

Exxon Valdez Oil Spill
Restoration Project Final Report

**Developing an Interactive Water Quality and Habitat
Database and Making It Accessible on the Web**

**Restoration Project 02668
Final Report**

**Joel Cooper
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February 2005

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Study History: Project 02668 outlines the development of an interactive water quality and habitat database and making it accessible on the web. This one-year project was originally funded from October 1, 2001 to September 30, 2002. Due to contract issues with the Alaska Department of Environmental Conservation, the project was granted a deadline extension to December 31, 2002. An extension to complete the final report was requested and an extended due date of May 15, 2003 was granted to allow time to incorporate summary information from a database demonstration/training session held in early April 2003. A second extension was requested and an extended due date of June 2, 2003 was granted to allow for internal review of the report prior to submittal.

Abstract: The Citizens' Environmental Monitoring Program (CEMP) Partnership of the Cook Inlet Watershed and the Alaska Department of Environmental Conservation have come together to form a database committee to create a consistent data management system where all citizen groups and agencies can equally share, report and review their water quality and habitat data. A Microsoft Access database has been developed to provide a simple user interface to facilitate the collection and storage of water quality data. The user interface has been designed to provide simple and efficient data entry, while the database insures that the information recorded is compatible with the Environmental Protection Agency's STORET (short for STOrage and RETrieval) data system. Once water quality data have been entered into the database, an export routine can be run to create a STORET Interface Module (SIM) compatible exchange file that can be imported into SIM and then migrated to STORET. Once in STORET, these data can be exported to the EPA National STORET Warehouse. The data are then made accessible on the Internet via CIIMMS, Alaska's Cooperatively Implemented Information Management System. Access to these data will help facilitate a better understanding about threats to, and solutions for, water quality and habitat.

Key Words: CEMP Partnership of the Cook Inlet Watershed, CEMP, CIIMMS, citizens, database, habitat, water quality data, volunteers, STORET, SIM

Project Data: Data is available at the CIIMMS website <http://info.dec.state.ak.us/ciimms/> and the STORET website <http://www.epa.gov/storet/>. Data may also be found at individual users websites.

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DEVELOPING AN INTERACTIVE WATER QUALITY AND HABITAT DATABASE AND MAKING IT ACCESSIBLE ON THE WEB

EXECUTIVE SUMMARY

Some of the biggest challenges in the world of data collection are the management of the data collected and making them accessible to all data users. Toward that end the Citizens' Environmental Monitoring Program (CEMP) Partnership of the Cook Inlet Watershed and the Alaska Department of Environmental Conservation have come together to form a database committee to create a consistent data management system where all citizen groups and agencies can equally share, report and review their water quality and habitat data.

To develop a user-friendly data management system for data entry, storage, analysis, retrieval, and accessibility requires the use of several different computer technologies and an extreme wealth of patience. The system also needs to be dynamic enough to evolve with the changing technologies and methods.

The overall goal for an interactive water quality and habitat database is to design a user interface that provides simple and efficient data entry, while insuring that the information recorded is compatible with STORET (short for STORage and RETrieval), the Environmental Protection Agency's (EPA) largest computerized environmental data system. Once water quality data have been entered into the database, an export routine can be run to create a STORET Interface Module (SIM) compatible exchange file that can be imported into SIM and then migrated to STORET. SIM facilitates the flow of data from a local water quality database or Laboratory Information Management System (LIMS) into a local copy of the EPA STORET database. Once in STORET, these data can be exported to the EPA National STORET Warehouse. The data are then made accessible on the Internet through a network node via CIIMMS, Alaska's Cooperatively Implemented Information Management System. CIIMMS is a web-based system that provides access to a broad spectrum of timely data and analysis tools via the Internet. Access to these data will help facilitate a better understanding about threats to, and solutions for, water quality and habitat.

OBJECTIVES

The overall goal of this project is to make data more accessible and more useful to decision makers, stakeholders, resource managers, and the public. The objectives include:

- 1) Creating a consistent data management system where all citizen groups and agencies can equally share, report and review their water quality and habitat data;
- 2) Interfacing citizen-collected data with EPA's STORET to make them more useful to agencies; and
- 3) Making habitat and water quality data accessible on the Internet in a user-friendly, interactive format with links to GIS maps, photos and graphs.

METHODS

In order to choose which track to follow the database committee identified constraints and priorities, reviewed existing programs, and participated in trainings, demonstrations and

assessments. Database committee meetings were scheduled periodically to discuss findings and to chart the next step of development for the project.

RESULTS

Assessment: The results of this assessment outlined several STORET Integration Options for implementing an integrated STORET system in Alaska, each with advantages and disadvantages. The assessment made the following recommendations for CEMP Partner organizations.

- The CEMP Organizations provide a wide variety of STORET compatible sampling data. These data will provide an excellent assessment of the ambient water quality of many significant water bodies throughout the state. Integration of these data into STORET should be considered a high priority.
- Migration of historic data should be addressed on a case-by-case basis. Many of the CEMP Organizations have historic data in an electronic format that should be considered a high priority for migration to STORET.
- Due to the diversity in the CEMP Organizations, different data loading options may be selected by different programs.

The assessment also laid out different deployment options.

Contracting: The database committee set out to work with contractor, Gold Systems Inc., to incorporate functions of the CEMP Water Quality Database into their SIM-DE database to develop a simple user interface in Microsoft Access to facilitate the collection and storage of water quality data. The user interface had to be designed to provide simple and efficient data entry, while insuring that the information recorded is compatible with STORET. Once water quality data has been entered into the database, an export routine needed to be written to create a STORET Interface Module (SIM) compatible exchange file that can be imported into SIM and then migrated to STORET.

Database: In October 2002 Gold Systems Inc. provided a copy of the database for beta testing and a completed version in January 2003. The current version of the MS Access database can be found at <http://www.epa.gov/storet/otherapps.html>.

Training and Demonstrations: A poster and demonstration of the database was presented on 1/13/03 at the *Exxon Valdez* Oil Spill Symposium. Additional demonstrations were conducted at the Alaska Forum on the Environment and at the 3rd Annual Conference of the CEMP Partnership of the Cook Inlet Watershed in February 2003. On April 3, 2003, database training was held in Anchorage at a state computer lab.

Future Database Development: Based on initial database committee recommendations and input received from users during beta testing, trainings and demonstrations, a new itemized list of modifications and additions in order of priority has been drafted. Funding from the EPA Challenge Grant Program has been secured by the Alaska Department of Environmental Conservation for additional work on the data management system. At a minimum work will be completed on the top 5 priority items in the summer of 2003 with training, data migration and deployment scheduled for the September 2003.

DISCUSSION

The database committee is well on its way to achieving its overall goal of this project to make data more accessible and more useful to decision makers, stakeholders, resource managers, and the public. To fulfill our objective of creating a consistent data management system where all citizen groups and agencies can equally share, report and review their water quality and habitat data, for the most part, relies on getting the data into STORET. STORET is EPA's largest computerized environmental data system and contains raw biological, chemical, and physical data on surface and ground water collected by federal, state and local agencies, Indian Tribes, volunteer groups, academics, and others. All 50 States, territories, and jurisdictions of the U.S. are represented in these systems. In addition, it has been chosen by the Alaska Department of Environmental Conservation as their repository for water quality data. It is therefore a logical selection for a central repository for data collected.

The challenge has been getting the data into STORET through a user-friendly data entry interface and then making it accessible on the Internet in a user-friendly format. There is no question that with enough time, money and training, most anyone could navigate through the multitude of entry forms in STORET to enter their data. But with state and federal budgets for water quality monitoring continuing to decline, volunteer collected data, through citizen based monitoring, have become more important in state monitoring programs. When volunteer monitoring programs looked to use STORET, they usually came away asking the question found in this recent Volunteer Monitor List Serve Correspondence- "I noticed EPA's new and improved STORET is now available <http://www.epa.gov/STORET/>. Does anyone know of other less massive data storage programs for physical, chemical, and biological data that are available for volunteer monitoring groups/organizations to use?"

The database committee recognized this challenge and made one of its project objectives to interface citizen-collected data with STORET to make it more useful to agencies. Toward that end the committee sought to better understand STORET through research, assessments and trainings and came away seeing STORET as a great repository for data, but wanting a less complicated data entry system for citizen groups to use.

The CEMP Partnership of the Cook Inlet Watershed had already developed a user-friendly Microsoft Access database, the CEMP Water Quality Database, but it lacked an easy and efficient way to migrate data to STORET. At the same time the Southern Ute Indian Tribe was working Gold Systems Inc. to develop an MS Access application, SIM-DE, capable of exporting the data to STORET. Through collaboration, sharing of financial and technological resources, patience, and Internet communications a user-friendly data entry interface is becoming a reality that can be shared not only with agencies, Indian Tribes, and volunteer groups in Alaska, but across the country.

To make data more accessible on the Internet, the committee has been working with CIIMMS, Alaska's Cooperatively Implemented Information Management System. The data are then made accessible on the Internet through a network node via CIIMMS. CIIMMS is a logical choice for providing Internet access for this project since it is was designed as a user-friendly web-based

system made to provide access to a broad spectrum of timely data and analysis tools via the Internet.

CONCLUSION AND RECOMMENDATIONS

Conclusion

To develop an interactive water quality and habitat database and make it accessible on the web is very complex and time-consuming process that requires collaboration of technological, financial, and human resources. There is no way a project of this scale would ever work without the broad base cooperation and collaboration of agencies and organizations. This project has shown that it is possible to collaborate and cooperate to build such a system. It is important to recognize that a project of this nature, one that provides all of us invaluable information about our water resources, is a project that will never end and must carry on into perpetuity. Therefore we must continue to develop a dynamic system capable of changing with technology and time. By maintaining such a system we will help facilitate a better understanding about threats to, and solutions for, water quality and habitat.

Recommendations

1. Continue to identify agencies and organizations to collaborate with on the project for funding and human and technological resources.
2. Continue to use the process of gathering information, assessment, development, testing through use, and meeting to reassess and then repeat the process to build the on previous work completed.
3. Train more people locally in computer programming.
4. Provide accessible support services to the system users.

DEVELOPING AN INTERACTIVE WATER QUALITY AND HABITAT DATABASE AND MAKING IT ACCESSIBLE ON THE WEB

INTRODUCTION

Some of the biggest challenges in the world of data collection are the management of the data collected and making them accessible to all data users. As state and federal budgets for water quality monitoring continue to decline, volunteer collected data, through citizen based monitoring, have become more important in state monitoring programs (Mauger 2003). The State of Alaska has recognized this reality and has fostered and supported citizen based monitoring. Toward that end the Citizens' Environmental Monitoring Program (CEMP) Partnership of the Cook Inlet Watershed and the Alaska Department of Environmental Conservation have come together to form a database committee to create a consistent data management system where all citizen groups and agencies can equally share, report and review their water quality and habitat data.

To develop a user-friendly data management system for data entry, storage, analysis, retrieval, and accessibility requires the use of several different computer technologies and an extreme wealth of patience. The system also needs to be dynamic enough to evolve with the changing technologies and methods.

