



A REPORT
TO THE
MONTANA
LEGISLATURE

LEGISLATIVE AUDIT
DIVISION

09DP-01

INFORMATION SYSTEMS AUDIT

*Consolidated
Environmental Data
Access and
Retrieval System:
Verification of Data
Accuracy and Integrity*

*Department of
Environmental Quality*

SEPTEMBER 2009

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September 2009

The Legislative Audit Committee
of the Montana State Legislature:

We conducted an Information Systems audit of the Consolidated Environmental Data Access and Retrieval System (CEDARS). The Department of Environmental Quality (DEQ) operates and maintains CEDARS to assist in the administration of environmental and facility site data including permits and fines. The focus of the audit was to determine the success of the migration process and if CEDARS was operating as expected in maintaining customer records and generating reports. Security controls to maintain the integrity of CEDARS data were also reviewed during the audit.

Overall, we found DEQ has controls in place to ensure CEDARS is accurately reporting environmental and site data, as well as securing access to CEDARS. However, we did identify areas where DEQ can improve. As a result, we issued two recommendations relating to improving system development by implementing best practices for migration of new programs into CEDARS, and improving business continuity of CEDARS operations by implementing a disaster recovery/business continuity plan.

We wish to express our appreciation to personnel within the Department of Environmental Quality for their cooperation and assistance.

Respectfully submitted,

/s/ Tori Hunthausen

Tori Hunthausen, CPA
Legislative Auditor

TABLE OF CONTENTS

Figures and Tables.....ii
Appointed and Administrative Officialsiii
Report SummaryS-1

CHAPTER I – INTRODUCTION.....1
Introduction1
Audit Objectives.....2
Audit Scope and Methodology3
Audit Overview.....3

CHAPTER II – CEDARS DEVELOPMENT5
Introduction5
Program Structure Conversion.....5
Program Data Migration.....6
Historical Databases Maintained6
Implementation of Best Practices6

CHAPTER III – DATA SECURITY AND INTEGRITY9
Introduction9
Change Management Controls9
User Access Controls9
Data Entry Controls10
Reporting Controls11

CHAPTER IV – BUSINESS CONTINUITY.....13
Introduction13
Disaster Recovery/Business Continuity Plan13

DEPARTMENT RESPONSEA-1
Department of Environmental QualityA-3

FIGURES AND TABLES

Figures

Figure 1	CEDARS Architecture	2
----------	---------------------------	---

APPOINTED AND ADMINISTRATIVE OFFICIALS

**Department of
Environmental Quality**

Richard Opper, Director

Tom Livers, Deputy Director

Dan Chelini, Chief Information Officer

REPORT SUMMARY

Consolidated Environmental Data Access and Retrieval System

The Consolidated Environmental Data Access and Retrieval System (CEDARS) is a computer system implemented by the Department of Environmental Quality (DEQ) to assist in the administration of environmental and facility site data including permits and fines. CEDARS development began in 2000 with the migration of legacy environmental databases into a single integrated system. CEDARS was put into production in 2002. To date, business processes for five legacy applications have been migrated into sub-systems within CEDARS. Additional applications will be implemented into CEDARS depending on funding and departmental needs.

Facility site data stored in CEDARS includes permit information, client contact information, and environmental records. The data and functionality of CEDARS is used by employees from multiple departments in DEQ to maintain business records, permits, fines, and a multitude of environmental data. Reports generated from CEDARS data are used by DEQ personnel, the Environmental Protection Agency (EPA), and the public.

CEDARS plays an important role in the maintenance of environmental and site data. As such, it is imperative the system is accurately storing, processing, and reporting data. In consideration of this, we established audit objectives to determine if DEQ had successfully and accurately migrated legacy data into CEDARS and verify CEDARS was accurately maintaining customer records and generating reports. We also performed audit work to determine if security controls are in place to ensure the integrity of CEDARS data.

