ES/ER/TM-88/R1

Environmental Data Management Implementation Handbook for the Environmental Restoration Program

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Environmental Data Management Implementation Handbook for the Environmental Restoration Program

Environmental Restoration Division
Oak Ridge, Tennessee

April 1996

Prepared by
Environmental Information Management
Data Quality Program
for
U.S. Department of Energy
Office of Environmental Management
under budget and reporting code EW 20

LOCKHEED MARTIN ENERGY SYSTEMS, INC.
managing the
Oak Ridge K-25 Site
Oak Ridge Y-12 Plant
and Environmental Restoration and Waste Management activities
at the Oak Ridge National Laboratory, Paducah, Kentucky, and Piketon, Ohio, Gaseous Diffusion Plants
under contract DE-AC05-84OR21400 for the
U.S. DEPARTMENT OF ENERGY

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Acknowledgments

The authors wish to express their sincere appreciation to the members of the ES/ER/TM-88 review team for their participation in early formative discussions and for providing invaluable comments on draft materials. Members of the review team were Gary A. Person, Sam E. Stinnette, Warren T. Thompson, John H. Vanderlan, Jackie L. Williams, Terry L. Hatmaker, and Becky A. Lawson. The authors also wish to thank the numerous ER peer reviewers for their thoughtful and insightful comments.

The continuing support and encouragement of David Herr, Environmental Information Program Manager, over the course of this revision effort is gratefully acknowledged.

PREFACE

This handbook has been prepared to define the technical approach for support of all data management activities surrounding Environmental Restoration project collection and analysis of environmental data. Also, this handbook has been prepared to provide Lockheed Martin Energy Systems Environmental Restoration project managers, data managers, and technical staff guidance and specific requirements for preparing a data management implementation plan.

This document was prepared under Work Breakdown Structure 1.4.12.2.3.04.04.03 (Activity Data Sheet 8304, “Technical Integration”).

CONTENTS

TABLES

FIGURES

ABBREVIATIONS

ADC	authorized derivative classifier
ADP	automated data processing
AR	administrative record
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chain-of-custody
DC	document coordinator
D&D	decontamination and decommissioning
DMC	Document Management Center
DMIP	data management implementation plan
DMP	data management plan
DOE	U.S. Department of Energy
DOE-ORO/ERD	U.S. Department of Energy Oak Ridge Operations/Environmental Restoration Division
DQA	data quality assessment process
DQO	data quality objectives
EDD	electronic data deliverable
EE/CA	engineering evaluation/cost analysis
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERWM	Environmental Restoration Waste Management
FFA	Federal Facility Agreement
GIS	Geographic Information System
GISST	Geographical Information Systems and Spatial Technologies Server
IRM	Information Resource Management
LMER	Lockheed Martin Energy Research Corporation
LMES	Lockheed Martin Energy Systems, Inc.
OREIS	Oak Ridge Environmental Information System
ORNL	Oak Ridge National Laboratory
PDB	project data base
PDC	project data coordinator
PEMS	Project Environmental Measurements System
pH	symbol used to express acidity and/or alkalinity on a scale of 0 to 14
QA	quality assurance
QC	quality control
RA	remedial action
RCRA	Resource Conservation and Recovery Act of 1976
RD/RA	remedial decision/remedial action
RI/FS	remedial investigation/feasibility study
RFA	request for analysis
RTL	ready-to-load
SAP	sampling and analysis plan
SAS	Statistical Analysis System
SDM	Systems Development Methodology

SMF	Software Management Framework
S&M	surveillance and maintenance
SOW	statement of work
SPARCC	sensitivity, precision, accuracy, representativeness, completeness, and comparability
SQL	Structured Query Language
SSG	Sample Shipment Group
TI	Technical Integration
TOA	Tennessee Oversight Agreement
URL	uniform resource locator
V/V	verification/validation
WWW	World-Wide Web
Y-12	Oak Ridge Y-12 Plant

EXECUTIVE SUMMARY

The purpose of this handbook is to assist environmental restoration (ER) projects in the preparation of a data management implementation plan (DMIP). The DMIP identifies and documents an ER project's requirements and responsibilities for the management, quality assurance, use, and archival of its environmental data. It is important that a project complete its DMIP in the early planning phase to ensure that the necessary and appropriate data management systems and personnel are in place before the project begins acquiring data. All ER projects that collect or use environmental data at the Oak Ridge National Laboratory, the Oak Ridge Y-12 Plant, the Oak Ridge K-25 Site, the Paducah Gaseous Diffusion Plant, the Portsmouth Gaseous Diffusion Plant, and surrounding onsite and offsite areas must prepare a DMIP. Project types that often collect environmental data include surveillance and maintenance, decontamination and decommissioning, remedial design/remedial action, and remedial investigation/feasibility studies. Even if a project does little environmental data management, a DMIP is required to document this fact.

This handbook implements several provisions of the *Environmental Data Management Policy for the ER Program* and is also a local implementation of the American National Standard, *Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (ANSI/ASQC E4-1994).

The ER program collects, analyzes, and interprets vast amounts of environmental data in order to make sound decisions concerning remediation activities. In many instances, the defensibility of these decisions is based on the integrity of these data. Because the scale of remedial activities has increased significantly, it is crucial to the ER program to effectively manage, share, and reuse these data, which are a valuable resource.

The ER program established the Environmental Information Management (EIM) program within the ER Technical Integration program. EIM's mission is to (1) provide trained and qualified data specialists (measurements and geospatial) to ER projects; (2) implement a consistent, comprehensive, and efficient approach for managing project environmental data; and (3) consolidate appropriate project and historical data for use by regulators and the ER program.

In order to present this information in as cost-effective and as efficient a manner as possible, the hard copy distribution of this handbook will be kept to a minimum. This handbook will be updated as frequently as needed to support ER project data management activities. A configuration-controlled electronic copy will be placed on the Energy Systems internal World-Wide Web server in a portable document format file and will be accessible from the ER EIM program home page. The uniform resource locator (URL) for the ER EIM program home page is **http://www-internal.ornl.gov/ER/ernet3.html**.

1. INTRODUCTION

In October 1995, the Environmental Restoration (ER) program established the Environmental Information Management (EIM) program within the Technical Integration (TI) program. EIM's mission is to (1) provide trained and qualified data specialists (measurements and geospatial) to ER projects; (2) implement a consistent, comprehensive, and efficient approach for managing project environmental data; and (3) consolidate appropriate project and historical data for use by regulators and the ER program. EIM has undertaken several initiatives to support its mission. They are as follows:

- supporting the Oak Ridge Environmental Information System (OREIS) to serve as a long-term repository of important project-generated and historical data;
- supporting the Project Environmental Measurements System (PEMS) to manage project environmental measurements data;
- preparing guidance documents and procedures that implement the provisions of the *Environmental Data Management Policy for the ER Program*; and
- incorporating appropriate elements of the *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (ANSI/ASQC E4-1994) into guidance documents and procedures to ensure that only necessary and sufficient data management requirements are identified and documented.

1.1 PURPOSE AND SCOPE

The purpose of this document is to help data managers, technical staff, and project managers in preparing a project data management implementation plan (DMIP). The DMIP identifies and documents a project's requirements and responsibilities for managing, using, and archiving environmental information. Sufficient detail must be provided in the DMIP to define clearly

- what data types the project will generate and use;
- who is responsible for the various activities related to information management;
- how the project will manage its data; and
- when data exchanges will occur and between whom.

The DMIP must be completed early in the life cycle of a project to ensure that the necessary and appropriate data management systems and personnel are in place before a project begins acquiring data. The DMIP must also be reviewed and updated if necessary.

The DMIP only pertains to the management of a project's environmental information. Environmental information includes electronic or hard copy records obtained by a project that describe environmental processes or conditions. Information generated by the project (e.g., analytical results from samples collected by the project) and obtained from sources outside the project (e.g., historical data) fall within the scope of the DMIP. Certain types of information, such as personnel or financial records, are outside the scope of the DMIP. A more detailed definition of environmental data with examples is given in Appendix A.

All ER projects that collect or use environmental information at the Oak Ridge National Laboratory, the Oak Ridge Y-12 Plant, the Oak Ridge K-25 Site, the Paducah Gaseous Diffusion Plant, the Portsmouth Gaseous Diffusion Plant, and surrounding onsite and offsite areas will prepare a DMIP. Project types that often collect environmental information include surveillance and maintenance (S&M), decontamination and decommissioning (D&D), remedial design/remedial action (RD/RA), and remedial investigation/feasibility study (RI/FS). Even if a project does little environmental data management, a DMIP is required to document this fact.

1.2 AUDIENCE

The principal readers and users of this document are project data coordinators (PDCs) and technical leads. The technical lead is the technical "owner" of a project and typically serves as the single point of contact for the project manager on all technical issues. The PDC serves as the single point of contact for the project on all data management issues. The technical lead and PDC have primary responsibility for preparing a project's DMIP. Once the DMIP is prepared, the PDC ensures that the project's data management activities are completed in a timely, appropriate, and cost-effective manner. Project managers and other members of the project team may also find this document useful in understanding the issues important in the management of project environmental information.

1.3 IMPLEMENTATION

The project manager, technical lead, and PDC have primary responsibility for initiating DMIP preparation. In addition, at specific times it may be productive to involve other members of the project team such as task leaders, members of field teams, data users, and other data management staff in discussions of data management needs. The minimum set of project data management requirements depends on the project scope. Ideally, the project team should work together to

(1) identify project data management requirements;

(2) make the data management decisions that will define an efficient environmental data collection and handling process for the project; and

(3) clearly define project team interactions and responsibilities for data collection and management.

The project manager, technical lead, and PDC should initiate this activity by following the process outlined in Sect. 2.

1.4 ORGANIZATION

This document is divided into seven sections, followed by four appendices.

Section 1 defines the purposes, scope, organization, and audience of the document.

Section 2 describes the steps for preparing a project data management implementation plan.

Section 3 defines the roles and their responsibilities for carrying out the project data management activities outlined in Sect. 4.

Section 4 describes typical activities and responsibilities related to project environmental data management. Each activity description includes the process requirements and business rules that pertain to that activity, a process flow and responsibility diagram, and a description of the processes represented in the diagram.

Section 5 identifies software configuration control and data management system administration requirements.

Section 6 is a list of references cited in this document.

Section 7 defines the terms used in this document.

Appendix A defines environmental data with examples.

Appendix B lists the project data types to be transferred to OREIS.

Appendix C provides descriptions of selected data management systems.

Appendix D provides an overview of OREIS. Sections 3, 4, and 5 provide background material that may be useful in preparing a DMIP.

2. PREPARING A PROJECT DATA MANAGEMENT IMPLEMENTATION PLAN

APPLICABILITY:	All ER projects
USE:	Guidance for the project managers, technical leads, and project data coordinators in developing the project DMIP
IMPLEMENTATION:	Project managers, technical leads, and project data coordinators
CONSIDERATIONS:	During the development of a project's DMIP, many data management requirements and activities will be considered. However, not all will be applicable. For those that are applicable, they will be implemented appropriately to the project's needs.
SUMMARY:	A description of the steps to follow in preparing a project data management implementation plan.

This section describes the steps to follow in preparing the DMIP. It is written primarily for PDCs and technical leads who share the responsibility for preparing the DMIP. Project managers will also find this section useful in understanding the purpose and scope of the DMIP.

The DMIP identifies and documents a project's requirements and responsibilities for managing, using, and archiving environmental information. Table 1 is a summary of the contents of the DMIP. Sufficient detail must be provided in the DMIP to define clearly

- what data types the project will generate and use;
- who is responsible for the various activities related to information management, and where applicable, the procedures that will be followed;
- how the project will manage its data; and
- when data exchanges will occur and between whom.

Table 1. Outline of the project data management implementation plan (DMIP)

PROJECT DATA MANAGEMENT IMPLEMENTATION PLAN (DMIP) OUTLINE
1. Introduction • Briefly describe the project mission. • Summarize data types needed by the project. • Summarize project data management activities and interactions (e.g., Environmental Restoration (ER) technical programs, Industrial Hygiene, Health Physics, Site Compliance Organizations, Site Environmental Monitoring Organizations, Sample Management Office).
2. Data Needs and Sources • Identify project data needs (e.g., attach copies of forms to be used, identify geographic information system coverages). If data from sources outside the project will be used, these sources should be identified.
3. Oak Ridge Environmental Information System (OREIS) and ER Document Management Center (DMC) Transmittals • Identify data types, format, and frequency of transfer to OREIS. • Identify data records and frequency of transfer to ER DMC.
4. Data Management Activities • Identify data management activities to be done for project data collection tasks. • Assign project roles and responsibilities for the data management activities for each data collection task.
5. Data Management and Geographic Information Systems and Process Administration • Identify project data management and geographic information systems to be used (e.g., Project Environmental Measurements System, OREIS, Geographical Systems and Spatial Technologies Server). • Identify any project specific systems to be used for analysis, modeling, or mapping. • Describe how the project will ensure that data, geographic, and analysis systems and processes are controlled.

Projects are encouraged to organize their DMIP according to Table 1 whenever possible. Key in the DMIP are the definitions of project activities, roles, and responsibilities related to data management. Many of these roles, responsibilities, and activities are common across projects. Section 3 of this document describes the frequently occurring roles and responsibilities. Section 4 presents generic activity descriptions based on the roles and responsibilities presented in Sect. 3. Whenever possible, projects should adopt these processes, adapting them when necessary. This will simplify preparation of the DMIP.

The DMIP must be completed early in the life cycle of a project to ensure that the necessary and appropriate data management systems and personnel are in place before a project begins acquiring data. The PDC and technical lead will consult with other members of the project team in preparing

the DMIP. The DMIP must also be reviewed periodically and updated if necessary. An annual review, usually at the beginning of the fiscal year is the minimum requirement. Table 2 summarizes the activities and responsibilities involved in preparing the DMIP. The remainder of this section describes these activities and responsibilities.

Table 2. Activities and responsibilities for developing a project data management implementation plan

Activities	Project manager	Technical lead	Project data coordinator
Request project data coordinator	**P**		
Identify project data needs and sources	**R**	**P**	**S**
Identify project data management requirements	**R**	**P**	**P**
Identify project data records management requirements	**R**	**P**	**P**
Define project data management responsibilities	**R**	**S**	**P**
Determine project data base needs	**R**	**S**	**P**
Develop project DMIP	**R**	**P**	**P**

P = Primary responsibility
S = Support responsibility
R = Review

2.1 REQUEST A PROJECT DATA COORDINATOR

Every project must have a PDC. The PDC is an information management professional who is responsible for helping the project identify and fulfill its data management and data record needs according to ER's data management policy. The ER EIM program is responsible for approving the PDC assigned to each project. When the project team is being formed, the project manager should contact the EIM program manager to review the project scope, objectives, and schedule. Based on this review, the EIM and project managers will designate a PDC to collaborate with the technical lead in preparing the DMIP. The effort required by the PDC in preparing the DMIP will depend on the complexity of the project's data management activities.

2.2 IDENTIFY DATA NEEDS AND SOURCES

The PDC and technical lead, with the appropriate members of the project team, will identify the data needs of the project. These needs will be identified during scoping meetings and by discussions with members of the project team. The data uses, types, and sources should be considered in defining the requirements. Typical data uses include documenting the status of facilities, contaminant transport modeling, geospatial analysis, compliance reporting, and risk assessment. Identifying data types focuses on such issues as the maps, drawings, photographs, facility observations, field measurements, inspection checklists, environmental media, analytes, sampling locations, sampling dates, number of samples, and data quality necessary to support the

intended data uses. Data sources may include historical archives, project-generated information, and data obtained from other ongoing projects.

2.3 IDENTIFY OREIS REQUIREMENTS

The PDC and technical lead will work with an OREIS representative to identify the project data that must be transferred to OREIS. They will review the project's data types to decide upon the OREIS deliverables, format, and schedule. Appendix B provides guidance on the types of data that OREIS can accept.

2.4 IDENTIFY DATA RECORD MANAGEMENT REQUIREMENTS

The PDC and technical lead will work with the project team to identify the project's data record management requirements. Data records are documents that show how samples and data were collected, processed, and used by a project. The PDC will identify the types and quantity of data records that will be generated by the project and determine the appropriate frequency for transferring these records to the ER Document Management Center (DMC).

2.5 DEFINE DATA MANAGEMENT ACTIVITIES AND RESPONSIBILITIES

This step will define how information will flow within the project and who is responsible for data collection, transfer, update, and maintenance. A clear understanding of these responsibilities is critical to ensuring that the routine technical activities of a project are done efficiently and cost effectively. Based on participation from the project team, the PDC and technical lead will document the project's data management activities. Sect. 4 provides activity descriptions and responsibilities that are common to many ER projects. The PDC and technical lead are encouraged to use these descriptions as a starting point for documenting project activities. These descriptions may be modified as needed to fit a project's needs. The process and business rules associated with the activities will be presented to the project team and reviewed for applicability and completeness. Any project specific requirements should be noted and included in the DMIP.

The data management processes also will be reviewed with respect to the way defined roles are to be carried out on the project. For a small project several roles may be done by one individual whereas on a large project the responsibilities of one role may be shared by several people. The project team must understand the role definitions and the interactions between the roles to ensure the timely and accurate availability of data.

2.6 DETERMINE DATA BASE NEEDS

The PDC and technical lead will assess the project's data base needs. Figure 1 illustrates the steps in this process and Table 3 lists some potential factors to consider in determining whether a project should automate its data. The ER program requires that PEMS be given first consideration in managing a project's data. Factors to consider include the complexity, types, and volume of the project's data; reporting schedule and scope; who must access the project data; when and how data access will occur; and what data must be available.

Based on these and other relevant considerations, the PDC and technical lead will give the project manager recommendations for the project data base and data management team.

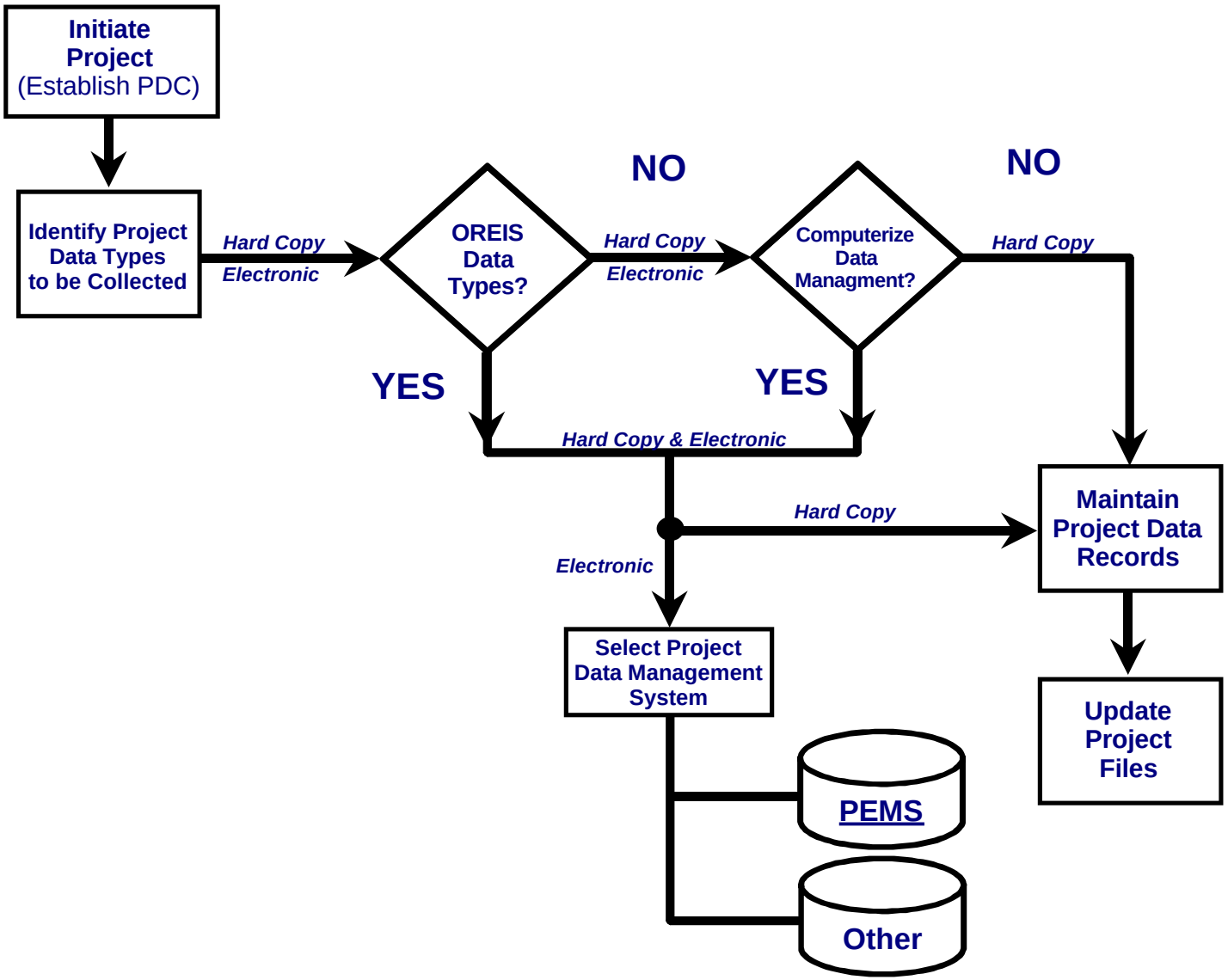

Fig. 1. Identify Project Data Management Requirements

Table 3. Potential factors to consider in deciding whether to automate a project's data

Factors	Low	Medium	High
What is the quantity of data?			
What is the frequency of data coming in?			
What portion of the in-coming data are in an electronic format?			
What is the time criticality of reporting or making the data available for use?			
How often are reports created from the data?			
How important is it to share data within the project?			
How often are data used as input to computer models?			
How complex are the data (i.e., number of different sample media, locations, and analytes)?			

Scoring: 4 or more highs, probably automate
1–3 highs, consider automation
0 highs, probably not cost effective to automate

The PDC will coordinate the implementation of the project's approach for managing its data. The PDC will draw upon the EIM program and other ER organizations as needed to identify the staff and approaches necessary to support the project data management needs. This includes identification of support for specialty areas, such as geospatial analyses, analytical service coordination, statistical analysis, meeting facilitation, and verification/validation plan preparation. The PDC will also work with the project staff to identify data collection forms needed. The PDC should also identify the implementing procedures and training that may be required by project team.

2.7 PREPARE DATA MANAGEMENT IMPLEMENTATION PLAN

All of the decisions made in the previous steps are documented in the project's DMIP. The PDC and technical lead are responsible for preparing this plan following the outline shown in Table 1. The DMIP is approved by the project manager, the EIM program manager, and the records and document management program manager.

3. DATA MANAGEMENT ROLES AND RESPONSIBILITIES

APPLICABILITY: All ER projects

USE: In reference to data management activities selected from Sect. 4.

Implementation: Project managers, technical leads, and project data coordinators

CONSIDERATIONS: It should be understood, from a project organization and resource allocation perspective, that only those roles needed to fulfill the project's specific data management requirements are applicable, and that one person may perform more than one role.