A Microsoft Access database has been developed to provide a simple user interface to facilitate the collection and storage of water quality data. The user interface has been designed to provide simple and efficient data entry, while the database insures that the information recorded is compatible with STORET (short for STOrage and RETrieval), the Environmental Protection Agency's (EPA) largest computerized environmental data system. Once water quality data have been entered into the database, an export routine can be run to create a STORET Interface Module (SIM) compatible exchange file that can be imported into SIM and then migrated to STORET. SIM facilitates the flow of data from a local water quality database or Laboratory Information Management System (LIMS) into a local copy of the EPA STORET database. Once in STORET, these data can be exported to the EPA National STORET Warehouse. The data are then made accessible on the Internet via CIIMMS, Alaska's Cooperatively Implemented Information Management System. CIIMMS is a web-based system that provides access to a broad spectrum of timely data and analysis tools via the Internet. Access to these data will help facilitate a better understanding about threats to, and solutions for, water quality and habitat.

Collaboration and Project Development

This project is the merging and collaboration of many efforts. In 1996, Cook Inlet Keeper established the Citizens' Environmental Monitoring Program (CEMP) to actively involve citizens in collecting reliable water quality data in the Cook Inlet Basin. In October 1998 the Cook Inlet Information Management and Monitoring System (CIIMMS) effort began with the goal of developing a web-based system that would provide access to a broad spectrum of timely data and analysis tools via the Internet. In the fall of 1999 Anchorage Waterways Council, a CEMP partner, contracted HDR Engineering to work with Cook Inlet Keeper in developing a customized Microsoft Access database, CEMP Water Quality Database, capable of handling all CEMP water quality data as well as training records, and kit maintenance and supply records. Also in 1999 the Alaska Department of Environmental Conservation (ADEC), Division of Air

and Water Quality decided to use the modernized Environmental Protection Agency (EPA) STORET database for water quality data.

This project began to take form at the CEMP Partnership of the Cook Inlet Watershed's first annual conference in December 2000. The purpose of the meeting was to link current and potential monitoring groups and agencies together to coordinate efforts, build credibility, and exchange information and ideas. The meeting was well attended by over 26 professionals representing 14 different organizations and agencies including: Cook Inlet Keeper, Homer Soil and Water Conservation District, Anchorage Waterways Council, Kenai Watershed Forum, Wasilla Soil and Water Conservation District, Port Graham/Nanwalek Watershed Council, University of Alaska Anchorage's Environment and Natural Resource Institute, Alaska Department of Environmental Conservation's (ADEC) Nonpoint Source Program, U.S. Geological Survey (USGS), U.S. Fish and Wildlife Kenai National Wildlife Refuge, Environmental Protection Agency (EPA), *Exxon Valdez* Oil Spill Trustees Council, and Cook Inlet Information Management and Monitoring System project team members. The meeting included discussions of quality control procedures, volunteer and equipment management, and data management and accessibility.

To tackle the questions of data management and accessibility, a database committee was formed composed of Cook Inlet Keeper, Alaska Department of Environmental Conservation, UAA's Environment and Natural Resource Institute, Mat-Su Borough, Anchorage Waterways Council, Wasilla and Homer Soil and Water Conservation Districts, and the Kenai Watershed Forum. The discussions lead the committee to at least two possible development tracks with many hybrids in between. These two development tracks are:

1. The CEMP partners use, maintain and continue to develop the CEMP Water Quality Database. The data will then be exported then imported into STORET.
2. The CEMP partners enter data directly into STORET and then extract the data for their local needs through a data-download or through the EPA-developed report application (Kunibe 2000).

In February 2001, Cook Inlet Keeper submitted a proposal to the U.S. Fish and Wildlife Service Cook Inlet Coastal Program, with the database committee members as cooperating entities, to develop an interactive water quality and habitat database and make it accessible on the web. This proposal was modified to include more detail and was submitted in April to the *Exxon Valdez* Oil Spill Trustee Council for additional funding. The funding secured from these proposals provided the committee the ability to identify which track to take, pursue the development of that track and identify how to work with existing technologies to make the data available on the Internet.

This report attempts to outline one path of a data management system from data entry on an individual user's computer to the accessibility of the data on the Internet, but primarily focuses on the development of a Microsoft Access database, which has been developed to provide a simple user interface to facilitate the collection and storage of water quality data and insures that the information recorded is compatible with STORET. Users of this database include: CEMP Partner organizations; ADEC, Water Programs, Division Spill Prevention and Response Program, Division of Environmental Health-Solid Waste Program; Alaska Department of Natural Resources; National Park Service; Native American Fish and Wildlife Society; and

Tribal organizations. Figure 1 shows the schematic of Alaska's STORET Central Data Exchange (CDX) Implementation.

In order to gain a better understanding of this project, it is important to provide further background about the CEMP Partnership of the Cook Inlet Watershed, SIM, SIM-DE, STORET, and CIIMMS.

CEMP Partnership of the Cook Inlet Watershed

In 1996, Cook Inlet Keeper established the Citizens' Environmental Monitoring Program (CEMP) to actively involve citizens in collecting reliable water quality data in the Cook Inlet Basin. Educating people about their natural resources, discussing the impacts we have on our environment and what that means to water quality, and the benefit of having more eyes watching out for watershed and estuarine health are reasons enough to engage volunteers in monitoring their streams and bays. However, with dwindling resources for water quality monitoring at both state and federal levels, the need for volunteer-collected data is increasing in Alaska, especially when the monitoring program is well designed and institutes quality assurance/quality control measures.

With EPA funding passed through the Alaska Department of Environmental Conservation and guidance from a Technical Advisory Committee (TAC), Keeper developed a Kachemak Bay Pilot Project as a working template that could be adopted by other groups interested in conducting citizen-based monitoring programs. The objectives of CEMP are to: 1) inventory baseline water quality in the Cook Inlet Basin, 2) detect and track water quality trends and report significant changes, and 3) raise public awareness of the importance of water quality through hands on involvement. Water quality parameters, data quality objectives, and site selection criteria were developed with a Technical Advisory Committee made up of professionals representing various federal, state, and local agencies and diverse scientific backgrounds.

With assistance from the TAC, Keeper selected water quality parameters and testing methods that have proven successful in citizen-based programs throughout the United States. To ensure adequate quality assurance oversight and consistency of CEMP data, Cook Inlet Keeper produced a Quality Assurance Project Plan (QAPP) in 1998, which describes both how the program is managed (quality assurance) and how its technical activities are carried out (quality control).

Since Cook Inlet Keeper established Alaska's first consistent and coordinated volunteer water quality monitoring program in 1996, other groups have requested Keeper's assistance in establishing volunteer monitoring in their communities. Through these collaborations, the CEMP Partnership of the Cook Inlet Watershed has evolved and includes the Anchorage Waterways Council, Cook Inlet Keeper, Environment and Natural Resources Institute - University of Alaska Anchorage, Kenai Watershed Forum, Matanuska-Susitna Borough, and Homer, Wasilla and Upper Susitna Soil and Water Conservation Districts. The Partnership has been working to integrate the interests and concerns of the Native communities throughout Cook Inlet and, in addition, is working with the Native American Fish and Wildlife Society to share examples of methods, protocols, and Quality Assurance information. To date the Partnership has trained more than 450 volunteers throughout the Cook Inlet Watershed to monitor more than 198 sites.

Alaska STORET Central Data Exchange (CDX) Implementation

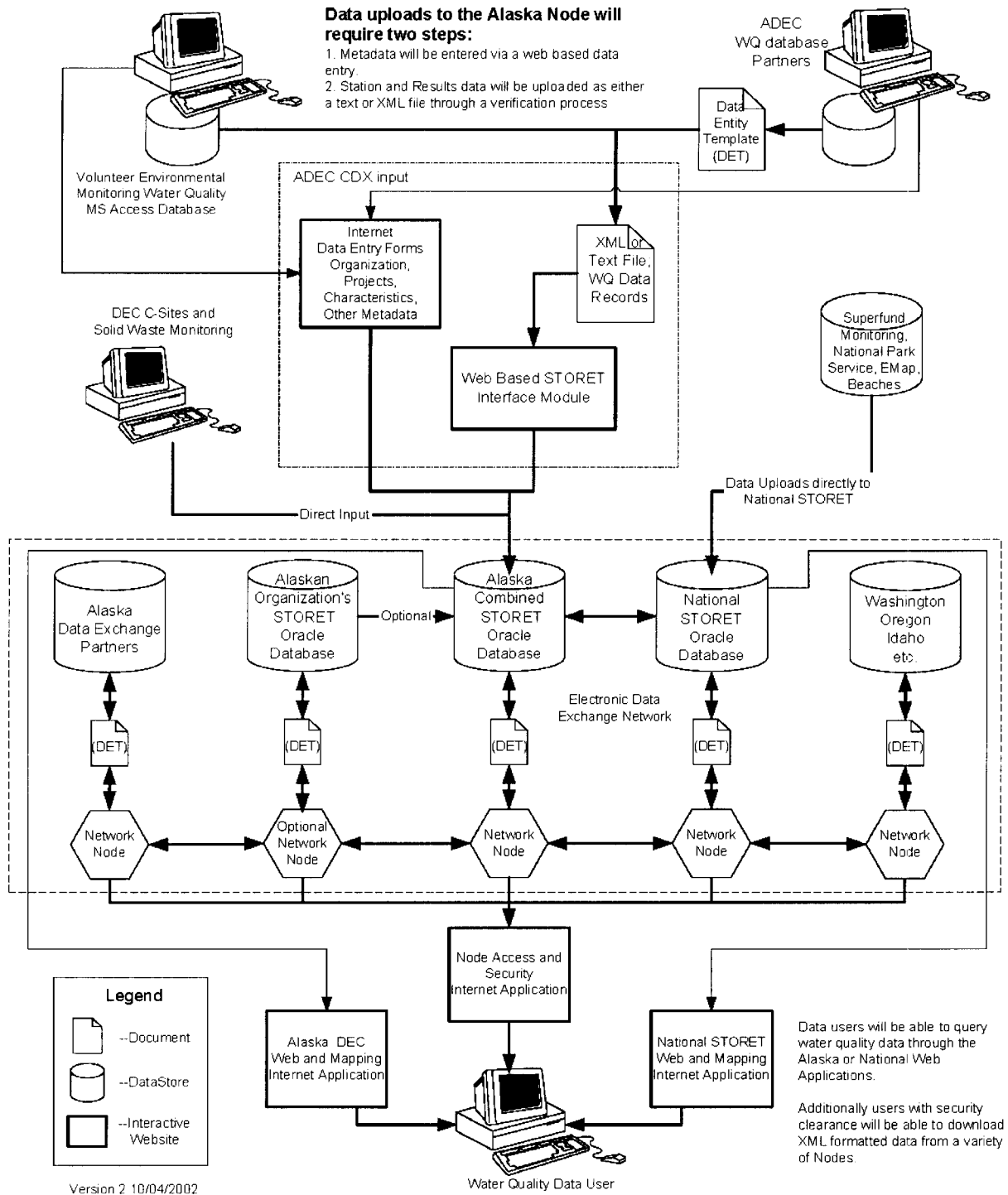


Figure 1. Schematic of Alaska's STORET Central Data Exchange (CDX) Implementation.

