Exxon Valdez Oil Spill
Restoration Project Final Report

Cook Inlet Information Management and Monitoring System
Restoration Project 01391
Final Report

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September 2001

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Study History: This project was initiated in 1999 as the Cook Inlet Information Management and Monitoring System submitted jointly by the Alaska Department of Environmental Conservation and the Alaska Department of Natural Resources. During 1999 work focused on identifying appropriate data sets pertaining to Cook Inlet, conducting a user needs analysis, and developing a Prototype application. The project was approved in August 1998 on a limited scale, designed to facilitate a data inventory and a user needs analysis. The results of the user needs analysis and data inventory effort were reviewed by the Trustee Council in March 1999 and authorization was received for development of a content-limited fully functional prototype, focusing on the Kenai River watershed. Development of a fully functional prototype and the evaluation thereof provided the foundation for the development of a fully functional website focusing on the Cook Inlet Watershed. The Initial Production Phase of this website was authorized as a component of the 2000 and 2001 Work Plan, and was completed in September 2001. CIIMMS became a statewide system in July 2001.

Abstract: The Cook Inlet Information Management and Monitoring System (CIIMMS) provides an interactive website that links to a geographically distributed system of information providers. Through the CIIMMS website, users are able to identify and access (e.g., download and/or print) information ranging from primary data (geospatial and tabular) to reports, project descriptions, and other documents across a variety of themes, such as habitat, land use, resource management, pollution, and water-quality information. CIIMMS also provides (on-line) tools to make it easy to contribute information to the CIIMMS network.

CIIMMS constitutes the hardware, software, and information components of the Cook Inlet Information Management and Monitoring System. CIIMMS also establishes a framework for sharing and managing information efficiently and cooperatively. CIIMMS has established relationships between participating agencies that are built on respect for each agency's mission, resources, and data. CIIMMS provides guidelines on how to implement various aspects of the CIIMMS framework. The CIIMMS tools, framework and many participants enable a unified approach to information management in the Cook Inlet Watershed to help agencies and organizations use existing resources more effectively.

Key Words: information management, CIIMMS, website, Cook Inlet, resource management, natural resource management, clearinghouse, data clearinghouse, World Wide Web, Internet

Project Data: Information is available on line at http://info.dec.state.ak.us/ciimms.

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Executive Summary

The Cook Inlet Information Management and Monitoring System (CIIMMS) is an interactive web site developed in response to needs identified by the Cook Inlet User Community. This website was developed as part of an Exxon Valdez Oil Spill (EVOS) Restoration funded project intended to make information relative to the Exxon Valdez Oil Spill damage assessment and restoration more readily available to permitters, regulators, researchers, and the public in response to a state commitment to Cook Inlet interests.

The CIIMMS project was initially funded in 1999 to conduct a user needs analysis and develop a prototype system as an evaluation tool useful for development of a final set of system specifications. Further funding in 2000 and 2001 focused on the implementation of the Initial Production Phase of the system specifications delivered during the prototyping phase of CIIMMS. As EVOS funding draws to a close further expansion of CIIMMS to other areas of the State of Alaska is scheduled to proceed using EPA 319 grant funds. CIIMMS will initially expand to Northern Southeast Alaska, Prince William Sound and the Copper River Delta, and the Fairbanks or Northern region of the state. In addition, further functional expansion will focus on implementation of the EPA STORET database as a repository for water quality data and information linked to CIIMMS.

CIIMMS is a unique website providing a one stop portal to Alaska's natural resource information and data. CIIMMS utilizes existing repositories and clearinghouses and existing FGDC standards to search across profiles for biological, geospatial, and bibliographic data and information at a distributed network of locations. CIIMMS focuses on geographic locations and provides users with a means of locating information relative to a particular geographic place in Alaska using a map based search and gazetteer. CIIMMS also provides users with an opportunity to contribute their own information and data to the user community through an online metadata entry tool for projects, data, and information. A map based data entry component of the metadata entry tool makes it easy for contributors to define the particular area of interest to which the data or information pertains. Metadata can be stored in the centralized CIIMMS data or project repository or sent to the appropriate State or Federal geographic data clearinghouse node. CIIMMS also harvests information from websites that focus on Alaska resource information. CIIMMS has designed a web-links browse tree to which users can contribute website links for the web harvest. The web harvest and the search and browse functions of CIIMMS will continue to grow, becoming more valuable to the user community exponentially over time.

CIIMMS was designed to accommodate changes in use, technology, funding and staffing. It was intended to be maintainable, sustainable and extensible over the long term. CIIMMS has demonstrated the benefits and experienced the frustrations associated with distributed data access, large multi-agency projects, and utilization of cutting edge technology.

CIIMMS has facilitated the discovery of and access to available data and information in the Cook Inlet Watershed and consequently provided the framework for distributed access to data and information throughout the State of Alaska.

Introduction

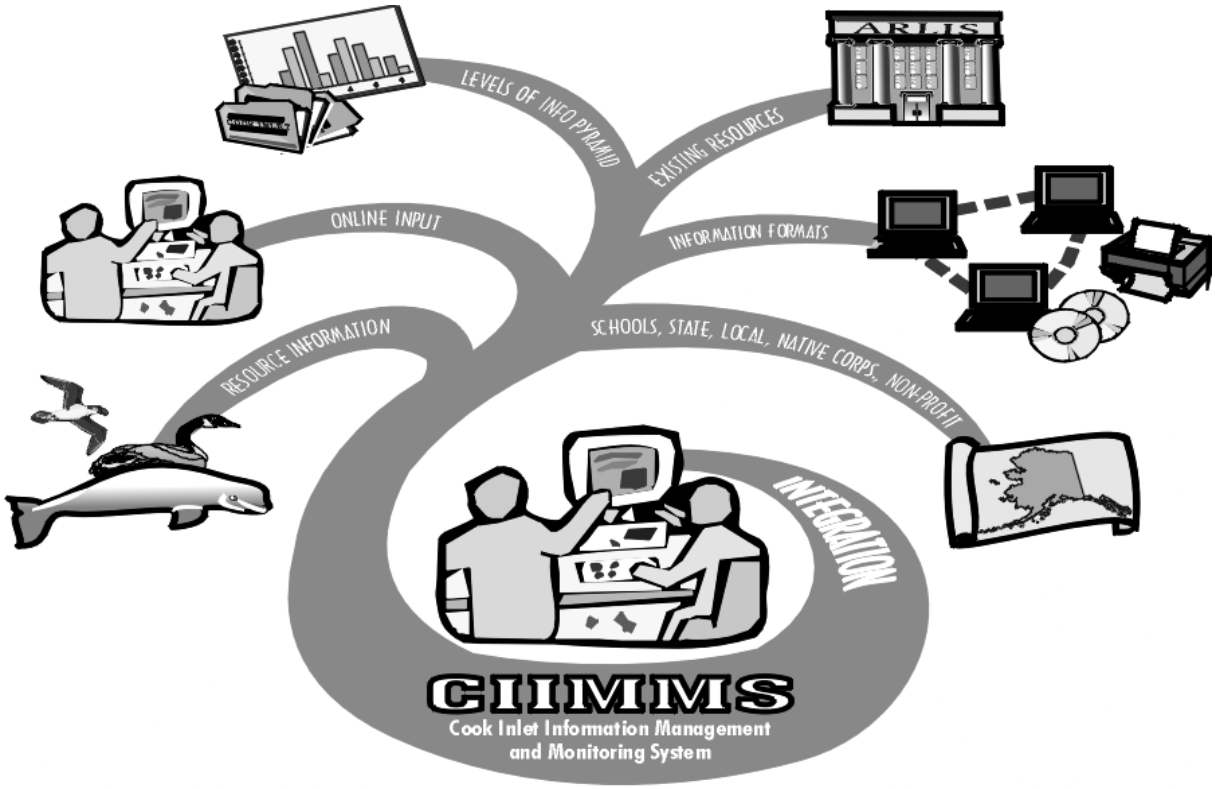
Attitudes, capabilities, and expectations regarding information are evolving. Information sharing has become an expectation rather than an anomaly. Even so, it is currently difficult to develop a comprehensive picture of existing data resources when working to understand the health and needs of a watershed. In most large, intensively used and managed watersheds, such as Cook Inlet, some stakeholders collect and analyze samples and generate data, while others rely on data to monitor resources, conduct research, or make management and policy decisions. Educators, scientists, students, researchers, resource managers, private organizations, and individual citizens are interested in a diverse set of information resources from primary data (e.g., geospatial and tabular data sets) to reports, contact information, project descriptions, and other documents across a variety of themes, such as climate, land use, animals and their habitats, resource management, pollution, and water quality. All gain through sharing resource information.

There is a need to use existing data more efficiently, to make funding more effective, and to stem the loss of historic knowledge. The Cook Inlet Information Management and Monitoring System (CIIMMS) provides a web-based framework that makes natural resource information and data available to anyone with World Wide Web access. CIIMMS has delivered a website with tools for accessing, contributing and sharing information for the Cook Inlet watershed. This site and its associated graphical user interface supports monitoring, management and restoration of resources and services injured by the *Exxon Valdez* Oil Spill, and provides access to data sets and tools valuable to addressing the ecological health of a watershed. CIIMMS allows regulators, resource managers, planners, and others to approach decision-making from a watershed perspective.

The CIIMMS project envisioned a wide-range of users (not just scientists and agency personnel) sharing and accessing valuable information about the Cook Inlet watershed and Cook Inlet-related activities (figure 1). The information sources and types ranged from primary data (geospatial and tabular) to reports, project descriptions, and other documents across a variety of themes, such as habitat, land use, resource management, pollution, and water quality.