SUMMARY: The roles described in this section are general descriptions and summaries of responsibilities identified for the data management activities outlined in Sect. 4. The actual roles to be performed for a given project depends upon which data management activities, described in Sect. 4, are implemented by the project as specified in the DMIP. This section is to be used as a reference for Sect. 4. Subsection 3.1 defines project data management roles called out in the Sect. 4 process flows. Subsection 3.2 defines the roles of ER programs that may be interacting with the project data management team.

3.1 PROJECT ROLES

Project roles are defined generally and will fit most project management structures.

Project Manager

The project manager has total responsibility for completing an assigned ER project. The project manager leads the effort to define the scope of an environmental problem or facility operation. With respect to data management this involves directing the project team in determining potential sources of existing data, identifying the study area and/or, facility to be addressed by the project, and selecting the most effective data collection approach to pursue. The project manager may also be the technical contact for subcontracted project support and should ensure that the flow down of data management requirements is defined in a statement of work (SOW).

Technical Lead

A technical lead is the technical "owner" of an ER project and typically serves as a single point of contact for the project manager on all technical issues. This person will provide appropriate technical support during project conceptualization, scoping, execution, and post-action evaluation. The technical lead also may be the technical contact for subcontracted project support and should ensure that the flow down of data management requirements is defined in a SOW.

Project Team

The project team consists of the technical staff and support staff (including the data management team) that conduct the various tasks required to successfully complete the ER project (See Table 4, "Data Management Activity Responsibilities"). Team members develop a conceptual model of the project site. Based on this model, they determine if more information is needed to make decisions about the site. If more sampling and analyses are needed, the team develops a work plan or sampling and analysis plan (SAP) to acquire that information. This team provides information needed by the decision makers (i.e., stakeholders).

Task Leader

A task leader conducts specifically defined tasks associated with an ER project. A task leader will supervise the field team activities for preparation and surveys of field sites and facilities and field data collection. The task leader ensures that the field activities have been properly recorded in the field logbooks or data collection forms and reviewed. Responsibilities include identifying, recording, and reporting project non-conformance or deviations. The task leader also may be the technical contact for subcontracted project support and should ensure that the flow down of data management requirements is defined in a SOW.

Field Team

The field team consists of those individuals who perform any activities taking place in the field (e.g., inspections, monitoring, sampling, well construction, purging, equipment installation). They will be responsible for recording field activities in field logs and data sheets.

A field quality assurance (QA) reviewer will be the member of the field team who will review the field logs and determine if all applicable procedures were followed while the team was collecting samples and data. This includes such things as ensuring all samples were labeled properly, instruments were appropriately calibrated before taking measurements, and all information was recorded correctly.

Data Management Team

The data management team is composed of a project data coordinator (PDC) and data management specialists as necessary to support an ER project. The PDC has the responsibility for developing and implementing the project DMIP to ensure that project data management requirements are met. The PDC sees to it that any existing data or new project data are properly incorporated into the project's hard copy data record file or data base, as appropriate, and ensures that the project data are properly incorporated into OREIS, as applicable. The PDC must ensure that hard copy data records are processed according to project data records management requirements as stated in the DMIP. The PDC also interacts with EIM program support staff and is responsible for identifying and obtaining data management training for the project team.

The PDC also is responsible for overseeing the activities of the data management specialist. The data management specialist is responsible for entering project information into the project data records file and/or data base and ensuring that all information has been entered correctly. The data management team works with field teams to facilitate data collection and with data users to ensure easy access to the data.

Table 4. Data management activity responsibilities

	DATA MANAGEMENT ACTIVITIES	PROJECT TEAM MEMBERS									ER PROGRAMS	
		Project Manager	Tech. Lead	Task Leader	Field Team	Data Team	Analytical Coord.	V/V Coord.	Lab	Data User	OREIS	IRM
PLAN	4.1 SCOPE PROJECT	X	X	X		X						
	4.2 ACQUIRE EXISTING DATA					X				X		
	4.3 PLAN PROJECT ENVIRONMENTAL DATA COLLECTION	X	X	X		X	X	X			X	X
IMPLEMENT	4.4 PREPARE FOR FIELD ACTIVITIES			X	X	X					X	
	4.5 COLLECT FIELD DATA			X	X	X						
	4.6 PROCESS FIELD DATA			X	X	X				X		
	4.7 COLLECT FIELD SAMPLES			X	X	X	X			X		
	4.8 SUBMIT SAMPLES FOR ANALYSIS				X		X		X			
	4.9 PROCESS LABORATORY ANALYTICAL DATA					X	X		X			
REVIEW	4.10 REVIEW DATA			X		X	X			X		
	4.11 VERIFY AND VALIDATE DATA	X				X		X				
	4.12 CONSOLIDATE DATA AND RECORDS					X					X	X
	4.13 ANALYZE AND USE DATA	X				X				X	X	

The PDC is responsible for quality assurance oversight of data management activities performed by Lockheed Martin Energy Systems (LMES) and Lockheed Martin Energy Research Corporation (LMER) organizations and subcontractors supporting project tasks.

Analytical Coordinator

The analytical coordinator develops the agreement of work to be performed by an analytical laboratory in the form of a project-specific laboratory SOW. Analytical methods, detection limits, minimum detectable activities, laboratory quality control (QC) requirements, and deliverable requirements are specified in the SOW. This person interacts with the PDC to ensure hard copy and electronic deliverable formats are properly specified and interfaces with the contract laboratory to ensure these requirements are understood and met.

The analytical coordinator is responsible for working with the data verification/validation (V/V) coordinator to ensure that analytical SOWs incorporate necessary deliverables so that data packages from the laboratory will be appropriate for verification and validation as may be specified in the project's V/V plan.

Data Verification/Validation Coordinator

The data V/V coordinator is responsible for ensuring the development and documentation of the project V/V plan, and for implementation (when needed) of validation through the appropriate ER procedures. The project V/V plan is the documented strategy for implementation of data verification and validation to meet project needs. The project V/V plan includes the approaches for verifying that analytical and field data are complete and have accurately fulfilled requested analyses and contractual requirements. The data V/V coordinator is responsible for interfacing with the laboratory concerning data package deficiencies. When data validation is performed external to the project, the data V/V coordinator should prepare a validation SOW as the mechanism by which validation implementation requirements are communicated from the project to the validation organization.

The data V/V coordinator also is responsible for overseeing the activities of the data verifiers and validators. The data verifier has responsibility for ensuring that analytical and field data are verified according to the project V/V plan. This includes identifying and resolving problems that need to be addressed. The data validator has responsibility for ensuring that analytical and field data are validated against a defined set of criteria, (i.e., the project V/V plan) and includes evaluating associated QC samples to ensure that analyses were performed within specified control parameters. Validation problems must be identified and appropriately resolved. Qualifiers and reason codes may be assigned to the data to indicate usability concerns.

Data User

Data users typically are members of the project team who require access to project information to perform reviews, analyses or ad hoc queries of the data. The data user determines project data usability by comparing the data against pre-defined acceptance criteria and assessing that the data are sufficient for the intended use. This person performs data reviews, as appropriate (e.g., quality checks; assessing sensitivity, precision, accuracy, representativeness, completeness, and comparability (SPARCC) parameter conformance; evaluating adherence to data quality requirements).

The data user also shall be responsible for retaining any computer code [e.g., SQL code, Statistical Analysis System (SAS) code, GIS coverage] used to generate data products (e.g., tables, graphs, maps) included in project reports. This requirements is to ensure that data products can be reproduced in the future.

Contract Laboratory

The contract laboratory may be considered a project subcontractor that must fulfill the project-specific laboratory SOW. Contract laboratories may be either LMES Analytical Service Organization laboratories or laboratories external to LMES. The laboratory interacts with project analytical coordinators and V/V coordinators. The contract laboratory ensures (1) that requested analytical analyses are performed within specified time limits; (2) that results are reported with any associated qualifiers, detection limits, minimum detectable activities, and appropriate uncertainties that may be required; (3) that laboratory QC results are reported as required; and (4) that all data deliverable format requirements specified in the SOW are met.

3.2 PROGRAM ROLES

Subsection 3.2 defines the ER program data and information management roles that may interact with the project teams as they conduct the various tasks required to successfully complete an ER project.

3.2.1 Technical Integration Program

Two components of the Technical Integration (TI) program, the EIM program and the Information Resource Management (IRM) program, support project data management activities.

Environmental Information Management Program

EIM supports environmental data management activities, from project planning and execution, through information review, analysis, reporting and archival. It includes appropriate data management and geographic information systems to facilitate processes.

Information Resources Management Program

IRM provides the full-range of records and information services. It includes operation of the ER DMC and compilation and maintenance of the ER administrative record (AR) file.

3.2.1.1 Environmental Information Management Program

The EIM program supports ER project data management with data management staff, access to existing data, data analysis and geospatial data analysis tools, procedures, training, and information systems support as follows:

- Project data coordinators (PDCs): PDCs serve as the single point of contact and coordination for all support of environmental data management activities, from project planning through information archival and development of a project DMIP (Sect. 2).

- Environmental Data Management Support: Staff provide technical support to PDCs for the complete project data life cycle and all data management activities (Sect. 4).

- Data Quality Program: Staff provide a framework to ensure a consistent, comprehensive, and efficient approach for environmental data management across ER through development of data management plans, procedures, and work aids.

- Geospatial Support: Staff provide geospatial support for ER projects including integrating global positioning systems (GPS) into field data collection, spatial analysis, preparing OREIS deliverables, and management of spatial data resources. It maintains the GPS equipment and facilities and the Geographic Information Systems Spatial Technologies (GISST), a data repository and data server for geographic data. The WWW interface for GISST provides easy access to GIS coverages of the ORR, Paducah, and Portsmouth facilities base map data. GISST also provides disk space and tools for each project to store and access project specific geographic data. GISST is intended to augment the GIS data capabilities of OREIS by making available GIS data that are not required to be sent to OREIS but may still be useful within and across ER projects.

- Information Systems Support: Staff support and maintain the automated environmental information management infrastructure (e.g., software, hardware, data model, data base) required to support ER projects. The ER program selected a single computer system, PEMS, to be utilized by ER projects across the Oak Ridge Reservation to support their environmental measurements data management tasks. Staff support includes but is not limited to supporting and modifying PEMS for specific projects. PEMS provides organization, integrity, security, traceability, consistency, and auditability of the environmental measurements data generated during an ER project's life cycle. PEMS supports sample analysis planning, laboratory statements of work, field planning and logistics, sample collection and shipment, field measurements and verification, bar coding, analytical laboratory results (electronic data deliverables and data validation), sample and forms tracking, and assessment. PEMS support includes the enhancement and maintenance of PEMS and the migration of PEMS to projects across ER, as well as the preparation of OREIS data deliverables. PEMS provides project-level support whereas OREIS provides long term archival and access for regulators and others.

- OREIS: Staff support and maintain a consolidated, standardized, quality-assured environmental measurements and geospatial data in a publicly accessible and configuration-controlled data management system in support of the ER program and ER projects. Appendix D provides an overview of OREIS and its data management goals. OREIS staff work closely with the PDC to prepare and review the project DMIP as it relates to OREIS data types and data transmittal requirements. OREIS staff are responsible for receiving and reviewing data transmittals from the PDC, working with the PDC to resolve data problems, and ensuring written authorization from the PDC (and project manager as needed) to officially load the data into one of the OREIS data bases (i.e., measurements and geographic data bases) for public use.

  OREIS is a consolidated, quality-assured, and configuration-controlled environmental data management system. It is comprised of hardware, commercial software, customized integration software, an environmental measurements data base and a geographic data base, and documentation. OREIS users are provided services such as training, data products generation support, the OREIS news group, and a user interface.

The scope of OREIS includes data supporting environmental restoration, compliance, and surveillance activities. Environmental data that are incorporated in OREIS include known quality measurement and spatial data from various environmental media such as groundwater, surface water, sediment, soil, air, and biota. The types of environmental data within OREIS include but are not limited to chemical, biological, ecological, radiological, geophysical, and lithological data. The scope does not include project-specific activities (e.g., sample tracking, field results data entry, equipment calibration records) or project control tools (e.g., cost accounting or milestone tracking) as these activities and tools are accommodated through other computer systems.

OREIS fulfills the environmental information management obligations of the Department of Energy-Oak Ridge Operations (DOE-ORO) under an enforceable Federal Facility Agreement (FFA) Docket No. 89-04-FF under Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Sections 3008(h) and 6001 of the Resource Conservation and Recovery Act of 1976 (RCRA).

3.2.1.2 Information Resource Management Program

The IRM program provides for the management and coordination of all records, document control, publications, document information systems, and CERCLA administrative record activities conducted as part of the ER mission. The IRM technical objective is to establish an integrated, compliant, and cost-effective information management system from a single platform in support of all DOE/ER records activities.

- Project records coordinator (PRC): Each project is assigned a project records coordinator to facilitate the transfer of project records to the ER DMC. The PRC works with the project manager to identify project records to be forwarded to the ER DMC for inclusion in the project file. In addition, the PRC works with the PDC to develop and implement the data records management section of the DMIP.

- Administrative record (AR) coordinator: This person is responsible for the creation and maintenance of Administrative Records, Administrative Record Files, Post Decision Files, No Further Investigation Files, the General Reference Compendium, and the Document Request System for the Oak Ridge Reservation. The AR coordinator provides guidance to ER program and project staff regarding the compilation of legally defensible CERCLA administrative records.

- Document coordinator (DC): This person ensures consistent implementation of ER primary, secondary, and project-specific report requirements. The DC establishes and maintains a baseline of all ER reports produced by ER project staff, ER subcontractors, DOE/ER prime contractors, and matrix staff. Baseline information is compiled from the task work agreements, the FFA Appendix E milestone schedules, and the project manager's input. The DC also issues document numbers for primary, secondary, and project-specific ER reports; coordinates classification and technical information review of all ER documents and coordinates resolution of any issues preventing public release with project manager; and coordinates document editing, reproduction, distribution, and delivery.

4. PROJECT DATA MANAGEMENT ACTIVITIES

APPLICABILITY: PLANNING Sections 4.1, 4.2, and 4.3 apply to all projects.

IMPLEMENT DATA COLLECTION Sections 4.4 thru 4.9 should be implemented as necessary to meet project needs as identified in the DMIP.

REVIEW AND USE DATA Sections 4.10 thru 4.13 should be implemented as necessary to meet project needs as identified in the DMIP and data validation plan.

USE: Project data coordinators select the necessary activities to implement to meet project needs and then document in the DMIP. This section guides project implementation.

IMPLEMENTATION: Project managers, technical leads, and project data coordinators have the responsibility for initiating most activities.

CONSIDERATIONS: It should be understood for the IMPLEMENT DATA COLLECTION and REVIEW AND USE sections that only those activities needed to meet the project's specific data collection and management requirements are applicable. Most ER projects will not implement all activities. Recall that one person may perform more than one set of responsibilities.

SUMMARY: Section 4 defines typical environmental data management activities in the context of a generic ER project's life cycle. These activities have been partitioned into the component processes shown in Fig. 2. This is a comprehensive set of activities, and it is unlikely that any given project will implement all activities.

The activities have been grouped into three categories. **PLANNING** activities identify project data needs, identify existing information, plan for additional data collection if needed, and identify project data management needs (DMIP). **DATA COLLECTION** activity descriptions identify the data management support and project team interactions that will facilitate efficient field data and field sample collection, event documentation, data processing, and reporting. **REVIEW AND USE** activities involve evaluation of data quality, project use and reporting of data, and long-term archival of project data and records as appropriate.

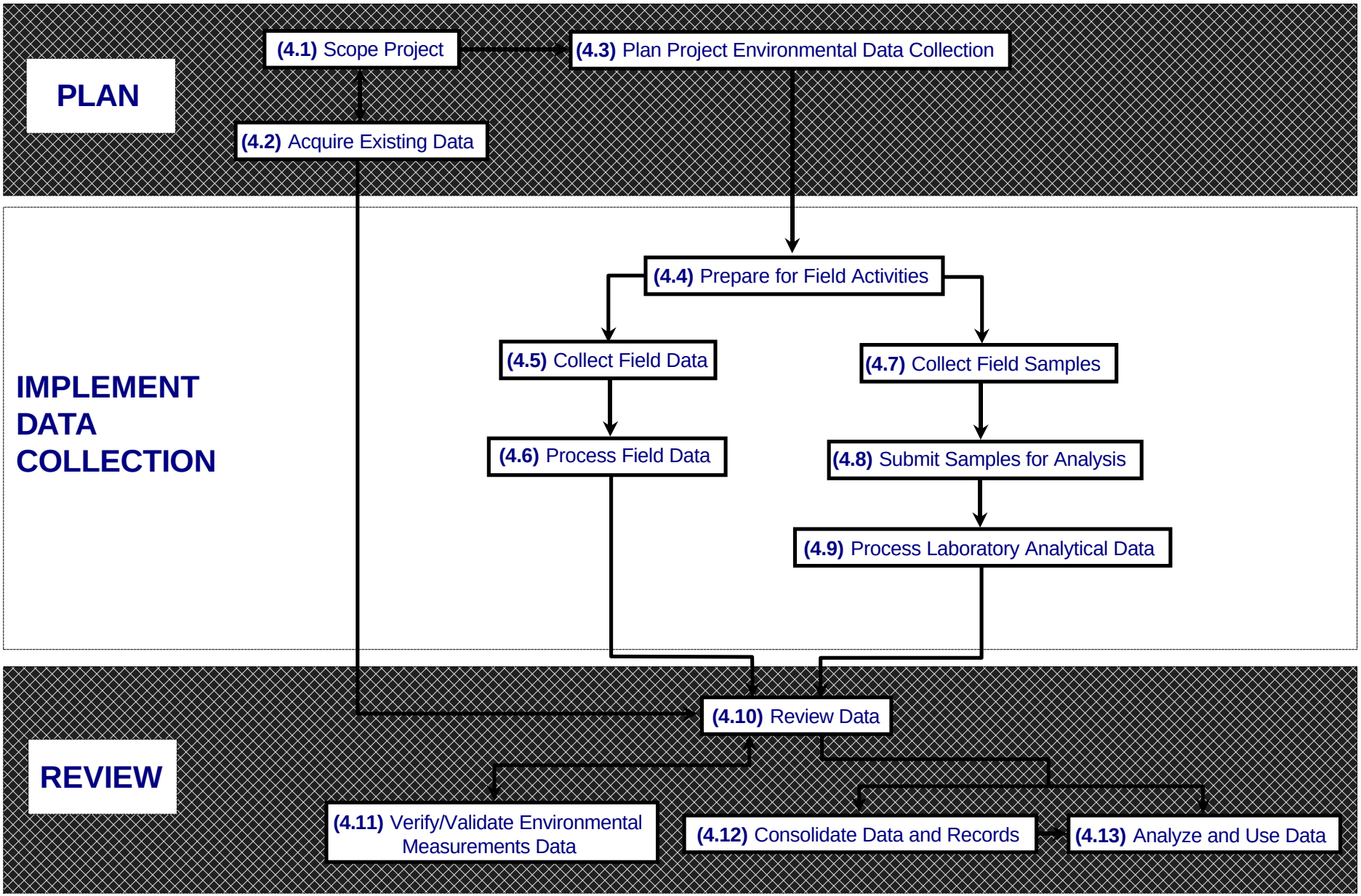

Fig. 2. (Sect. 4.0) Project Data Management Activities

The activities identified in this section describe a project data life cycle that starts with project planning for determining data needs, gathering existing data, planning for data collection as needed, collection of field data and samples, sample analysis and data processing, data review, usage of the data for reporting and decision-making purposes, and the long-term archival of the data and records. Data management activities and interactions are defined within the context of the project life cycle.

Each subsection provides the following information about each activity:

- a general activity description with project implementation requirements and business rules;
- a process flow and responsibility diagram for implementing the activity; and
- specific descriptions of activities on each process flow and how the particular activity interacts with the other activities and processes.

Refer to Sect. 3 for descriptions of individual roles and responsibilities identified for the data management activities outlined in this section.

Project teams implementing the activities described in this section should understand that this plan is not a "source of requirements" for developing the project work plan, selecting field measurement or sampling procedures, or readiness review requirements. Those requirements are found in other requirements documents and procedures. This plan defines data management activities and interactions within the overall project life cycle context. It will ensure that PDCs are interacting with other members of the project team at appropriate times so that an efficient and documented data collection, processing, and reporting process can be implemented as needed for the project.

4.1 SCOPE PROJECT

An ER project can be conducted to meet objectives associated with characterization, remedial design, remedial action, monitoring, S&M, or D&D activities. Each project typically will require the acquisition or collection of environmental data to support or achieve project objectives. Data are used primarily as the basis for supporting or making specific decisions such as the following:

- Characterization: What is the source, nature, and extent of contamination at a site?
- Decontamination and decommissioning: Which areas in the building are radioactively contaminated?
- Environmental compliance: Do liquid and gaseous effluent concentrations meet discharge requirements?
- Monitoring: Has the remedial action been effective in stopping the release of strontium?
- Remedial design: What is the depth to bedrock where the cutoff wall will be located?
- Remedial action: Have the limits of the soil contamination been reached?
- Surveillance and maintenance: Is the level of the liquid in the tank changing?

In each of these examples, the project team will make a decision regarding the amount of a specific type of data that must be obtained, analyzed, and made available so that the question can be addressed, a decision made, and an action taken that satisfies project objectives.

Data management provides an ER project with the process for managing the life cycle of environmental measurements data generated by the project. The process encompasses the planning of project data requirements through the collection, review, and usage of the data for decision-making purposes to the long-term archival of the data. This process would be applicable for any type of ER project (RA, S&M, D&D, incentive task order).

The nature of the decision-making process for an ER project is inherently repetitive. Existing data are evaluated to determine what is known about the site or facility in question. Questions regarding the nature of the contamination (type, location, amount, source, processes, etc.) are formulated. Potential actions (e.g., remove, remediate, demolish, monitor) are identified to address the site or facility. Sufficient data of adequate quality must exist or be collected by the project to support the decision.

For projects where the potential for risk to human health and the environment exists, an acceptable level of uncertainty may be defined for each remediation decision. This is typically accomplished through the structured data quality objectives (DQO) process. A project may repeat the collection of additional data until the uncertainty surrounding a decision has been reduced to an acceptable level. The following sub-sections provide additional detail and requirements for each of the steps within this activity.

Figure 3 shows the process flow and responsibility diagram for the activities that are typically a part of project scoping.