SIM, STORET Interface Module

The STORET Interface Module (SIM) facilitates the flow of data from a local water quality database or Laboratory Information Management System (LIMS) into a local copy of the EPA STORET database. Once in STORET, this data can be exported to the EPA National STORET Warehouse. Gold Systems Inc has developed this system for EPA (Dave Wilcox, Gold Systems Inc, Personal Communication, May 2003).

SIM-DE, SIM Data Entry Module

In December 2001, Gold Systems, Inc began working with the Southern Ute Indian Tribe to develop an MS Access data collection application called SIM-DE. This application collects sampling activity data and is able to export the data in a format, which can be accepted by the EPA's STORET program via SIM, a data entry and validation tool that was designed to load large volumes of data into the STORET database (Dave Wilcox, Gold Systems Inc, Personal Communication, May 2003).

STORET

The U.S. Environmental Protection Agency (EPA) maintains two data management systems containing water quality information for the nation's waters: the Legacy Data Center (LDC), and STORET.

The LDC contains historical water quality data dating back to the early part of the 20th century and collected up to the end of 1998. STORET contains data collected beginning in 1999, along with older data that has been properly documented and migrated from the LDC. Both systems contain raw biological, chemical, and physical data on surface and ground water collected by federal, state and local agencies, Indian Tribes, volunteer groups, academics, and others. All 50 States, territories, and jurisdictions of the U.S. are represented in these systems.

Each sampling result in the LDC and in STORET is accompanied by information on where the sample was taken (latitude, longitude, state, county, Hydrologic Unit Code and a brief site identification), when the sample was gathered, the medium sampled (e.g., water, sediment, fish tissue), and the name of the organization that sponsored the monitoring. In addition, STORET contains information on why the data were gathered; sampling and analytical methods used; the laboratory used to analyze the samples; the quality control checks used when sampling, handling the samples, and analyzing the data; and the personnel responsible for the data (U.S. EPA, 2003).

CIIMMS, Alaska's Cooperatively Implemented Information Management System

The CIIMMS effort began in October 1998 as a two-year project (with funding provided by the *Exxon Valdez* Oil Spill Trustee Council) with the goal of developing a web-based system that would provide access to a broad spectrum of timely data and analysis tools via the Internet. The specific task was to provide a site that supported monitoring, management and restoration of resources and services injured by the *Exxon Valdez* Oil Spill. Additionally, the site would provide access to data sets and tools so that regulators, resource managers, planners, and others could address the ecological health of the Cook Inlet watershed and approach decision-making from a watershed perspective. In July of 2001 CIIMMS was changed from the Cook Inlet

Information Management and Monitoring System to Alaska's Cooperatively Implemented Information Management System.

To develop a mapping application, CIIMMS and US EPA Region 10 have worked together to bring Alaska Legacy STORET data to the web using a mapping interface. The Legacy STORET Mapping Application also provides you with the opportunity to zoom in to both Anchorage and Fairbanks. Querying the map display provides access to the tables and supporting STORET data.

Users can also query STORET tables directly using the links provided on the STORET introduction page. Users can search STORET Invent, Grab Samples, Composite Samples and USGS Daily Flows in a non mapping application accessing tabular data (CIIMMS 2003).

OBJECTIVES

The overall goal of this project is to make data more accessible and more useful to decision makers, stakeholders, resource managers, and the public. The objectives include:

- 1) Creating a consistent data management system where all citizen groups and agencies can equally share, report and review their water quality and habitat data;
- 2) Interfacing citizen-collected data with EPA's STORET to make it more useful to agencies; and
- 3) Making habitat and water quality data accessible on the Internet in a user-friendly, interactive format with links to GIS maps, photos and graphs.

METHODS

In order to choose which track to follow the database committee identified constraints and priorities, reviewed existing programs, and participated in trainings, demonstrations and assessments. Database committee meetings were scheduled periodically to discuss findings and to chart the next step of development for the project.

Constraints

The database committee identified the following constraints:

- The data need to end up in STORET.
- Local groups want to be able to develop their own custom reports.
- There should be minimal learning curve, especially for the users entering field visit data.
- Mat-Su Borough needs to maintain a copy of their data on an AS400 for archival purposes.
- Many users felt comfortable with their ability to create reports in MS Access and familiarity with the CEMP Water Quality Database.
- Local groups want to be able to maintain their data electronically in their own database for internal use.

Priorities

The database committee identified the following priorities for developing a consistent data management and reporting system:

1. move data in a simple and easy way;
2. make data available to the public on the Internet in an educational and meaningful way with links to charts, maps and photos;
3. interface data with EPA's STORET water quality database so that it is more useful to scientists and resource managers;
4. allow for local groups to view their own data once it is entered;
5. create a way for local groups to compare their data with data from other citizen monitoring partners and with agencies;
6. allow local groups to view water quality data from any source which is relevant to their area of interest;
7. include database securities protocols that are appropriate for the web; and
8. allow for a database system which opens up a wider variety of water quality and habitat parameters and methods.

Existing Programs

The committee identified model programs such as IOWATER (www.iowater.net) for guidance. The committee also looked at other existing systems of Alaska data that they could use to help build a unified database – those include: 1) The CEMP Water Quality Database which is used by Keeper, Kenai Watershed Forum, Wasilla Soil and Water Conservation District, and Anchorage Waterways Council; 2) CIIMMS database; 3) Mat-Su Borough Lake data which is under development; 4) ENRI's EDAS access database which is for professional-level aquatic macroinvertebrate data; 5) ENRI's Educational database which is purely educational and being developed for web application; 6) EPA's STORET which is the national water quality database clearinghouse for all EPA-funded projects; and 7) USGS's NWIS for professional USGS-collected data.

Training, Demonstrations and Assessments

In March 2001, the Alaska Department of Environmental Conservation, Division of Air and Water Quality contracted Gold Systems Inc. to do a STORET Data Assessment. The Department identified the following sources that are generating water quality data that they wanted in STORET:

- data from 319 grants including citizens' volunteer water quality monitoring;
- discharge monitoring reports from state permitted facilities;
- groundwater and surface water from contaminated site monitoring; and
- data from public drinking water source testing (Kunibe 2001).

In early April the database committee members and personnel from ADEC, Division of Air and Water Quality, attended a three-day STORET training followed by a STORET Interface Module (SIM) demonstration, meeting and discussion in May. The training and demonstration were Options for the Water Quality Division.

RESULTS

Assessment

The results of this assessment outlined several STORET Integration Options for implementing an integrated STORET system in Alaska, each with advantages and disadvantages. The assessment made the following recommendations for CEMP Partner organizations.

- The CEMP Organizations provide a wide variety of STORET compatible sampling data. These data will provide an excellent assessment of the ambient water quality of many significant water bodies throughout the state. Integration of these data into STORET should be considered a high priority.
- Migration of historic data should be addressed on a case-by-case basis. Many of the CEMP Organizations have historic data in an electronic format that should be considered a high priority for migration to STORET.
- Due to the diversity in the CEMP Organizations, different data loading options may be selected by different programs (Gold Systems Inc. 2001).

The assessment also laid out different deployment options. Figures 2 and 3 shows schematics of different deployment options. Figure 2 depicts organizations using a local database application that exports to Alaska Water Quality Division (AWQ) SIM then to AWQ STORET and finally on to the National STORET warehouse.

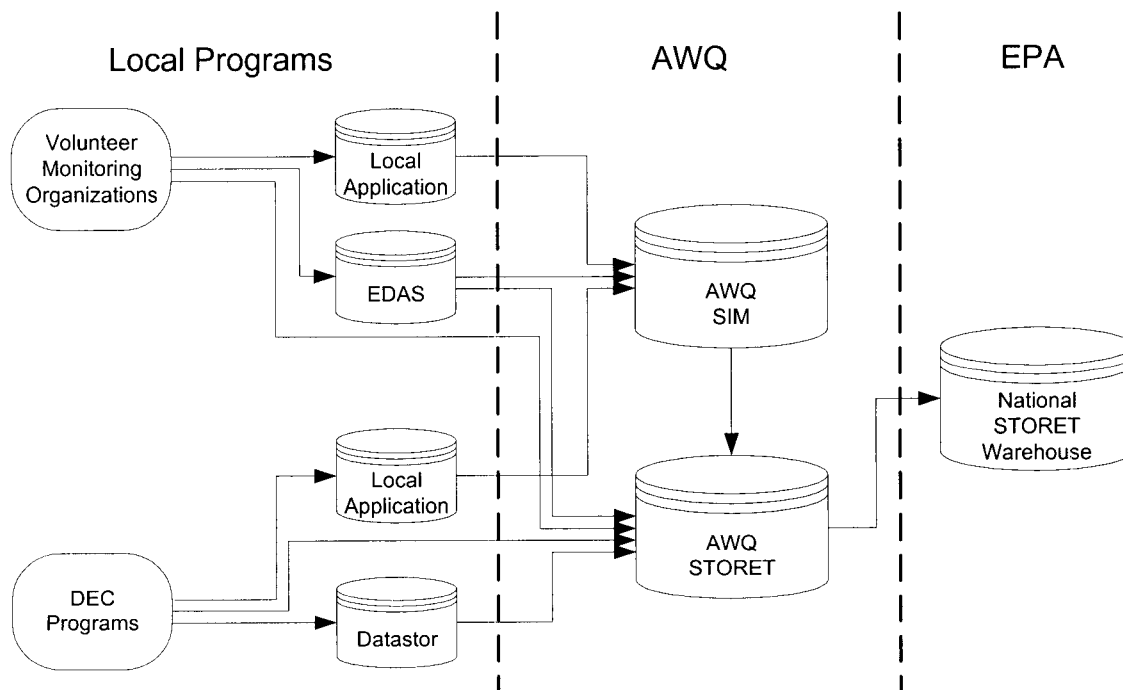


Figure 2. STORET and SIM databases deployed on AWQ Server.

Considering all the information gathered the database committee chose to follow a path similar to that which is depicted in figure 2 and the volunteer 1 path in figure 3 further develop the Microsoft Access Database as the local application. The following points were made for taking this path:

- ease and familiarity of using the CEMP Water Quality (MS Access) Database;
- data could be migrated into STORET via SIM by programming a routine into the Access database; and
- users could continue to electronically store and use their data locally while making it accessible through the Internet via CIIMMS and STORET.