CIIMMS appears to the user as a modern website, with the ability to search for information from a variety of sources in a variety of formats, as well as the capacity to receive information from a variety of contributors. Behind the scenes, CIIMMS is a complex undertaking with human and technological components working in tandem. Human interactions; communication, cooperation, collaboration, attitudes, and ideas form the foundation of CIIMMS. Technology, including hardware, software, emerging standards and protocols, as well as bits and bytes of data have made CIIMMS a reality.

FIGURE 1: CIIMMS CONCEPTUAL DESIGN STRUCTURE.



The process of accessing information and building a distributed network of information providers via the web is iterative. Technology is rapidly changing, as are interests and capabilities of various contributors. Thus, CIIMMS presents sliding targets and benefits from an adaptive management approach to development and expansion.

A prototyping effort and extensive User Needs Analysis conducted during the first year of funding focused initial functionality on Search, Browse, and Contribute categories. A major design decision focused the system toward a distributed system, which gathers or harvests information from a variety of user maintained sites. CIIMMS does however provide the opportunity for those users who do not have the capacity to maintain and serve their own datasets to the public to house their data on the CIIMMS site.

CIIMMS can be viewed at http://info.dec.state.ak.us/ciimms/. The CIIMMS website became fully functional in September 2000 following extensive analysis and research into current web technologies. The Initial Production Phase website became operational in January 2001 with additional features and functionality added during the following 6 months. As of July 2001, CIIMMS became the Alaska Cooperatively Implemented Information Management System and began expanding statewide, focusing initial functionality on three additional regions: Southeast Alaska, Prince William Sound, and the Northern region of the state.

Objectives

CIIMMS needed to provide a way for the Cook Inlet community (resource managers, scientists and researchers, educators, students, industry, and individual citizens) to identify, share and access, and contribute (on-line) valuable knowledge, information, and data about the Cook Inlet watershed from a distributed network of data resources and information providers. The following six objectives were defined as necessary to meet this need:

1. Provide one point of access to Cook Inlet data, information, and ongoing projects.
2. Provide search and access tools in a web browser environment
3. Provide online data entry and storage for FGDC compliant metadata.
4. Provide flexibility, building upon existing data integration efforts.
5. Remain a user-defined system in terms of usability and functionality.
6. Become sustainable and maintainable, within shared agency parameters.

Methods

The Alaska Department of Natural Resources (ADNR) and the Alaska Department of Environmental Conservation (ADEC) established a multi-agency project team when the CIIMMS project was launched. The team included members from the U.S. Environmental Protection Agency, the U.S. Forest Service, the U.S. Geological Survey, and the Alaska Resources Library and Information Services Library (ARLIS). Science Applications International Corporation (SAIC) provided technical guidance and support to the CIIMMS team. Team meetings were held bimonthly via teleconference in order to accommodate the dispersed locations of team members.

As lead agencies, ADEC and ADNR were jointly responsible for project implementation, drawing upon the expertise within each agency. Both agencies worked cooperatively with technical consultants in the areas of hardware and software upgrade requirements, data acquisition and translation support, application development, and staff training. ADEC focused primarily on maintenance of the CIIMMS website and server, development and incorporation of ADEC databases for access by CIIMMS, and water-quality issues and database design. ADNR provided expertise in the areas of geo-referenced data issues, visualization tools, and resource management issues.

The team defined a three-phased CIIMMS' implementation scheme:

Phase I: The Pilot Phase, generating a functional prototype (completed December 1999);
Phase II: Initial Production Phase (January 2000 - September 2001); and
Phase III: Final Implementation Phase (October 2001 – July 2003).

User outreach and coordination were critical to all phases.

Phase I: The Pilot Phase, Development of the CIIMMS Prototype

An extensive user-needs analysis and prototyping effort conducted during the pilot phase focused initial functionality on Search, Browse, and Contribute capabilities. It resulted in a major design decision to develop a distributed system that would gather or harvest information from a variety of user maintained sites. Additionally, CIIMMS would provide the opportunity for those users who did not have the capacity to maintain and serve their own datasets to the public, to house their data on the CIIMMS site. Phase I delivered the CIIMMS prototype website which by design, was limited in functionality and geographic scope.

The pilot phase encompassed the following activities:

- Assessment of user needs through surveys, focus groups, and a 100-person stakeholder workshop, which also evaluated current information management approaches within the Cook Inlet community.

- Development of the "Cook Inlet Information Management Requirements and Recommendations" post-workshop report (available online at http://info.dec.state.ak.us/ciimms see *About CIIMMS* link). More than 100 Cook Inlet stakeholders contributed directly to this document's evaluation of CIIMMS priority information, functions, system design, and user interface.

- Design and implementation plan for the CIIMMS prototype (accessible online at http://info.state.ak.us/ciimms. To view the "Pilot Phase Implementation Plan" document, see the *About CIIMMS* link).

The Phase I deliverable was the CIIMMS prototype website. The prototype area of interest, CIIMMS home page and the functionality and access delivered by the CIIMMS pilot phase, prototype website is shown in Figures 2, 3, and Table 1 respectively.

The prototype website acted as a clearinghouse node for searching and reviewing Cook Inlet related metadata (i.e., an electronic card catalog that characterizes specific Cook Inlet information resources). Metadata records characterized data sets and project descriptions, and a web crawler provided a fast index to Cook Inlet related web sites. Wherever possible, metadata records contained hyperlinks to the information resources that they characterized. Such resources included spatial and tabular data, maps, project descriptions, technical reports, organization points of contact, and other useful documents. Specific information included ecosystem assessment data, land ownership maps, government reports on contaminated sites, or restoration projects. Information could be viewed, downloaded, and printed by the user.

The CIIMMS prototype provided a common interface for searching through bibliographic metadata, geospatial metadata, and keyword-based metadata on the CIIMMS server and other Internet-linked information servers. CIIMMS-accessible servers included Alaska's geospatial clearinghouses; state and local libraries; local, state and federal agencies'

websites; and non-governmental websites, such as those of local newspapers, research centers, and citizens' groups.

CIIMMS users were able to find information using either the search or browse functions. Contribute capabilities were envisioned but not fully functional.

FIGURE 2: MAP OF THE COOK INLET BASIN CIIMMS PROJECT STUDY AREA AND CIIMMS PROTOTYPE STUDY AREA (KENAI RIVER WATERSHED).

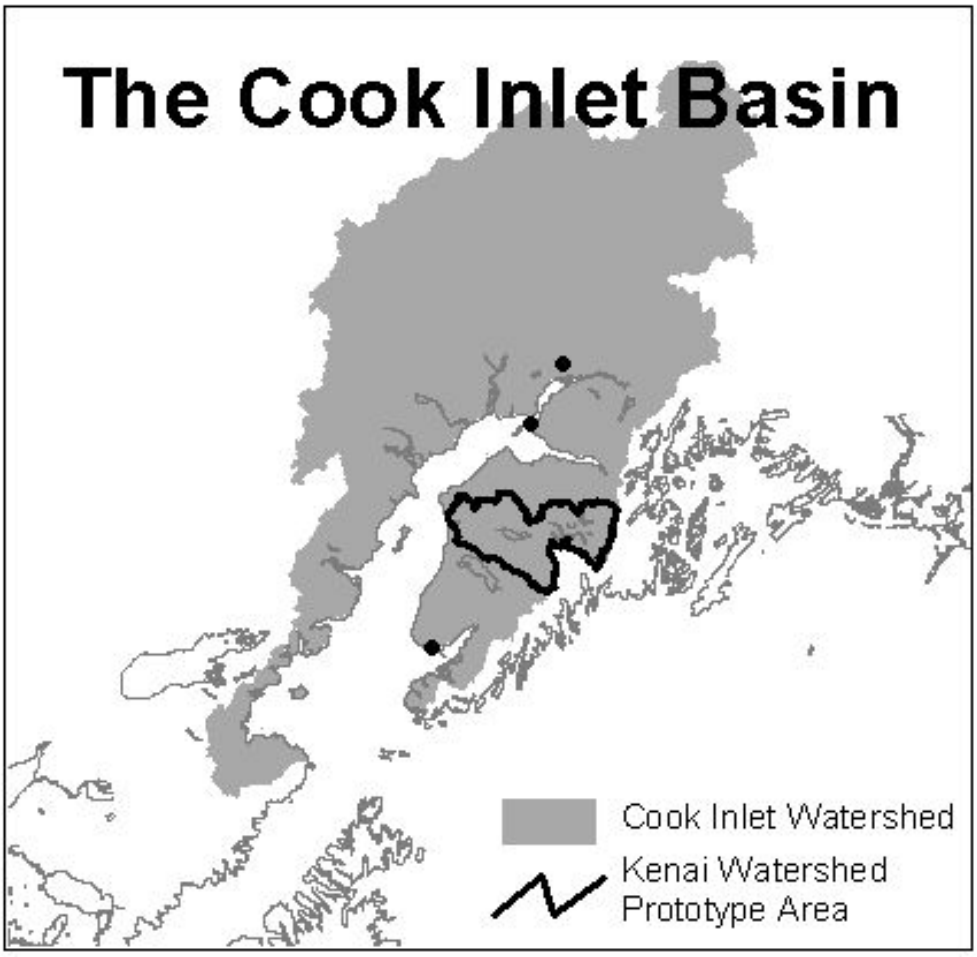


FIGURE 3: CIIMMS PROTOTYPE WEBSITE HOMEPAGE.