Overall, we found DEQ has controls in place to ensure CEDARS is accurately reporting environmental and site data, as well as securing access to CEDARS. However, we did identify areas where DEQ can improve. This report includes two recommendations for DEQ relating to improving system development by implementing best practices for migration of new programs into CEDARS and improving business continuity of CEDARS operations by implementing a disaster recovery/business continuity plan.

Chapter I – Introduction

Introduction

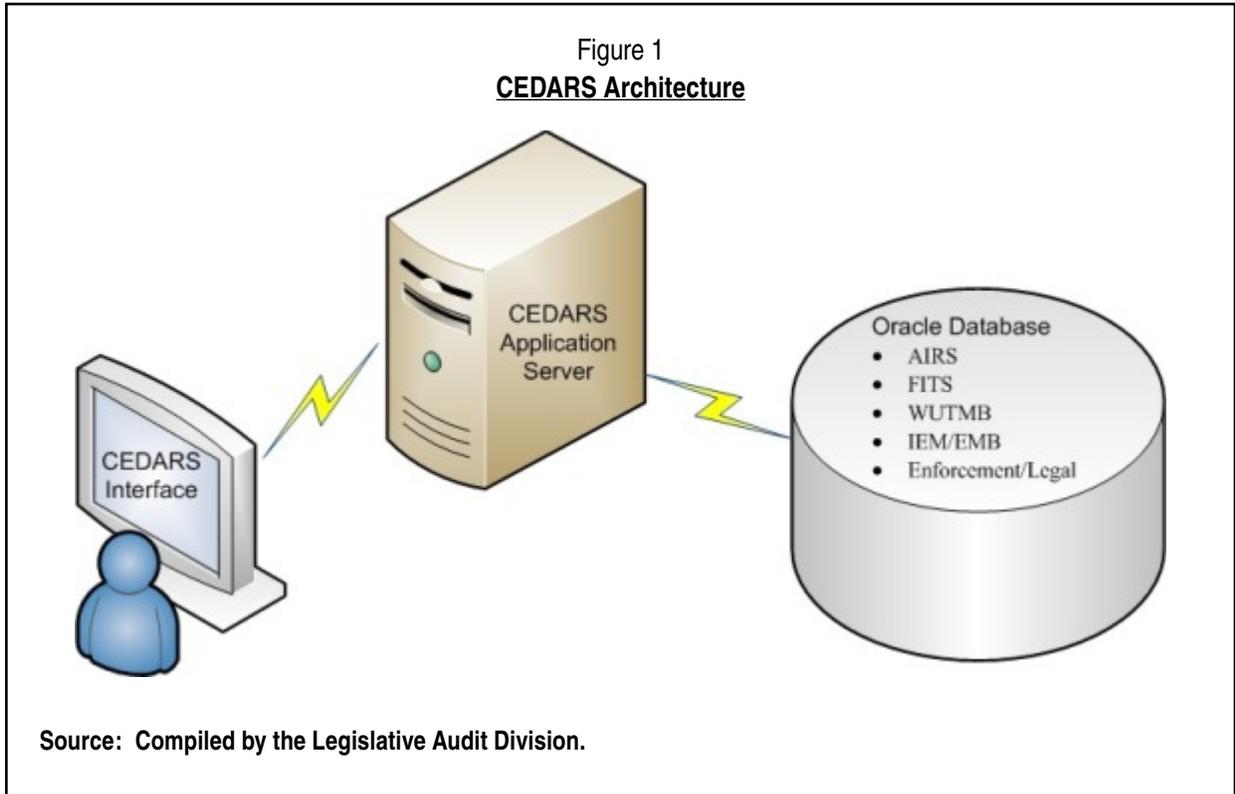
A critical part of Department of Environmental Quality (DEQ) program administration is maintenance of environmental data. To assist in this task, the agency developed multiple databases and systems accommodating data within the various programs. System operations include management of water quality, air quality, hazardous waste, as well as a multitude of other environmental permitting programs. At peak, 175 individual databases were in use throughout the department.