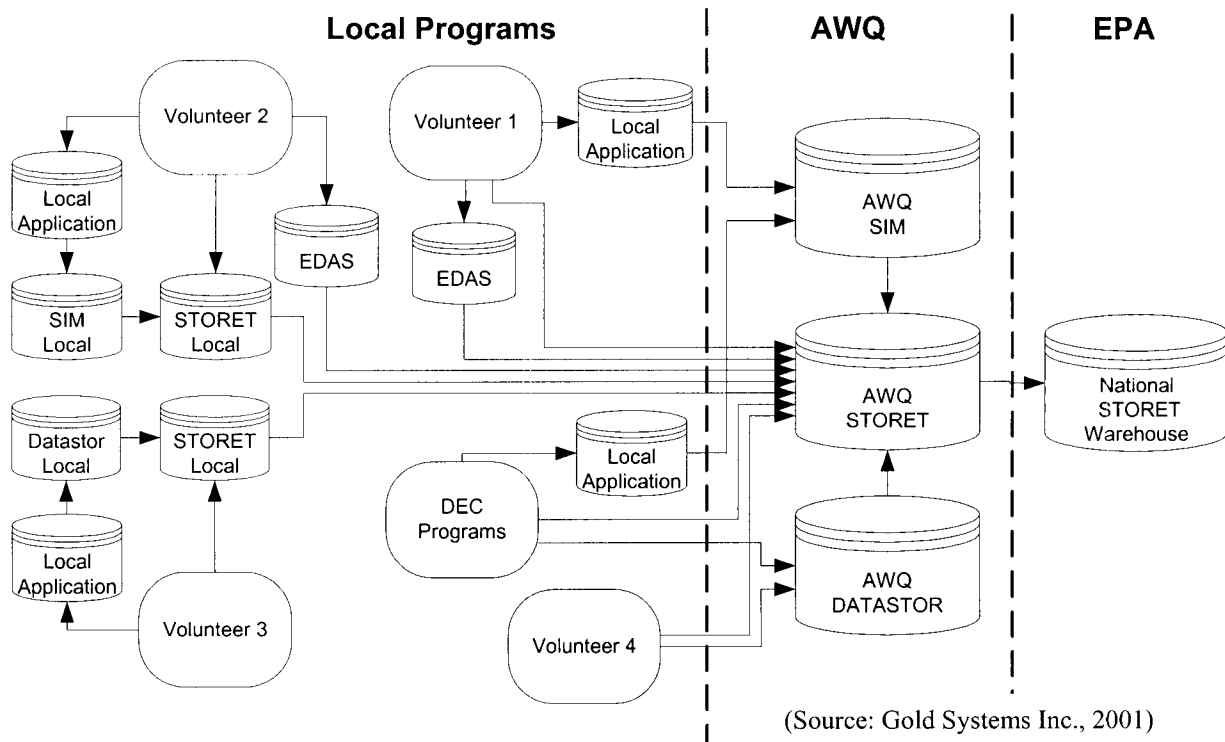


Figure 3. Additional Deployment Options for Volunteer Organizations.

Contracting

The database committee set out to work with contractor, Gold Systems Inc., to incorporate functions of the CEMP Water Quality Database into their SIM-DE database to develop a simple user interface in Microsoft Access to facilitate the collection and storage of water quality data. The user interface had to be designed to provide simple and efficient data entry, while insuring that the information recorded is compatible with STORET. Once water quality data has been entered into the database, an export routine needed to be written to create a STORET Interface Module (SIM) compatible import file that can be imported into SIM and then migrated to STORET.

The database committee began to recognize that the funds they had available may not be enough to complete every thing they wanted to include into the database, so they set out to create a laundry list of to do items for the database development and then prioritize those items for bid. The contractor suggested breaking the items down into modules. At the January 17, 2002 database committee meeting, the committee came up with the following module list in order of priority:

1. Additions to the Core Module- These were to add to the main data entry component of the SIM-DE database: formulas that were programmed into the CEMP Water Quality Database; additional time fields; and Data Quality Objectives checks.
2. Station Module-This module would create STORET compatible fields into the database for monitoring stations as outlined in the STORET Assessment. Additional fields for station status were also to be added.
3. Graphing Module- This module would link excel with the in the access database through Microsoft query. Graphs of the data for each site and parameter would be generated plotting the data over time. State and federal water quality standards or other key thresholds will be shown on the graph.
4. Personnel (Volunteer Tracking) Module-This module would add to the volunteer tracking component from the CEMP Water Quality Database and improve the tracking of training records.
5. Equipment Module- The equipment module will allow for the tracking of items of equipment.
6. Groundwater Module-This module was to incorporate the ability to enter groundwater data, but was consider something to include at a much later date, since CEMP organizations were not currently collecting groundwater data.

Additional items the committee wanted bids on included training from the contractor and a users guide.

The contractor took the database committee's list and further broke the modules down and also added components that need to be added in order to make the database more compatible with STORET. The following bid items were provided:

- Multiple Organization Support
- Calculated and Non-STORET results
- Result and Replicate Average Report
- Additional Dates and Times in Activity
- Data Entry Enhancements
- Additional Result QC Checks
- New Station Module
- Equipment Tracking Module
- Volunteer Tracking module
- Prepare Users Guide
- 1 year of on-going support, estimated 4 hours per month

The committee reviewed the funds available, the itemized bids, and their priorities. The committee also considered additional monies ADEC was seeking to put into the project. Cook Inlet Keeper then contracted with Gold Systems Inc. to complete the following bid items:

- Multiple Organization Support
- Calculated and Non-STORET results
- Result and Replicate Average Report
- Additional Dates and Times in Activity
- Data Entry Enhancements
- Volunteer Tracking module

Database

In October 2002 Gold Systems Inc. provided a copy the database for beta testing and a completed version in January 2003. The current version of the MS Access database can be found at <http://www.epa.gov/storet/otherapps.html>.

The contractor and database committee recognized that the current database needs further modifications and additions. The following is an explanation of the various requirements and components of the current database. In addition, suggestions and comments from the database training held April 3, 2003 are presented and future modifications, additions, data migration and database deployment are discussed.

Software Requirements

In order to run this database a user will need Microsoft Access 2000 (9.0.3821 SR-1) or higher.

Configuration

The database was designed allow for configuration to meet the users needs without the need for developing a completely new database. Configuration can be done while still maintaining compatibility with STORET.

Characteristics

Individual characteristics such as Dissolved Oxygen can be configured into the database. Specific information such as: units; method; link to the method procedure; method range; is the result numeric; should the result be exported to STORET; should it appear in a report; and what permitted values are allowed can be programmed for that characteristic. Essentially any field on a users data sheet can be configured and made available on the data entry form through the characteristic setup. This form will be modified and is discussed in the future developments section of this report. Figure 4 shows the current version of the characteristic form.

The screenshot shows a software window titled "SIM-DE - [Characteristics]". The menu bar includes File, Edit, View, Insert, Format, Records, Tools, Window, and Help. The toolbar contains various icons for file operations and editing. The main form area is titled "Characteristic ID: 00" and contains the following fields and options:

- Name: Dissolved Oxygen
- Required: Y (dropdown)
- Unit Type: WTVOL (dropdown)
- Default Unit ID: mg/l (dropdown)
- Dflt Analytical Procedure: Dissolved Oxygen - Micro Winkler Azide Modified (dropdown)
- Minimum Value: 0
- Maximum Value: 20
- Document Path: "C:\simde\093002 Dissolved Oxygen-Micro Winkler Titration SOP."
- Sampling Instructions: Sampling instructions for Dissolved Oxygen...

On the right side of the form, there are several checkboxes:

- Result Report:
- Sample Frac. Req.:
- Analytic Proc. Req.:
- Calculated:
- Export:
- Numeric Result:

At the bottom, there are two panels: "Analytic Procedures" and "Permitted Values". The "Analytic Procedures" panel shows a list with "Dissolved Oxygen - Micro Winkler Azide Mod" selected. The "Permitted Values" panel is currently empty. Below these panels, there are record navigation controls showing "Record: 14" and "1 of 1 (Filtered)". At the very bottom, there is a "Form View" section with a "Start" button, a "FLTR" button, a "NUM" button, and a system clock showing "3:54 PM".

Figure 4. Characteristic Form from the SIM-DE database.

Activity Characteristic Set Types

Users can then configure activity characteristic sets and defaults to avoid unnecessary repetitive data entry and allows the user to create a data entry form based on the data they collect. Figure 5 shows activity characteristic set default form, while Figure 6 shows where the user can select the activity characteristic set needed in the order that they will appear on the data entry form. After beta testing and gathering input from the various users during training the activity characteristic set default form will be modified and is discussed in the future developments section of this report.

SIMDE - [CharSetTypes]

File Edit View Insert Format Records Tools Window Help

Arial 9 B I U

Characteristic Set Type:

Description:

Activity Defaults

Trip Id:

Activity Category:

Type:

Medium:

Collection Procedure:

Reference Point:

Depth:

Depth Units:

Record: 14 of 4

Characteristic Set Type ID

NUM 4:42 PM

Figure 5. Activity Default Form from the SIM-DE database.

SIMDE - [CharSetTypes]

File Edit View Insert Format Records Tools Window Help

MS Sans Serif 8 B I U

Characteristic Set Type ID:

Type Description:

CharSets

Characteristic ID	Description	Sort Order
<input type="text" value="BCS-2N50ML"/>	<input type="text" value="Borger Color System - 2nd # 50 ml"/>	<input type="text" value="6"/>
<input type="text" value="TSA"/>	<input type="text" value="Turb. Sample Size"/>	<input type="text" value="7"/>
<input type="text" value="TRA"/>	<input type="text" value="#.5 ml Turb. Reagent Additions"/>	<input type="text" value="8"/>
<input type="text" value="TUR-CALC"/>	<input type="text" value="Calculated Turbidity"/>	<input type="text" value="9"/>
<input type="text" value="PH"/>	<input type="text" value="pH-Octet Comparator (LaMotte- 5858)"/>	<input type="text" value="10"/>
<input type="text" value="DOWTC"/>	<input type="text" value="Fix Water Temp in deg C during Dissolved O<sub>2</sub>"/>	<input type="text" value="11"/>
<input type="text" value="DOTT"/>	<input type="text" value="Dissolved Oxygen Titration Date and Time"/>	<input type="text" value="12"/>
<input type="text" value="NNZR-COLOF"/>	<input type="text" value="Nitrate-N (Zinc Red.) Color Description"/>	<input type="text" value="13"/>
<input type="text" value="NNZR-READ"/>	<input type="text" value="Nitrate-N (Zinc Red.) Reading"/>	<input type="text" value="14"/>
<input type="text" value="CBTM"/>	<input type="text" value="Coliscan Coliform Bacteria Test - Time Mixed"/>	<input type="text" value="15"/>
<input type="text" value="CBTP"/>	<input type="text" value="Coliscan Coliform Bacteria Test - Time Plated"/>	<input type="text" value="16"/>

Record: of 38

Record: of 4

Characteristic ID - key to Characteristics Table

Start NUM 4:43 PM

Figure 6. Activity Characteristic Set Selection Form from the SIM-DE database

Personnel

Personnel contact and training information can be entered into the database and is associated with the data they collect. Figure 7 shows the personnel information form.