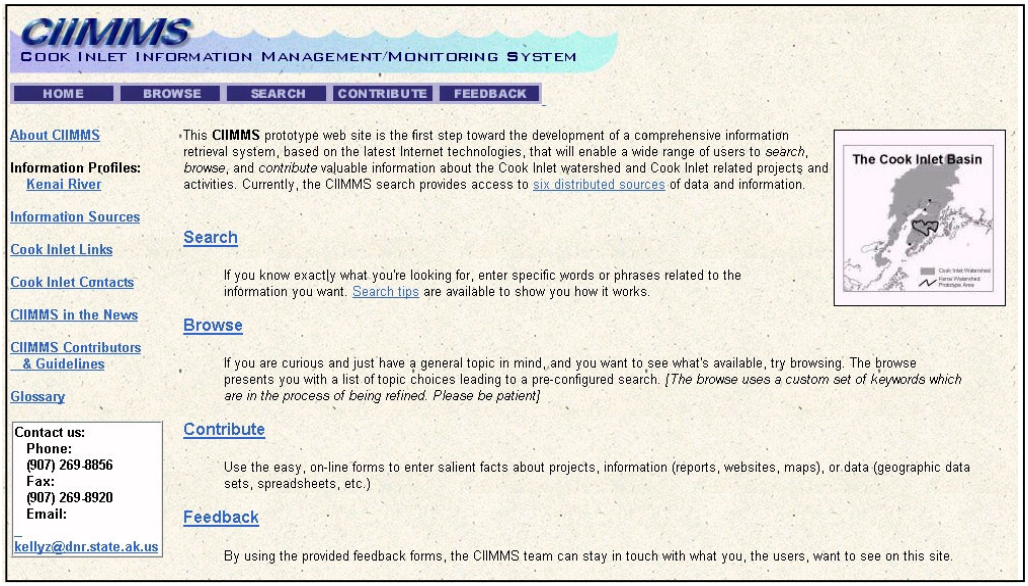


TABLE 1: DESIGN SUMMARY FOR CIIMMS PROTOTYPE

Geographic Scope	Kenai River Watershed
Information Types	Anadromous streams/species, wetlands, ground water well logs, EVOS data, etc.
Information Sources	ADEC, ADF&G, ADNR, Kenai Peninsula Borough Planning Department, USGS, and others
Functions	Search, browse, on-line metadata entry capability
Features	
-- Identifying	• Categorical indexes for Cook Inlet information inventory • Keyword and advanced metadata searching • Restoration project activities
-- Accessing	• Ability to view, download, and print static maps and web documents • Metadata records linked to actual data and summary information • Hotlist of all related offsite links
-- Contributing	• Form for suggesting information and links to add to clearinghouse • Metadata entry tool for data/projects (short form) to populate clearinghouse
Evaluation Tools	• Feedback forms online

Evaluation criteria developed for the CIIMMS prototype, were distributed at all CIIMMS outreach and demonstration workshops. General evaluation criteria included ease of use, response time, usefulness of information, visual appearance, and other appropriate factors. Simple straightforward forms were available in both hard copy and interactive on-line format in order to collect spontaneous and/or reflective feedback from workshop participants. This approach provided for rapid collection of reviewer feedback during the Pilot Phase. User feedback and reviewer comments were used to build the specifications for the Initial Production Phase.

Phase II: Initial Production Phase

CIIMMS Phase II, the Initial Production Phase, expanded the project's study area, improved the website's look and feel, and provided more robust functional capabilities. Figure 4 illustrates the improved look and feel of CIIMMS Phase II. Incorporating lessons learned from the prototype, this phase emphasized a more sophisticated implementation strategy, enhanced system design and functional capabilities, and long-term operations and maintenance requirements. Hardware and software were upgraded and a web based search and data entry capability were added as new functionality. Table 2 summarizes the expanded information types, information sources, features and system functions included in the Initial Production phase of CIIMMS.

FIGURE 4: CIIMMS INITIAL PRODUCTION PHASE WEBSITE HOMEPAGE.

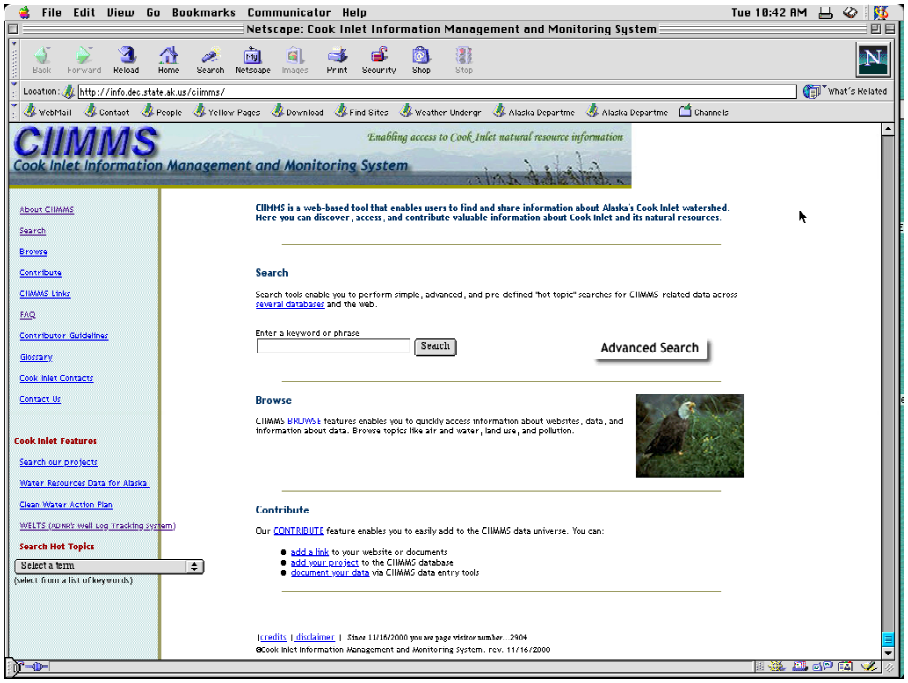


TABLE 2: DESIGN SUMMARY FOR PHASE II CIIMMS INITIAL IMPLEMENTATION

Geographic Scope	Cook Inlet Watershed
Information Types	Anadromous streams/species, wetlands, ground water well logs, EVOS Final Reports, EVOS Map Products, Planning Documents,
Information Sources	ADEC, ADF&G, ADNR, ADGC, Kenai Peninsula Borough, USGS, USEPA, Alaska Resources Library and Information Services, Municipality of Anchorage Geospatial Clearinghouse, Alaska State Geographic Data Clearinghouse, Alaska Geographic Data Clearinghouse, Alaska State Library, Anchorage Municipal Library, Cook Inlet Keeper, Cook Inlet Regional Citizens Advisory Council, Watershed Cooperative of Alaska, Alaska Clean Water Action Partners, Kenai Watershed Forum, Cook Inlet Spill Prevention and Response Inc., University of Alaska; ENRI, Natural Heritage Program, School of Engineering, US Natural Resources Conservation Service, USFS, USFWS, US MMS, Cook Inlet National Water Quality Assessment Program, Kachemak Bay Ecological Characterization Project.
Functions	Search, browse, on-line FGDC compliant metadata entry capability, map based search, map based data entry, gazetteer, web harvest, web links browse tree
Features	
-- Identifying	• Categorical indexes for Cook Inlet information inventory • Keyword and advanced metadata searching • Map based search • Restoration project activities • Gazetteer • Searchable project database
-- Accessing	• Ability to view, download, and print static maps and web documents • Metadata records linked to actual data and summary information • EVOS Final Reports • Hotlist of related offsite links • Distributed access to Well Log data • Distributed access to STORET water quality data • Distributed access to ENRI Stream Team monitoring data
-- Contributing	• Form for suggesting information and links to add to clearinghouse • Metadata entry tool for data/projects (short form) to populate clearinghouse • Full FGDC compliant metadata entry form. • Map based data entry for geographic location information • Web links browse tree user input.
Evaluation Tools	• Feedback forms online

Implementation Plan and System Architecture
The documents "CIIMMS Draft Production Phase Implementation Plan" and "Draft Systems Operation and Maintenance Strategy" describe the CIIMMS design strategy and system architecture as well as its relationship to longer term system operation and maintenance. These documents were the first deliverables of Phase II and are available on line at http://info.dec.state.ak.us/ciimms/ using the "About CIIMMS" link.

The CIIMMS Project Team evaluated several options in developing the CIIMMS system architecture. These included the Chesapeake Bay system design (specifically, its metadata entry tool), the Federal Geographic Data Committee (FGDC) clearinghouse design, and several commercial-off-the-shelf (COTS) products (Compusult Metamanager, Blue Angel Technology). The Team decided to base the architecture on a COTS solution. A COTS solution has the advantage of providing access to software upgrades, as technology changes, and access to a vendor-supplied "Help Desk" for aiding the CIIMMS administrator with system maintenance. A COTS solution also 'frees' CIIMMS administration from dependency on a technical contractor.

The COTS software solution, MetaStar Enterprise, developed by Blue Angel Technologies was selected for the CIIMMS system architecture. MetaStar Enterprise integrates database, search engine, and web technologies in a single solution that provides for the search and discovery of metadata and information via the Internet. Enterprise is a bundle of the MetaStar Data Entry, Repository, Gateway, and Server components. The architecture also includes the MetaStar Harvester, which is a software robot that gathers selected information from designated websites. This tool gathers and parses XML and HTML, extracting designated elements such as HTML tags and META tags (e.g., title, body, meta, etc.). The robot allows CIIMMS to include web-page information in its metadata database and search engine. This process is referred to as a full web harvest.