In calendar year 2000, DEQ began an effort to integrate the various program systems and databases into a single Oracle database with a shared web application used to access data. This project was named the Consolidated Environmental Data Acquisition and Retrieval System (CEDARS). Based on DEQ documentation, management intended to integrate all individual databases into CEDARS; however, according to current DEQ management further integration of additional databases will depend on funding and departmental needs. CEDARS was first placed into production in 2002 as an integrated database storing information for sites of environmental interest to DEQ. This core site data system is modeled after the Environmental Protection Agency's (EPA) Facility Identification Template for States.

To date, DEQ has migrated the following five legacy applications into subsystems within CEDARS, each with its own official application interface requiring a valid username and password to access the subsystem:

- ◆ Airs (Air Quality Subsystem)
- ◆ Enforcement/Legal
- ◆ FITS (Facility Identification Template for Sites)
- ◆ IEM/EMB (Industrial and Energy Minerals Bureau)
- ◆ WUTMB (Waste and Underground Tank Management Bureau)

The official application interfaces provide access to appropriate program data and functions critical in maintaining site and environmental data. The multiple subsystems and associated data in CEDARS, including these five programs, all reside in the same database. Figure 1 provides a visual description of the CEDARS architecture.



Audit Objectives

Multiple interfaces to the CEDARS production database exist allowing users to collect, analyze, review, and compile reports on environmental information. There are over 275 CEDARS users spread across all divisions within DEQ. One of the critical functions of CEDARS is to access and retrieve data records, and provide environmental reports used by DEQ personnel, the EPA, and the public. Based on the importance of environmental information and reliance on data by DEQ, EPA, the Montana State Legislature, and the public, our audit focused on the security and integrity of data in CEDARS.

CEDARS plays an important role in the maintenance of environmental and site data. As such, it is imperative the system is accurately storing, processing, and reporting data. Due to the critical role of the system, we conducted audit work to address the following four objectives:

1. Verify data records completely and accurately migrated into CEDARS from external databases.
2. Verify access to CEDARS is authorized and appropriate.
3. Verify reports output by CEDARS are accurate.
4. Ensure DEQ has developed a plan to recover CEDARS in the event of an emergency or major outage.

Audit Scope and Methodology

DEQ has migrated five unique program applications into subsystems within CEDARS. The scope of our audit primarily focused on the integrity of data within the five subsystems including accurate migration and reporting of data. In addition, outside influences can affect system operations and data integrity. Consequently, we included security of the CEDARS application and hardware in the scope of this audit. Specifically, we reviewed user access to CEDARS and plans for ensuring continued operation of the system in the event of a disaster or major outage.

Testing of CEDARS functionality and controls was conducted through a combination of IT staff interviews, review of agency documentation, observation of CEDARS processes, and extraction and analysis of CEDARS data using a computer assisted audit tool.

This audit was conducted in accordance with Government Auditing Standards published by the United States Government Accountability Office (GAO). We evaluated the control environment using state law, best practices, and generally applicable and accepted information technology standards established by the IT Governance Institute.

Audit Overview

Based on our work, we conclude DEQ has successfully migrated five program subsystems into CEDARS, including successful migration of data records. We identified system and security controls in place to maintain CEDARS data. While these controls are in place, we identified areas in the development of CEDARS where DEQ could improve. Specifically, system development best practices should be implemented to ensure continued successful migration of future program subsystems, including documenting cost and time requirements to help monitor cost efficiency. In addition, DEQ can improve the continuity of CEDARS operations by implementing a disaster recovery program. The remainder of this report discusses our findings and recommendations.

Chapter II – CEDARS Development

Introduction

The development of the Consolidated Environmental Data Access and Retrieval System (CEDARS) was based on two processes. The first was conversion of program structure and functionality of legacy systems, including business process forms and reports, into a new consolidated Oracle database. The second process involved a complete and accurate migration of program data into the new database.