Personnel ID: CIK-40

First Name: Ann Day Phone: (907) 399-7119

Last Name: Wieland Evening Phone: (907) 235-6919

Cell Phone:

Address: P. O. Box 1395

City: Homer State: AK Zip: 99603

Personnel Type: Volunteer Monitor Email: agpacSU@webtv.net

Monitor Type: Current Web Address:

Training

Training Code	Date	Recertification Date	Description
Phase I	6/19/97		In two, three to four (3-4) hour sessions new volunteers are intr
Phase II	6/20/97		This phase entails hands-on training to ensure that each volun
Phase III	10/19/97		Trainers work with each citizen volunteer and monitoring group
Phase IV		6/14/00	quality control and re-certification session
Phase IV		9/4/01	quality control and re-certification session

Record: 1 of 1 (Filtered)

Form View FLTR NUM 4:09 PM

Figure 7. Personnel Information Form from the SIM-DE database.

Data Entry

Once a user has configured the database to meet their program needs, data entry can begin. The user can select the default data entry form based on the data set they need to enter. Figure 8 shows the window that allows the user to select and start their default activity.

Press the Assign Next ID button to get the next available ID.

Group ID: CIK

Year: 03

New Activity ID: _____

Replicate No.: _____

Activity Type: KBCEMP-FMO

Leave the Replicate for QC purposes.

Activity is a replicate

Buttons: Assign Next ID, Start Activity, Cancel, Close Form

Status Bar: Form View, NUM, 5:20 PM

Figure 8. Start New Activity Form from the SIM-DE database.

Once the user starts the activity they can begin to enter their data. Figure 9 shows the current version of the data entry form. After beta testing and gathering input from the various users during training the data entry form will be modified and is discussed in the future developments section of this report.

SIMDE - [Activity]

File Edit View Insert Format Records Tools Window Help

Arial 9 B I U

Activity ID: CIK-03-00001 Create Replicate Depth: Start Date: 1/7/03 Time: 2:00:00 PM
 Replicate No.: 1 Depth Units: m End Date: 1/7/03 Time: 4:30:00 PM
 Trip ID: Winter 2002 Reference Point: Surface Data Entered: 1/7/03 Edited: 1/7/03
 Exported: 1/8/03
 Projects: ProjectID: Kachemak Bay & Anch Personnel: Personnel ID: CIK-40
 Station ID: KB-556 Medium: Water
 Type: Field Mstr/Obs Collect Proc.: Standard Method (19th Edition)
 Act. Category: Routine Mstr/Obs Gear ID:

Calculate Results Instructions Close Form

Characteristic ID	Result Value	Units	Date	Time	Field/Lab Procedure	Sample
Hanna Meter Combo Calibration- yes or no	yes		1/7/03	13:30	AIG026-CALB	
Precipitation in inches during the last 24 hours	1.5	in	1/7/03		HABITAT002	
Precipitation Type	Snow		1/7/03		HABITAT002	
Weather Description	Precipitatio		1/7/03		HABITAT002	
Number of Previous Days Weather was Similar	1	days	1/7/03		HABITAT002	

Record: 1 of 59

Form View FLTR NUM

Start L M V O E S M A A 3:42 PM

Figure 9. Data Entry Form from the SIM-DE database.

Calculations

Several methods in the CEMP program require calculations of the measurements taken from the field to get a final result for reporting. The CEMP Water Quality Database had programmed formulas into the database to eliminate the possibility of math errors. The CEMP database was programmed to calculate results for % saturation, salinity, temperature, turbidity, bacteria, conductivity, secchi depth, and orthophosphate. **Example:** CEMP monitors measure salinity by measuring the specific gravity and temperature of the water and then salinity is calculated in ppt. The database committee considered this a high priority to move these programmed calculations into the new database.

SIM-DE has calculated results set up and configured in the characteristic setup form. A flag was added to the characteristic setup form to allow the characteristic to be flagged as 'calculated'. When result data entry is being performed in the activity form, result rows for any calculated results will appear in the form if they are also marked as default characteristics in the set up table. A button on the form may be pressed to 'get calculated results'. When this button is pressed, and also upon saving the form, calculations will be performed for all results in the activity. The formulas will then be coded as regular VBA (Visual Basic for Access) functions that can be executed by the Activity form processes as needed. Calculations for the following were included: salinity; ortho-phosphate; specific conductance at 25 Deg C; dissolved oxygen saturation; turbidity in JTUs; bacteria; Secchi depth; and F to C conversion.

Export Data To STORET

One of the keys to the success of this data management system is the ability to move data into STORET. Figure 10 shows the Export Options Form that allows a user to export the data to STORET and Figure 11 shows a SIM compatible exchange file created by SIM-DE that can be imported into SIM and then migrated to STORET.

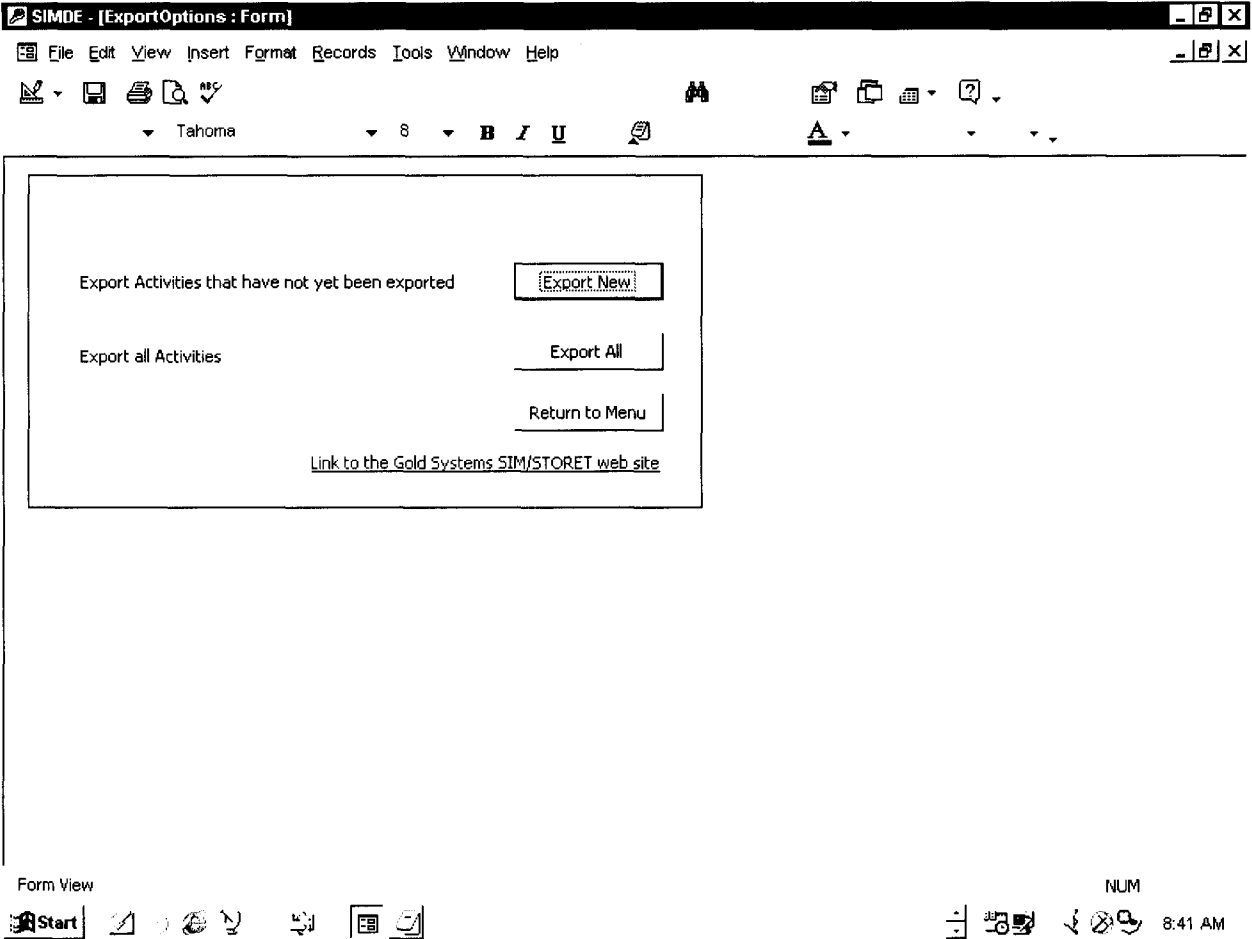


Figure 10. Export Options Form from the SIM-DE database.

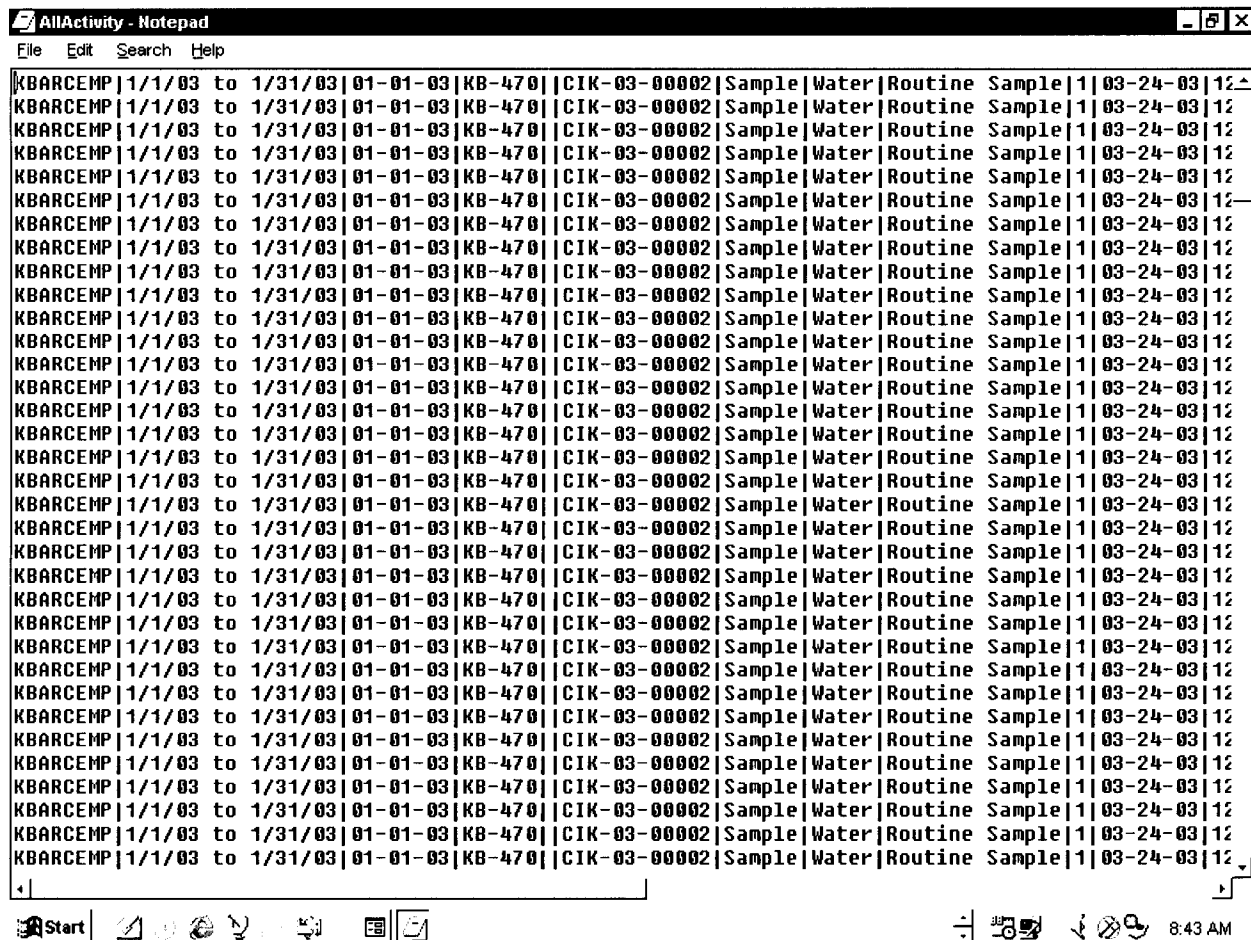


Figure 11. SIM Compatible Exchange File created by SIM-DE database.