Identifying and accessing metadata and information is accomplished by using the Z39.50 standard client-server protocol for information retrieval and the Blue Angel MetaStar Harvester for focused web crawling of non-Z39.50 sites that contain web pages and hypertext relevant to Cook Inlet. A map-based query tool facilitates the search and discovery of metadata. The system architecture also provides for online linkages to data and information through data downloads (via ftp), document viewing via portable document formats (PDF) files, and image viewing through standard formats, such as graphics interchange format (GIF) files.

Figure 5 shows a high level schematic of the system architecture, consisting of three tiers:

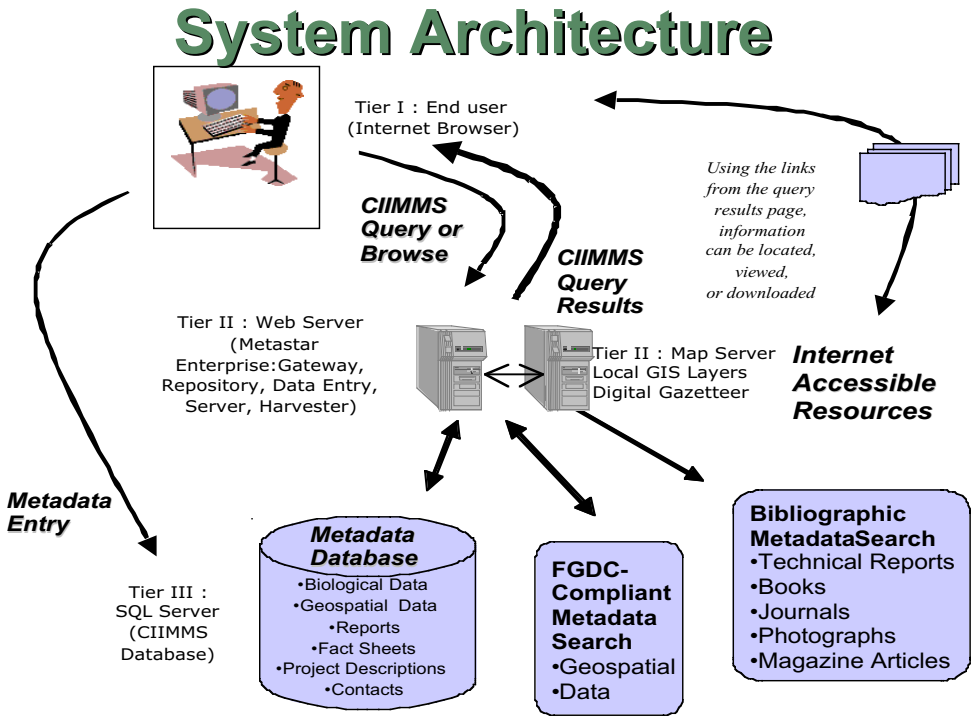
- Tier I: End user machine with an Internet Browser.

- Tier II: Web Server housing the Metastar Enterprise software for discovering and accessing metadata and information from all levels of the CIIMMS Information Pyramid, and the Map server, which provides map based metadata search and data entry functions. This function displays local GIS layers and a digital gazetteer. The map

presentation and associated GUI allow bounding coordinates, place names and subject keywords to be passed to the MetaStar Enterprise software.

- Tier III: SQL Server housing the CIIMMS metadata, projects, and contacts database.

FIGURE 5: HIGH LEVEL SYSTEM ARCHITECTURE



Key features of the system architecture include its distributed nature, cross profile search capabilities, the CIIMMS web harvest and the map based search and data entry.

Distributed System

CIIMMS utilizes a hybrid centralized/distributed design, meaning that some CIIMMS metadata and information resources are housed on the CIIMMS server (centralized), while other resources are housed on servers located elsewhere (at different agencies or physical locations) throughout the state (distributed).

To test the distributive concept, a few distributed sites such as the ADNR Map Server, ADNR Well Log Database and the University of Alaska Environmental and Natural Resources Institute (ENRI), Macro-invertebrates database were made accessible via CIIMMS. These pioneer sites provided lessons learned and expertise to organizations interested in providing data and information access via CIIMMS.

CIIMMS can help organizations become more successful at providing access to their own data and information using emerging web technologies. CIIMMS has also provided web-published guidelines and technical support. CIIMMS data access standards (i.e. Open GIS Compliance) as well as accepted "minimum" metadata standards established through coordination between the Alaska Geographic Data Committee and the CIIMMS Advisory Group, lay the technical foundation for CIIMMS to incorporate new distributive technologies as they arise

Cross Profile Search
Use of the Z39.50 protocol allows CIIMMS to search and acquire metadata from other metadata servers. The Z39.50 standard specifies formats and procedures that standardize the exchange of information between a client and a server, allowing a user to search remote databases, identify records that meet specified criteria, and retrieve desired records. One of the primary advantages of this protocol is that it allows consistent access to a large number of diverse and heterogeneous information sources. This allows CIIMMS to search bibliographic, geospatial, and biological profiles or data sources simultaneously, a very useful, cutting edge capability.

Web Harvest
The CIIMMS web harvest expanded to a two-level harvest and user-defined links capabilities were added. The option to direct the web crawl to an additional level within web sites allows the user to hunt for search terms more precisely. The user-defined links provide a tool for managing large quantities of web links with very little maintenance while ensuring that the site continues to be responsive to user needs.

Users can enter web links of interest via an on-line form, including a description and categorization of the link. A user who knows more about the relevance of the link than the CIIMMS administrators can provide this information directly to CIIMMS. The CIIMMS administrator can monitor submitted links, check for broken links stored in the CIIMMS database on a regular basis and remove any broken links from the system.

Map Based Search and Data Entry
A long-term goal of the CIIMMS architecture is to provide a web-based mapping service that gives users access and viewing capabilities to web-accessible geospatial data within the CIIMMS network of servers. Such a map-based search feature provides a resource for the expansion of CIIMMS to provide web-based access to geographic data in the future.

ArcIMS version 3.0 and the OGC Web Mapping Test Bed Connector were chosen to perform the CIIMMS map-based search. The software is consistent with the emerging open-GIS standards and was released in June of 2000. Additionally by using these standards, the CIIMMS project was able to cooperate with a USGS EROS field office (AGDC) Mapping Testbed Project.

The map server component provided a map based metadata search function and allows contributors to enter geographic location information about their data and projects in metadata records using a map-based data-entry tool. This tool displays local GIS layers, selected boundary files (HUC, Quad, Borough) and a digital gazetteer to generate place

name keywords and bounding rectangle coordinates. These criteria are then passed to the Blue Angel Technology MetaStar Enterprise to facilitate the search and discovery of metadata across a variety of metadata profiles (Dublin Core, FGDC, and NBII).

CIIMMS is a collaborator in the spatial data community and has worked closely with the representatives of the Federal Geographic Data Committee's National Spatial Data Infrastructure. As such CIIMMS defined the minimum project and data information requirements to be consistent with the FGDC initiated Content Standards for Digital Geospatial Metadata released in 1994, the NBII, and Dublin Core. The FGDC metadata standard is quite complex. CIIMMS has attempted to distill the elements of this standard into an easily understood form for web-based submittal.

Information Access

As previously mentioned CIIMMS uses a hybrid centralized/distributed design to enhance access to information. Some metadata is housed on the CIIMMS server and some metadata and data are physically located on other servers throughout the state. The physical location is intended to be transparent to the user in terms of performance.

Distributed information added to CIIMMS during the Initial Production Phase includes:

- ADNR Map Server for map based search.
- ADNR Well Log Database
- University of Alaska ENRI, Macro invertebrates database

During the Initial Production Phase, CIIMMS also expanded users' access to knowledge, information and data by increasing the number and type of datasets available via the CIIMMS website. Several new data clearinghouses were added to the list of Z39.50 servers accessible via the CIIMMS website including the Alaska Resources Library and Information Services collection, the Anchorage Municipal Library, the Alaska State Library (including the Capital Cities Library), and the Municipality of Anchorage Geospatial Clearinghouse

In addition, the following data resources were modified, completed, and made available for on line access via CIIMMS.

- ADF&G habitat metadata;
- ADF&G Anadromous Waters Catalog
- EVOS GIS data previously made accessible via the EVOS-sponsored Research & Restoration CD-ROM now available on ASGDC with FGDC-compliant metadata and direct downloads.
- EVOS Final Reports, full text in pdf format linked to EVOS project records;
- Research and entry of Cook Inlet projects, related to water quality or other natural resource issues, complete with project manager contact information, and on-line links to website and/or data, where available;
- Cataloging at ARLIS of titles to bibliographic references relevant to Cook Inlet; using an ENRI bibliographic database project related to Kenai River as source material;

- Creation of metadata for ADEC and ADNR data resources, including easement atlas data, land use management plan data, and some oil & gas related data sets;
- Creation and deployment of an on-line database of ADNR's well log database, known as Well Log Tracking System (WELTS) containing over 25,000 records of well logs with information related to the well, with links to the pdf format of the related well log, viewable directly;
- Creation and deployment of an on-line database for the collection and display of macro-invertebrate data from educational groups and native villages; this database, known as the Stream Team was created in cooperation with UAA-ENRI's Biological Monitoring and Assessment program;
- Connectivity to STORET database being implemented by ADEC at the state level to hold all data related to water quality efforts with connections to the National STORET database maintained by EPA.

