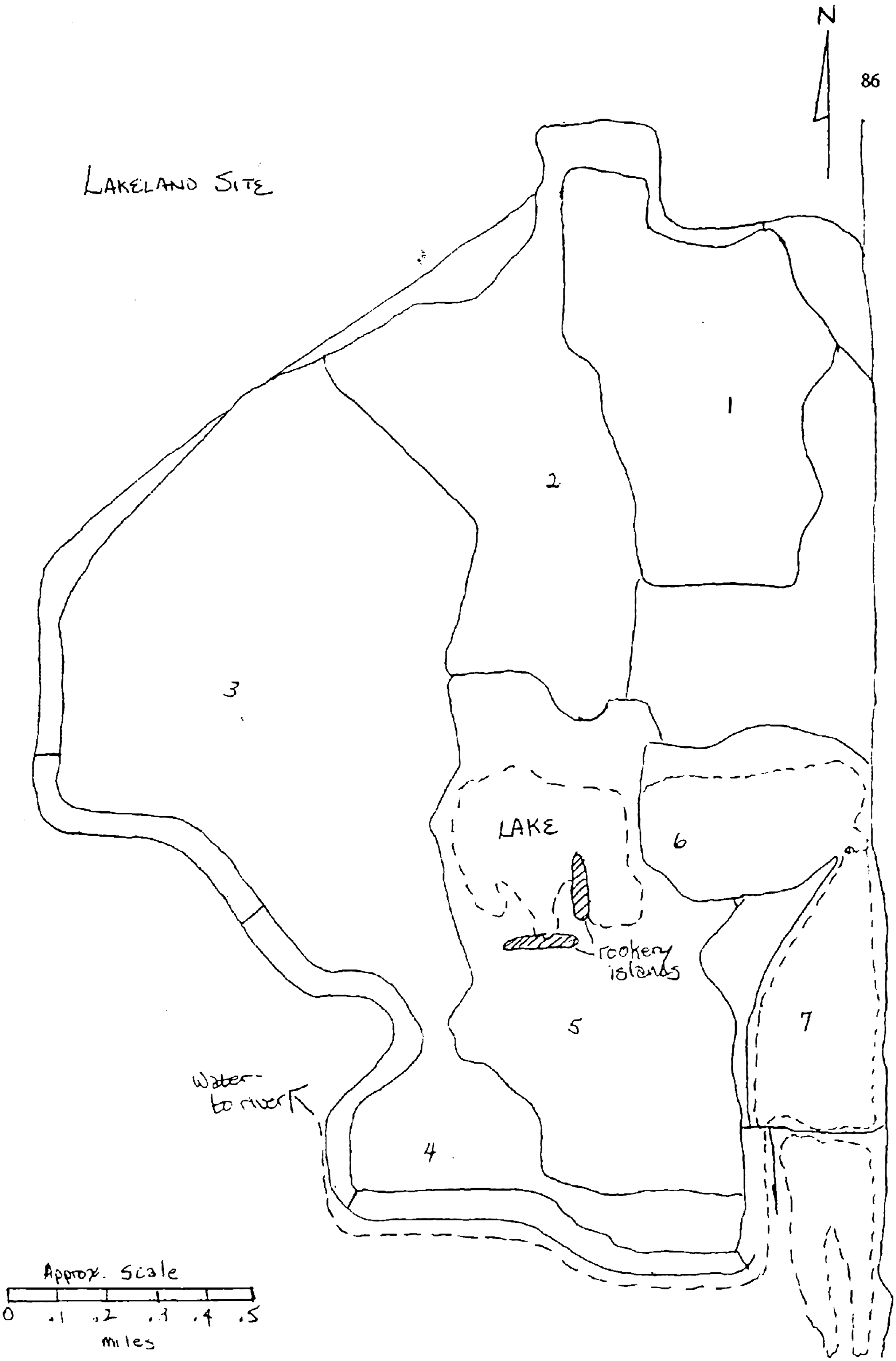





A
B
C
D
E
F
1
2
N
Collins, MS



Orlando Site


LAKELAND SITE
N
86
1
2
3
4
5
6
7
LAKE
rookery islands
Water to river
Approx. Scale
0 .1 .2 .3 .4 .5
miles

INCLINE VILLAGE, NV