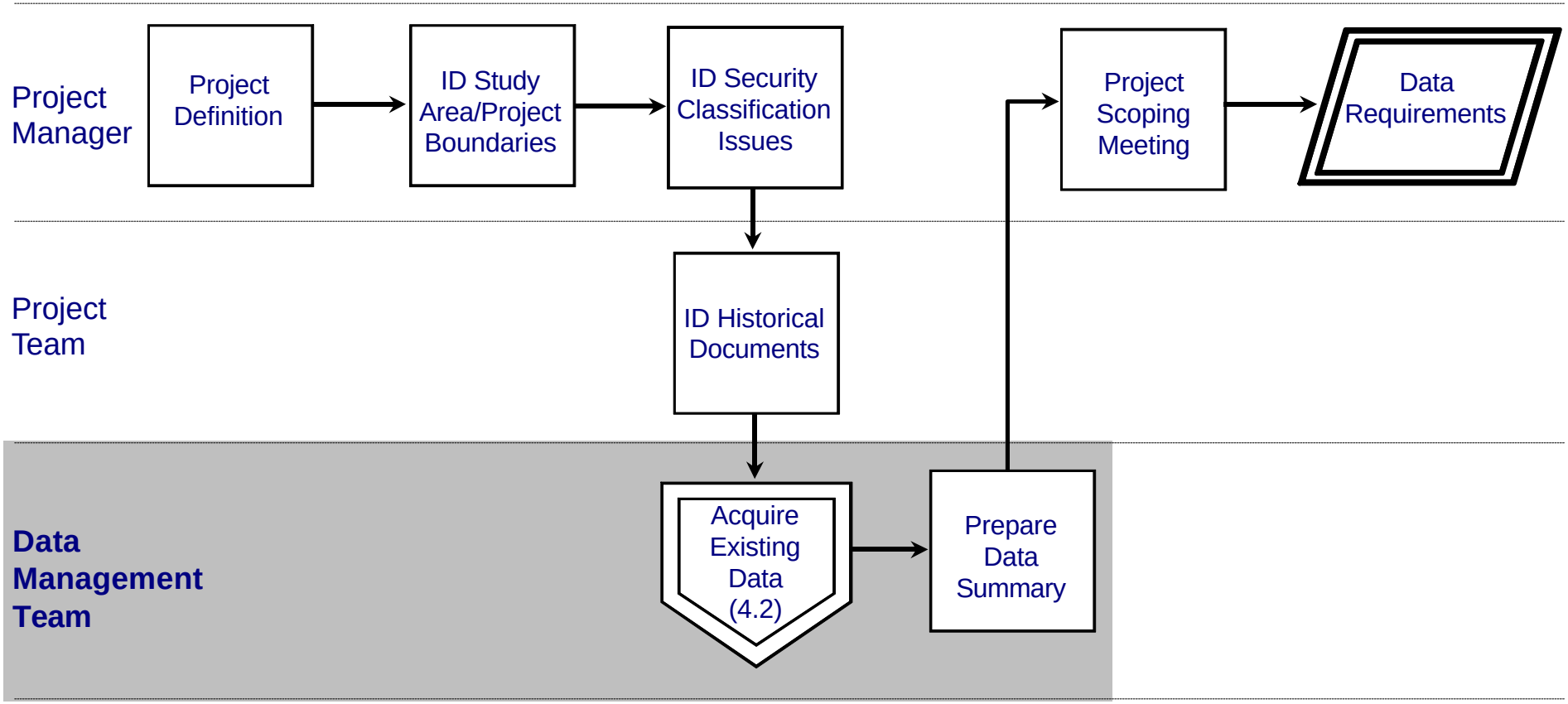

Fig. 3. (Sect. 4.1) Scope Project

Process Requirements and Business Rules

1. Project, site, and facility boundaries will be identified and geographically bounded.

2. A security review of the project site is required to identify classification issues that may result in classified data.

4.1.1 Project Definition

The approaches taken and amounts of effort necessary to define an ER project vary considerably. The degree of complexity that surrounds the process of defining projects is determined by the requirements instituting them. For instance, an S&M project may be implementing permit requirements, which say; "monitor well 123 for parameters X, Y, and Z every year." Or it may be carrying out a regulation which says "inspect this facility for three conditions every week." For this type of project, the effort necessary to define and scope a project is significantly reduced and should be reflected in the implementation of this section.

For more complex ER projects, project definition involves the identification of those questions that must be answered in order to meet the project objective. For some projects, this scoping activity is conducted during a meeting with the project team. For other projects, the project is defined through the DQO process. Scoping typically has several phases. The first is a preliminary scoping effort by the project manager and technical lead to identify the initial characteristics of the project. This activity typically is based on limited information or data. A second phase involves the use of more detailed information by the project team to develop the specific details for the project. Some projects have a DQO phase that includes the project team, DOE, and the regulators in the scoping activity (See Sect. 4.1.7).

To focus on specific questions related to many ER projects, the conceptual model is a convenient management and analytical tool. For example, a typical objective of a characterization project is to determine the nature and extent of contamination at a site. Development of a conceptual model of the site involves defining the environmental setting (e.g., topography, geology, surface water, groundwater) and physical facilities to the extent possible. This requires defining an area of contamination, acquiring any available data concerning the area, identifying potential contaminants of concern within that area, defining the pathways of transport for the identified contaminants from source to final receptor, and specifying the environmental risks of the contamination. Existing information is gathered and analyzed by the project team to specify the details of the problem.

4.1.2 Identify Project Boundaries

Once a project has been defined, the boundary or extent of the project can be established. The project may encompass a fixed area, an enclosed area such as a building, or a defined starting point that will evolve as data are collected and evaluated (e.g., from a contaminant release source to a contaminant plume).

Each study site must be defined with specific geographic boundaries. Also, information used to develop the models of contamination levels shall be made available for later reference. These actions will facilitate the sharing of data across projects and allow spatial data queries on existing data sets.

4.1.3 Identification of Security Classification Issues

Typically, the operational or functional purpose of a project site or facility is known at the time of project inception. After defining the project or site boundary, consideration must be given to the possibility that classified activities were conducted or classified materials exist within the project boundaries. In burial grounds, there is the possibility that classified waste may be present. Also, it is possible that only a portion of a building or facility housed classified operations. If such activities occurred or classified material is present, the specific classification issues must be identified and incorporated into project planning activities. The potential for classification may not arise until existing data are obtained (Sect. 4.2). Existing data and data collected to meet project objectives may require special handling.

4.1.4 Identify Historical Documents

Previously developed information may be available for a project site or facility in historical documents, reports, or records and should be gathered by the project team. Existing information may provide supporting information for the project site including classification issues, past usage, and potential contaminants. The types of reports, documents, and records that may be available may include operational or process information, waste management records, historical environmental compliance data, surveillance records, radiological surveys, research studies conducted at the site, geographical data from site surveys, data from previous remediation studies, conceptual site models from similar projects, and regulatory requirements (e.g., concentration limits). Information collected by the project team will be provided to the data management team for evaluation (Sect. 4.2).

4.1.5 Acquire Existing Data

The process flow and responsibilities for this activity are described in Sect. 4.2.

4.1.6 Prepare Data Summary

Information is compiled describing the project site and facility area, based upon site inspections and evaluations of existing information. This may be part of an RI, engineering evaluation/cost analysis (EE/CA), or other project document. A conceptual model may be formulated to define the geographic area of interest and the current assumptions regarding the potential contaminants of concern. The information for the conceptual model is maintained to allow later refinement of the assumptions made about contamination levels at the site.

4.1.7 Project Scoping Meeting

A project scoping meeting is held to finalize the project objectives, identify the decisions that the project will support, and identify tasks needed to meet the project objectives. The meeting is scheduled after the project is adequately defined, support activities (e.g., Environmental, Safety, and Health and Data Management) are determined, and the project team is identified. The scoping meeting may include only the project team or may be a formal DQO workshop that includes staff from DOE and the regulatory agencies, as defined in the ER procedure “Implementing and Documenting the Data Quality Objectives (DQO) Process for Environmental Restoration (ER) Projects” (ERWM/ER-P2305).

4.1.8 Project Data Requirements

The project team, in collaboration with the various decision makers (i.e., stakeholders) and data users, should specify the use, quantity, and quality of the data to be collected, and, as appropriate, specify decision criteria, acceptable levels of uncertainty, and acceptable tolerances for an incorrect decision based on the data in the form of DQOs, as required by the ER procedure "Implementing and Documenting the Data Quality Objectives (DQO) Process for Environmental Restoration (ER) Projects" (ERWM/ER-P2305).

4.2 ACQUIRE EXISTING DATA

Previously collected environmental data, which may provide descriptive information for the subject study site or facility and suspected contaminants, are collected by the project team. The information may include historical environmental compliance and surveillance data, geographical data from site surveys, and data from previous remediation studies.

Existing data should undergo the same data review and assessment examinations as any newly collected data. This will ensure that the quality of previously collected data is known and documented. (**Note**: It is not always possible to gather the necessary QC and other supporting data to conduct the desired level of reviews and assessments, because of missing historical data.)

Process Requirements and Business Rules

1. Projects shall begin their data search with OREIS. For information on using OREIS, contact the OREIS program office at (423) 576-4710.

2. Executive Order 12906 (April 13, 1994) requires that any existing geographic data be identified prior to any new geographic data collection.

3. An evaluation of the existing environmental data shall be performed to determine whether it can be used (either stand-alone or in conjunction with data collected by a project). The data evaluation strategy shall be documented.

4. Previously collected environmental data that are reviewed by the project shall be inventoried and documented following guidelines defined in the EIM program work aid “Inventory and Documentation of Existing Data” (EIM/WA-2).

A process flow and responsibility diagram is shown in Fig.4 for the activities involved in acquiring existing data. The following sub-sections provide additional detail and requirements for each of the steps within this activity.

4.2.1 Locate Existing Data

The project manager and or technical lead define the temporal, spatial, and subject criteria to use in identifying relevant existing data. These criteria are given to the PDC who searches OREIS for existing measurements and/or geographic data. The GISST data server may be searched for relevant, non-quality assured geographic data.

Additional data may be identified through interviews with knowledgeable staff and other appropriate means. Using this list, the PDC contacts the appropriate data custodian. Data sources may include (but are not limited to) OREIS, the ER DMC, a project data base, a project file, or a specific data custodian. These data could include physical, chemical, and radiological measurements data, geographic information systems files, photographs, videos, conceptual site models for similar projects, regulatory standards, and remedial action goals that have been defined locally for similar projects.

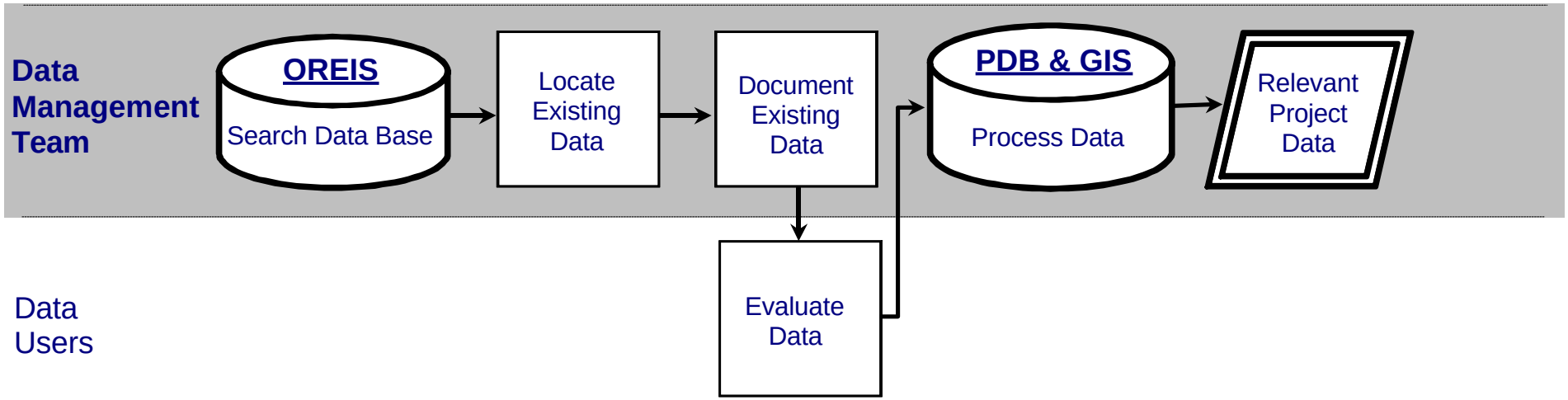

Fig. 4. (Sect 4.2) Acquire Existing Data

4.2.2 Document Existing Data

The PDC should ensure that a Data Inventory Form and a Documentation Checklist (EIM/WA-2) is completed for each data source. The PDC will place the completed Data Inventory Form and Documentation Checklist in the project data record file. Geographic data should be documented based on guidelines described in "Guidelines for the Creation and Management of Geographic Data Bases Within a GIS Environment" (ES/ER/TM-56), the Documentation Checklist, and the Spatial Data Transfer Standard (SDTS)/Federal Information Processing Standard (FIPS) Publication 173: *Content Standards for Digital Geospatial Metadata*.

4.2.3 Evaluate Data

The data users should evaluate the existing data for relevance to the projects data needs and the intended uses of the data. The evaluation strategy must be documented. At this point the project team members determine which data are useful and appropriate for inclusion in the either the project Data Records File or the Project Data Base.

The inventory of all evaluated data should be transferred to the project Data Records File regardless of whether the data are included in the Project Data Base. This will document the extent of the existing data review.

4.2.4 Process Data (Project Data Base)

The project data coordinator incorporates the appropriate existing data into the project data base system as appropriate. Data summary reports are generated to ensure all data are loaded properly and are accessible by the data users. Geographic data should be loaded into a GIS and converted into a common coordinate system (e.g., Tennessee State Plane, NAD83). Map overlays should be produced with each of the GIS data layers to check data conversion occurred correctly. All data processing steps during data conversion and data base loading should be documented.

4.3 PLAN PROJECT ENVIRONMENTAL DATA COLLECTION

At the beginning of this step, the project's goals, strategies, key steps, and data requirements have been defined so the more detailed project plans can be developed. The planning phase of a project typically is concerned with the development of budgets, schedules and the various required plans. A process flow/responsibility diagram is shown in Fig.5 for this activity.

Process Requirements and Business Rules

1. All projects will prepare a data management implementation plan (DMIP). See Sect. 2.
2. All projects will document a data verification and validation strategy appropriate to their needs, as required by the ER procedure “Data Validation Plans for Environmental Restoration Projects” (ERWM-P2215).

4.3.1 Data Requirements

Project data requirements have been identified during the scoping phase of a project, as discussed in Sect. 4.1.4. These data will typically be of the following types:

- data pertaining to activities, operations, processes, and hazardous substances used at the site;
- data pertaining to past waste management and disposal practices;
- data relating to the types and quantities of hazardous substances present in the site environment including previous sampling results;
- data pertaining to site environmental conditions and migration potential;
- historical and aerial photographs and base map data; and
- GIS coverages of soils, geology, hydrology, and known contaminant plumes.

4.3.2 Develop Work Plan

All projects develop some type of documentation that describes in detail how the project objectives will be achieved. The resulting documents will range in size and complexity from a straightforward work plan to a highly detailed document that includes an SAP requiring regulatory approval prior to the initiation of activities. A work plan should be developed to an appropriate level of detail and specificity so any contractor could implement it.

An ER project develops a work plan specific to their type of project and regulatory requirements. Types of project work plans include

- D&D,
- S&M,
- RI/FS,
- RD/RA, and
- EE/CA.

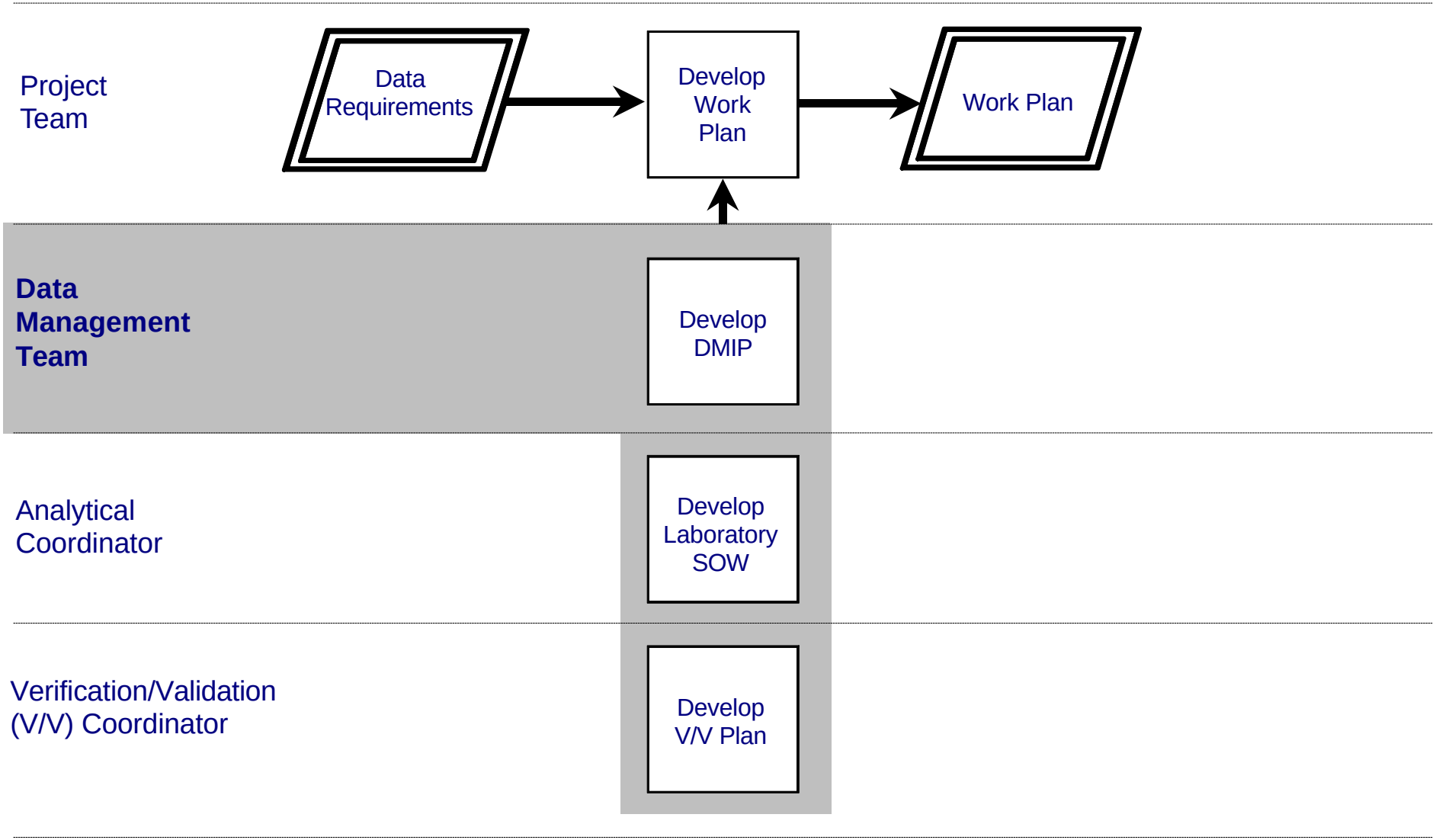

Fig. 5. (Sect. 4.3) Plan Project Environmental Data Collection

In addition, supporting and supplemental plans and procedures may be developed as components of a work plan. Types of supplemental plans include the following:

- SAP,
- quality assurance,
- waste management,
- health and safety,
- DMIP, and
- project verification and validation (V/V) plan (usually part of SAP or QA plans).

Of greatest interest to the data management team are the tasks defined in a work plan that involve environmental data collection. This information includes existing data, collection of field data, field site preparation, collection of field samples, field and laboratory analyses, data uses, data access, generation of data records, data evaluation and analysis, and project reporting. Information typically included in sampling and analysis or quality assurance plans is needed to prepare the DMIP and project V/V Plan.

4.3.3 Develop Data Management Implementation Plan

The steps leading to the preparation of the project DMIP are discussed in Sect. 2.

4.3.4 Develop Laboratory Statement of Work

The Analytical Services Coordinator prepares the description of work to be performed by an analytical laboratory as a project-specific laboratory statement of work (SOW). The number of samples, analytical methods, detection limits, minimum detectable activities, laboratory QC requirements, and data deliverable requirements are specified in the SOW. The SOW should specify that the laboratory produce a test electronic data deliverable (EDD) for review by the PDC as part of the awarding of the SOW contract. The Analytical Services Coordinator should interact with the V/V Coordinator to ensure that all deliverables needed for verification and validation are included in the SOW.

4.3.5 Develop Verification and Validation (V/V) Plan

The verification and validation (V/V) coordinator is responsible for development of the project V/V plan. The project V/V plan is the documented strategy for implementation of data verification and validation to meet project needs. The validation effort could range from none to extensive, depending upon project needs and objectives. The project V/V plan should be included as a section in the project work plan, QA plan, or SAP, as appropriate.

The plan includes the approaches for both data verification and data validation. The V/V coordinator is responsible for preparing a validation SOW as the mechanism by which validation implementation requirements are communicated from the project to the validation organization. Requirements for planning environmental measurements verification and validation as part of the project scoping or DQO process is described in the ER procedure “Data Validation Plans for Environmental Restoration Projects” (ERWM-P2215).

4.4 PREPARE FOR FIELD ACTIVITIES

Upon completion of the work plan several activities occur that require interaction between technical leads/project managers and the data management team. These include implementation of the project DMIP data records management system and may include preparation of field monitoring sites.

Field preparation activities are performed to make a site ready for data and sampling operations as appropriate. This may include surveying the sites and marking sampling locations; identifying and obtaining any required permits; installing and inspecting any necessary wells, weirs, etc.; and installing and testing any necessary field equipment. Data management concerns relate to identifying monitoring locations, associating monitoring equipment with a location to allow sampling activities, and decommissioning existing monitoring locations. The activity flow diagram for the activities that are part of field preparation is shown in Fig. 6.

Process Requirements and Business Rules

1. If an automated data management system is used (e.g., PEMS), the following must occur:

   - all system users have been trained and have access to the system as appropriate;
   - system reference tables have been populated; and
   - laboratory data deliverables can be loaded, and test EDDs have been received from the laboratories and can be loaded in the project data base.

2. Project data collection checklists and data entry forms have been created and are ready for use.

3. The PDC should establish the data records management system defined in the DMIP.

4. The PDC should ensure that data management team and field team have been trained for records management responsibilities.

5. Monitoring location identification will be standardized within ER projects and should be unique across ER projects to make it easier to find and use existing measurements data taken at a location. Aliases should be used when non-ER organizations have data that are useful to ER.

6. Geographic coordinates for field sites will be determined for each site and recorded. The coordinate system (e.g., Tennessee State Plane, Administrative Grid) and method of determining geographic coordinates will also be recorded with the estimated (or true) accuracy.