Initial Production Phase Enhanced Functionality

Search

Search capabilities were enhanced to include options such as pick-lists, advanced Boolean operations, and the ability to impose geographic boundaries on an expanded set of data sources that include:

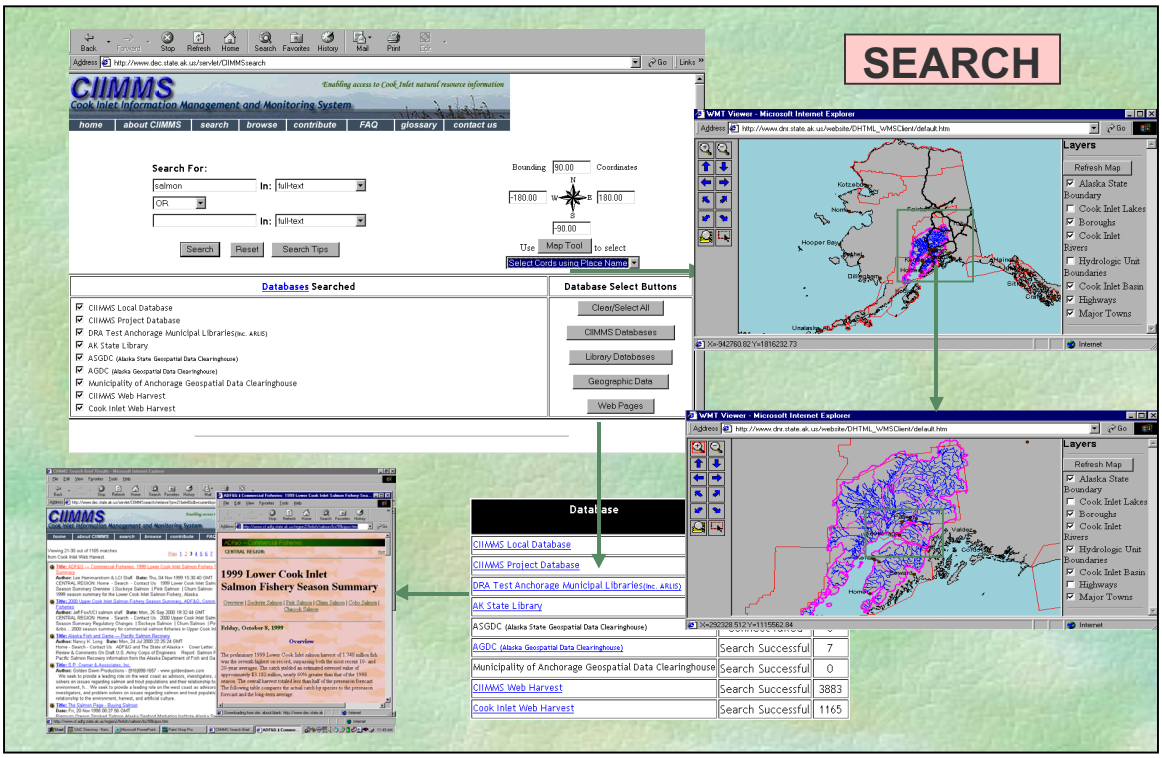
- CIIMMS local Databases (data)
- CIIMMS Project Database
- Alaska Resources Library and Information Services
- Anchorage Municipal Libraries
- Alaska State Library (including Capital Cities Library)
- Alaska State Geographic Data Clearinghouse
- Alaska Geographic Data Clearinghouse
- Municipality of Anchorage Geospatial Data Clearinghouse
- CIIMMS full Web Harvest
- CIIMMS two level Web Harvest

The Hot Topics search added to the left-hand sidebar of the CIIMMS home page provides a pick list of topics of interest with an embedded simple search function. A simple one-term search feature, available from the CIIMMS homepage, provides for a simple or Boolean search without stipulating specific metadata fields or specific databases to search. By selecting the Advanced Search feature on the CIIMMS homepage, the user is provided with additional ways to constrain a search to yield more specific results. Drop down pick lists allow fielded searches (the user may request a full text search, or a search of a specific field such as the Title or Author) providing the user with an easy way to build more complex Boolean searches, avoiding syntax errors. Checkboxes provide the user with the ability to specify which databases are to be searched.

A user can also focus a search on a particular geographic area using the map based search feature or a drop down location list (fig. 6). The map-based search uses latitude/longitude coordinates in combination with CIIMMS generated geographic keywords to locate

information for a particular "area of interest," searching across geographic (FGDC), bibliographic (BIB1, Dublin Core) and biological (NBII) metadata profiles.

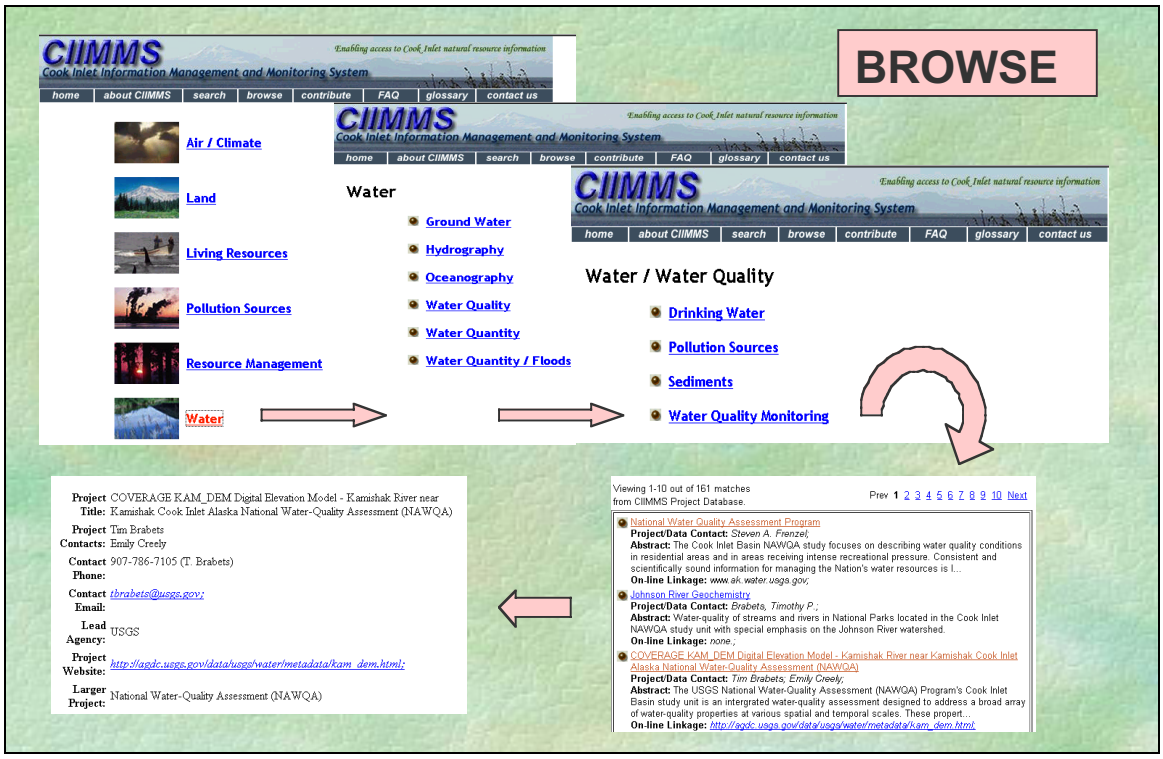
FIGURE 6: EXAMPLE ILLUSTRATING SEARCH FUNCTIONALITY



Browse

The Browse capability of CIIMMS was expanded to include an originator browse tree, a "point and click method" for defining a canned search. A browse tree is a set of hierarchically organized lists of terms that provide a semantic guide for finding information resources according to a particular theme or subject. A user may select categories and subcategories, while the browse feature builds a complex search composed of a list of keywords to be submitted to the search engine when the user is finished. Prior to submission of the search request, the user is presented with the results of the defined search, which may be further edited by the user. Effective search terms are difficult to anticipate and as a result CIIMMS will continue to respond to feedback in order to formulate searches that respond to a variety of user needs. Figure 7 illustrates the flow of a user browse.

FIGURE 7: EXAMPLE ILLUSTRATING BROWSE FUNCTIONALITY



Contribute

The Contribute functionality became easier to use during the production phase with the addition of on line help, form preview, and a map-based data entry tool. "Contribute" allows users to keep CIIMMS current and provides a cost effective way for the system to grow, becoming ever more useful to users. User contributions provide the key to long-term sustainability of CIIMMS.

The CIIMMS contribute function provides several ways for a user to make information about projects, data, or information discoverable by others. The intent of the distributed CIIMMS system is that data or information be maintained on the user's computer or server, and pointed to via the metadata entered in CIIMMS. CIIMMS can, if necessary, store or host a user's data/information. On line tools are available for user's to enter metadata from their computer.

A user must create a user profile, which involves choosing a username and password and providing CIIMMS with some basic identifying information, such as email identification, organizational affiliation, and contact information. Once a user has established a user profile, metadata information can be entered using the on-line form as illustrated in Figure 8.