During the inception of CEDARS, a management decision was made to have the conversion process performed mostly by private contractors, while the migration of program data was to be performed mainly by Department of Environmental Quality (DEQ) personnel. The decision to have data migrations performed internally was made in order to keep product knowledge and expertise in the department to help expedite current and future development. Testing by DEQ personnel was to be performed during, and at the end of, each phase of migration to ensure completeness.

Our first objective was to review data migration documentation to ensure all data and program functionality was successfully moved from legacy program databases into CEDARS. DEQ established migration processes for each program converted to CEDARS. We reviewed the CEDARS migration processes for consistency and integrity. During our review, we noted DEQ had not documented its processes on how migration should occur; however, migration results were documented. Audit testing consisted of review and verification of results to ensure complete migration of data, business processes, database structure, and functionality.

Program Structure Conversion

In order to get an understanding of the controls over the process, we reviewed existing documentation from three of the five subsystems in CEDARS. For each migration, existing documentation of the original program structure was compared with the current CEDARS production structure to ensure formatting rules were in place and tested during each conversion. Based on our comparison, existing documentation supports complete conversion of two of the three subsystem applications. Even though we identified a lack of documentation for one of the three subsystems, all five CEDARS subsystems are in use.

Since documentation was incomplete, we further reviewed controls to determine if DEQ management accepted subsystem conversion. As part of DEQ's migration processes, management was to accept the conversion before migration to the production environment occurred, so we would expect documentation to exist. However, we

found management acceptance was not consistently documented nor maintained for any of the migrations we reviewed.

Program Data Migration

In order to determine successful migration of program data to CEDARS, we reviewed the controls in place over the process. During development, the data being migrated needed to be tested to ensure it migrated to the new structure in CEDARS without being lost. This process took multiple attempts, each one generating a report with successes and errors for each data item. A report with no errors indicated a 100 percent complete migration of data. Our review identified final reports containing errors, which indicated less than 100 percent data migration.

At the end of this process, DEQ management was to sign an acceptance form. This acceptance indicated either 100 percent of the data migrated to the CEDARS database structure error free, or management accepted less than 100 percent data migration. However, DEQ did not retain these forms, so we cannot verify management accepted and approved CEDARS data migration.

Historical Databases Maintained

Because there was incomplete documentation of the data migration process, we cannot verify all data from each legacy system was completely transferred to CEDARS. As a result, we performed work to identify additional procedures which would ensure critical program data has not permanently been lost. After conversion, the legacy databases were relocated to a different section on DEQ's internal network. Access to the legacy databases was retained, only for database administrators, should future needs arise requiring recovery of historical data.

CONCLUSION

Audit work determined the multiple migration processes established by DEQ followed similar procedures including implementation of formatting rules, testing procedures, exception reports, and management approval. Due to lack of documentation, we were unable to verify completeness and success of CEDARS migration.

Implementation of Best Practices

The Montana Information Technology Act (MITA) outlines state law for system development. MITA laws regarding development of information technology resources state:

“It is the policy of the state that the development of information technology resources in the state must be conducted in an organized, deliberative, and cost-effective manner.” (§2-17-505(2), MCA)

MITA also requires agencies to develop information technology plans which should include a life cycle cost analysis for investments in new projects and resources. (§2-17-524(1)(e), MCA)

The State’s Chief Information Officer has established new policy on project management. The Project Management Interim Policy, approved March 3, 2009, establishes the requirements for the utilization of project management methodologies as defined by the State of Montana Project Management Office. In addition to MITA and state policy, best practices suggest standard system development organization for a project like CEDARS should include a feasibility and requirements study, requirements definition, detailed design, programming, testing, installation, and post-implementation review. During our audit, we were unable to identify documentation verifying DEQ followed best practices when developing CEDARS. While MITA and policy mentioned above had not been implemented at the time of initial CEDARS development, best practices have been in place for years. If current project management practices for CEDARS development followed initial documentation practices, DEQ would not be able to confirm compliance with state law or policy.