Training and Demonstrations

A poster and demonstration of the database was presented on 1/13/03 at the *Exxon Valdez* Oil Spill Symposium. Additional demonstrations were conducted at the Alaska Forum on the Environment and at the 3rd Annual Conference of the CEMP Partnership of the Cook Inlet Watershed in February 2003.

On April 3rd, 2003, a database training was held in Anchorage at a state computer lab. Joel Cooper, Research Coordinator with Cook Inlet Keeper and principal investigator of this project, and Russell Kunibe, Analyst Programmer with ADEC conducted the training. A total of 24 personnel attended the training from the CEMP Partnership organizations, ADEC, Alaska Department of Natural Resources (ADNR), National Park Service (NPS), U.S. Fish and Wildlife Service-Water Resources Division, Native American Fish and Wildlife Society, and Chickaloon Village.

The participants made the following comments and suggestions and are no particular order:

- Trip ID is missing Trip End Date
- For list of Analytical Procedures we should start with the STORET's list and use the Code of Federal Register Method ID Number and Name for Analytical Procedure ID

Number and Name. Example: pH, EPA 150.1, pH-Electrometric. We should start by importing STORETS default list.

- Move the help function to every window.
- Put the buttons in each menu in a more logical order (i.e. the order in which they would be used).
- Top priority is to define the fields in the database. Need to have table fields described.
- Selecting the significant digits needs to be characteristic specific. Example: For Specific Gravity there is the need for 5 significant digits 1.0270. We need to be able to enter this number without it rounding it to 1. Significant digits will vary from characteristic to characteristic. We need to be able to set this accordingly for minimum and maximum values. For a specific characteristic, significant figures of the 'result value' will vary depending upon the measurement resolution of the field instrument or lab analytical method. Also, SIMDE database treats the 'result value' field as text. One question is whether the 'result value' text field can be changed to a numeric field in EXCEL without losing significant figures.
- Min and max fields need to set to decimal place.
- The fonts need to be a fixed on some computers, on some of the installations the font was showing up different and some of the letters were getting truncated.
- Create an Analytical Method Type. This would be like the Unit Type.
- Need to be able to select both the collection procedure and the analytical procedure on the characteristic form.
- Color code all fields that are STORET throughout the database
- Show all descriptions instead of codes in all drop down menus.
- When configuring your datasheet and putting the methods in the order they will appear, if you want to change one position, you need to manually change them all. It should be more like configuring a tab order where you just place them in the right order.
- When starting a new activity, when some people tried to select a different Group ID the activity form would not open
- There is no place on any of the menus to enter project information. Suggestion to incorporate the project information will be added from the National Park Service database.
- On the new activity form move the Assign Next ID button next to the New Activity ID Field.
- End date cannot precede Start Date. On the activity form you can enter an end date that can precede the start date.
- Lake datasheet needs to be considered.
- Suggestion to have in the results value to have result sub form for replicates.
- Look into making multiple entry forms in which any type matrix data set (i.e. 10 x50). This would require another data entry form that will allow us to add data from a matrix. In this case we would only be adding results according to preset parameters. This would be for the lake info, or for a flow cross-section or other data that comes in this type of format. We also take field readings of pH, spec. conductivity, water temp, and salinity in cross section (Equal width increments of 5 to 15 location across the river depending on how well mixed it is). Most of the time readings are taken mid-depth at each point in the river, but occasionally, vertical readings are made at several depths at each point. Since the equal width increments range from 5 to 15, there needs to be at least 15 columns

rather than 10 (i.e. 10 x50). One column is needed for each station/location in the river. If vertical parameter readings are made at several depths at each point, then there needs to be enough rows to enter data for each depth. For rivers, it is unlikely there will be 50 readings in a column of water (i.e. 10 x50), however, for very deep lakes, 50 could be appropriate. Appendix 1 shows a data entry array request by the Mat-Su Borough Lake Monitoring Program.

- UAA-ENRI personnel need to be involved with in the development of the biological module.
- Add a title to all forms and sub forms
- Display units in activity sub form but don't allow for edits
- Need to use Alaska Department of Fish and Game stream names when possible.
- Get rid of Activity sub form counter (i.e. record 1 of 17) it causes confusion and is not necessary.
- On an activity form add a macro button on the sub for to open up lake profile form.
- Need to add Station Module.
- Distribute a next version by June 30, 2003
- At the next training, people come in with their data and we will move into the new database.
- Consider doing training in smaller groups or by agency or organization type.
- It will be easier to learn SIMDE database with users own data sets as demos and follow it through from start to finish.
- Have people bring in a datasheet from their group to enter and help with configuration.

Future Database Development

Based on initial database committee recommendations and input received from users during beta testing, trainings and demonstrations a new itemized list of modifications and additions in order of priority has been drafted. Funding from the EPA Challenge Grant Program has been secured by ADEC for additional work on the data management system. At a minimum work will be completed on the top 5 priority items in the summer of 2003 with training, data migration and deployment scheduled for the September 2003.

1. Rapid Data Entry Forms

Description

A new activity form would be created to facilitate the rapid entry of data into SIM-DE.

The SIM-DE application uses a data model that supports the easy transfer of data to the STORET application via SIM or WEBSIM (a new Web-Based version of the SIM application). As such, the data model enforces several STORET business rules that add a layer of complexity to the data entry process. Specifically, the rule that a STORET Field Activity can only have a single Medium, Sample Collection Procedure, and Category (Field Measurement or Sample) can result in the need to enter several Field Activities for each sampling event. Additionally, a second rule that replicate samples are stored as separate field activities, also results in duplicate data entry.

In the current SIM-DE application, the interface has been designed to simplify data entry but ultimately still reflects the requirements of the underlying data structure. The development of a

new rapid data entry form that mimics the sampler's field sheets and can collect all data for a sampling event would greatly simplify the data entry process. This new form would not be created in the traditional sense where each field on the form relates to a column in a single underlying table and record. Instead, the form would accept all of the data for a sampling event and then write this data to several records in several tables when the form is saved. Such a form would greatly simplify the data entry process for the user, but is much more difficult to create and maintain.

The new form will have a layout similar to the existing SIM-DE Activity Entry form, except that several of the activity level fields would be moved to the results list to allow users to enter results that will be stored as several different activities. It is also possible that these data elements could be added to the characteristic defaults, to avoid having to enter them for each result.

Once a sampling event has been entered and saved through the new rapid data entry form, the data will be saved in several underlying tables and records. This means that if this form is used to view or edit an existing sampling event, it must read and display the data from these sources as well.

Replicate data will be supported on this form in one of two ways. Either a second and third result column will be added to this form to capture replicate results, or each replicate will simply be entered on a separate row. The advantage to the later is that it would be much easier to re-display and would have no limitation on the number of replicate results that can be entered.

2. Station Module

Description

A new module will be added to SIM-DE to support the entry of Station information, and the preparation of a STORET compatible station import file. The module will consist of:

- a. A form used to display a list of stations stored in the SIM-DE database. This list will allow queries by 'station status' and other columns selected by CEMP to be included in the list.
- b. Addition of a 'station status' flag. Valid values include *Active*, *Other*, and *Seasonal*.
- c. A detail form used to enter or edit a station record. Only one location per station will be supported. Well definitions (i.e. Casing, intervals, etc.) will not be supported.
- d. Capability to export station records to a SIM compatible file format for import into STORET.

3. Project Module

Description

Incorporate project information from National Park Service database.

4. Update SIM-DE to interface with SIM v2.0 and STORET v2.0

Description

Significant updates have been made to both SIM and STORET that will be included as part of the v2.0 release of each application. Systems Analysis needs to be completed to determine what modifications will need to be made to SIM-DE to ensure that it can generate a SIM v2.0 /

STORET v2.0 compatible import file. In addition to basic compatibility issues, SIM-DE should be reviewed to determine if any of the new data elements available in STORET v2.0 should be added as well.

5. Documentation

Description

Several forms of documentation will be provided:

- a. A simple users guide outlining both data entry and data export capabilities of SIM-DE. All system configuration options will be outlined in this guide as well. This document will be provided in an electronic format, which can be distributed in either electronic or hard copy format by CEMP.
- b. Internal Data Column Documentation. All columns within SIM-DE will be documented within the MS Access property sheets.
- c. A SIM-DE -> STORET data map. This document would outline how each column in the SIM-DE application relates to a corresponding column in the STORET database. Where there is not a simple one-to-one correspondence between the columns in the systems, additional information will be provided.
- d. Schema Entry Relationship diagrams will be created and made available through the Access interface. Hard copies could be generated and distributed as needed by CEMP.

6. Additions / Changes to allow input and export of Macro invertebrate data

Description

Support for Multi-Taxon Population Census biological results. This data would be recorded and stored in SIM-DE in a similar fashion as the existing chemical results. Each taxa would be listed as a characteristic, with the count for each taxa stored as the result. The SIM-DE characteristics table would need to be enhanced to differentiate Taxa from other characteristics. The SIM-DE data entry window would ensure that biological and chemical results would not be mixed within a single activity. The SIM-DE export scripts would need modifications to generate the SIM compatible Biological Results Export files.

In addition to the development required for SIM-DE, there may be additional development effort if SIM-DE is to prepare a WEBSIM compatible import file. The current version of WEBSIM runs against the STORET v2.0 database, but does not support the migration of Biological data. As such, the WEBSIM application would have to be expanded to support biological data as well.

7. Data Quality Objective Check Box

Description

Addition of a new Data Quality Objective check box to indicate whether or not a result has met it's Data Quality Objective. This enhancement would require the addition of a database column in the results table and a new checkbox on the activity data entry form(s). This data element, however, would not be exported to STORET and will not have an affect on the data that is.