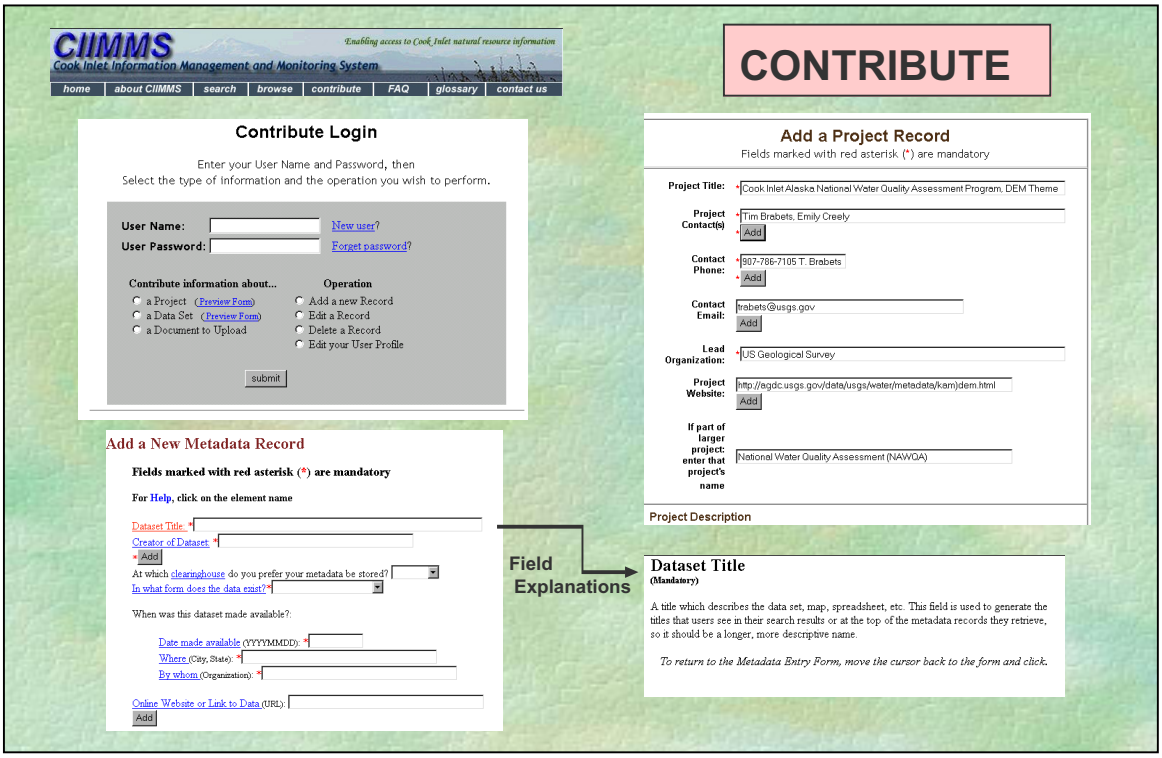
The metadata entry form provides for the entry of hyperlinks to information resources that the metadata record characterizes. Such resources may include spatial and tabular

data, maps, project descriptions, technical reports, organizational points of contact, and other useful documents.

"Contribute" features include:

- Step-by step instructions, in the form of a tutorial to assist users in making their data or information available via CIIMMS.
- Contributor Guidelines, in the form of an on-line publication that provides technical specifications for advanced contributors.
- Direct links to all on-line metadata entry forms and upload tools, for repeat customers.
- Inclusion of a map based data entry feature for geographic project or data location information.

FIGURE 8: EXAMPLE ILLUSTRATING CONTRIBUTE FEATURES



Outreach and Coordination

Throughout Phase I and Phase II of CIIMMS, considerable effort was focused on coordination with ongoing information management initiatives, such as the AGDC and ASGDC, to avoid redundancy and to take advantage of synergistic opportunities with regard to data and information sharing.

Initial user outreach took the form of an extensive three-day facilitated stakeholder meeting to identify priorities of the potential user community. This user needs workshop identified high, medium, and low priorities, which were incorporated into the phased implementation plan. A CIIMMS Advisory Group was formed which met periodically to provide direction, evaluation, and feedback to the CIIMMS Project Team to ensure useful and effective implementation. Membership of the advisory group was initially derived from stakeholders in an existing group, known as the Cook Inlet Coalition (CIC), and supplemented by representatives from stakeholder groups that were not a part of the coalition but represent the larger CIIMMS community. The advisory group provided valuable insight to the Pilot and Initial Production Phases.

Additional outreach efforts were viewed from multiple perspectives and targeted audiences that strategically fit CIIMMS' needs during its initial implementation phase. The principal purposes were to meet initial data accessibility requirements and to build support of the web-shared-accessibility concept so that the CIIMMS structures could be carried into the future of information management in Alaska. Efforts focused on entities that maintain priority datasets classified by the user needs assessment and those that 1) met EVOS dataset requirements; 2) were supportive agencies whose information was already accessible; and 3) agencies that had a desire to move their information into current technology but had not yet actually committed resources.

Outreach activities included educating stakeholders on the use of CIIMMS, as well as educating data providers on steps necessary to make data available via the CIIMMS site, or, preferably, from their own server. Outreach material was distributed in written, electronic, and verbal formats. Documents and guidelines were made available via the CIIMMS site itself. Additionally, data documentation and data access procedures and guidelines were personally presented to selected data providers and stakeholders.

Information was presented to users from two perspectives: 1) what CIIMMS can do to improve data accessibility and 2) what is needed in order to make information available to CIIMMS. Outreach efforts specifically supported the population of the FGDC-compliant metadata databases (State and Federal) and the CIIMMS database (non-FGDC-compliant metadata) for priority datasets with non-FGDC-compliant metadata for the watersheds throughout the Cook Inlet basin.

User Training and Standards

CIIMMS is a collaborator in the spatial data community and has worked closely with the representatives of the Federal Geographic Data Committee's National Spatial Data Infrastructure. As such CIIMMS defined the minimum project and data information requirements to be consistent with the FGDC initiated Content Standards for Digital Geospatial Metadata released in 1994, the NBII, and Dublin Core. The FGDC metadata standard is quite complex and while CIIMMS has attempted to distill the elements of this standard into an easily understood form for web-based submittal, it became clear that additional training of contributors would be beneficial. CIIMMS coordinated Metadata Training during the duration of the CIIMMS Project with the Department of Natural Resources manager of the Don't Duck Metadata Grant funded by the USGS, Federal Geographic Data Committee. Training sessions were held in Juneau, Mat-Su, and Anchorage and were funded by a separate USGS grant.

CIIMMS attempts to help organizations become more successful at providing access to their own data and information using emerging web technologies, by providing web-published guidelines and technical support.

System Operations and Maintenance Strategy

CIIMMS developed a Draft system operations and maintenance strategy in order to help ensure that the technical capabilities gathered through this project extend beyond the EVOS funding cycle. A "Draft Final, System Operations and Maintenance Strategy" was completed in August 2000 and is available on line at http://info.dec.state.ak.us/ciimms/ under *About CIIMMS*. This document has been revised and updated to reflect the current functionality and technical requirements of the system and is included as Appendix B.

This document presents four major aspects of CIIMMS operations and maintenance:

- Program management,
- System operation,
- Configuration management, and
- Software maintenance.

System operation involves administrative control procedures, computer center support, user interaction, and application software operation. Configuration management defines system maintenance as corrective, functional, or adaptive and describes procedures for reviewing, approving and implementing these types of maintenance. Following the decision to modify the system, several important aspects must be considered for implementing the changes. This includes the procedures for updating the documentation; ensuring source code standards are maintained, and implementing, reviewing, and testing source code changes. These represent important functions of software maintenance.

The CIIMMS system requires regular maintenance to ensure up-to-date data and information. Maintenance is required for the CIIMMS system and for the hardware on

which the system resides. The two servers used in the prototype and initial production phase of CIIMMS system architecture are maintained by their respective agencies according to the procedures already established for those agencies. Each agency ensures that the servers are operational and functioning at an optimal level. Additional servers incorporated into the CIIMMS framework will be operated and maintained per protocols established by the source agency or organization. As necessary, operation and maintenance guidelines will be prepared and distributed by the CIIMMS Project Team and CIIMMS Advisory Group.

There are three major aspects of the CIIMMS system that require regular updates and maintenance: the CIIMMS metadata database, the links to Z39.50 compliant servers, and the links to outside Internet sites.

The CIIMMS metadata database will be updated regularly by participants who submit metadata to CIIMMS. Procedures are established that allow for quality assurance (QA) of metadata that are submitted to ensure accuracy and appropriateness for inclusion in the database. The Project Team will carry out these QA procedures on a regular basis. The criteria for metadata to be submitted to the database are easily available to CIIMMS users to ensure awareness of CIIMMS metadata standards.

The Project Team will check links to Z39.50 compliant servers on a regular basis to ensure that the links are correct and functioning properly. Links to outside Internet sites also will be checked and updated on a regular basis. This will minimize "dead links" and maximize the quality of information available through CIIMMS.

The CIIMMS site provides an easily accessible area for users to provide direct feedback on the operation of the system. User feedback helps ensure the system is operating properly and provides additional checking of system functions and content. The feedback will be checked frequently and the system maintained accordingly.

Phase III: Final Implementation Phase

CIIMMS will transition to a statewide system during the final implementation phase of this project. This process will include a user needs assessment, coordination with data providers, and user outreach as the Project Team moves beyond Cook Inlet to focus on Prince William Sound, Northern Southeast Alaska, and the Northern Region of the State. The Alaska Department of Environmental Conservation has secured initial funding for these efforts through EPA 319 non-point source pollution funds. This effort will focus on extending geographic scope as well as connectivity and integration with the national EPA supported STORET database. Additional documentation of activities associated with this phase of CIIMMS will be posted to the CIIMMS website.