Review of the existing documentation for the multiple conversion processes revealed use of multiple contractors and frequent turnover of DEQ personnel during development. According to DEQ personnel, the amount of turnover and contracted work made it difficult to organize and maintain internally created and contractor provided documentation. Existing documentation over the migration process includes testing queries, error reports, data structure tables, and other files specific to each subsystem. Based on past experience with constantly changing personnel working on CEDARS conversion, complete and consistent documentation will help DEQ ensure consistency with future migration procedures.

Project management best practices suggest documentation of cost, funding, and design methodology. Audit work found five subsystems have been developed and migrated into CEDARS, with additional subsystems being developed in the future. Based on our review, DEQ appears to be working to ensure data integrity is maintained and system functionality is working as expected. However, DEQ did not document the amount of work performed, resources required, and time involved to complete the migration of the five subsystems currently within CEDARS. As a result, DEQ cannot provide the overall cost and time spent on CEDARS to this point, or the additional cost required

to fully complete CEDARS migration. Also, DEQ has not documented its processes to ensure future migration of legacy systems into the CEDARS environment is consistent. Because migration of legacy systems and data into CEDARS is an ongoing process, DEQ should implement best practices and document the process to ensure a complete and consistent transfer and acceptance of program structure and data.

RECOMMENDATION #1

We recommend the Department of Environmental Quality comply with system development law and policy by implementing policy for migration and documenting all steps of the process.

Chapter III – Data Security and Integrity

Introduction

System and security controls over the Consolidated Environmental Data Access and Retrieval System (CEDARS) ensure the integrity of data, business processes, and reports generated from the system. These controls include change management tracking software with audit logging and management acceptance of change; user access; system edits and constraints to ensure accurate, consistent, and complete data; and a process to detect and prevent duplicate data records in the database. This chapter discusses our findings related to ensuring CEDARS data integrity.

Change Management Controls

Even if DEQ has maintained the integrity of CEDARS data, this does not mean the system is processing data to meet the needs of DEQ and the State. There should be change management controls in place to ensure CEDARS functionality is working as expected, including request, development, test, and approval of all system changes. DEQ can confirm accurate processing and add needed functionality to the system via its change management process. The main control over change management is DEQ's TrackIt application. TrackIt is a management tool used to maintain a record of all CEDARS system change requests. It is the starting point for all change requests including, but not limited to, system changes such as granting user access, correcting data errors, coding fixes, and adding program functionality.

In order to complete a change request, appropriate management approval is required, which is documented and maintained in TrackIt. Review of the controls in place over this process were performed to ensure TrackIt is working as intended, and as such, is ensuring CEDARS processing has been requested, developed, tested, and approved prior to availability to DEQ users.

CONCLUSION

Based on our audit work, we conclude DEQ has implemented change management procedures for CEDARS.

User Access Controls

User access to CEDARS databases was reviewed to ensure access is authorized, appropriate, and based on job responsibilities. Access to CEDARS is limited through an internal policy of least privilege, granting a user only enough access to perform their job duties. Request forms and management approval for access are stored in TrackIt.

User access is determined by groups of combined access called packages. There are a multitude of packages, each containing policies granting access to various programs in CEDARS. There are policy packages which affect all CEDARS users, as well as specific packages developed for different bureaus, programs, and job positions. Audit work reviewed user access based on job duties and subsystem program needs. In addition to packaged access, a user can request access to a specific aspect of CEDARS such as a table, form, or report via the change management process in TrackIt. Our review of CEDARS access determined user access was segregated by program and least privilege. For example, an employee in the Enforcement/Legal department only has access to Enforcement/Legal tables, forms, and reports in CEDARS.

CONCLUSION

Based on our audit work, we conclude there are controls in place to ensure access to CEDARS is reviewed and authorized by management, which ensures appropriateness for all users.

Data Entry Controls

Data entry controls help ensure the completeness and accuracy of data in CEDARS. There are multi-level controls over CEDARS data entry, including system edits, required fields, and data formatting. System edits are program code used as controls in data entry and processing. Data entry fields can be marked as required. If a required field is left blank, the control will halt data entry processing and prompt the user to enter a valid value in the required field in order to continue. Data formatting rules ensure consistent data types for each form. For example, ensuring a phone entry has all ten numbers and only numeric characters. Auditor review of the production environment determined controls are in place to ensure complete and accurate entry of data into CEDARS.