8. Configurable Formulas

Description

The existing SIM-DE application can perform several calculations on the result data entered. The formula for each calculation is currently hard coded into the SIM-DE application. This enhancement would store these formulas in the SIM-DE database and then provide users with a user interface that would allow editing an existing formula or adding a new one of their own.

9. Equipment Tracking Module

Description

The Equipment module will allow for the tracking of items of equipment. Fields stored for each item will include those described under the equipment module are below. A field for equipment 'status' will be added to allow a piece of equipment to be flagged as 'active', 'out of service', etc. For each piece of equipment cataloged, a log will be kept for:

- a. Calibration (date, test type, calibration method, personnel id, standard value, actual value)
Test type – test being calibrated (ph, conductivity, etc. in a user defined code table)
Calibration method - (user defined code table)
Personnel ID – lookup from volunteer/personnel module
Standard value – The value of sample used to calibrated instrument
Actual value – Actual calibration value obtained
- b. check in – check out (date in, date out, personnel id)
- c. maintenance log (date, action performed, personnel id)
- d. technical support (date, action performed, personnel id)

A query/report by date range and organization will be available for the 4 logs. A query/report will be available to show equipment currently checked out to a particular person.

Fields:

ID Number (an ID number that is related to the organization that owns the equipment)
Serial number
Model (name or number)
Equipment description
Checked out by
 Select personnel ID
Check out date
Returned by
 Select personnel ID
Return date
Maintenance Log
 Maintenance date
 Maintenance performed
Calibration Log
 Calibration date
 Calibration method (allow for calibration methods to added as needed)
 pH
 Calibration values (allow to add calibration values as needed)

Conductivity
 Calibration values (allow to add calibration values as needed)
 Manufacturer
 Contact Information
 General/Ordering
 Address
 State
 Zip
 Phone
 Fax
 Web
 Technical Support
 Address
 State
 Zip
 Phone
 Fax
 Web
 Technical Support Log
 Support Provided

Queries:

- What equipment do each personnel check out?
- What equipment is being used at each site?

Reports:

- Maintenance log
- Calibration log
- Technical support log

10. QC Checks

Description

- a. method range – specific to method/characteristic combination. To support this feature, an intersection table between field/lab procedures and characteristics will be added along with a form to maintain the data. Only methods configured for a characteristic will be able to be selected in the Activity form. (configurable restriction). If ‘range’ exceeded, invalidate the result for that characteristic.
- b. sensitivity - specific to method/characteristic combination. This feature will also use the intersection table between field/lab procedures and characteristics. Sensitivity is specified as a single numeric entry. A result should only be reported up to the sensitivity level specified. If sensitivity is out of range, invalidate the result for that characteristic.
- c. Precision - specific to method/characteristic combination. This feature will use the intersection table between field/lab procedures and characteristics. Precision will be specified as a single numeric entry. When there are replicates for an activity, the ‘precision

range' for a particular method/characteristic combination must fall within the value specified. This check will be performed when an Activity record is saved – the system will look to see if replicate data is present and perform the check if it is. A message will be presented to the user notifying them of the result of the check. (Note: this feature checks the result against a 'precision standard' - in addition, the actual precision could be calculated and sent to storet. This later feature will not be included at this time.) If precision is out of range, invalidate the result for that characteristic on the activity and the replicate.

- d. Accuracy - QC results (blanks and spikes) may be added as results on a separate activity record of type TRIP QC. When sent to STORET they are associated with the TRIP rather than a particular activity. The Accuracy check involves comparing the result obtained on the QC sample against the know value for the sample.

11. Characteristic Import / Export Utility – SIM-DE

Description

This enhancement would add the ability to import and export characteristic configuration information between installations of SIM-DE.

12. Characteristic Group Import / Export Utility – STORET

Description

This enhancement would add the ability to import and export characteristic group defaults between installations of STORET. Additionally, characteristic groups could be copied from one STORET Org ID and Imported into a separate STORET Org ID.

13. Data Logger Support

Description

Addition of a module to support data logger results in SIM-DE. This enhancement would required significant modifications to both SIM-DE and SIM v2.0. Data Logger results follow a different set of business rules than results generated through a field activity. Additionally, the existing SIM module (v1.2.2 and v2.0) do not support data loggers. Before SIM-DE could generate a data logger export file, SIM would need to be enhanced to support the migration of this data.

14. Graphing Capabilities

Description

The current version of SIM-DE was not originally designed to be a data repository, but rather as a tool to allow users to enter data for the sole purpose of migrating it to STORET. As such, very little reporting capabilities were created for the current SIM-DE. Now that it is clear that the SIM-DE will serve a dual role as a local data repository, reporting capabilities can be added in a couple of ways.

The first option is in the generation of set reports that can be run off the SIM-DE menus. These reports could be dynamic in that they would accept a variety of parameters to filter the dataset, but static in the types of information the display. The second option is to assist the SIM-DE

users in creating their own Ad Hoc reports. To this end, a series of data views could be created to simplify the underlying data structure and thus the creation of Ad Hoc reports.

15. Photo Support

Description

The new version of the STORET application (v2.0) supports the storage of photos in many of the forms and tables. The SIM v2.0 and WEBSIM applications, however, do not currently include photo support. As such, enhancements would have to be made to SIM, WEBSIM, and SIM-DE in order to facilitate this information.

16. XML Support

Description

The WEBSIM application has been enhanced to include basic support for XML result files. SIM-DE could be enhanced to generate these XML files instead of the current flat files that are produced. Additionally, support for XML Projects, XML Stations, and several of the preference and default tables could be added to both SIM-DE and WEBSIM. Each type of data would require the creation of an XML Schema, and XML generator in SIM-DE and an XML parser in WEBSIM.

DISCUSSION

The database committee is well on its way to achieving its overall goal of this project to make data more accessible and more useful to decision makers, stakeholders, resource managers, and the public. To fulfill our objective of creating a consistent data management system where all citizen groups and agencies can equally share, report and review their water quality and habitat data, for the most part, relies on getting the data into STORET. STORET is EPA's largest computerized environmental data system contains raw biological, chemical, and physical data on surface and ground water collected by federal, state and local agencies, Indian Tribes, volunteer groups, academics, and others. All 50 States, territories, and jurisdictions of the U.S. are represented in these systems (EPA 2003). In addition, it has been chosen by ADEC as their repository for water quality data. It is therefore a logical selection for a central repository for data collected.

The challenge has been getting the data into STORET through a user-friendly data entry interface and then making them accessible on the Internet in a user-friendly format. There is no question that with enough time, money and training, most anyone could navigate through the multitude of entry forms in STORET to enter their data. But with state and federal budgets for water quality monitoring continuing to decline, volunteer collected data, through citizen based monitoring, have become more important in state monitoring programs (Mauger 2003). When volunteer monitoring programs looked to use STORET, they usually come away asking the question found in this recent Volunteer Monitor List Serve Correspondence- "I noticed EPA's new and improved STORET is now available <http://www.epa.gov/STORET/>. Does anyone know of other less massive

data storage programs for physical, chemical, and biological data that are available for volunteer monitoring groups/organizations to use?" (Nolan 2003).

The database committee recognized this challenge and made one of its project objectives to interface citizen-collected data with STORET to make it more useful to agencies. Toward that end the committee sought to better understand STORET through research, assessments and trainings and came walking away seeing STORET as a great repository for data, but wanting a less complicated data entry system for citizen groups to use. The CEMP Partnership of the Cook Inlet Watershed had already developed a user-friendly Microsoft Access database, the CEMP Water Quality Database, but it lacked an easy and efficient way to migrate data to STORET. At the same time the Southern Ute Indian Tribe was working Gold Systems Inc. to develop an MS Access application, SIM-DE, capable of exporting the data to STORET. Through collaboration, sharing of financial and technological resources, patience, and Internet communications a user-friendly data entry interface is becoming a reality that can be shared not only with agencies, Indian Tribes, and volunteer groups in Alaska, but across the country.

To make data more accessible on the Internet, the committee has been working with CIIMMS, Alaska's Cooperatively Implemented Information Management System. The data are then made accessible on the Internet through a network node via CIIMMS. CIIMMS is a logical choice for providing Internet access for this project since it is was designed as a user-friendly web-based system made to provide access to a broad spectrum of timely data and analysis tools via the Internet. Figure 1 shows the path of the data system described in this report from the MS Access Database to SIM to STORET to the Web and Mapping Application (i.e. CIIMMS).

To depict how information will be accessed on the figures 12-15 shows how you can find a station on a map (Figure 12); view the station information (Figure 13); create a query to find the data you want at that station (Figure 14); and then view the data in tabular format (Figure 15). Future developments will allow for accessing photos and graphs.

CONCLUSION AND RECOMMENDATIONS

Conclusion

To develop an interactive water quality and habitat database and make it accessible on the web is very complex and time-consuming process that requires collaboration of technological, financial, and human resources. There is no way a project of this scale would ever work without the broad base cooperation and collaboration of agencies and organizations. This project has shown that it is possible to collaborate and cooperate to build such a system. It is important to recognize that a project of this nature, one that provides all of us invaluable information about our water resources, is a project that will never end, it must carry on into perpetuity. Therefore we must continue to develop a dynamic system capable of changing with technology and time. By maintaining such a system we will help facilitate a better understanding about threats to, and solutions for, water quality and habitat.

Recommendations

1. Continue to identify agencies and organizations to collaborate with on the project for funding and human and technological resources.

2. Continue to use the process of gathering information, assessment, development, testing through use, and meeting to reassess and then repeat the process to build the on previous work completed.
3. Train more people locally in computer programming.
4. Provide accessible support services to the system users.