Results

Initial project benefits have been realized throughout the Cook Inlet watershed. Communities affected by the project included Anchorage, Homer, Kenai, Nanwalek, Nikiski, Ninilchik, Port Graham, Seldovia, Soldotna, and Tyonek. CIIMMS allows researchers to share information and provides a single search of multiple data sources. It reduces the time needed to find out about data, reports, permits and associated data, and on going projects within the watershed.

This cooperative project embraced information needs of State, Federal, municipal, tribal, educational, and other entities concerned with watershed management. Although designed for Cook Inlet, the system is expanding to other regions of the state using a two-year capital improvement project funded by the Environmental Protection Agency through the Alaska Department of Environmental Conservation.

Specific components of each phase are detailed in Tables 1 and 2. Technical milestones and specifications are described in the "CIIMMS Initial Production Phase Implementation Plan" which is viewable on the CIIMMS web site at http://info.dec.state.ak.us/ciimms. While the CIIMMS website is the public's view of the final product for the project, the "About CIIMMS" section of this web site contains documentation that fully describes the history, plans, and technical specifications for the project.

CIIMMS' Federal Geographic Data Committee (FGDC) and Open GIS (OGC) compliant technical framework and multi-agency participation poise the project to act as a platform and or cooperator for spatial data test bed grants, which mesh with the Alaska Geographic Data Committee's goals. Additionally, the Global Disaster Information Network program has discussed the CIIMMS project as a potential showcase for handling the wide variety of information resources required during disaster recovery.

Technical roadblocks are small compared to cooperation and coordination issues. Data dissemination by agencies on a broad scale is happening more slowly than was perceived at the beginning of the project, but CIIMMS is uniquely situated to assist with associated issues as they emerge within the data community. Consistent approaches towards data dissemination will facilitate data integration in the future, as more organizations make their data available. The CIIMMS team continues to assist information providers with public access via CIIMMS, and is committed to providing agencies and organizations with viable options, considerations, and tools necessary for creating a central resource for decision-making within the Cook Inlet and, in Phase III, throughout the state. Various projects, some focusing on Natural Resources, some on the Coastal Zone, some concerned with village health, are interested in using CIIMMS as a component of information management systems slated for future development.

Data standards have yet to be established for water quality and biological resources, and will need to be addressed in coordination with national efforts as CIIMMS migrates to a fully distributed system. This requires diligence in coordination and cooperation as data environments continue to change. For example, the AGDC and Clearinghouse are

actively working towards providing data on-line in the Open GIS format. ADEC is developing an on-line water-quality data-management system, which will be accessible via CIIMMS.

Discussion

The Problem

As permitting and regulatory agencies ADNR and ADEC must make decisions that affect Alaska's resources and the public. Many of these decisions can be controversial and contentious. The Commissioners of ADNR and ADEC wanted to ensure that adjudicators, regulators and the public were all able to access all pertinent research and information relative to a particular natural resource decision and speak from a common knowledge base during discussions or when making a particular decision. Unfortunately the project team found that:

- Data was hard to find and access.
- Data was not always well described or useful.
- There was no one place to get information.
- Historical information was being lost.
- Integration of data and information was difficult.
- Access to technology was quite variable.

In considering these problems and looking at the reality of agency budgets, staffing, and time lines, the project team initially identified several very basic design principles to ensure that the project was manageable. It was important that CIIMMS be:

- Maintainable.
- Sustainable.
- Accessible.
- Extensible.
- Built on other's efforts.

The Approach

The CIIMMS team followed a logical development sequence that involved continued interaction with the user community. As previously described the CIIMMS project team was made up of representatives from a variety of state and federal agencies with technical support provided by a contractor who was an integral part of the project team and development effort. The CIIMMS team identified the user community, surveyed users regarding desired functionality, and data and information that the user community had and also wanted to access. A contractor facilitated an extensive user needs analysis workshop and analyzed the results in coordination with the CIIMMS project team. A prototype design was developed focusing on a subset of the project area. The user community tested the prototype, provided feedback and served as a sounding board for further project team evaluation. Results of the prototyping effort formed the basis for the

final system design and specifications to be implemented in the Initial Production Phase. The Initial Production Phase expanded the geographic focus and provided additional functionality and resources for users. Peer review was an integral part of the development effort and provided invaluable feedback.

Data Inventory and User Needs Analysis

The user needs analysis showed that first and foremost, people wanted to know what data and information was out there, where it was, and how to acquire it. High levels of frustration with current access were expressed. Twenty-five agencies and over 100 individuals, including representatives from non-profit organizations and native corporations, participated in the User Needs Analysis. Analysis of the initial data inventory produced some disconcerting results. In summary:

- Lack of statewide standards for data format and documentation.
- Lack of a geographic component for much of the available synthesized information and data.
- Not all high priority data was digital
- Data existed in a variety of databases in a variety of software formats and was often of varying and undocumented quality.

Constraints

In further analyzing the results of the user needs survey and data inventory as well as the results of the user needs workshop it became clear that there were additional technological and institutional constraints that would by necessity mold CIIMMS.

Technological Constraints	Institutional Constraints
Users with a wide variety of computing platforms running a wide variety of software.	Data ownership and control. Institutional inertia.
Varying internet connection speeds and computing power on the part of users.	Concern about misuse of data made available on line.
A distributed approach requires consistent application and use of standards	Reluctance by some to share data.
Open GIS, a potential solution, but an emerging technology	Limited geographic scope limited utility for some organizations.
Inconsistencies among data providers, utilization of different web technologies.	Primary use of data vs. secondary use.
Clearinghouses already established.	Lack of resources.

The constraints outlined above were matched against the user community's needs to define the CIIMMS system parameters.

Constraints + Needs = System Parameters

It was determined that CIIMMS would be Internet based using a thin client in order to ensure that the website was usable for all users regardless of platform or software availability. A hybrid centralized/distributed system was selected with the long-term goal of providing a distributed system in order to minimize maintenance. The centralized system initially provides users without an Internet server a mechanism for deploying data and information. CIIMMS' initial focus was on identification and access to data with further development occurring in phases as defined by users' needs. CIIMMS by necessity was a multi-agency implemented project. The multi-agency nature of the project provided more brains, more access, and more expertise. It did require more effort but the end result proved worth the investment. It was also determined that it was imperative that ways be provided for users to contribute and own their own information. Lack of long-term resources precluded any other approach.

Software Selection

Two major pieces of software were selected for implementation within CIIMMS: the Blue Angel Metastar Enterprise Suite, and the ESRI ArcIMS Internet map serving software. Both pieces of software were off the shelf, yet the web technologies upon which they are built are still fledgling. Both use server side java and XML, two new web technologies that are continuing to evolve.

The Blue Angel support team has been quite generous with the CIIMMS project team and we are very grateful for their attention. However, as with many new software products, time was spent debugging the software and reporting or defining problems. To Blue Angel's credit, these problems were always fixed in the next release of the software. The software is very powerful and at the present time, does not have any competitors, which would have proved as viable for delivering the functionality desired by CIIMMS.

ArcIMS version 3.0 as previously mentioned was the tool of choice for the CIIMMS Map based search tool. However, the open-GIS tools and connectors provided by ESRI were not fully supported by ESRI, although SAIC was able to work with ESRI to address problems to some degree. While this new technology has presented many technical difficulties for the project team; for long-term viability, open GIS protocols, tools, and connectors will provide flexibility and opportunities for cooperation and expansion. CIIMMS is poised to take advantage of growth in emerging standards and technology.

Interagency Effort

CIIMMS has demonstrated that an interagency effort can work. Much of the success of CIIMMS can be attributed to the project managers' commitment to communication and outreach and high-level organization. Team meetings on a bi-weekly basis were invaluable for keeping participants apprised of the project's progress, stumbling blocks, upcoming hurdles and for providing a forum for the exchange of ideas, offering assistance, and sharing skills. An interagency project has the opportunity to bring the best from a variety of sources to the table with a common purpose. CIIMMS drew from the expertise, energy, and creativity of a variety of institutions. CIIMMS became the sum of

all of these parts. The multi-agency nature of this project also provided an objective forum for the testing of ideas, functions, and design. Different agencies go about their business in different ways. By bringing the culture of a variety of organizations to the table, CIIMMS stood a better chance of providing a service for a larger cross section of Alaska.

The downside of a multi-agency project is that project management requires more time, organization, and energy. More coordination and communication is needed. Meetings by necessity must be prescheduled with a planned agenda. Minutes must be written. Because of the State's size, teleconferences were often a necessity. In addition, the primary contractor for CIIMMS as well as some secondary contractors, were out of state and the four hour time difference forced the project team to work hard to meet deadlines, become better organized, and plan far enough in advance to accommodate differing schedules.

Funding Organization's Project Requirements

The rigid requirements imposed by the funding organization on the project were difficult to meet while at the same time keeping the project moving forward. Enormous amounts of time and resources were spent generating documentation and project proposals for essentially a two-year project. While peer review is a useful component of the EVOS process and provides an important opportunity for higher-level technical feedback, which may not be readily available to agency staff, a more streamlined, less time consuming process would allow more resources to be focused on project implementation and deliverables.

Changes in technology were difficult to take advantage of because of project deliverables. Some deliverables were unable to be fully met. Collection of EVOS data and information proved especially difficult and without external support, the project team was unable to get cooperation on data access issues from Principal Investigators of previous projects. This effort took a lot of time and the failure to achieve significant measurable results in this area was a disappointment. The CIIMMS team did make available all completed EVOS final reports on line as a means of addressing this issue.