Environmental data in CEDARS is organized by site and stored in the Facility Identification Template for Sites (FITS) section. When entering environmental data into CEDARS, a user can either add to a current site or create a new site. Because users from multiple programs may create or access records for a single permit holder, there is a risk duplicate records could be created for the same permit holder.

The main control preventing duplicate entry of permit holder site information is a two part process. The first part of the process is an automated system edit activated when a user submits permit holder site data. This automated script checks for potential duplicates by comparing the submitted site information with current CEDARS data.

The data compared includes required information such as name, address, latitude and longitude. If any potential duplicates are identified they are listed in a popup screen pausing data entry. The user then reviews the popup list and determines if the submitted data duplicates a current site in CEDARS.

The second part of the process relies on the user's determination if the information being entered is a new site. If it is a new site, the user will save the data as a new entry. If user analysis determines the submitted site information is a duplicate, they notify the individual who submitted the original site information and work to merge the updated information with the appropriate record.

CONCLUSION

Based on our audit work, we conclude controls are in place to ensure data entered in CEDARS is complete and accurate.

Reporting Controls

Reports generated from CEDARS may be used by department staff and management, state and federal officials, and the public. Audit work was performed to determine if controls are in place to ensure the accuracy of CEDARS reporting.

We reviewed two aspects of reporting: data integrity controls, and the programming code responsible for outputting reports. The first aspect of control over the accuracy of reporting is the integrity of CEDARS data. Data integrity starts with data entry controls, continues with change management controls, and is complete only when an accurate report is generated. As concluded previously, data entry and change management controls are in place to help ensure data integrity.

Once data integrity was determined, we reviewed the programming code which generates reports from CEDARS data. We selected a judgmental sample of standard reports available to CEDARS users and analyzed the programming code. Three standard CEDARS reports were analyzed with plans to increase the number of reports analyzed if errors were found.

Analysis included review of the data tables accessed by the report to determine completeness of reported data. Once the data tables were identified, we developed queries to generate ad-hoc reports with the same delineating factors as the three standard CEDARS reports reviewed. We generated reports for Air Fees, Methamphetamine Cleanup Program, and Enforcement cases. Review of the standard report output

compared with our ad-hoc queries showed a 100 percent match in reported data. As a result, we did not expand our analysis to include additional reports.

CONCLUSION

Considering our review of data entry controls, change management controls, report code analysis, and report comparisons, we conclude controls are in place to ensure standard reports are accurately reporting CEDARS data.

Chapter IV – Business Continuity

Introduction

An important responsibility of the Department of Environmental Quality (DEQ) is to maintain the availability of the Consolidated Environmental Acquisition and Retrieval System (CEDARS) in the event of a disaster or major outage. Availability of CEDARS data is critical to the business processes of multiple programs within the department. As such, any long term outage of the system could hinder the productivity of users who rely on CEDARS to perform their daily job duties resulting in a higher cost for services performed, and inconveniencing both the department and permit holders.

There are a number of events that could occur resulting in a loss of CEDARS operations. The worst case scenario would involve a natural disaster. Events such as earthquakes, flooding, theft, electrical outages, fire, and human error can damage critical CEDARS components, potentially resulting in the inability to process environmental data for the State.

Disaster Recovery/Business Continuity Plan

State law regarding security responsibilities of departments for data state: “Each department head shall: implement appropriate cost-effective safeguards to reduce, eliminate, or recover from identified threats to data.” (§2-15-114(3), MCA) In addition, to mitigate the damage resulting from major and minor disasters, best practices suggest organizations test, implement, and maintain a disaster recovery/business continuity plan. The organization should develop policies, plans, and procedures to regain access to data, workspace, lines of communication, and critical business processes.