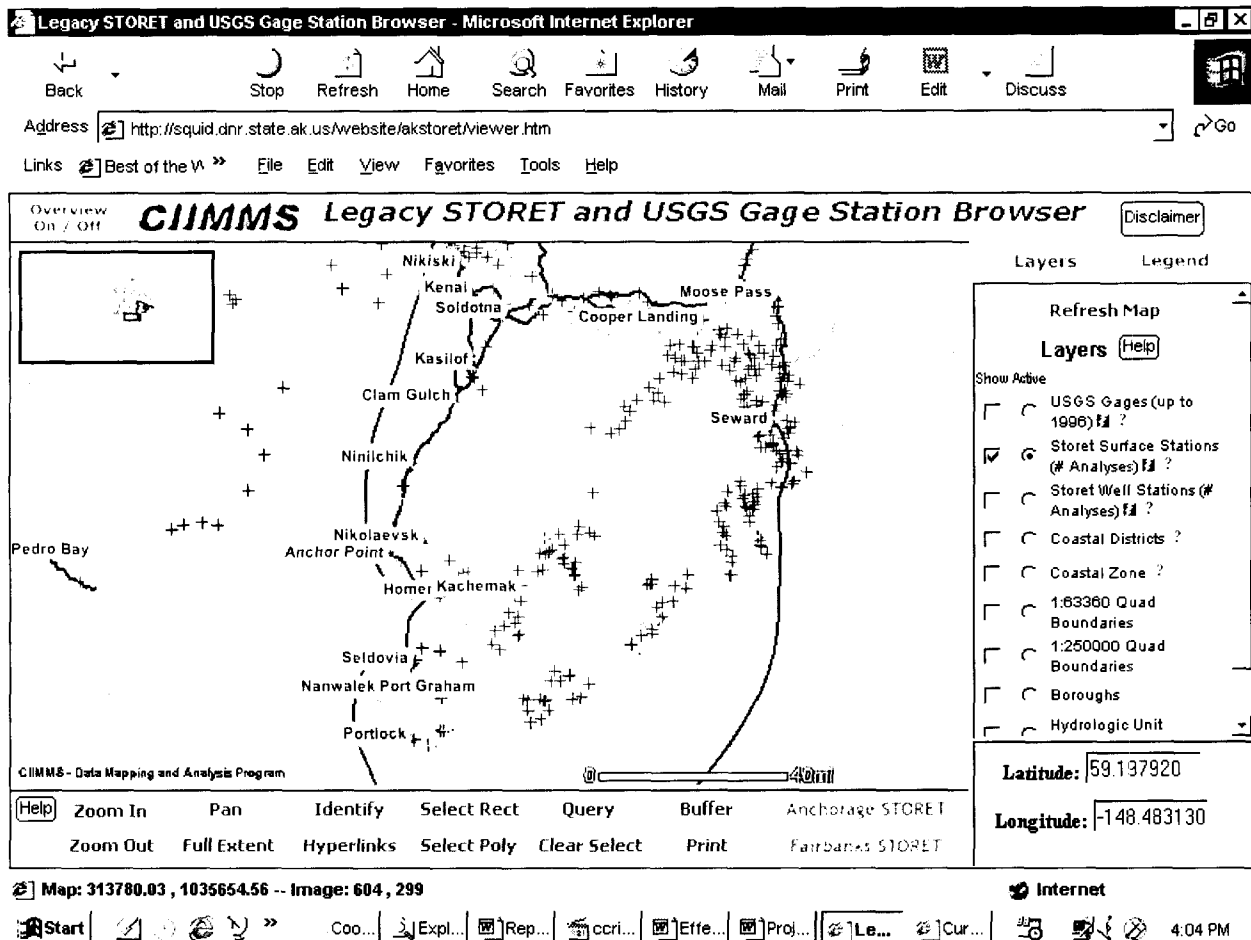


Figure 12. CIIMMS Mapping Application-Locating Surface Stations.

Query/Selection Results - Microsoft Internet Explorer

Storet Surface Stations (# Analyses)

Rec	OBJECTID	AGENCY_STA	STATION_NA	LATNUM	LATDD	LONGNUM	LONGDD	AGENCY	STATION	TYPE1	HUC
1	1435	112WRD:15240800	DEEP C AB NF NR NINILCHIK AK	595856	59.982	1511448	-151.247	112WRD	15240800	STREAM	19020301
2	1436	112WRD:15240900	NF DEEP C AT MOUTH NR NINILCHIK AK	595859	59.983	1511452	-151.248	112WRD	15240900	STREAM	19020301

Start | [Icons] | Coo... | Expl... | Rep... | ccri... | Effe... | Proj... | Leg... | Qu... | 4:06 PM

Figure 13. CIIMMS Surface Station Results.

CIIMMS - Microsoft Internet Explorer

Address http://info.dec.state.ak.us/storetleg/storeinvent.asp?AGENCY_STA=112WRD%2015240600 Go

Links Best of the Web File Edit View Favorites Tools Help

State:

Select either a Sub-basin or County Sub-basin: County fips:

Agency_Station: Station Type:

Parameter Group: Additional Station
 Type Descriptor:

Date From: Date To:
Select either a date range or a beginning or ending date (mm/dd/yy)

Parameter#: Remark Code: Num Obs Greater than:

Further Limit Parameter# by Analytical Results Choose either 1,2,or 3

1) Select Results with Minimum Greater Than: And - Or Maximum Less Than:

2) Select Results with Average Greater Than:

3) Select Results with Maximum Greater Than:

Done Internet

Start Co... EX... Re... W... Eff... Pr... Le... Qu... CI... 4:20 PM

Figure 14. CIIMMS Data Query Form.

CIIMMS - Microsoft Internet Explorer

Address <http://info.dec.state.ak.us/storetleg/storetresult.asp>

Links Best of the V » File Edit View Favorites Tools Help

filename: in1445.xls

agency_sta	station_name	parno	short_name	num_obs	xmin	xmax	xmean	variance	std_dev	remark	beg_date	end_date	grp
112WRD 15240600	DEEP C AB TR 1 NR NINILCHIK AK	10	WATER TEMP CENT	12	1	14	8.7083	20.975	4.5799		7/14/1978	9/3/1980	16
112WRD 15240600	DEEP C AB TR 1 NR NINILCHIK AK	11	WATER TEMP FAHN	12	33.8	57.2	47.675	67.965	8.2441	\$	7/14/1978	9/3/1980	16
112WRD 15240600	DEEP C AB TR 1 NR NINILCHIK AK	61	STREAM FLOW, INST-CFS	17	8	146	26.812	1233	35.114		7/14/1978	9/3/1980	05
112WRD 15240600	DEEP C AB TR 1 NR NINILCHIK AK	95	CNDUCTVY AT 25C MICROMHO	13	30	95	56.154	275.66	16.603		7/14/1978	9/3/1980	13
112WRD 15240600	DEEP C AB TR 1 NR NINILCHIK AK	95	CNDUCTVY AT 25C MICROMHO	14	25	95	53.928	323.78	17.994	TOT	7/14/1978	9/3/1980	13
	DEEP C AB		CNDUCTVY										

Done

Start Co... Ex... Re... W... Eff... Pr... Le... Qu... CI... 4:22 PM

Figure 15. CIIMMS Station Results from Query.

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LITERATURE CITED

CIIMMS [Homepage of CIIMMS: Alaska's Cooperatively Implemented Information Management System], [Online]. (2002, June 20 - last update). Available: <http://www.info.dec.state.ak.us/ciimms/> [2003, May 13].

Gold Systems Inc. 2001. Alaska Water Quality Division, STORET Integration Options. Salt Lake City, UT. 30 p.

Gold Systems Inc. 2003. SIM-DE Modifications Proposal and Cost Estimate for Citizens' Environmental Monitoring Program-Draft, March 2003. Salt Lake City, UT.

Kunibe, R. 2000. CEMP Data Committee Meeting Notes 12/14/00. Alaska Department of Environmental Conservation, Division of Air and Water Quality, Data and Monitoring, Juneau, Alaska.

Kunibe, R. 2001. STORET Data Assessment. Request for Proposal Number: 18-5029-01 Alaska Department of Environmental Conservation, Division of Air and Water Quality, Data and Monitoring, Juneau, Alaska.

Kunibe, R., C. Fries, K. Zeiner, J. Hock, G. Kellogg, L. Patrick, and W. Samuels. 2001. Cook Inlet Information Management and Monitoring System, *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 01391), Alaska Department of Natural Resources, Office of the Commissioner, Anchorage, Alaska.

Mauger, S. 2003. Effectiveness of Citizens' Environmental Monitoring Program, *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 02667), Cook Inlet Keeper, Homer, Alaska.

Nolan, J.K. 2003. Subject: Data Storage, Volunteer Monitor List Serve Correspondence, April 23, 2003. volmonitor-Owner@lists.epa.gov

U. S. Environmental Protection Agency. 2001. STORET Interface Module (SIM) Version 1.2 User's Guide and Reference Manual, Office of Water.

U. S. Environmental Protection Agency. 2003. [Homepage of About STORET], [Online]. (2003, June 2 - last update). Available: <http://www.epa.gov/storet/about.html> [2003, June 2]

U. S. Environmental Protection Agency. 2003. [Homepage of About STORET], [Online]. (2003, June 2 - last update). Available: <http://www.epa.gov/storet/> [2003, June 2]

APPENDIX 1

Matanuska-Susitna Borough Data Entry Array Request

The Matanuska-Susitna Borough Lakes program is requesting that an Array or Matrix be created to collect data, which would then parse or distribute that information to the standard record format.

Below you will see an example of one of our field sheets:

Lake: Memory . Date: 6/4/02 . Initials: sil

Equipment: Please circle Hydrolab 1 2 3 Quanta 1 2 3

Readings for temperature and dissolved oxygen will be taken at 1-meter intervals until the bottom is reached or the end of the cable. Please record bottom depth. Conductivity and pH will be taken at the surface, then at 1 meter, and approximately ¾ of the total depth of the lake”

Site A- 1st Reading				
Depth (may be 1, 3, 5 or 10 other various meter increments)	Temperature	Conductivity	Dissolved Oxygen	pH
Surface	14.78	.075	11.43	8.37
1 m	14.83	.075	11.40	8.46
2 m	14.81	.075	11.26	8.46
3 m	13.69	.074	14.20	8.37
4 m	9.60	.075	13.84	7.90
5 m	8.87	.075	12.15	7.51
Bottom 5.9m	8.25	.075	9.92	7.32
Site A- 2nd Reading				
Surface	14.32	.074	10.63	8.36
1 m	14.83	.074	10.68	8.44
2 m	14.79	.074	10.73	8.44
3 m	12.45	.075	13.49	8.26
4 m	9.69	.075	13.56	8.05
5 m	8.76	.076	11.55	7.56
Bottom 5.9m	8.34	.071	8.66	7.27

Site B- 1 st Reading				
Depth	Temperature	Conductivity	Dissolved Oxygen	pH
Surface	14.98	.074	10.40	8.23
1 m	14.98	.074	10.53	8.23
2 m	14.83	.073	10.45	8.26
3 m	11.74	.077	13.01	7.77
4 m	8.40	.080	11.42	7.43
5 m	7.91	.082	10.41	7.27
6 m	7.66	.084	8.64	7.10
Site B- 2 nd Reading				
Surface	14.45	.073	10.07	8.11
1 m	14.98	.073	10.33	8.18
2 m	14.82	.073	10.35	8.24
3 m	12.29	.077	12.58	7.84
4 m	910	.080	11.35	7.47
5 m	7.98	.081	10.49	7.31
6 m	7.64	.083	8.55	7.19

Bottom for site B 6.1 meters

As you can see there is a large amount of data collected in a very small space. We would like to see an array developed which can collect data, as in the sample above, easily with a single number entry for each cell of information.

1,1	1,2	1,3	1,4	1,n
2,1	2,2	2,3	2,4	
3,1	3,2	3,3	3,4	
4,1	4,2	4,3	4,4	
n,1				n,n

Array example

Each column of the array could be associated with a data characteristic such as depth, temperature,

Each Row would have it's own row identifier as in the example above.

Once the data is collected in each cell a routine could then populate the standard data/characteristic table based on the characteristic assigned to the column and given an iteration identifier based on the row.

Based on our conversations with other partners we estimate that an array 8 wide by 20 deep would be flexible enough to handle a single set of readings for Mat-Su and all of the other partners. If you have any further questions feel free to contact me.

Harry Banks, Programmer/Analyst
Matanuska-Susitna Borough