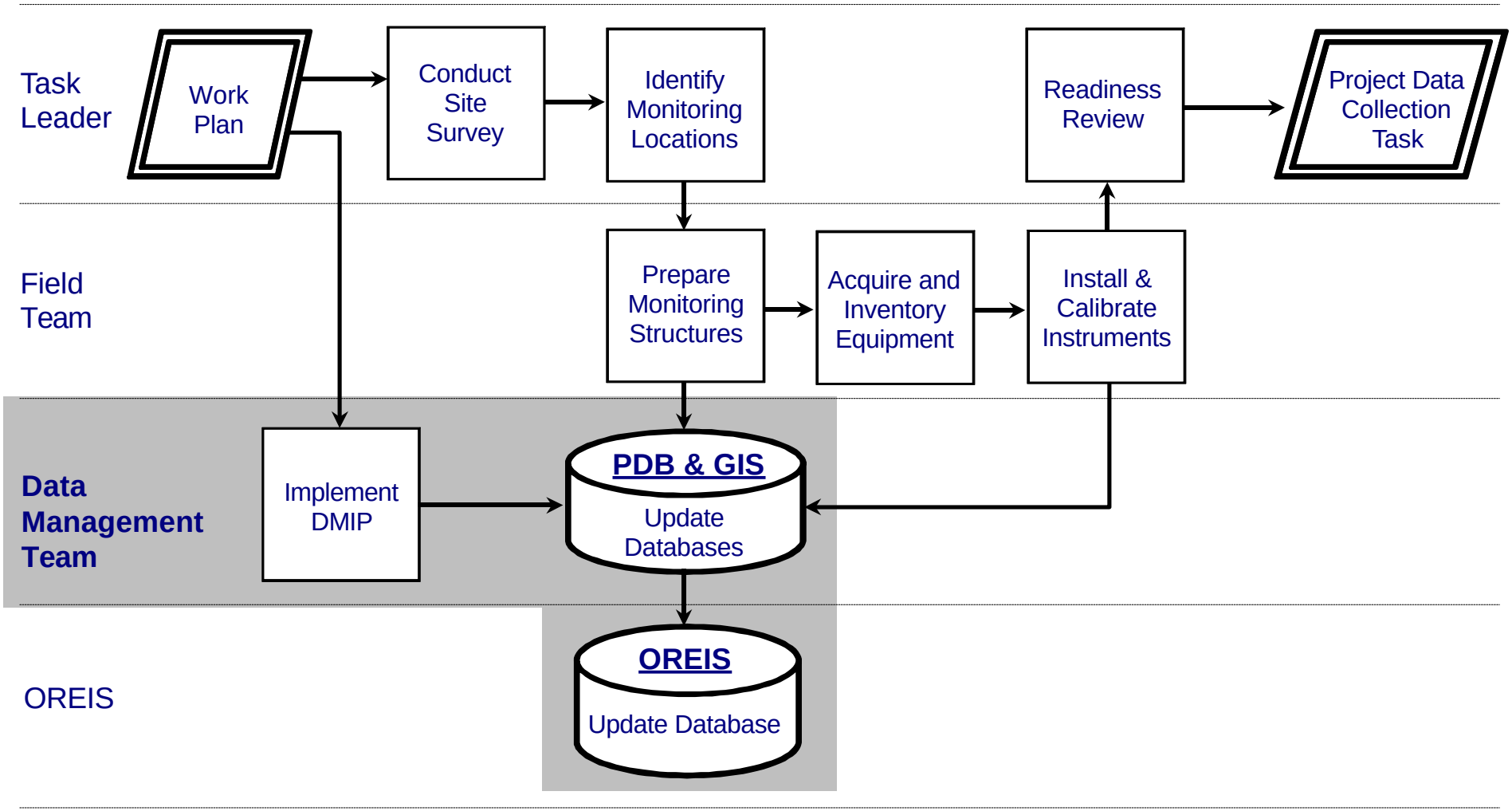

Fig. 6. (Sect. 4.4) Prepare for Field Activities

4.4.1 Implement Data Management Implementation Plan and Data Records Management

The PDC oversees the implementation of the DMIP. The DMIP implementation should occur before field samples, measurements, or monitoring take place to ensure that the appropriate infrastructure is ready to manage project data. This activity is required for manual and automated data management activities. The PDC also oversees the implementation of the data records management activities defined in the DMIP. The records management configuration should occur prior to the collection of field samples and measurements.

4.4.2 Conduct Site Survey

The field team leader should inspect the site(s) for optimum siting of monitoring stations and associated equipment. This information should be documented as a site map (hard copy and/or GIS file) and stored in the project file. Locations for monitoring stations and equipment should be physically marked with flagging, stakes, or other appropriate means.

4.4.3 Identify Monitoring Location

Monitoring locations are defined by assigning a unique project identifier for the location and associating the identifier with geographic grid coordinates. If an identifier has previously been assigned from historical sampling activities, then its uniqueness must be confirmed. It may be necessary to designate the historical identifier as an alias and assign a new unique identifier.

Geographic grid coordinates and the method of determining the coordinates must be obtained. Coordinates for each site can be determined from a hard copy map, conventional surveying, GPS surveying, or any other appropriate method. The method should be selected based on the accuracy requirements of the project. Relevant information necessary to determine and document accuracy should be recorded as well. For classic or GPS survey methods, the type of equipment, processing software, network adjustments, and accuracy reports should be recorded.

4.4.4 Prepare Monitoring Structures

Installation of monitoring structures at a study site may include, air monitoring stations, meteorological stations, wells, boreholes, weirs, etc. Existing wells or boreholes may be removed from service and plugged. Data regarding drilling and construction (e.g., bore hole logs), purging events, and the associated measurement activities will be recorded.

4.4.5 Acquire and Inventory Equipment

An inventory of equipment numbers for all equipment/instruments required for sample collection and/or field measurements should be developed.

4.4.6 Install and Calibrate Instruments

Field preparation activities also can include installation/initial calibration of field instruments at a given location. Data regarding the configuration of monitoring locations and instrumentation will be maintained. Information describing the unique characteristics of a monitoring location will be recorded.

4.4.7 Update Project Data Base

All data collected during steps 4.4.2 through 4.4.6 should be incorporated into the project data base.

4.4.8 Update OREIS

All data relative to the preparation of field sites will be delivered to OREIS. The data may come in one or more transmittals, but the relevant station/location data must be in OREIS at the same time as or before measurements and GIS data are transmitted.

4.4.9 Data Readiness Review

The PDC prepares a project data management readiness review checklist prior to the collection of field and sample measurements. This readiness review checklist should detail what has been done to ensure that the activities outlined in the DMIP have been implemented.

4.4.10 Project Data Collection Task

Once all previous steps in Section 4.4 have been completed environmental data collection may commence. The PDC should be notified of near-term sampling activity schedules to ensure proper data management activities occur.

4.5 COLLECT FIELD DATA

Depending on the type of project, collecting field data may involve taking measurements, making observations, completing inspection checklists, making surveys, or taking photographs at particular monitoring locations. Field data collection includes the activities that prepare equipment, personnel, and material, as well as the actual activity done in the field to collect the data. Sample collection may occur at the same time that field data are collected. Sect.4.7, Collect Field Samples, describes the activities associated with sample collection.

Field data collection events are planned and scheduled. Necessary data entry forms, checklists, field logbooks, and project data sets are prepared for collecting data. The type of information collected, as well as the design of monitoring event forms that will capture them, are determined when field activities are planned.

Recorded information will provide sufficient data and observations to enable participants to reconstruct events that occurred during the data collection process and to help qualify the data. Reviews of the recorded data are performed to ensure completeness and correctness.

Because of the wide difference in project data collection needs, ranging from simple to complex, not every project will do each step in this process. An important part of preparing the DMIP is tailoring these processes to fit the needs of the individual project. The requirements listed below and the process flow/responsibility diagram shown in Fig. 7 apply to field data collection activities in general.

Process Requirements and Business Rules

1. Use and control of field logbooks and data forms will adhere to Environmental Surveillance Quality Control program (ESP) procedure “Field Logbooks and Data Forms” (ESP-503).

2. Field documentation, including logbooks, data forms, and inventory checklists will be completed
   according to the ER procedure “Development, Completion, and Control of Data Forms and Logbooks” (ERWM/ER-P2205).

3. Field logbooks will be secured.

4. Field logbooks will undergo a QA review.

5. Field data collection documentation will be maintained in a field event file by a project team member designated by the project technical lead. The field event file may include copies of field data forms, relevant pages from field logbooks, completed field inspection checklists, photos or photo lists, and videos.

6. Modifications to planned activities and deviations from procedures will be recorded, as required by the ER procedures “Controlling and Documenting Field Changes to Approved Field Sampling Plans” (ERWM/ER-P2303) and “Development, Completion, and Control of Data Forms and Logbooks”(ERWM/ER-P2205).

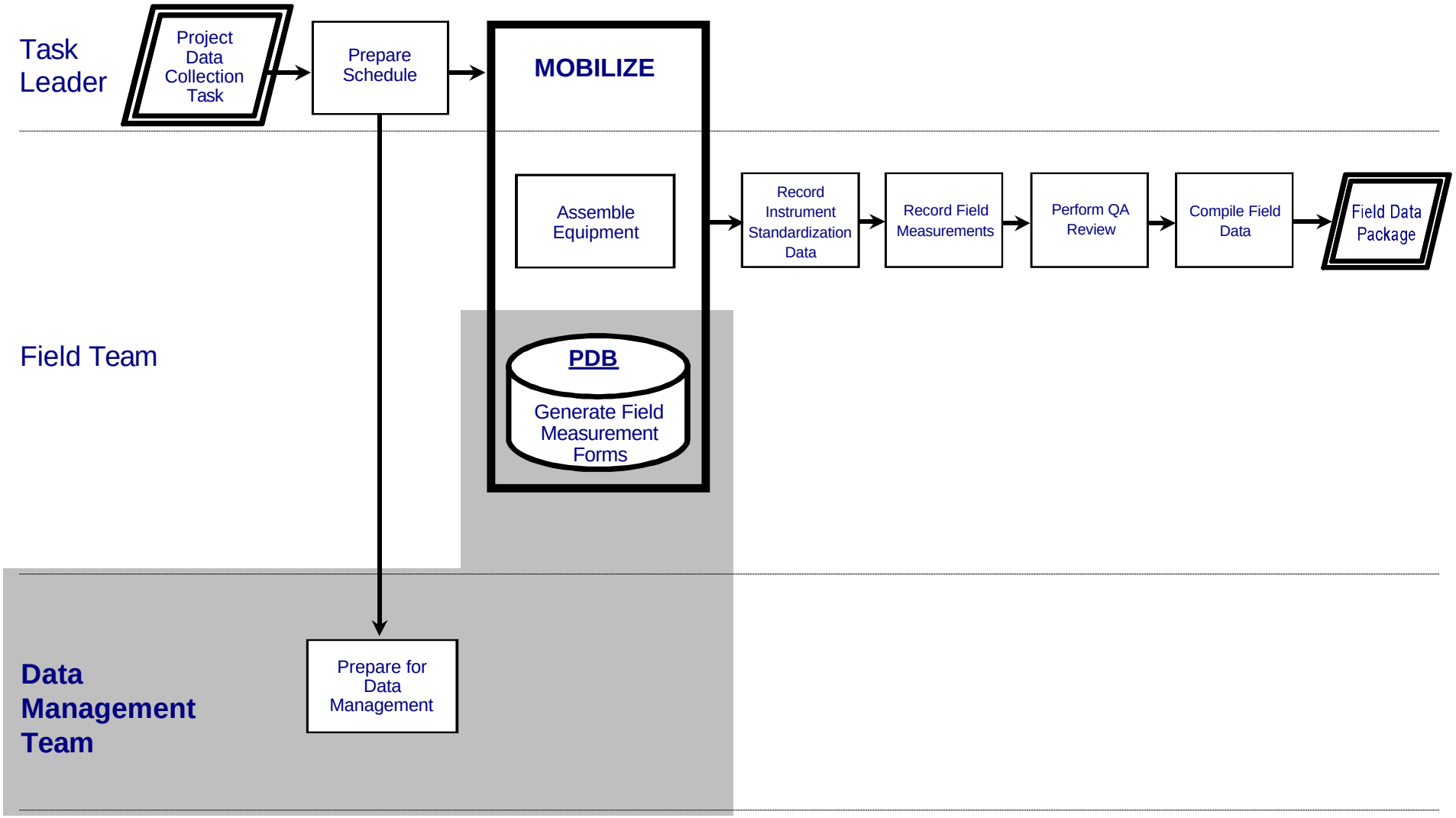

Fig. 7. (Sect. 4.5) Collect Field Data

4.5.1 Prepare Schedule

The task leader prepares a schedule for the event's activities. Each monitoring event is defined by the monitoring location and the data that will be collected there. The schedule describes the field data to be collected at each location. After completing the schedule for the field event, the task leader sends a copy to the PDC.

4.5.2 Prepare for Data Management

The PDC is notified of the field event by the task leader. Advance notice allows the PDC to schedule the time and personnel for data entry and data processing. It also helps to ensure that the field data that are collected will be available for use in the project data base in a timely manner.

4.5.3 Mobilize

Mobilizing for the field event involves generating any field forms or checklists needed, assembling field equipment, and conducting any project-specific training required before going out to the field.

4.5.3.1 Generate Field Data Forms

Inspection checklists or forms containing predefined information about the field event, such as locations and the measurements to be made, may be preprinted to reduce recording time in the field and ensure consistency of information.

In the case of projects that have chosen to automate the recording process in the field, the data entry forms are replaced by recording equipment such as bar code readers and data loggers. Any preparation of this equipment is done at this time.

4.5.3.2 Assemble Equipment

The field team assembles the equipment necessary to support the field event. This may include bar code readers, instruments needed to collect field measurements, and equipment for downloading information that may be contained in data loggers in the field. Identification numbers of equipment are recorded.

4.5.4 Record Instrument Standardization Data

Field instruments are calibrated for taking field measurements and information documenting the calibration is recorded in field logbooks and on data entry forms or bar code readers for later downloading. The types of information that should be recorded include

- type of instrument;
- instrument serial number or property number;
- time and date of calibration;
- instrument reading; and
- substance used to calibrate (where appropriate).

Calibration should be done according to the instrument manufacturer's instructions. For instruments that are not calibrated for each field event, the date of last calibration should be recorded.

4.5.5 Collect Field Data

Field data may be gathered in conjunction with sample collection at some sites. This section only pertains to gathering field data, not collecting samples. See Sect. 4.7, "Collect Field Samples," for the activities associated with actual sample collection.

The data are recorded based on their type and the project's needs. Some examples of field data include site photographs, surveys, completed surveillance checklists, water temperature and flow measurements, population counts, and taxonomic identification. The time and date of collection, as well as the name of the individual recording the collection, should be included with the data. Comments on weather, unusual site conditions, etc. also may be recorded.

4.5.6 Perform QA Review

A QA review is conducted of the information recorded during field data collection. The field data (in logbooks, data forms, etc.) will be checked to verify that they are recorded correctly and that appropriate instrument calibration has been performed. If sampling is being done along with data collection, sampling information is also reviewed. See Sect. 4.7.11 , "Perform Field QA Review," for information related to sample collection. Any problems identified will be corrected as appropriate. This activity may result in the creation of one or more field event changes to resolve discrepancies determined between planned and actual events.

4.5.7 Compile Field Data

The field data are collected in preparation for submission to the data management team. This may be copies of logbook entries, completed checklists or data measurement forms, downloaded data logger data, or barcode reader files. Records of field event changes as a result of anomalous occurrences during the field event may be included. The field team leader is responsible for making sure that all the data are compiled and delivered to the appropriate data management team member for processing.

4.6 PROCESS FIELD DATA

Processing field data includes receiving the field data collection package and processing it to make the data available for data reviews and subsequent use. The task leader is responsible for making sure that the field data package is delivered to the appropriate data management team member. The field data package may contain copies of logbook entries, completed checklists or data measurement forms, downloaded data logger data, or barcode reader files. Information recorded during the processing of the field data will document the completeness of the data and will provide a record of any modifications made to the field data.

Because of the wide difference in project data collection, ranging from simple to complex, not every project will do each step in this process. An important part of preparing the DMIP is tailoring these processes to fit the needs of the individual project. The requirements listed below and the process flow/responsibility diagram shown in Fig. 8 apply to field data processing activities in general. Specific activities are described in the following text along with how the particular activity interacts with the other activities and processes

Process Requirements and Business Rules

1. Each field data package will be added to the project data records file and will be submitted to the ER DMC in accordance with work aid "Identification and Processing of Environmental Data Records" (EIM/WA-1).

2. If any field data have been transferred in an EDD, the contents of the EDD will be verified in accordance with the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214).

4.6.1 Update Project Files

The field data package and any field event changes or notes relating to problems or revisions in the field data should be added to the project file for submission to the ER DMC in accordance with the records work aid (EIM/WA-1).

4.6.2 Process Field Data Package

Depending on the project's needs, the field data package may be identified and logged for tracking purposes. The remainder of this step applies to projects that automate the field data.

Field data received in hard copy format may be entered into an electronic data base to meet project requirements. The data should be entered using double data entry or single entry with verification as specified in the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214).

Field data received in electronic form, such as barcode readers or data loggers, will be processed using programs that are designed for use with the specific equipment and that have undergone a documented QA review (Sect. 5.2.2, "Software Quality Assurance"). Data processing records are kept to log the processing done to each field data package. These records become part of the project file.

Once the field data have been processed into an electronic form they are put into the project data base, described in Sect. 4.6.4, "Update Project Data Base."

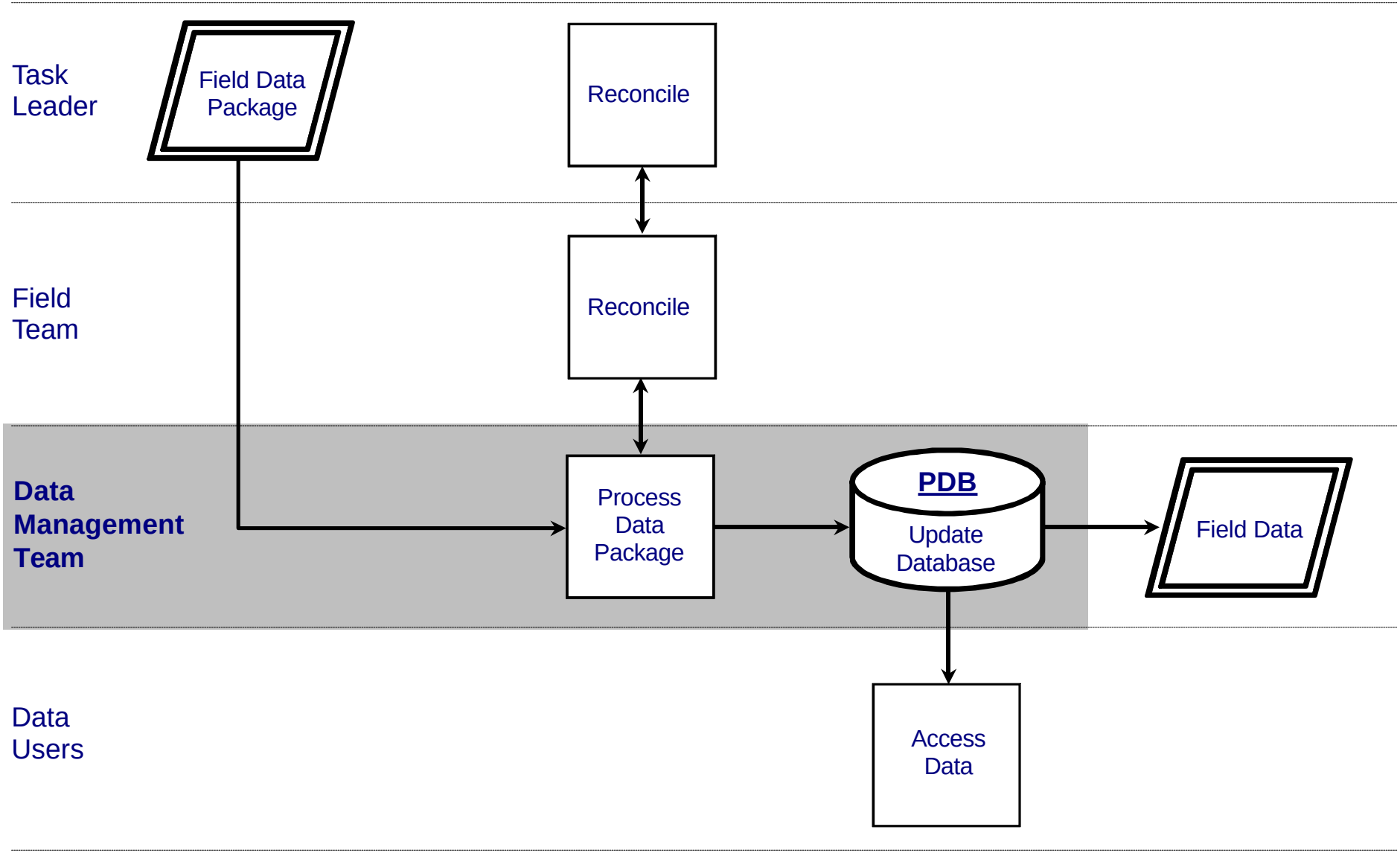

Fig. 8. (Sect. 4.6) Process Field Data

4.6.3 Reconcile

Problems in field data documentation or content noted in the field data processing step should be resolved according to the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214). The resolution of these problems may require interactions with the field team, the technical lead, and the task leader. Documentation is kept on problem resolution and becomes part of the data processing records that are included in the project file.

4.6.4 Update Data Base

If the data are going to be used in hard copy form only, this step does not apply. The project data base is updated with the field data that have already been processed . The final disposition of the field data is recorded in the data processing log and the project files may be updated.

4.6.5 Update Project Files

Data processing records should be included in the project file for submission to the ER DMC. This includes the log of field data registration, the field data processing logs, field data verification records, and any correspondence related to resolution of problems found in the field data.

4.6.6 Access Data

The data management team makes the data available in either electronic or hard copy form for the project review.

4.7 COLLECT FIELD SAMPLES

The Collect Field Samples phase includes the activities conducted to gather samples from a particular monitoring location within a study site. Field sampling events are planned and scheduled. Necessary data entry forms, field logbooks, and data sets are prepared for data capture. The field sampling events are conducted to collect the samples and record the information in logbooks and monitoring event forms. Recorded information is intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the data collection process and to help qualify data. Reviews of the recorded data are performed to ensure correctness.

Process Requirements and Business Rules

1. The possession and transfer of samples will be documented from collection to final disposition, as required by ESP procedure "Sample Chain of Custody" (ESP-501). Each sample will be assigned a unique project identifier.

2. All field activities will be documented sufficiently to enable reconstruction of events. Field sampling documentation, including logbooks, data forms, and inventory checklists, will be completed according to the ER procedure "Development, Completion, and Control of Data Forms and Logbooks" (ERWM/ER-P2205).

3. All sampling documents associated with field sample collection will be maintained in a field event file. The event file will include copies of the chain of custody forms, field forms, analytical requests, and copies of the relevant pages from the field notebooks and other appropriate documents as determined in the DMIP. The event file will become part of the project file as described in the ER procedure "Identification, Distribution, and Maintenance of Environmental Restoration Records" (ERWM/ER-P1110).

4. Modifications to planned activities and deviations from procedures will be recorded in accordance with the ER procedure "Controlling and Documenting Field Changes to Approved Field Sampling Plans" (ERWM/ER-2303).

5. Field logbooks and data collection forms will undergo a QA review in accordance with the ER procedure "Development, Completion, and Control of Data Forms and Logbooks" (ERWM/ER-P2205).

6. Verification of project data base contents will follow the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214).

A process flow/responsibility diagram is shown in Fig. 9 for the field sample collection activities. The following sections provide additional detail and requirements for each of the steps in this activity.

4.7.1 Prepare Schedule

The task leader will prepare a schedule of upcoming sampling events, the frequency of the schedule
(weekly, monthly, etc.) will vary for different projects. This schedule should include the types and numbers of samples to be collected from each monitoring locations within the study site. The task leader should send a copy of the schedule to the PDC and analytical services coordinator.