DEQ management recognizes the need for a disaster recovery/business continuity plan as an important aspect of business operations. DEQ has policy in place addressing disaster recovery as well as a continuity of operations plan. The recovery of CEDARS hardware is addressed in a Service Level Agreement (SLA) with the Department of Administration’s (DOA) Information Technology Services Division (ITSD). The SLA states ITSD is responsible for complete restoration of hardware. The estimated time frame listed in the SLA is a range of one day to eight weeks. It also states customers are responsible to ensure agency applications and databases are included in the State disaster recovery plan. While the SLA provides procedures for hardware recovery, a CEDARS specific step by step plan detailing the recovery process is needed in order to fully recover CEDARS. Once server hardware functionality is restored, it is up to the department to follow its detailed plan to restore and test CEDARS data and program code.

While DEQ also has a continuity of operations plan, it does not address CEDARS specifically. The plan lists critical functions with estimated recovery times, but it does not address how the functions will be recovered. Additionally, it does not detail work to be done in the interim between service interruption and recovery. Without a detailed plan providing specific steps, DEQ cannot provide an estimated time frame as to when 100 percent of CEDARS functionality would be available following an outage.

RECOMMENDATION #2

We recommend the Department of Environmental Quality develop a Disaster Recovery/Business Continuity Plan specifically defining steps for recovering from service interruptions to the Consolidated Environmental Data Access and Retrieval System.

DEPARTMENT OF
ENVIRONMENTAL
QUALITY

DEPARTMENT RESPONSE



September 16, 2009

Kent Rice
Information Systems Audit Manager
Room 160, State Capitol
Helena, MT 59620

RECEIVED
SEP 17 2009
LEGISLATIVE AUDIT DIV.

Dear Mr. Rice:

I have received and reviewed the Information Systems audit of the Consolidated, Environmental Data Access and Retrieval System (CEDARS). Overall, the results of this audit are pleasing and I would like to express my appreciation for you and your staff's hard work in this effort.

Below are the department's responses to the report's recommendations.

Recommendation #1:

"We recommend the Department of Environmental Quality comply with system development law and policy by implementing policy for migration and documenting all steps of the process."

Response #1:

The department concurs with this recommendation. Since the start of the development process for this application much has changed in state policy and law relative to IT system development controls. Even though CEDARS has been developed and deployed successfully we are not able to provide adequate documentation that describes the process used, costs, requirements, or in house resources used.

The department currently has a formal Project Management Methodology that predates the state CIO's effort cited in the report. Implementation of that methodology has been slow due to staff turnover over the past several years but it is currently being used for all IT development projects or significant IT efforts. We believe strengthening this practice with a department-wide policy that requires use of a methodology and describes a System Development Life Cycle will ensure adequate documentation and better development project controls.

Kent Rice
September 16, 2009
Page 2 of 2

Recommendation #2:

“We recommend the Department of Environmental Quality develop a Disaster Recovery/Business Continuity Plan specifically defining steps for recovering from service interruptions to the Consolidated Environmental Data Access and Retrieval System.”

Response #2:

The department does not concur with this recommendation.

The audit report states that the Data Base Hosting Service Level Agreement (SLA) between DOA/ITSD and DEQ only provides “restoration of hardware.” The department feels this interpretation of the agreement is incorrect. The agreement clearly outlines the use of back-up schemes, restoration of data bases and applications from backup media, and use of “ITSD’s Disaster Recovery Plan” in the event of an emergency. The audit report states, “Once server hardware functionality is restored, it is up to the department to follow its detailed plan to restore and test CEDARS.” Although the department agrees that DEQ staff will have to verify the system is restored to the most current backed-up version, it is ITSD’s responsibility under the SLA to restore our databases and applications.

Thus the department feels that our agreement with ITSD clearly provides full recovery of CEDARS information and functionality in the event of a disaster.

Please contact me if you have any questions. Thank you for the opportunity to provide our responses.

Sincerely,



Richard H. Opper
Director

c: Linda Atkins, FS