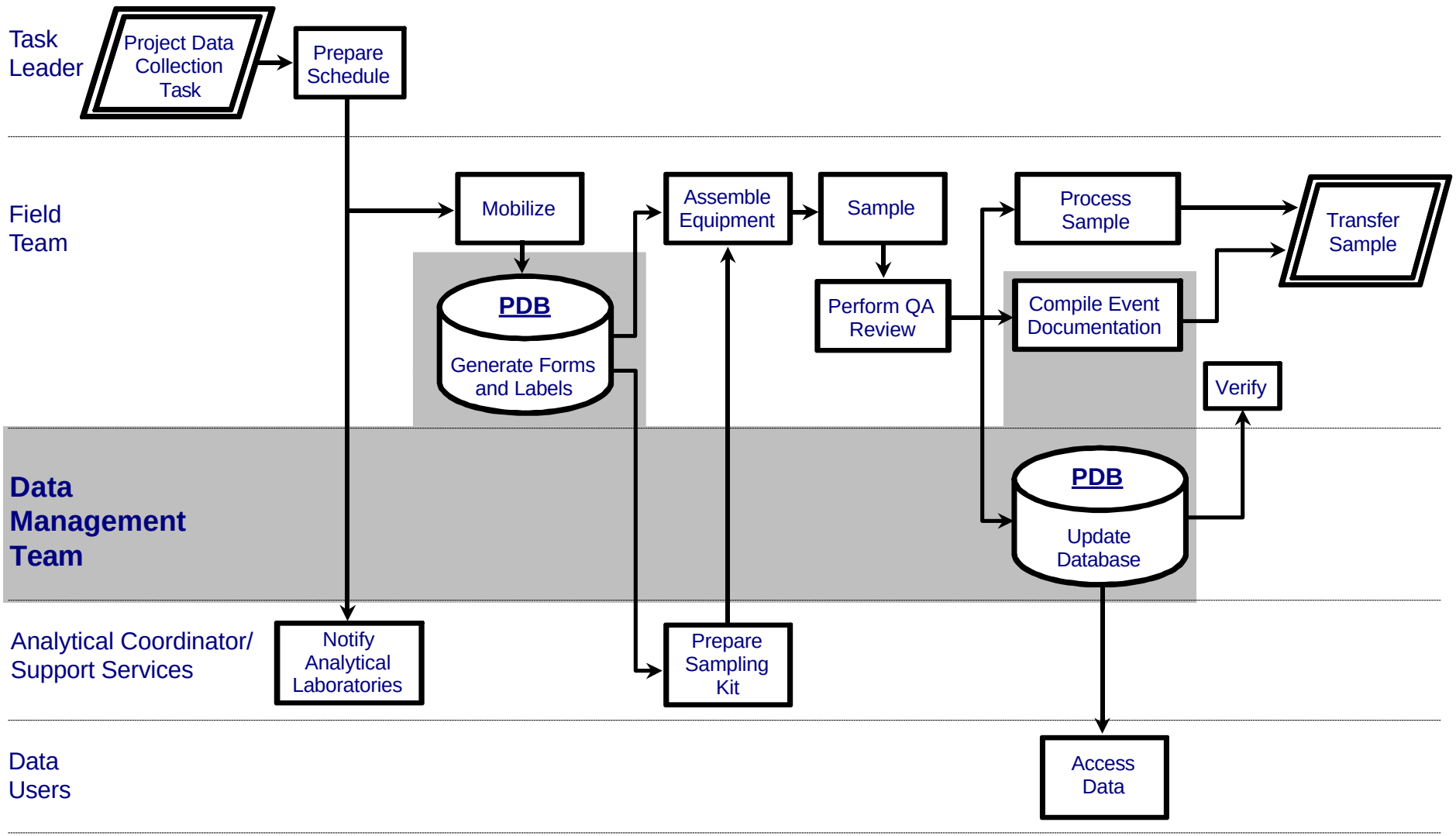

Fig. 9. (Sect. 4.7) Collect Field Samples

4.7.2 Generate Forms and Labels

Each sample that will be collected during a planned sampling event is identified. Information about the sample and associated sampling methods (e.g., sampling location, container type, preservatives) may be preprinted on sample container labels. Field logs and data entry forms are prepared to support the monitoring events. If automated, the project data base should be updated with information concerning planned samples.

4.7.3 Notify Analytical Laboratories

The analytical services coordinator notifies laboratories of anticipated sample shipments including the numbers of samples and the analysis type requested.

4.7.4 Assemble Equipment

The field team assembles the equipment necessary to support the sampling event. This may include bar code readers and equipment needed to collect field measurements, and download information that may be contained in data loggers in the field. A field equipment checklist can be used to document this step. All equipment identification numbers, if available, should be recorded

4.7.5 Prepare Sampling Kit

The analytical coordinator directs the analytical support services to assemble the containers and labels necessary to support the sampling event. The project data base may be used to produce preprinted labels and sampling forms.

4.7.6 Sample

Samples will be collected in compliance with field sampling procedures and the appropriate information regarding sampling activities, site conditions, and any unusual occurrences will be recorded in field logbooks or on data entry forms.

4.7.7 Process Samples (as applicable)

Samples may need additional preparation before shipping to an analytical lab. Three examples of processing samples are (1) compositing of samples (spatial or temporal), (2) centrifuging to obtain water and sediment from a sample, and (3) filtering part of the sample. It is important to maintain the relationships of the original sample(s) and its associated sample event information to any additional samples that may result from the sample processing.

4.7.8 Update Project Data Base

The project data base is updated to reflect the sample collection and processing information.

4.7.9 Verify Project Data Base

The information entered into the project data base is reviewed for correctness by comparing field forms, logbooks, and bar code reader reports to the information entered in the data base.

4.7.10 Access Data

The data in the project data base are available for use at any time by the project team. Data users can perform sample tracking queries (e.g., what samples were planned, collected, shipped).

4.7.11 Perform Field QA Review

A QA review of the information recorded during field sampling is conducted. The review includes the activities of verifying field measurements data by verifying that data are recorded correctly and checking that instrument calibration has been performed. In addition, verification is performed on the accuracy and completeness of forms and logbooks, sample information, chain-of-custody numbers associated with the samples, and analyses requested for the samples. Any problems with the sample collection effort, (e.g., incomplete information, necessary sample not collected) are identified, along with taking the necessary actions to correct the problems. This activity may result in the creation of one or more field event changes as a result of discrepancies determined between planned and actual events, and the cancellation of shipping and/or analysis.

4.7.12 Compile Event Documentation

The field team will compile the sampling event documentation using a field event documentation checklist to ensure all necessary documents are present.

4.7.13 Update Project Files

The event documentation file is added to the project file.

4.8 SUBMIT SAMPLES FOR ANALYSIS

Submitting samples to a laboratory for analysis includes the activities to prepare, package, and document the samples to be shipped, the actual shipping process, and the verification of the receipt of samples by the laboratory. A process flow/responsibility diagram is shown in Fig. 10 for these activities. The samples to be shipped to the lab are obtained by the "Collect Field Samples" activities described in Sect. 4.7. The data received from the laboratory analyses of these samples are processed according to the activities described in Sect. 4.9 "Process Laboratory Analytical Data." Information recorded during this sample submission activity is intended to provide sufficient sample tracking records and to document events that potentially affect data quality.

Process Requirements and Business Rules

1. The transfer of samples will be documented as required by the ESP procedure "Sample Chain of Custody" (ESP-501).

2. Each sample container will be assigned a unique identifier and labeled in accordance with the ESP procedure "Sample Chain of Custody" (ESP-501).

3. Samples will be shipped according to instructions contained in the ESP procedure "Preparing Samples and Laboratory Standards for Transport and Shipping" (ESP-505). Samples must have a radiological survey done by Health Physics before transfer to the laboratory.

4. Samples that are not hand delivered by the sample custodian must be safeguarded with signed custody seals.

4.8.1 Prepare Samples for Shipment

Preparation for shipping can include the final sample processing such as splitting, compositing, filtering, and preservation (Sect 4.7.8). The sample containers to be shipped must be labeled with at least the sample identifier, requested analysis, and collection date.

4.8.2 Finalize Samples to Sample Shipment Group

Some projects assign samples to a Sample Shipment Group (SSG) prior to shipment. The SSG is a sample tracking grouping used to identify which samples were shipped together. The SSG does not designate the sample analysis grouping used by the laboratory. The laboratory should group samples for analysis in the most economical way within holding time and batch requirements defined in the laboratory SOW. Preliminary assignment of the SSG can be made as soon as the samples are planned but the grouping must be reviewed and, if necessary, revised to identify the samples actually included in the shipment.

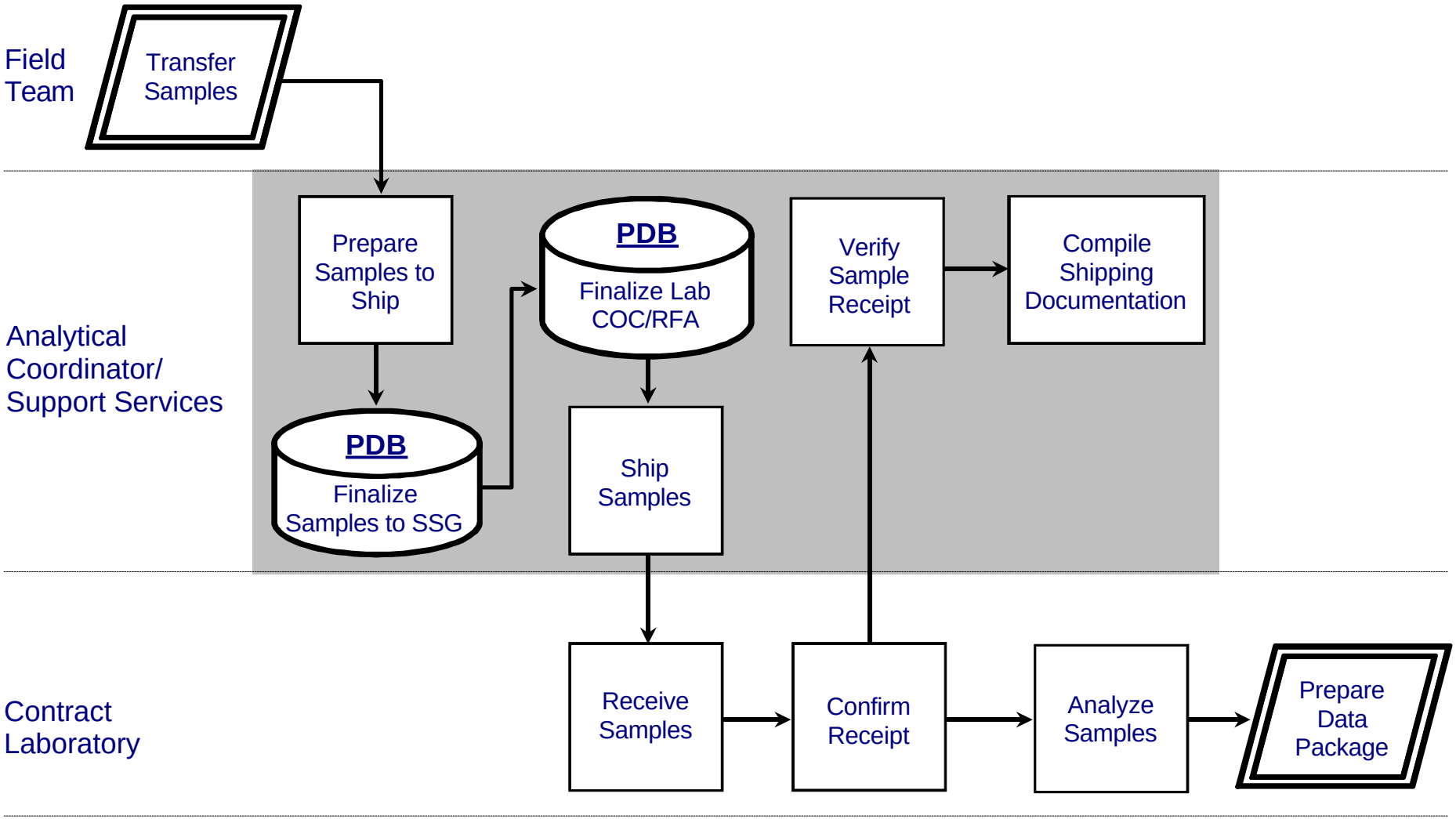

Fig. 10. (Sect. 4.8) Submit Samples for Analysis

4.8.3 Finalize Laboratory Chain-of-Custody / Request for Analysis

A chain-of-custody (COC) must accompany the samples to the laboratory as specified in the ESP procedure "Sample Chain of Custody" (ESP-501). The COC must at a minimum include the sample identifier, matrix, collection date and time, sample type, preservative, requested analysis, unique COC number, and signature blocks for documenting each sample custody transfer. A preliminary COC can be produced as soon as the samples are assigned to an SSG; but the COC must be reviewed and, if necessary, revised to identify the samples actually included in the shipment.

Some projects may require a Request for Analysis (RFA) form. The RFA should be completed before shipment and should be checked against the COC to verify consistent information.

4.8.4 Ship Samples

Samples must have a radiological survey done by Health Physics before the samples are shipped to the laboratory. The COC, health physics tag, and when required, the RFA, will be packaged with the samples for shipment. Each sample should be checked against the COC as it is packed for shipment. The samples should be shipped according to instructions contained in the ESP procedure "Preparing Samples and Laboratory Standards for Transport and Shipping" (ESP-505).

4.8.5 Receipt of Samples by Lab

The laboratory should verify the custody seal (when applicable), the number of samples received, the sample identifiers, and requested analyses by checking the COC and sample labels. The condition of the samples upon receipt should be checked against required conditions (e.g., "keep samples at 4 °C") and the results should be noted on the COC. The COC should be signed and dated. The lab should keep the original COC until the final disposition of the samples is completed. A copy of the COC should be included in the analytical data package prepared by the lab.

4.8.6 Confirmation of Sample Receipt

The laboratory will notify the project analytical coordinator when the samples are received. This may be done by a letter of receipt or by returning a signed copy of the COC to the analytical coordinator. The SOW may request a same day facsimile for notification of receipt.

4.8.7 Verification of Sample Receipt

The information in the confirmation of laboratory receipt is verified concerning the samples received, the condition of the samples as received by the laboratory, the sample COC identification, and the analyses the laboratory will perform. The analytical coordinator is responsible for resolving any sample problems reported by the laboratory. Such resolution could include cancellation of the analysis on some samples.

4.8.8 Compile Shipping Documentation

The Shipping File should contain all documentation involved in processing and transferring samples to the laboratory. This should include a signed copy of the COC, a copy of the health physics tag, the shipping order, and lab confirmation of sample receipt. Other records such as laboratory notification of impending sample shipment and laboratory login forms could be included.

4.8.9 Analysis by Lab

The laboratory analyzes the samples in accordance with the laboratory SOW.

4.8.10 Preparation of Data Package by Laboratory

The laboratory prepares the data package and EDD according to the specifications in the laboratory SOW.

4.9 PROCESS LABORATORY ANALYTICAL DATA

Processing laboratory data includes the activities of receiving and processing the data package and making the data available for data reviews. Information recorded during the data processing will document the sample tracking/data completeness and will provide an audit trail for any modifications made to the laboratory deliverables. A process flow/responsibility diagram is shown in Fig. 11 for these activities.

Process Requirements and Business Rules

1. Each data deliverable will be assigned a unique identifier for data tracking.

2. Each data package will be added to the project data records file and submitted to the ER DMC in accordance with the work aid "Identification and Processing of Environmental Data Records" (EIM/WA-1).

3. The contents of an EDD will be verified in accordance with the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214).

4. For data going to OREIS, the minimum data required are the mandatory fields defined in the OREIS ready-to-load format referenced in the ER procedure "Transmitting ER Data in Ready-to-Load (RTL) Form to the Oak Ridge Environmental Information System (OREIS)" (ERWM/ER-P2701). The current format definitions are available from the OREIS program office.

5. All diskettes received as electronic deliverables will be scanned for viruses before the deliverable is processed. Any detected virus must be reported in accordance with "Reporting ADP Resource Related Incidents" (CP-201).

4.9.1 Register Data Package

The data package will be delivered to the project analytical coordinator. The data package will, at a minimum, contain a hard copy record of the results. Each data deliverable should be assigned a unique identifier for data tracking purposes and the date the deliverable was received should be recorded. Where applicable, this identifier should be cross referenced in the project data base and should be used to index the records in the document management center.

The analytical coordinator should review the data package for completeness and legibility and notify the laboratory of any problems found in the data package.

If an EDD was requested by the project, it may be included in the data package or may be sent directly to the project data management team. The EDD could be submitted as diskette, tape, or electronic file transmitted over a communications network. If the EDD is included in the data package, the analytical coordinator should forward the EDD to the project data management team.

If an EDD was not requested and the data are going to be entered into an electronic data base by the project the analytical coordinator will supply the data management team with a copy of the appropriate sections of the data deliverable for use in data entry. If an EDD was not requested and the data are going to be used in hard copy form only, then the data processing steps 4.9.3 through 4.9.7 do not apply.

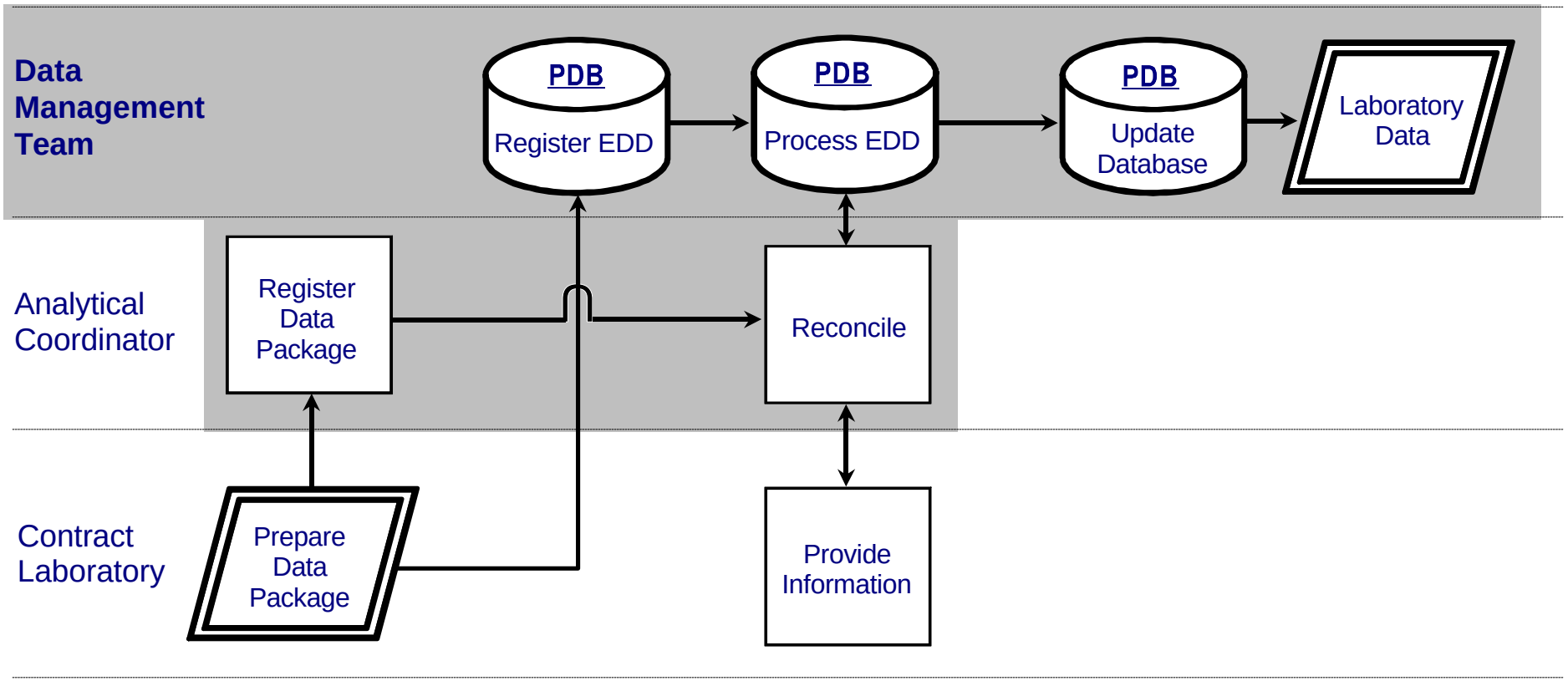

Fig. 11. (Sect. 4.9) Process Laboratory Analytical Data

The data package and any correspondence related to problems or revisions in the data package should be added to the project file for submission to the document management center in accordance with the records work aid (EIM/WA-1).

4.9.2 Register EDD

The data management team should keep a log of all the EDDs submitted to the project. This log can be a hard copy record or an electronic registration system. Any diskette that is received should be scanned for viruses before the deliverable is processed. Any detected virus is considered an ADP resource related security incident and must be reported in accordance with "Reporting ADP Resource Related Security Incidents" (CP-201).

4.9.3 Process EDD

Data received only in hard copy format will sometimes be entered into an electronic data base to meet project requirements. The data should be entered using double data entry or single entry with verification as specified in the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214). Once the hard copy data are in electronic format, it follows the same processing steps as an EDD received directly from the laboratory.

The EDDs will be read and processed using programs that have undergone a documented QA review. The contents of the EDD should be verified against the hard copy data package according to the requirements in the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" ERWM/ER-P2214.

The project should keep a log of all the EDDs processed and note problems encountered and resolved during that processing.

4.9.4 Reconcile EDD Problems

Problems in format or content noted in the EDD should be resolved according to the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214). The resolution of these problems may require interactions with the analytical coordinator and the analytical laboratory.

A record must be kept of any changes made to the EDD. An electronic system for managing file changes is recommended, however, a hard copy record of changes may be sufficient for some projects.

4.9.5 Update Project Data Base

The project data base should be updated with the sample results and associated laboratory data qualifiers. For data going to OREIS the minimum data required are the mandatory fields specified in the RTL format referenced in the ER procedure "Transmitting ER Data in Ready-to-Load (RTL) Form to the Oak Ridge Environmental Information System (OREIS)" (ERWM/ER-P2701). These data include sampling location and date, sample type and media, laboratory code and analysis method, parameter identification, and results and associated qualifiers. Contact the OREIS program office for the current RTL definitions and details on mandatory fields.

Some projects also may require that additional QC data be added to the data base. Some examples of QC data are matrix spike results or percent recoveries, laboratory duplicate results, and laboratory blank results.

The data processing records should be included in the project file for submission to the ER DMC. The data processing records that should be included in the file are the EDD registration log, the EDD processing logs, data verification records, and correspondence related to resolution of EDD problems.

4.10 REVIEW DATA

The data review process determines whether a set of environmental data satisfies the data requirements defined in the project scoping phase. This process involves the integration and evaluation of all information associated with a result. Figure 12 shows the process flow/responsibility matrix for this activity. Not all of the activities shown in this figure may be applicable to a specific project, since the project decides the extent and nature of the data review. Also, any verification and validation activities (Sect. 4.11) should precede the data review since the qualifiers assigned in this phase may affect the interpretations in the review phase.

The data reviewer is generally the task leader or principal investigator responsible for the technical implementation of the data collection activities defined during project scoping. The data review examines all data and supporting documentation acquired (historical and newly collected) by the project. The data reviewer will typically evaluate this information to assess the reasonableness of the data as compared with (1) the conceptual understanding of the system, (2) data from similar sites, (3) historical data, or (4) other criteria based on the reviewer's professional judgement. He or she may use tables, graphs, spatial analyses tools (GIS), and various statistical techniques to help in the review. When the review is completed, the following characteristics of the data should be known (where applicable):

- **Data authenticity**–Non-authentic data may result from either intentional or accidental reporting of incorrect data. Data entry errors, transcription errors, calculation errors, software failures, poor recording procedures, inadequate training, and lack of management oversight may result in the accidental reporting of incorrect data.

- **Data integrity–**Data have integrity if (1) they are reported as the result of procedures that ensure that proper sampling, chain of custody, and analysis methods were chosen and followed correctly; (2) results were not compromised because of intentional or accidental reporting of incorrect values; and (3) documents were maintained that show the procedures used.

- **Data usability–**Determination of data usability involves an evaluation of the data to decide if the data meet the data requirements defined in the project scoping stage. If the data meet the requirements, then the data are usable.

- **Outliers–**Outliers, or extreme values, may represent true results or may result from errors in sampling, analysis, or data processing.

- **Sensitivity, precision, accuracy, representativeness, completeness, and comparability (SPARCC)–**These parameters are collectively known as SPARCC and are defined in Sect. 4.10.3. The SPARCC parameters can be important in understanding the significance of the reported values and assessing the confidence associated with any decision based upon the values.

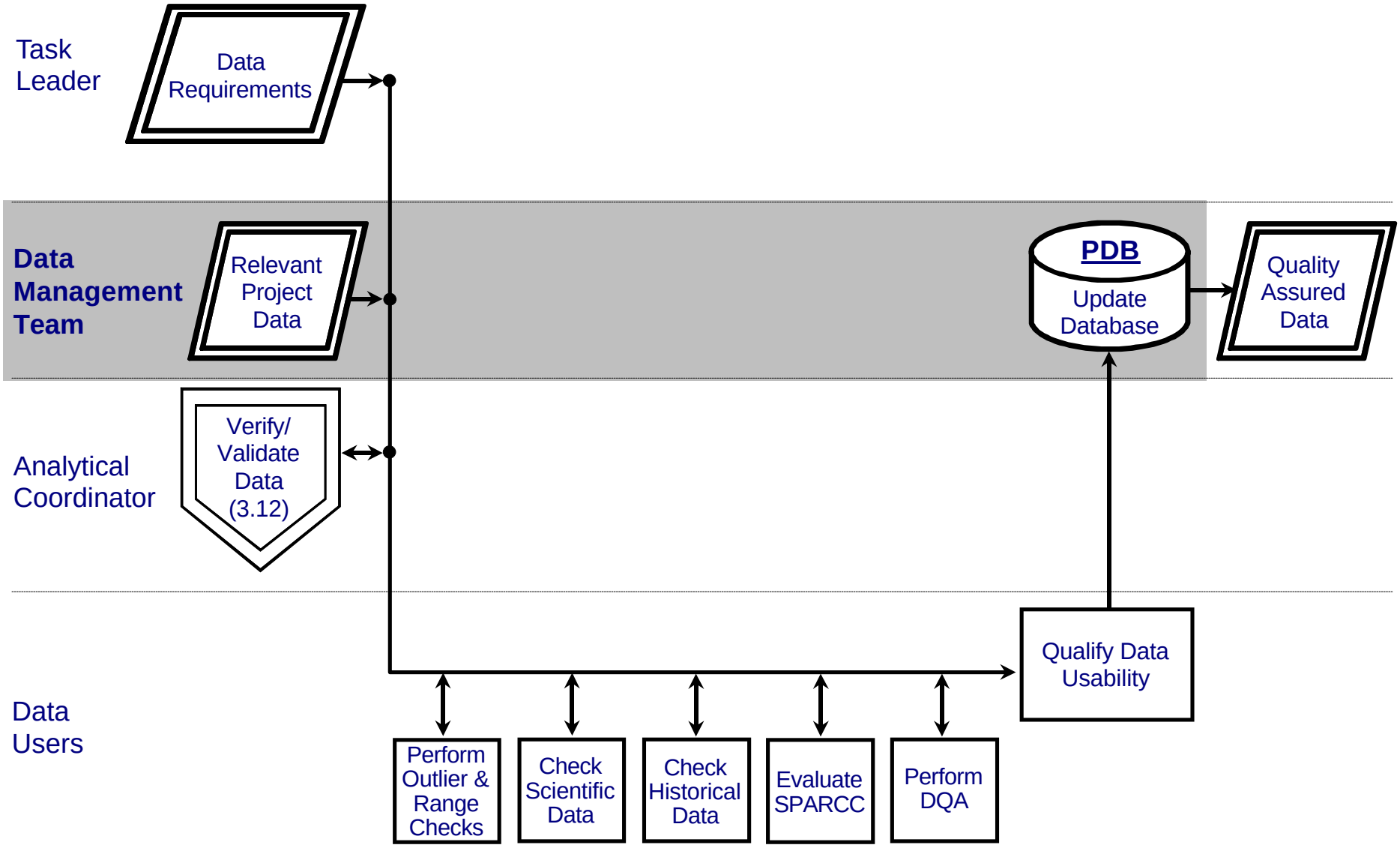

Fig. 12. (Sect. 4.10) Review Data

Process Requirements and Business Rules

1. Measurements data shall be assessed for adequacy for their intended use by comparing the data with the data requirements defined during project scoping (see Sect. 3.1). The standard usability qualifiers, as defined in the current version of "Data Dictionary for the Oak Ridge Environmental Information System (OREIS)" (ES/ER/TM-116) shall be linked with the associated data.

2. All relevant information associated with measurements data (i.e., metadata) shall be reviewed for consideration during the assessment process.

3. Previously collected environmental data shall be examined to determine whether they can be used (either independently or together with data collected by a project) by the project. When available, the sampling design, sampling collection and analysis methods, and quality control data (i.e., metadata) should be used in the review.

4.10.1 Perform Outlier and Range Checks

Range checking involves looking at the distribution of measurements within meaningful data subsets. A variety of graphical tools such as box-and-whisker plots, stem-and-leaf plots, and time-series graphs can help in identifying extreme values. GIS displays can also be used to detect spatial outliers. If extreme values are found, the reviewer should investigate these values to decide if they are accurate or due to a problem in sampling, analysis, or data reporting.

4.10.2 Perform Reasonableness Checks

The objective of this step is to assess the technical reasonableness of the data based on scientific and historical understanding of the system from which the data were obtained. Various data quality checks may be performed on the data, such as comparing pH and alkalinity measurements, calculating charge balances, comparing filtered and unfiltered measurements, analyzing frequency distributions, comparing a parameter's results from different methods, performing radiochemistry checks, using spatial displays to check for spatial biases, and comparing the range of observed data with historical values from the study site.

4.10.3 Evaluate Sensitivity, Precision, Accuracy, Representativeness, Completeness, and Comparability Parameters

Sensitivity, precision, accuracy, representativeness, completeness, and comparability comprise the SPARCC parameters. Sensitivity is the capability of the analysis method or instrument to discriminate between measurements based on differing concentrations of analytes and is defined by the limit of detection, limit of quantification, instrument detection limit, and the method limit of detection. Precision is the degree of mutual consent between independent measurements made under specified conditions. Accuracy is the closeness of agreement between an observed value and an accepted value. Representativeness expresses the degree to which the data accurately reflect the analyte or parameter of interest at an environmental site. Completeness is a measure of the amount of valid data obtained from a measurement system such as a laboratory or field instrument. Comparability is the confidence with which one data set can be compared to another set produced by different laboratories or field instruments. These parameters can be aid in understanding the significance of the reported data and assessing the confidence associated with decisions made using the data. Precision and accuracy are also evaluated during the verification and validation activities described in Sect. 4.11.

4.10.4 Perform Data Quality Assessment

An integral component of the data assessment process is the comparison of measurement results against the projects data quality requirements to determine if the data meet or exceed the “level of certainty” required for decision-making purposes. The field and analytical results are evaluated to see if the projects data quality requirements were met by the sampling and analysis activities.

4.10.5 Qualify Data Usability

A final determination of the usability of the data is made by the data reviewer/users. Data qualifiers are assigned to show the usability of the data for meeting project requirements and for usage by other projects after consolidation into OREIS.

4.10.6 Update Project Data Base

The data base should be updated with data usability codes assigned during the data review.

4.11 VERIFY AND VALIDATE ENVIRONMENTAL MEASUREMENTS DATA

Verification and validation of environmental measurements data are performed to evaluate data usability for a specific intended use. These processes may be implemented with field measurements and laboratory data. Through the process of verification, data are evaluated to assure compliance with non-technical contract-specified criteria. Through validation, data are technically evaluated to evaluate usability for a specific intended use; data of questionable quality or representativeness are qualified to alert the data user of data limitations. The process flow and responsibilities for this activity are shown in Fig. 13.

Process Requirements and Business Rules

1. Environmental measurements verification and validation are processes identified in the ESP procedure "Environmental Measurements Verification and Validation" (ESP-108) and must be considered for implementation as part of project scoping and Data Quality Objective (DQO) planning and subsequent sampling and analysis planning for environmental projects operating within the ER program.

2. Requirements for planning environmental measurements verification and validation as part of the DQO Process is described in the ER procedure "Data Validation Plans for Environmental Restoration Projects" (ERWM-P2215). Planning processes, including preparing the project V/V plan, are included in Sect 4.3.

3. Requirements for implementation of verification and validation are described in the following ER procedures:

   "Radiochemical Data Verification and Validation" (ERWM/ER-P2209)
   "Volatile and Semivolatile Data Verification and Validation" (ERWM/ER-P2210)
   "Pesticide/PCB Data Verification and Validation" (ERWM/ER-P2211)
   "Inorganic Data Verification and Validation" (ERWM/ER-P2212)

4. Data verification and validation reports are completed for each set of data which is verified and validated and are used as inputs to record data usability decisions within the project data base.

5. An exception reporting program should be maintained which tracks contractual deliverable deficiencies and technical quality requirement inadequacies. This program should be maintained through the use of verification/validation reason codes, which are summarized in the above implementation procedures.

4.11.1 Verify Data Deliverables

Data sets are received in either hard copy or electronic format by the verification/validation coordinator. These data sets are verified against requirements identified in the analytical SOW or other contract mechanism.

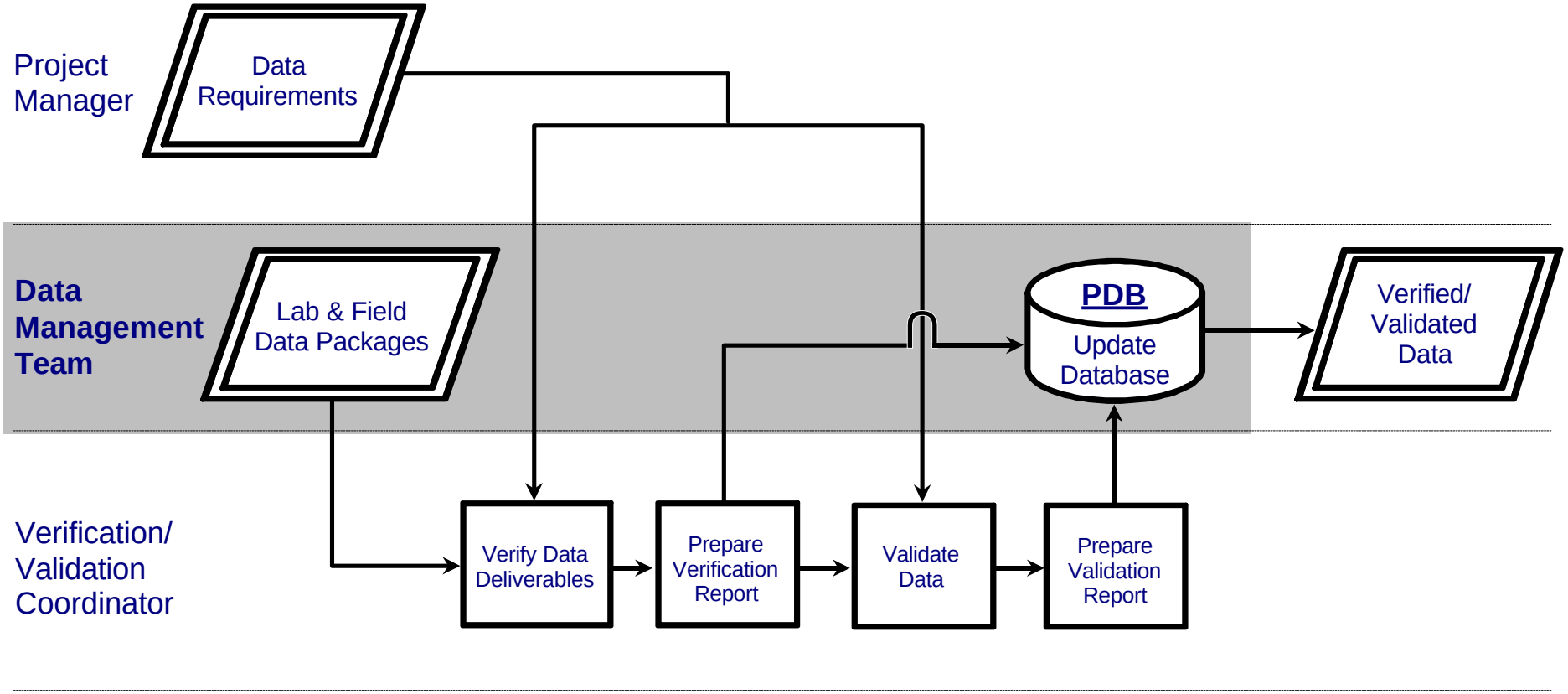

Fig. 13. (Sect. 4.11) Verify/Validate Environmental Measurements Data

4.11.2 Prepare Verification Report

During the verification process, the data verifier completes a verification report (included as an appendix in each of the procedures identified in this subsection's Process Requirements and Business Rules - No. 3). If electronic verification is implemented, specific contract-compliance checks, criteria and resulting electronic verification report must be documented. Following completion of verification, the data set and verification report are forwarded to the validator; a copy of the verification report is also transferred to the project file. If validation is to not be performed, the verification report should be transferred to the data management team to update the project data base (PDB).

4.11.3 Validate Data

Data sets and verification reports received from the data verifier are validated according to the procedures identified in this subsection's Process Requirements and Business Rules - No. 3. If electronic validation is implemented, specific technical evaluations, criteria and resulting validation report must be documented. Following validation, the data set is handed off to the data management team and the validation report is transferred to the project file.

4.11.4 Prepare Validation Report

The validator completes a validation report (included as an appendix in each of the procedures identified in this subsection's Process Requirements and Business Rules - No. 3) for each data set. If electronic validation is implemented, specific technical evaluations, criteria and resulting electronic validation report must be documented. Following completion of validation, the data set and validation report are handed off to the data management team; the validation report is also transferred to the project file.

4.11.5 Update Project Data Base

The verifier and validator transfer the respective reports and data (hard copy and/or electronic) to the data management team for subsequent incorporation into the PDB.

4.12 CONSOLIDATE DATA AND RECORDS

For many projects, a subset of the electronic project data will go to OREIS (see Appendix B: OREIS Data Types). Project staff, regulators, secondary data users, and other OREIS users will have access to these data. Once the data are in OREIS, they will be under OREIS configuration control. Current versions of the documentation referenced in this section are available from the OREIS program office, (423) 576-4710. The electronic data that do not go to OREIS will be archived from the project data management system. All project data records will go to the ER DMC. A process flow/responsibility diagram is shown in Fig. 14 for the consolidation of records and data activities.

Process Requirements and Business Rules

1. OREIS deliverables will be prepared in accordance with the current versions of "Data Dictionary for the Oak Ridge Environmental Information System" (ES/ER-TM-116), the ER procedure "Transmitting ER Data in Ready-to-Load (RTL) Form to the Oak Ridge Environmental Information System" (ERWM/ER-P2701), and the RTL format documentation using the listing of required, conditional, and optional fields; the field names; and the valid values contained therein.

2. Data in OREIS will be under configuration control in accordance with the ER Procedure "Submitting, Reviewing, and Approving Changes to the Oak Ridge Environmental Information System (OREIS)" (ERWM/ER-P2703) and OREIS program procedures.

3. Non-OREIS electronic data will be archived in accordance with the ER procedure "Archival of Environmental Data Within the Environmental Restoration Program" (ERWM/ER-P2200.014).

4. Data records will be transmitted to the DMC and stored in accordance with the ER procedure "Identification, Distribution, and Maintenance of Environmental Restoration Records" (ERWM/ER-P1110) and the EIM Work Aid "Identification and Processing of Environmental Data Records" (EIM/WA-1).

4.12.1 Prepare OREIS Deliverables (RTL)

The first step in this process is to determine what data to send to OREIS (see Appendix B: OREIS Data Types). Once the decision has been made as to what data to send to OREIS, a data transmittal package must be prepared in accordance with "Transmitting Data to the Oak Ridge Environmental Information System" (ERWM/ER-P2701) and "Data Dictionary for the Oak Ridge Environmental Information System" (ES/ER/TM-116). The key components of an OREIS data transmittal are the following:

- a completed OREIS Data Transmittal Form (geographic and/or environmental measurements),
- a clearance form that releases the data for public access,
- associated metadata,
- summary statistics or other measures to check the integrity of the data transfer process, and
- the data in an approved format.

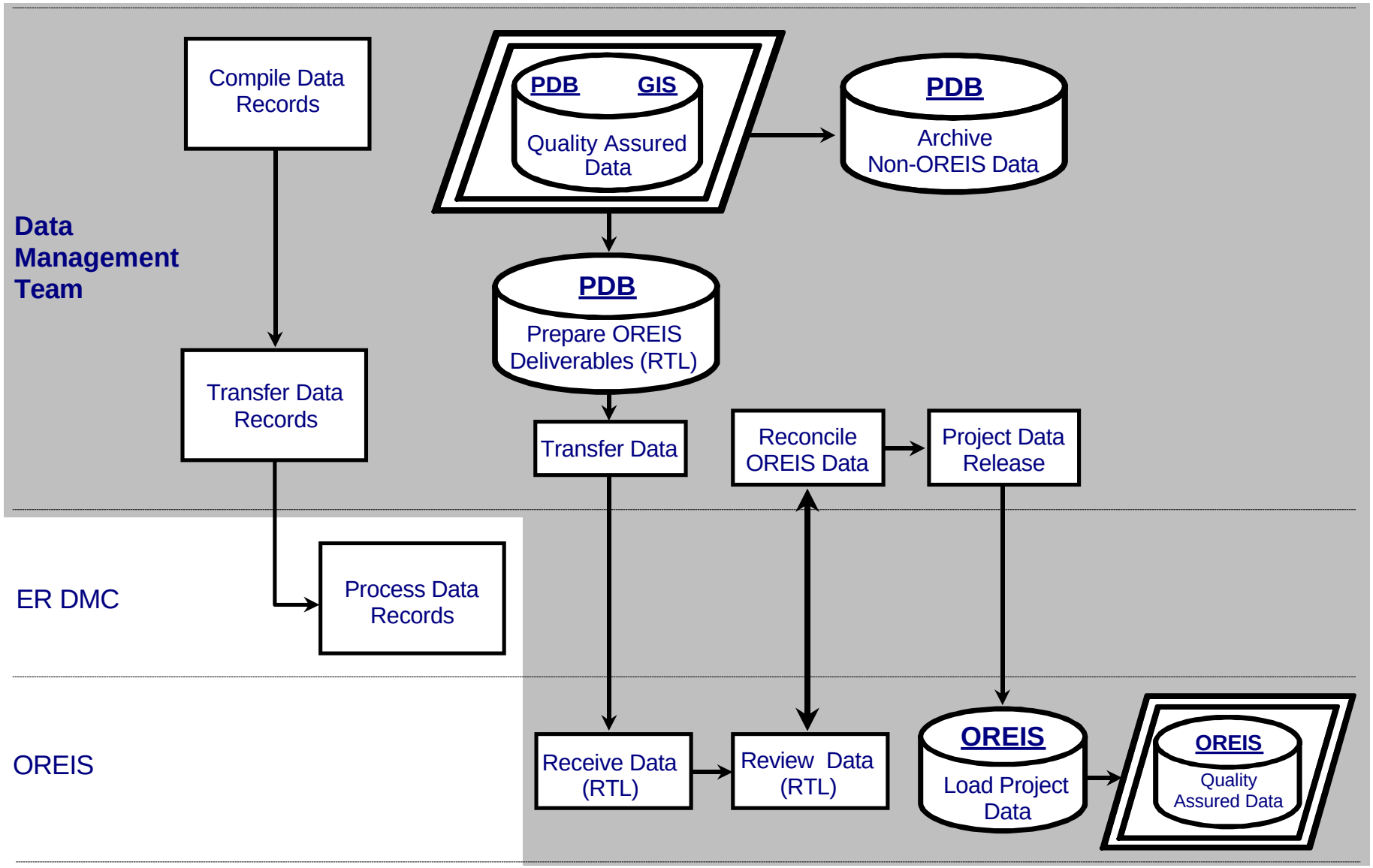

Fig. 14. (Sect. 4.12) Consolidate Data and Records

4.12.2 Transfer Data

Data will be transferred to OREIS quarterly, or according to a schedule agreed upon by the PDC and OREIS staff. Data may be transferred to OREIS via file transfer protocol, on a disk or tape, or any other mutually agreed upon format.

4.12.3 Receive Data (RTL)

When the completed data transmittal form is received, OREIS data management staff log in the transmittal, assign internal identification numbers, and notify the PDC.

4.12.4 Review Data (RTL)

The data package is assigned to an OREIS data management staff member for review and processing according to the OREIS program procedures “Processing and Review of Environmental Measurements Data” (OREIS/P-2803) and “Processing and Review of Geographic Information System Data” (OREIS/P-2802). The data are checked to ensure they were not corrupted during transfer and that they are in an accepted format. Further checks are performed to verify that the mandatory fields contain data and that valid values were used for coded fields. If problems are identified, OREIS staff work with the PDC until the issues have been resolved.

4.12.5 Reconcile OREIS Data

Several iterations of identifying and resolving problems may take place between the PDC and OREIS staff.

4.12.6 Project Data Release

Once the issues have been resolved to the satisfaction of OREIS and the PDC, a data release package is prepared by OREIS staff and sent to the PDC and/or project manager for approval. The data release package contains an OREIS Data Release Form, a summary of the OREIS processing that was performed, a count of the records that will be loaded in OREIS by table, a list of any conversions or assignments that were made by OREIS staff, a graphic representing locations that were transmitted, and summary statistics for comparison with the transmittal summaries. When the PDC and/or the project manager is satisfied with the transformations, if any, made by OREIS staff, the PDC and/or project manager signs the Data Release Form and returns it to OREIS staff.

4.12.7 Load Project Data

When the signed Data Release Form is received, the data are moved from the OREIS processing area to the OREIS data base tables.

4.12.8 Quality Assured OREIS Data

OREIS users are notified as additional data are available and can be accessed. The data are under OREIS configuration control and changes are made to the data only with the approval of the PDC and/or project manager.

4.12.9 Archive Non-OREIS Data

Project data that are not sent to OREIS are archived annually and upon closure of the project, according to "Archival of Environmental Data Within the Environmental Restoration Program" (ERWM/ER-P2200.014), from the project data management system.

4.12.10 Compile Data Records

Records identified during the project as data records will be collected and processed by the project, as instructed by the records work aid (EIM/WA-1).

4.12.11 Transfer Data Records

Project data records will be transferred to the ER DMC.

4.12.12 Process Data Records

The DMC will process and store the project data records.

4.13 ANALYZE AND USE DATA

The data analysis and use stage consists of those activities necessary to process the data and to generate data products for decision making or reporting. Data users may subset, summarize, and analyze the project data and generate text, tables, graphs, maps, models, and other products that describe the analysis results. This stage is often iterative. Results from one set of analyses often suggest other analyses. Figure 15 illustrates the process flow and responsibilities for this stage.

Process Requirements and Business Rules

1. A data analysis will be documented in sufficient detail to allow re-creation of the analysis.

4.13.1 Select Data

Data analyses typically focus on subsets of the project data base or OREIS. This step involves defining the subsets of interest, extracting these data from the data base, and transferring the data to the appropriate analysis tool (e.g., SAS for statistical analysis). Restructuring of the information in the data base via views or another means may be required to integrate all of the information necessary to conduct the analyses. Some consolidation of the data may also be required such as units standardization, spatial or temporal averaging, analyte aggregation, and decay correction of radiological results.

4.13.2 Analyze and Report Data

Data analysis involves summarizing the data to satisfy the technical requirements of the project. Examples include conducting statistical and spatial analyses, performing risk assessments, and conducting transport modeling. Results of the analyses are often published in a report and presented as tables, graphs, electronic files, maps, and three dimensional visualizations.

When analyzing data, sometimes errors are found in the data. The required changes must be communicated to the PDC, the project data base, and/or OREIS so corrections can be made.

Analysis tools provided in OREIS may be used or data may be downloaded and analyzed using other available tools.

4.13.3 Document Data Products

The information necessary to recreate a data product is documented and retained, as required by the ER standards “Data Product Documentation for the Oak Ridge Environmental Information System” (ERWM/ER-S2704) and “Format Requirements for Environmental Restoration Map Products” (ERWM/ER-S2710). This includes the code used to perform queries of the analysis data (e.g., SQL code, SAS code), the name of the data set (or data base) that contains the data used in the analysis, the procedures describing the steps taken to perform the analyses, the order in which the steps are conducted, the name of the person who performed the analysis, and the date the analysis was performed.

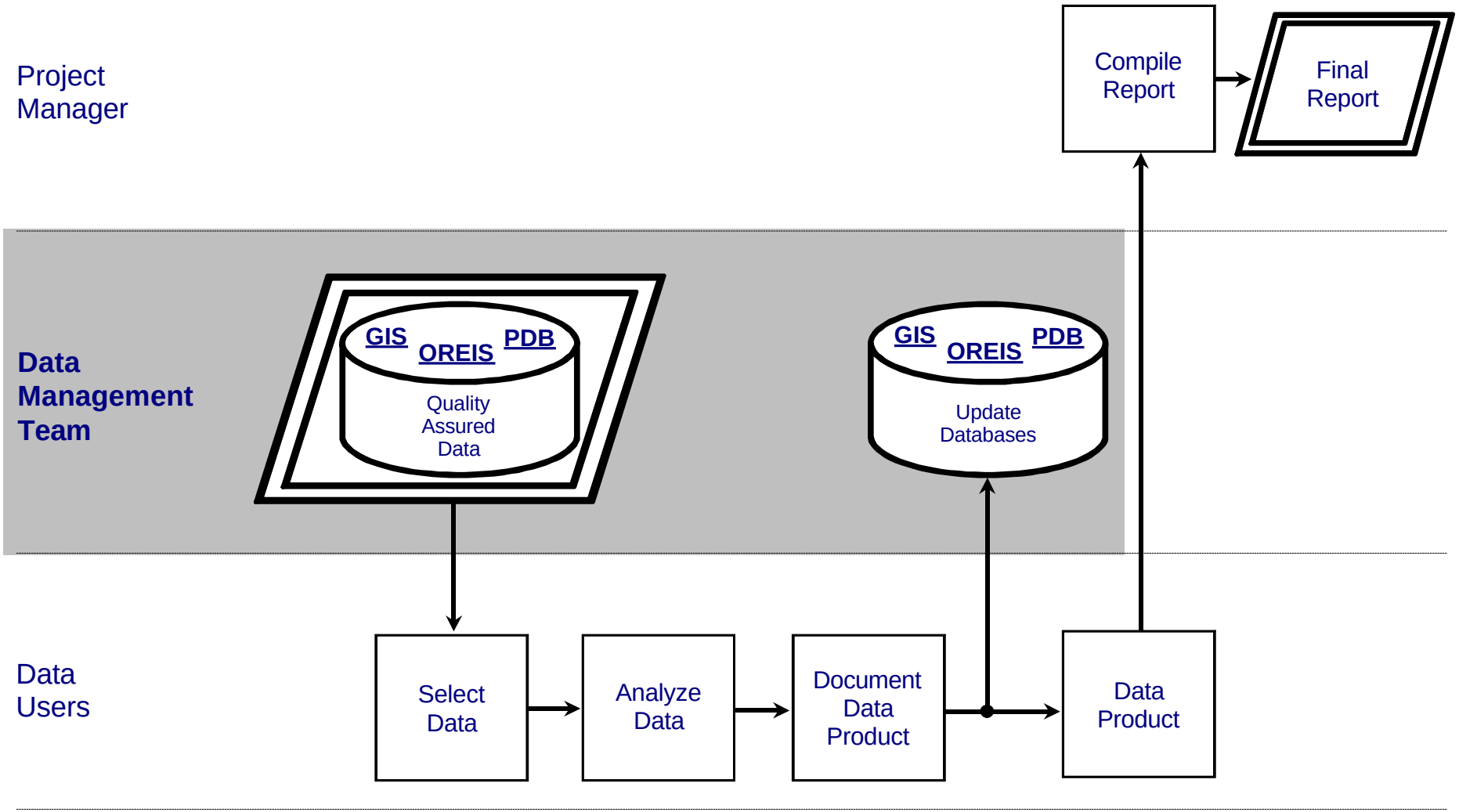

Fig. 15. (Sect. 4.13) Analyze and Use Data

5. SOFTWARE AND COMPUTER SYSTEM IMPLEMENTATION GUIDANCE

APPLICABILITY: **Section 5.1 is applicable to ER Projects using project specific software and an electronic data base.**

Section 5.2 should be implemented by projects selecting existing ER computer systems and software (such as PEMS and OREIS) for project work.

Section 5.3 applies to all projects implementing an electronic data base.

USE: **Project data coordinators use the guidance to meet project needs and document implementation in the DMIP.**

IMPLEMENTATION: **Project data coordinators have the responsibility for ensuring that a project data base and project software are appropriately documented.**

CONSIDERATIONS: **Projects that select an existing ER computer system and software for project work will reduce the amount of project specific data base and software documentation that may be necessary. Section 5.3 implementing procedures have checklists/worksheets that facilitate completing project documentation.**

SUMMARY:

This section defines documentation, quality assurance, and configuration control requirements for software and data management systems used on ER projects. The project data coordinator (PDC) will implement the appropriate guidance to meet project needs.

This chapter defines documentation, quality assurance, and configuration control requirements for software and data bases used on ER projects. Section 5.1 applies to all projects using an electronic data base and provides requirements for project specific data bases and software. Section 5.2 applies to projects selecting existing data management systems (e.g., PEMS, OREIS) and defines the requirements a system must satisfy to be acceptable for use on ER projects. Section 5.3 applies to all projects using an electronic data base and defines requirements for the day to day operation of the data management system.

5.1 PROJECT-SPECIFIC DATA BASE AND SOFTWARE REQUIREMENTS

The need for project-specific data bases and software will vary depending on the scope of the project. A project may utilize an existing data management system and therefore will have no project specific software and data bases; while another project may develop project specific PC data bases or spread sheets, and/or software programs to process, analyze, or report the project data.

This section presents the minimum documentation, QA, and configuration control requirements for project specific data bases and software developed by an ER project. Software and data bases must be compliant with the LMES instruction "Software Management Framework (SMF) Requirements for Software Development and Acquisition" (CU-140 INS). The *Automated Data Processing (ADP) Systems Development Methodology (SDM)* K/CSD/INF/86-3) is the preferred methodology for use in the ER program.

5.1.1 Project Data Base Documentation

Project specific data bases include spreadsheets, data sets, and data bases (e.g., FoxPro, ORACLE) defined by the project data management group to manage the project data. The project specific data bases should be documented in the project file. The data base documentation should identify the commercial data base product used, the data base name, structure, and locations. The backup and recovery plans for the data bases should also be documented according to the ER procedure "Backup and Restoration Processes for Environmental Data Management Systems within the ER Program" (ERWM/ER-P2207).

The minimum data base documentation will consist of

- name of commercial software used;
- names of project data bases created;
- data base structure definitions, including field names and descriptions; and
- storage location and media.

5.1.2 Project Software Documentation

Project specific software includes programs written by the project data management group for data management activities and programs written by the project team for the production of data products (see ADP SDM for a more detailed definition). Data products are defined as any extraction, summary, or analysis of tabular data which result in an electronic data extraction summary or a hard copy product such as tables, graphs, statistics, or maps.

Software documentation should include the software program name, description, special requirements, author, revision, completion date, and documentation of the QA review. Data products documentation should also include all information to uniquely describe how the data product was produced, including the sources used, the manipulations made, and the tools used to produce the data product. Software documentation can be maintained in hard copy or it may be included as comment blocks embedded within the project software program.

The minimum software documentation will consist of

- name of the commercial software used;
- name and version of the software program written by the project;
- author;
- date;
- revision;
- system requirements; and
- storage location.

5.1.3 Project Software Quality Assurance

The project should define the QA requirements for project specific software. At a minimum, software programs to load data, calculate statistics reported in project deliverables, and produce data products should be reviewed to ensure they meet the desired objectives. The reviewer should be someone other than the person who wrote the software program. The project specific software QA requirements should be defined in the project DMIP.

5.1.4 Project Specific Software Configuration Control

Project specific software should be protected from unauthorized modification or deletion. This can be accomplished by administrative controls or file security options provided by many computer operating systems. Changes to project software should be documented and a history of revisions which impact the results or data products should be included in the project file. Commercial products are available to maintain a record of software revisions [e.g., Revision Control Software (RCS)]. Another way to do this is to keep the initial or baseline software in a storage area separate from the working software. Then, when the software changes, the new software can be moved to this separate area also, there maintaining copies of all revisions. Project specific configuration and revision control should be documented in the project DMIP.

The minimum project software configuration control documentation should include

- commercial software used;
- program names;
- revisions (including dates of revision); and
- storage locations.

5.2 SYSTEM SOFTWARE REQUIREMENTS

Many ER projects will elect to use existing computing systems for the data base management and reporting activities. This section describes the software documentation, quality assurance, and configuration control requirements for systems used by ER projects. Software development includes ER data management systems with a wide range of functionality (e.g., PEMS, OREIS), as well as software developed to extract and calculate statistics used in an ER report.

The use of PEMS, with its infrastructure support, satisfies all of the requirements of this section. If the project includes sample collection for remedial design and remedial/ removal action or characterization (RI/FS), then PEMS should be used to manage the project data. PEMS can be considered for use for S&M and D&D activities that include sampling.

OREIS, which must be used in some manner by all ER projects, satisfies all of the requirements of this section. OREIS is a centralized, standardized, quality-assured, and configuration-controlled environmental data management system created to automate the storage and retrieval of environmental data in support of environmental restoration, compliance, and surveillance activities. Projects begin their data search with OREIS during the planning phase of a project's data management activities. Project data that are governed by the consolidated environmental data requirement of the FFA and the Tennessee Oversight Agreement (TOA), are part of an FFA milestone, and/or are used in an ER report (or to support conclusions drawn in a ER report) must be transmitted to OREIS.

5.2.1 Software Development

Data management systems for ER projects are to be managed conforming to the LMES instruction "Software Management Framework (SMF) Requirements for Software Development and Acquisition" (CU-140 INS). SMF contains suggested software development methodologies for use by Energy Systems. The *Automated Data Processing (ADP) Systems Development Methodology (SDM)* (K/CSD/INF/86-3) is the preferred software development methodology for use in the ER program. More information on SMF can be found on the LMES WWW internal server at the URL **http://www-internal.ornl.gov/acm/procedures/cu140ins.htm**.

5.2.2 Software Quality Assurance (SQA)

Identification of software QA needs and the mechanisms necessary to address them, are incorporated in the SMF development structure. Approved software methodologies must address quality and should satisfy requirements in the LMES standard "Software Quality Assurance" (ESS-QA-19.0). An example of an approved methodology is the Software Work Package Methods.

Prior to the development of software application programs, a requirements analysis shall be conducted. Developed software application programs shall be tested and validated to ensure compliance with all user requirements and to provide confidence that the software will perform satisfactorily in service. The technical adequacy of results generated by these applications shall also be reviewed by another person, tested and validated (e.g., does calculations, sample management, risk assessment). Configuration management of the developed software application programs shall be conducted.

5.2.3 Software Configuration Control

Changes and enhancements to software, both during the development process and after formal acceptance, are inevitable. Problems detected during testing must be corrected, existing system requirements often change or are reallocated to improve processing, and new requirements are often added. For any software development effort, this change process is controlled to ensure that only authorized changes or enhancements are incorporated and that system integrity is maintained.

Configuration control is applied to project baselines. A Software Configuration Management process must be identified and implemented. The flow of configuration control is managed by a reporting documentation system geared to track software changes.

Before any changes or enhancements are made to software applications, appropriate approval must be granted and documented. All changes or enhancements made to software applications shall be documented.

5.2.4 Data Base Structure Configuration Control

Data base configuration control includes many of the same requirements as software configuration control. Data base configuration control ensures that the physical data base design and implementation are properly protected from unauthorized changes or destruction and that authorized changes are identified and tracked.

Data base structures are controlled in the same way as software (Section 5.2.3). Before any changes or enhancements are made to a project's data base structure, appropriate approval must be granted and documented. Access control requirements shall be adhered to, and all changes or enhancements made to data base structures shall be documented.

5.3 SYSTEM ADMINISTRATION

This section addresses the day-to-day operations of a data management system, including backups, access, security, data entry, data control, and data archival. All ER projects using electronic data bases shall adhere to the requirements presented in this section. Reference procedures have also been provided (when available) to support project implementation of the following system requirements.

5.3.1 System Backups

Project data shall be protected from loss through preventative data base backup and recovery mechanisms in accordance with the ER procedure "Backup and Restoration Processes for Environmental Data Management Systems within the ER Program" (ERWM/ER-P2207). Data base backups shall be performed on a periodic basis at a frequency to be defined by each ER project. This frequency shall be selected to minimize the extent of consequences of data loss and time required for data recovery. Recovery procedures will be developed and documented in preparation for the event of hardware or software failure. The detailed description of the backup and recovery mechanisms shall be documented in the project DMIP.

5.3.2 System Access

The Energy Systems ADP Protection Handbook provides information regarding computer system access policies and procedures. These procedures apply to single user computer systems as well as multi-user systems.

5.3.3 Data Base Access

Projects shall protect data from unauthorized access by implementation of administrative and procedural controls. Access controls shall be managed based upon specific data user roles that will be defined by the types of data and functionality required (e.g., a data management specialist may have the capability of creating and updating data from field logs; a program manager may require read-only access to perform on-line queries). The mechanism for implementing access control shall be documented in the project data management implementation plan.

5.3.4 Data Security

A classification review shall be performed to determine if any special security considerations must be taken to protect a project's environmental data from unauthorized access. Data derived from the analysis of classified samples shall initially be classified but can be downgraded to unclassified or unclassified controlled nuclear information status, pending review by the Classification Office. Classified data whether electronic or hard copy must be processed and stored in a classified environment. Classified data cannot be stored or processed on an unclassified computer. Project data must be reviewed by an authorized derivative classifier (ADC) for classification level and category before the data are released outside the project, as required by the Energy Systems procedure "Classified Matter Protection and Control Program" (PS-111). The project data must be protected accordingly.

OREIS does not store classified data. Project data to be transferred to OREIS shall be reviewed by an ADC for proper level and category of classification. The site Classification Office and the site Technical Information Office shall then review the data for approval for public release. Only data which have been determined to be unclassified and approved for public release shall be transferred to OREIS as specified in "Transmitting ER Data in Ready-To-Load (RTL) Form to the Oak Ridge Environmental Information System (OREIS)" (ERWM/ER-P2701)

5.3.5 Data Entry

Data entry, transfer, and transformation activities shall be verified in accordance with the ER procedure "Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214) to ensure that data integrity is maintained. This includes all movement/copying of data from one storage medium to another and transformation from one format to another. All data, including analytical data produced and reported by a laboratory, must conform to this requirement.

This requirement encompasses all data recording media, such as handwritten or hard copy produced via electronic means, as well as electronically stored, such as in a data base. It also includes all data collection methods (e.g., electronic collection through real-time monitoring instrumentation, bar coding equipment, and handwritten log entries).

If a data transformation or transfer activity has occurred before receipt of the data by ER personnel (i.e., between creation and final reporting), the verification may be performed by the reporting party but only if sufficient evidence to support the validity of the process can be provided by the reporting party. For example, if a laboratory technician captures data from a laboratory instrument and records it in a logbook, enters the data from the logbook into an electronic data deliverable format, and then transfers the data to the project, the verification process may be performed by the laboratory. The mechanism for a project's data entry, transfer, and transformation verification processes shall be documented in the project DMIP.

5.3.6 Data Base Content Configuration Control

A project should establish configuration control requirements for the contents of the project data base. The requirements should ensure traceability of field and laboratory data from the original reported values through authorized data changes to current values stored in the data base. The configuration control should define the approval process required for making changes to the data base and the documentation required for each data base change.

The minimum information maintained for each data base change should include

- a description of the change;
- the reason for the change;
- the name of the individual making the change;
- the date of the change; and
- a copy of the data before the change took place.

5.3.7 Data Archival

Project data that have been quality assured shall be transferred to the ER DMC for archival in accordance with the ER procedure "Archival of Environmental Data within the Environmental Restoration Program" (ERWM/ER-P2200.014). This shall minimally be performed once a year and upon closure of the project. The ER DMC has long-term archival and data custodianship responsibilities for all archived project data. The schedule and mechanism for data archival shall be specified in the data management implementation plan.

6. REFERENCES

ANSI/ASQC (American National Standards Institute/American Society for Quality Control). 1995. *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* , ANSI/ASQC E4-1994.

DOE (U.S. Department of Energy). 1992. *Federal Facility Agreement for the Oak Ridge Reservation,* DOE/OR-1014, Environmental Protection Agency (EPA) Region IV, DOE, and Tennessee Department of Environment and Conservation, January 1.

Executive Order 12906. 1994. *Federal Register,* Vol.59, No. 71. April 13: 17671–17674.

Spatial Data Transfer Standard (SDTS)/Federal Information Processing Standard (FIPS) Publication 173: *Content Standards for Digital Geospatial Metadata*.

Energy Systems (Martin Marietta Energy Systems, Inc.). 1994. *Environmental Restoration Quality Program Plan*, ES/ER/TM-4/R4, Environmental Restoration Program, Oak Ridge, Tennessee, September.

Energy Systems (Martin Marietta Energy Systems, Inc.). 1994. *Guidelines for the Creation and Management of Geographic Data Bases within a GIS Environment*, Version 1.0, ES/ER/TM-56, Environmental Restoration Program, Oak Ridge, Tennessee.

Energy Systems (Martin Marietta Energy Systems, Inc.). 1996. *Data Dictionary for the Oak Ridge Environmental Information System (OREIS)*, ES/ER/TM-116/R1, prepared by the Environmental Restoration Program, Oak Ridge, Tennessee, March.

Energy Systems (Martin Marietta Energy Systems, Inc.). 1991. *Y-12 Plant Procedures Software Development and Control (80 Series)*, June.

Energy Systems (Lockheed Martin Energy Systems, Inc.) Instruction “Software Management Framework (SMF) Requirements for Software Development and Acquisition” (CU-140 INS).

Energy Systems (Martin Marietta Energy Systems, Inc.). 1990. *Automated Data Processing (ADP) Systems Development Methodology (SDM)*, K/CSD/INF/86-3, March.

Energy Systems (Martin Marietta Energy Systems, Inc.) Standard "Software Quality Assurance" (ESS-QA-19.0, Rev. 1)

Energy Systems (Lockheed Marietta Energy Systems, Inc.) Procedure "Classified Matter Protection and Control Program" (PS-111)

Tennessee Oversight Agreement. 1991. *State Oversight Agreement between the United States Department of Energy and the State of Tennessee*, effective date: May 13.

Energy Systems (Martin Marietta Energy Systems, Inc.). 1991. *Environmental Restoration Waste Management (ERWM) Programs Intersite Procedures Manual*, ES/ER/INT-26/R1, Oak Ridge, Tennessee, August. Procedures:

"Receiving, Processing, and Maintaining Environmental Restoration Program Records" (ER/C-P1110)

"Performance of Environmental Restoration Division Surveillance Activities" (ER/C-P1600)

"Conducting Project Readiness Reviews" (ER/C-P1610)

"Implementation of Training Program Requirements for Environmental Restoration Programs Personnel" (ER/C-P1613)

"Archival of Environmental Data Within the Environmental Restoration Program" (ERWM/ER-P2200.014).

"Development, Completion, and Control of Data Forms and Logbooks" (ERWM/ER-P2205).

"Radiochemical Data Verification and Validation" (ERWM/ER-P2209)

"Volatile and Semivolatile Data Verification and Validation" (ERWM/ER-P2210)

"Pesticide/PCB Data Verification and Validation" (ERWM/ER-P2211)

"Inorganic Data Verification and Validation" (ERWM/ER-P2212)

"Environmental Data Entry, Transfer, and Transformation Verification" (ERWM/ER-P2214).

"Controlling and Documenting Field Changes to Approved Field Sampling Plans" (ERWM/ER-2303).

"Implementing and Documenting the Data Quality Objectives (DQO) Process for Environmental Restoration (ER) Projects" (ER/C-P2305)

"Transmitting ER Data in Ready-To-Load (RTL) Form to the Oak Ridge Environmental Information System (OREIS)" (ER/C-P2701)

"Data Product Documentation for the Oak Ridge Environmental Information System" (ERWM/ER-S2704)

"Format Requirements for Environmental Restoration Map Products" (ER/C-S2710)

"Submitting, Reviewing, and Implementing Changes to the Oak Ridge Environmental Information System Data Structure (OREIS)" (ERWM/ER-P2703)

OREIS procedures, as follows:

"Processing and Review of Environmental Measurements Data" (OREIS/P-2803)

"Processing and Review of Geographic Information System Data" (OREIS/P-2802)

Energy Systems (Martin Marietta Energy Systems, Inc.). 1988. *Environmental Surveillance Procedures Quality Control Program*, ES/ESH/INT-14, Oak Ridge, Tennessee, September. Procedures:

"Environmental Measurements Verification and Validation" (ESP-108)

"Sample Chain of Custody" (ESP-501)

"Field Logbooks and Data Forms" (ESP-503).

"Preparing Samples and Laboratory Standards for Transport and Shipping" (ESP-505)

Energy Systems (Lockheed Martin Energy Systems, Inc.) Environmental Information Management Program work aids, as follows:

"Identification and Processing of Environmental Data Records" (EIM/WA-1).

"Inventory and Documentation of Existing Data" (EIM/WA-2).

7. DEFINITION OF TERMS

Analytical data validation: Analytical data validation is a systematic process, performed external from the data generator, which applies a defined set of performance-based criteria to a body of data that may result in physical qualification of the data. Data validation occurs prior to drawing a conclusion from the body of data.

Analytical data verification: Analytical data verification is a systematic process of evaluating the completeness, correctness, consistency, and compliance of a set of facts against a standard or contract which is performed by either the data generator or by an entity external to the data generator.

Bar code: A horizontal strip of vertical bars of varying widths and grouping which represent symbols referred to as "characters."

Bar code reader: An instrument that scans bar codes and converts the information into digital information that can be downloaded into a computer for further processing.

Compare program: A software program designed to compare the contents of two data bases or ASCII files and report any differences found.

Data entry: The manual keying of data directly into a data base or into data entry screens for transfer into a data base.

Data life cycle: The data management activities described in Sect. 4 cover the complete environmental measurements data life cycle: planning and requirements definition; preparation for sampling; field data collection; sampling documentation; sample tracking; data verification, review, and assessment; data consolidation and archival, analysis, and product generation; and data product documentation.

Data logger: An instrument that logs or records data automatically. Periodically the data is collected and processed.

Data quality assessment process (DQA): The DQA process is a tool for assuring that the type, quality, and quantity of data are appropriate for their intended use, answering two fundamental questions:

(1) Can the decision (or estimate) be made with the desired level of confidence, given the quality of the data set?
(2) How well does the sampling design perform over a wide range of possible outcomes?

Data usability: Data usability is the ability of data to satisfy a user's needs. Data usability is determined, for ER projects, through the evaluation of data and quality related to the sufficiency of supporting a remedial decision or action, in terms of the specific data quality objectives established for the site.

Data validation plan: The data validation plan is the documented strategy for prescriptive implementation of data verification and validation for an ER project. The plan includes the approaches for both data verification and data validation.

Double-data entry: A verification method used for the data entry process. This method involves data being simultaneously entered into two identical data bases or computer files (i.e., data entry screens) by two different data entry clerks. The resulting files are then compared electronically using a compare program. Any differences are noted, and all discrepancies and errors are then resolved and corrected.

Download: To transfer data from one computer (or instrument) to another computer (or instrument).

Drop-down list: A type of list displayed on a data entry screen in which you can only make choices from the list, rather than keying in arbitrary values.

Electronic data deliverable (EDD): An electronic file, or files, created by a data generator for the purpose of delivering information to a data receiver.

Free form input: A type of data entry where the values being entered are not restricted. The risk of inconsistent values in a data base is highest with free form input.

Legally-admissible environmental data: Environmental data which are relevant to the litigation at hand.

On-site measurement: An analytical determination made on site or in a close-support laboratory where real-time decisions will be made on the data.

Ready-to-load (RTL): A prescribed form for preparing, formatting and transmitting data. It allows the data to be loaded directly into the receiving data base as it is received. The specific format depends on the data base that is to receive the data.

Sample: A sample is physical evidence taken from an environment which represents the characteristics a specific location at a specific time; it is contained in single or multiple containers and is made up of all respective aliquots.

Technically-defensible environmental data: Environmental data of which the level of documentation is sufficient and the level of uncertainty is known to an extent providing the basis to withstand reasonable scientific challenge.

Verification: The act of reviewing, inspecting, testing, checking, auditing, or otherwise determining and documenting whether items, processes, services, or documents conform to specified requirements. In general, verification identifies errors that can be corrected. It is a process of evaluating the completeness, correctness, consistency, and compliance of a set of facts, or product, against a standard or contract.

APPENDIX A

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APPENDIX A: ENVIRONMENTAL DATA DEFINITION

Environmental data: those data obtained through an ER project's data collection activities to support project objectives related to environmental management or remediation decisions.

Environmental sampling and analysis data: these data include

- analysis results and associated information such as monitoring locations, sample dates, depths, and units; parameters, methods, and qualifiers;
- data review, validation, and assessment records; and
- data generation, transformation, and verification records; and
- data product documentation records.

Field site preparation activities generate environmental data: these data include

- site survey data and sampling locations;
- records of installing and inspecting any necessary wells, weirs, tanks, etc.;
- records of installing and testing any necessary field equipment; and
- documentation of changes in the status of monitoring locations (e.g., a damaged or plugged well).

Environmental data include geographical information: these data are managed as map data files and associated information. This can be in the form of measurement results linked to geographic coordinates, spatial models of measurement results in the form of extrapolated surfaces or volumes, and spatial interpolation of risk analysis results.

Environmental site survey data: these data include

- radiological, geophysical, and asbestos monitoring results for site;
- site meteorological data; and
- site population demographics.

S**ite and facility inspection and monitoring generate environmental data**: these data include

- field site conditions;
- field structure conditions and status;
- waste management storage area compliance checks;
- site and facility design specifications related to environmental management
- building inspection records and security requirements; and
- tank inspections, conditions, and content levels.

Field measurements generate environmental data: these data include

- measurement results and associated information such as monitoring locations, dates, depths, units; parameters, methods, and qualifiers;

- continuous monitoring of effluents during construction activities;
- continuous monitoring of water levels;
- data review, validation, and assessment records; and
- data generation, transformation, and verification records; and
- data product documentation records.

NOTE: Environmental data does not include financial or human resources data.

APPENDIX B

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APPENDIX B: OREIS DATA TYPES

RULES

1. If the data are covered under the consolidated environmental data requirement of the FFA and the TOA, or are part of an FFA milestone, the data must be transmitted to OREIS. The two exceptions are: (1) if the data are already in OREIS, send OREIS information identifying which records were used but do not resend the data, or (2) if the data transfer specification and implementation plan for submitting a particular type of compliance data have not been approved.

2. If data are used in an ER report or used to support conclusions drawn in a ER report the data must come to OREIS. The exception is if the data are already in OREIS, send OREIS information identifying which records were used but do not resend the data.

   NOTE: If the data are not in OREIS and the project is not the original source of the data (i.e., the project is not a groundwater project but uses historical groundwater data from the groundwater program), those data need to come to OREIS from the original source, and the records used by the current project need to be flagged. This way, OREIS can associate all the data used in a project with that project, even if the project does not provide the data to OREIS.

3. All sample measurements, field samples, GIS coverages, site preparation data, and supporting metadata generated or used by ER projects (including D&D and S&M) must come to OREIS. The exception is if the data are already in OREIS.

4. Data used to support a current or future risk assessment must come to OREIS.

5. If you have questions about what data to transmit to OREIS, contact the OREIS data specialist assigned to the project.

DATA TYPES AND DESCRIPTIONS

The following table outlines the data types that are to be transmitted to OREIS from ER projects and provides brief descriptions of each data type.

Table B1. Data Types To Be Transmitted to OREIS from ER Projects

Data Type	Description
Laboratory Measurements -chemical -rad -physical	• Sampled Media (groundwater, surface water, biota, soil, sediment, air, tank contents) • Sample Types (regular, replicates, trip blanks, field blanks, rinsates) • Metadata (methods, detection limits, lab and validation qualifiers)
Field Measurements -chemical -physical -screening -rad survey -geophysical -hydrological	• Monitored Media (groundwater, surface water, biota, soil, sediment, air, tank contents) • Result Types (regular and replicates) • Metadata (methods, field and validation qualifiers)
Construction Information	• Tanks, wells, boreholes, coreholes
Geospatial	• Coordinates for all sampling and monitoring locations • Raster or vector images or maps produced for or used in official regulatory reports • Metadata associated with the data transmitted
Historical Measurements Data (all types)	• As identified by a PDC for an active project or program • As identified by a risk assessor for an active project or program
Additional Data	• Tennessee Department of Environment and Conservation groundwater • Photographs • Well construction logs • Film clips • Health physics • Waste inventories

APPENDIX C

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APPENDIX C: DATA MANAGEMENT SYSTEM FUNCTION DESCRIPTIONS

There are three ER supported data management systems that provide services to projects. PEMS and GISST support project level activities. OREIS is the consolidated repository for ER data. The functions of each of these systems as they relate to ER project needs are outlined below.

PROJECT ENVIRONMENTAL MEASUREMENTS SYSTEM (PEMS)

PEMS is the data management system for use by all LMES Environmental Restoration Program projects to support any environmental sampling and measurement collection efforts. The system can be accessed by any project team member throughout the full project life cycle.

PEMS Functionality

- **Initiate the Project**

Project documents are reviewed for information to populate PEMS reference tables. The project Work Plan or Sampling and Analysis Plan contains the sampling locations, frequencies, analysis, containers, and field measurements to be collected. The software provides reference tables to populate the sampling tasks defined by the SAP prior to sampling for use in planning and sample collection. The laboratory statements of work (SOW) provide specific analytes, analysis methods, electronic and hard copy deliverables, and cost for sample analysis. The software provides reference tables to enter the laboratory SOW information. PEMS Information Services support personnel work with the PDC and analytical services coordinator during project initiation to ensure that PEMS can load the electronic data deliverables containing sample results..

- **Plan for Sampling**

PEMS supports planning to go to the field by providing tools to bring the information populated from the SAP as tasks over to field forms (field activity sheet or field chain of custody) so that containers can be assembled and labeled prior to going to the field. The software can generate sample container labels and bar code labels. The software also tracks the forms and log books associated with sampling events for traceability from the system to the hard copy.

- **Collect Samples and Field Measurements**

The field crews use the forms generated in Plan for Sampling to record field measurements and sample collection information such as the pH reading, sample collection date and time, and water conductivity. Bar code readers can be used in the field to scan sample collection information and field measurements. Bar coded information is downloaded into PEMS from the readers and loaded into the database after verification by field personnel. Use of bar code readers decreases manual data entry and improves data quality by reducing transcription errors in data entry. If bar code readers are not used, sample collection information and field measurements can be entered into PEMS via data entry screens.

PEMS has software to generate bar code labels for use on field forms, logbooks, and sample containers.

PEMS can load and display information collected by automatic data collection devices such as groundwater levels, conductivity, water temperature, surface water levels, and meteorological data. Tools are provided to validate the field measurements collected to detect malfunctioning devices, missing data, or data out of range for the device.

- **Ship Samples to Laboratories**

PEMS can generate the laboratory chain of custody for sample shipment. It also has sample tracking information on planned, collected, and shipped samples.

- **Receive and Process Analytical Results**

PEMS supports the tracking, electronic screening, and loading of electronic data deliverables (EDDs) into the project database. Customer and Quality Control (QC) result information can be loaded into the project database.

PEMS can screen and load several types of data deliverables. Contract Lab Program (CLP) deliverables are screened using the Contract Compliance Screening (CCS) software and Computer Aided Validation and Evaluation Assessment Tool (CAVEAT) software. The CLP deliverables include inorganics, organic pesticides, and semi-volatiles. In addition, non-CLP deliverables can be screened and loaded in PEMS (e.g. radiological, wet chemistry, etc.). It is important that the PDC and analytical services coordinator work with the Information Support staff when defining EDD's for a project.

- **Evaluate and Qualify Data**

PEMS provides data entry screens to permit the entry of data qualifiers and reason codes for analytical results.

- **Analyze and Access Data**

Several sample tracking reports are available to display sample status, holding time and turnaround times, validation status tracking, and milestones. ORACLE Browser and SAS are available for end users to generate customized reports for projects.

- **Transfer Project Data to OREIS**

OREIS ready to load files can be generated from PEMS to facilitate the transfer of project data to OREIS.

OAK RIDGE ENVIRONMENTAL INFORMATION SYSTEM (OREIS)

OREIS is the long term repository for environmental data for all Environmental Restoration projects. Its primary users include on-going projects, DOE and its contractors and subcontractors,other regulatory agencies, and the public. Projects may find existing data relevant to their objectives in OREIS.

OREIS Project Level Functionality

- **Access to Existing Data**

OREIS provides a starting place for projects that need historical data. The OREIS program office can assist project staff in determining whether data in OREIS are appropriate for their use. In addition, OREIS has a user interface and user support services to facilitate the identification and retrieval of relevant data.

- **Analysis and Access to Project Data**

OREIS provides a user interface, analysis tools, user support services, and project data to facilitate analysis and use of project data.

- **Analysis and Access to Data Across Projects**

OREIS contains a variety of data types from many projects and programs. Because the data are in a single consolidated, standardized data base, these data may be analyzed across projects.

- **Report Generation**

OREIS provides data analysis tools and easy retrieval of data to support the generation of project reports.

- **Evolve to Meet Project Needs**

OREIS continues to evolve to meet project needs by adding specific valid values to OREIS code tables, adding code types, adding fields to store data critical to a project's needs, and adding tables when appropriate.

- **Long-Term Storage of Project Data**

OREIS provides a centralized, standardized data base under strict configuration control to store and manage environmental data.

- **Submit Data to Regulators**

For FFA Milestone data, OREIS prepares and submits data to DOE, EPA, and the state.

GEOGRAPHIC INFORMATION SYSTEM SERVER TECHNOLOGY (GISST)

Geospatial Support (GSS) provides support to projects by assisting them in accessing data sets or high resolution aerial imagery and vector lines and polygons for the ORR and Paducah and Portsmouth sites. Additionally, GSS maintains the GISST, which provides the ability for projects to create project specific geospatial data storage/server functions in which data access can be controlled.

GISST Functionality

- **Access to Base Map and Remote Sensing Data**

The GISST provides, through OREIS or the GISST WWW, interface access to base map vector data (e.g., roads, buildings, elevation contours, hydrologic features) and digital ortho-imagery for the entire Oak Ridge Reservation, Portsmouth and Paducah DOE facilities. Data formats currently supported include Arc/Info and MapInfo for the vector data and BMP and TIF formats for the imagery data which can be used directly in both Arc/Info and Map/Info as well as other GIS packages (see Table C1). The data for each site has been broken into tiles to make the file sizes manageable. The GSS has the capabilities to concatenate multiple tiles of all features and provide data for areas larger than individual tiles. This has been a problem for GISST data users, particularly those using Map/Info.

- **Project Specific Data Server**

GISST provides the ability for projects to create project specific geospatial data storage areas and data servers. Access to project data is completely controlled by project personnel. For example, work in progress on a specific coverage can be accessed controlled to a single user. As work on the coverage nears completion the access can be extended to all project personnel for review. Once a final version is agreed upon, data can be transferred to OREIS and made available to the OREIS users community through a standard deliverable OREIS RTL file. GISST will provide projects storage space for large spatially-based data files, an access control system, a means for the GSS to more readily assist projects regarding spatial analysis methods, and a more timely movement of spatial data to OREIS. GSS provides the support for creating and managing this data storage/retrieval system.

Table C1. Standard GIS/CAD systems used and their functionality relative to EIM Data Management Requirements

GIS / CAD System	Platform	General Features: Ease of Use, Range of Functions, Data links, etc.	Conversion to Arc/Info for OREIS RTL
Arc/Info	PC-Windows Unix Workstation	Wide range of spatial analysis and data manipulation tools, requires working knowledge of GIS and Arc/Info commands and syntax. Line command operation. Multiple data table formats can be "hot-link" or converted to Arc-Info useable.	Preferred OREIS format is Unix Arc/Info
ArcView	PC-Windows Unix Workstation	Growing Range of spatial analysis tools. Easy GUI point and click use. Very good tool for spatial data query and map production. Links to data through DBF or ASCII tables.	Preferred format, may need to convert shape files
MapInfo	PC-Windows	Simple Easy User interface for mostly spatial data query and map making functions. Links to data through several common spreadsheets and data base systems.	Need to convert to Arc/Info
Erdas	Unix Workstations	Primarily raster-based system designed for image processing but performs a wide range of spatial analyses. Requires working knowledge of data and image processing and GIS. Limited data integration.	Arc/Info can handle *.lan and *.img files
GRASS	Unix Workstations	Primarily raster-based system with moderate range of spatial analysis tools. Inexpensive. Has image processing, GIS overlay, map making capabilities. Line command driven. No clean interface with existing data table formats.	Need to Convert to Arc Grid format
Intergraph	PC-Windows Unix Workstation	Mostly vector-based with raster overlay capabilities. Modular design allows for software customization based on needs. Base modules provide wide range of data input and development, GIS analysis and map production. Additional modules provide 3-D display and manipulation, and dedicated groundwater analysis tools. Can be used with several established databases including Oracle and Informix. Can be run from command line but has extensive user interface functionality.	Need to convert to Arc/Info format
AutoCad	PC-DOS/Windows Unix Workstations	Vector based system used primarily in the engineering fields, specifically for facilities management applications. Provides some database functionality for basic GIS operations. Basic tools provide 3-D capabilities. Recently developed user interface for Windows environment.	Need to convert to Arc/Info format

APPENDIX D

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APPENDIX D: OREIS OVERVIEW

The Oak Ridge Environmental Information System (OREIS) operates under a 1994 DOE-ORO written and approved charter. The charter provides the following information about OREIS:

OREIS is a centralized, standardized, quality-assured, and configuration-controlled environmental data management system. It is comprised of hardware, commercial software, customized integration software, an environmental measurements data base and a geographic data base, and documentation. OREIS fulfills the environmental information management obligations of the Department of Energy-Oak Ridge Operations (DOE-ORO) under an enforceable Federal Facility Agreement (FFA) Docket No. 89-04-FF under Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Sections 3008(h) and 6001 of the Resource Conservation and Recovery Act of 1976 (RCRA). Given the advantages and cost-effectiveness of computer technology for managing massive amounts of data, parties to the FFA and the Tennessee Oversight Agreement (TOA) chose to create OREIS in order to automate the centralized storage and retrieval of environmental data.

The basic mission of OREIS is efficient retrievability and long-term (>3 years) retention of ORO environmental data. Its primary users include DOE and its contractors and subcontractors who perform environmental restoration, compliance, and surveillance activities. Other users include the Environmental Protection Agency (EPA), the Tennessee Department of Environment and Conservation, other agencies, and the public.

The objectives of OREIS are to maintain data that are complete, consistent, and fully qualified as to their usability; to provide ease of accessibility of environmental data that support environmental planning, analysis, and decision making; to facilitate the efficient access, reporting, analysis, display, mapping, import, and export of data; to minimize the uncertainties associated with data, data products, and interpretation of results by strictly controlling data input, revision, and storage; to ensure that metadata are available for establishing the legal admissibility of the data and data products; and to minimize duplicative costs to DOE for data collection, management, analysis, and reporting as contractor and subcontractor changes occur.

The scope of OREIS includes data supporting environmental restoration, compliance, and surveillance activities. Environmental data that are incorporated in the OREIS computer system include known quality measurement and spatial data from the following environmental media: groundwater, surface water, sediment, soil, air, and biota. The types of environmental data within OREIS include but are not limited to chemical, biological, ecological, radiological, geophysical, and lithological data. In addition to environmental measurement data, the OREIS data base contains extensive descriptive and qualifier metadata to help document data quality and to enable end users to analyze the appropriateness of the data for secondary uses. OREIS contains both validated and unvalidated data as determined by the originating organization. To ensure that the quality of the data is known, OREIS flags the data validation status. The scope does not include project-specific activities (e.g., sample tracking, field results data entry, equipment calibration records) or project control tools (e.g., cost accounting or milestone tracking) which are available through other computer systems.

OREIS Data Management Goals:

The primary goals of OREIS data management are to maintain data that are complete, consistent, and fully qualified: to ensure the accessibility of environmental data that support environmental planning and decision making (e.g., regulatory reports, environmental analyses, risk assessments, and others); to facilitate the efficient accessing, reporting, analyzing, mapping, and exporting of the data; to minimize the uncertainties associated with the data, data products, and the interpretation of results; and to ensure that metadata are available to establish the context and quality of the data.

Centralization

OREIS is a centralized database that provides access to data for secondary users and long-term storage of environmental measurements and geographic data.

Consolidation

OREIS is a consolidated database for environmental measurements and geographic data from environmental programs and associated activities.

Standardization

OREIS is a standardized database, using required formats and valid values, aggregation, and other processing to ensure consistency.

Standardizing data is a major challenge of the OREIS program because similar data have been collected at sites using dissimilar methods and stored using different data definitions. It is essential that OREIS users be able to retrieve data for a specific attribute from different sites and have confidence that the results are comparable. OREIS has developed a Ready-to-Load (RTL) format that ensures consistency in data transmitted to OREIS by defining required data formats. In addition, OREIS has developed, in conjunction with other environmental and database professionals, lists of valid values for coded fields.

Evaluation

OREIS maintains appropriate qualifiers for historical and newly collected data.

Data providers are responsible for data verification and validation. The qualifiers are stored in OREIS to aid users in defining the usability of the data for specific purposes by secondary users. OREIS staff evaluate the data for completeness and consistency.

Analysis and Reporting

OREIS develops and maintains tools for reporting, analyzing, displaying, mapping, and exporting data to generate consistent products.

OREIS provides users direct access to the OREIS database through interactive menu screens to view data, access OREIS tools (e.g., Oracle Data Browser, SAS, and ArcView), produce standard reports and graphical displays, analyze and map geographic data, and export data for use in other systems. In addition, OREIS staff are available to assist in specialized data requests. In addition, OREIS is developing a PC WWW-based user interface that will allow users to view summaries of data and graphics and to download data.

Documenting Data

OREIS documents all data, data products, and data management activities.

Metadata are required to document or provide information about data. While the need for metadata in a database is well established, the concept of metadata and ways to define and implement it are evolving. Metadata are compiled by data providers and are transmitted to OREIS with the corresponding environmental data. Because of the many contributors and users, the variety of data types, the long-term expectations, and regulatory demands, metadata are extremely important to help users define the usability of data for secondary uses.

Security

OREIS maintains data security through controlled system access and routine database backups.

Although there is unlimited read-only access to data in OREIS by authorized users, access controls have been implemented to protect the integrity of the database. OREIS is designed using *K/CSD/INF/86-3 Automated Data Processing Systems Development Methodology.* The system is protected against unauthorized access or accidental data corruption through the use of passwords and maintenance of user access profiles. While users have read-only access, the OREIS Data Base Administrator (DBA) and other staff have write access and system privileges. The OREIS database and associated programs and data are routinely backed up to protect against system problems with copies of the backups place in archival storage.

User Feedback

OREIS incorporates user feedback in the evaluation, planning, and operation of OREIS to respond to user needs and maintain high levels of performance.

OREIS will continue to evolve as the needs of data providers and users change and as new technology becomes available. OREIS will continue to use review teams representing ER and EM programs, regulators, and other users to provide formal guidance for refinements to the system. OREIS data management staff work with data providers to refine guidelines for data transmittal and processing in order to simplify data transfer. OREIS staff work with users to determine needs for reports, analyses, displays, and access. OREIS uses the WWW, an OREIS user e-mail group, and online files to communicate with users. In addition, OREIS staff provide training to users about the capabilities and effective use of OREIS.

Configuration Control

To establish a process that involves establishing the baseline computer system and controlling system changes thereafter to be consistent with approved prioritization, quality, and budget parameters.

OREIS has a well developed configuration control plan. It is a process that involves establishing the baseline computer system and the baseline data structure. It is a process that controls system changes thereafter to be consistent with approved prioritization, quality, and budget parameters.

The driver for the configuration control process is an OREIS procedure,"Submitting, Reviewing, and Implementing Changes to the Oak Ridge Environmental Information System (OREIS)." This procedure helps control the following components:

- the commercial hardware and software;
- the user interface and customized software;
- the data model of the environmental measurements data base;
- the data values in the environmental measurements data base and the geographic data base;
- the reference tables of the environmental measurements data base;
- the geographic (spatial) data structure; and
- the OREIS documentation, including procedures.