Conclusion

The Cook Inlet Information Management and Monitoring System (CIIMMS) provides an interactive website that links a geographically distributed system of information providers. Through the CIIMMS website, users are able to identify and access (e.g., download and print) information ranging from primary data (geospatial, tabular) to reports, project descriptions, and other documents across a variety of themes, such as habitat, land use, resource management, pollution, and water-quality information. CIIMMS also provides tools to make it easy to contribute information to the CIIMMS network. In the long term, CIIMMS will use integrated information resources and tools to create a virtual community center for Cook Inlet learning, resource management, and related activities. Although participating Cook Inlet stakeholders agree that an information system that reaches out to and accommodates the needs of the wide range of

users found throughout the watershed is needed, there currently is no community-wide commitment to maintain the system.

Achieving the CIIMMS vision will require the cooperation of many entities. The success of CIIMMS depends on theoretical and practical participation across multiple contexts. CIIMMS moved from research and development to operational implementation by January 2001. At that time, a commitment to system operations and maintenance was needed in order for the CIIMMS framework to continue. Technology is not the limiting factor. Effective implementation will require the efficient sharing of information among disparate information generators and data users and across different operational environments. Information has to be found on the web in order for CIIMMS to be useful. This implies a need for communication and involvement from many orientations, be they technical, operational, institutional, political, or financial. Long-term sustainability will partially come from active user support. Although CIIMMS has been user-driven from its inception, specific efforts addressing coordination, system use, and data requirement must be continually pursued to ensure timely buy-in. These efforts need to reach appropriate technical, political, and organizational levels to ensure that appropriate opportunities are explored, and to reduce perceived conflicts and barriers.

In summary:

What CIIMMS Does:

- Help find answers to questions.
- Provide information relative to a query based on search terms selected because of a question.
- Help focus searches and increase relevance of responses.
- Provide a structure for cooperatively sharing resource information.
- Provide tools to access and retrieve information from disparate sources.
- Use and rely on standards, and also work in spite of a sometimes frustrating lack of standards.

What CIIMMS Doesn't Do:

- Think for you.
- Set standards.
- Automatically get your data.
- Survive unattended.
- Analyze data.
- Synthesize data.

What CIIMMS Can Do:

- Grow and expand to visually present information and data through the Open GIS protocols that are the foundation of the map-based search as this technology matures.
- Become more robust and useful over time, its usefulness increasing exponentially relative to the number of contributions.

Note:

CIIMMS became CIIMMS, Alaska's Cooperatively Implemented Information Management System in July 2001.

Acknowledgements

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Downtown Legal Copies, Inc.
Environmental Systems Research Inc.
Exxon Valdez Oil Spill Trustee Council, Principal Investigators, and Staff
Kenai Peninsula Borough
Municipality of Anchorage
Science Applications International Corporation.
University of Alaska Anchorage, Alaska Natural Heritage Program
University of Alaska Anchorage, Environment and Natural Resources Institute
University of Alaska Anchorage, School of Engineering
US Environmental Protection Agency
US Fish and Wildlife Service- Alaska Regional Office
US Forest Service – Chugach National Forest
US Geological Survey – Water Resources Division
US Minerals Management Service
US Natural Resources Conservation Service

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Appendix A: Glossary of Terms

ADEC ***Alaska Department of Environmental Conservation***

ADF&G ***Alaska Department of Fish and Game***

ADNR ***Alaska Department of Natural Resources***

AGDC ***Alaska Geographic Data Committee***

The Alaska Geographic Data Committee (AGDC) provides a forum for the coordination of spatial data development, the development of coordinated methodologies for implementing standards and policies, and for building geospatial data partnerships between Federal, State, and local agencies. The AGDC also provides leadership in the coordination of surveying, mapping, and related spatial data activities. Twenty Federal agencies and seven departments within the State of Alaska are active members of the AGDC. The committee facilitates data transfer and information exchange and the coordination of data collection to reduce duplication of effort (http://agdc.usgs.gov/).

AGDC ***Alaska Geospatial Data Clearinghouse***

The geographic data clearinghouse managed by the AGDC (http://agdc.usgs.gov/).

ARLIS ***Alaska Resources Library and Information Services***

ARLIS is a partnership of eight natural and cultural resource libraries and information centers, as well as other contributors. ARLIS provides a comprehensive collection of Alaskan resource information in a single location, served by a highly qualified staff.

ASGDC ***Alaska State Geospatial Data Clearinghouse***

A searchable node of the Alaska Geospatial Data Clearinghouse (http://www.asgdc.state.ak.us/).

BIB-1

A metadata profile for bibliographic data. A metadata profile is a community-specific agreement on searchable fields and meaning of retrieved data.

Chesapeake Bay Program

The Chesapeake Bay Program is the unique regional partnership that has been directing and conducting the restoration of the Chesapeake Bay since the signing of the historic 1983 Chesapeake Bay Agreement. The Chesapeake Bay Program partners include the States of Maryland, Pennsylvania, and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the U.S. Environmental Protection Agency, representing the Federal Government; and participating advisory groups (http://www.chesapeakebay.net/).

Chesapeake Information Management System

The web-based information management system developed by the Chesapeake Bay Program, which has provided ideas that are being used in the development of CIIMMS (http://www.chesapeakebay.net/).

CIIMMS Data Inventory

A survey of Cook Inlet related data and information (both electronic and hardcopy) compiled into a database.

CIIMMS Server

The computer on which the CIIMMS metadata, projects, and contacts database reside. Client-Server Architecture. The client server model is a model of computer communications in which a client computer calls a server computer to request a service. For example, a client may request a server to download (transfer) a file to it. The difference between the client and the server is that the client is the machine that initiates contact and the server is the machine that responds to the request for connection.

COTS Commercial Off the Shelf

Commercial Off-the-shelf refers to software developed and supported by a vendor rather than customized programming solutions.

Dublin Core A Simple Content Description Model for Electronic Resources

The Dublin Core is a metadata set intended to facilitate discovery of electronic resources. Originally conceived for author-generated description of web resources, it has attracted the attention of formal resource description communities, such as museums, libraries, government agencies, and commercial organizations (http://purl.oclc.org/dc/).

FGDC Federal Geographic Data Committee

The Federal Geographic Data Committee coordinates the development of the National Spatial Data Infrastructure (NSDI). The NSDI encompasses policies, standards, and procedures for organizations to cooperatively produce and share geographic data. The 16 Federal agencies that make up the FGDC are developing the NSDI in cooperation with organizations from State, local, and Tribal governments, the academic community, and the private sector (http://www.fgdc.gov/).

GIS Geographic Information System

In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information (i.e., data identified according to their locations). Practitioners also regard the total GIS as including operating personnel and the data that go into the system (http://info.er.usgs.gov/research/gis/title.html).

GRS Generic Record Structure

One of several record syntaxes used by Z39.50 to support the presentation of query results.

HTML Hyper Text Markup Language

The lingua franca for publishing hypertext on the World Wide Web. It is a non-proprietary format, based on SGML, for describing the structure of hypermedia documents -- plain text (ASCII) files with embedded codes for logical markup.

Information

All types of data generated and used by the Alaskan resource management stakeholders, ranging from primary data to highly reviewed and summarized data. For CIIMMS purpose, the term "information" does not encompass raw data (original, unmodified, field sampling, and laboratory results).

Information Pyramid

A graphical representation of data and information that the CIIMMS Project Team uses to illustrate the different levels of information and how they relate to one another. From the base to the tip of the Information Pyramid are raw data, primary data, processed data, summarized public data, research and management documents, and public documents.

JDBC Java Database Connectivity

The Java interface that make portable object-oriented access to relational databases possible and offers a robust model for writing applications that are easy to maintain.

MARC/USMARC Machine Readable Cataloging

The USMARC formats are standards for the representation and communication of bibliographic and related information in machine-readable form (http://lcweb.loc.gov/marc/96principl.html).

Metadata

Metadata are structured data that describe an information resource.

Meta tags

Metatags are html tags or codes used within the header of an html document to include information about a document such as the author, content, or key words. This information is used by servers, web browsers and search engines but is not seen by the reader.

NBII National Biological Information Infrastructure

The NBII is an electronic gateway to biological data and information maintained by Federal, State, and local government agencies; private sector organizations; and other partners around the Nation and the world (http://www.nbii.gov/index.html).

NSDI National Spatial Data Infrastructure

Consistent means to share geographic data among all users could produce significant savings for data collection and use and enhance decision-making. Executive Order 12196 calls for the establishment of the National Spatial Data Infrastructure defined as the technologies, policies, and people necessary to promote sharing of geospatial data

throughout all levels of government, the private and non-profit sectors, and the academic community (http://www.fgdc.gov/nsdi/nsdi.html).

OCLC ***Online Computer Library Center, Inc.***

OCLC is a nonprofit library computer service and research organization dedicated to the public purposes of furthering access to the world's information and reducing information costs (http://www.oclc.org/oclc/menu/home1.htm).

ODBC ***Open DataBase Connectivity***

ODBC is an open interface that allows applications to access different database systems through a common set of functions. With this powerful technology, developers need not learn multiple programming interfaces, since they can use the universal set of interfaces provided by ODBC. Standards supported in Microsoft ODBC: ANSI SQL, ISO 9075, X/Open SQL CLI.

Open GIS

OpenGIS is defined as transparent access to heterogeneous geodata and geoprocessing resources in a networked environment. The goal of the OpenGIS consortium is to provide a comprehensive suite of open interface specifications that enable developers to write interoperating components that provide these capabilities (http://www.opengis.org/).

PDF ***Portable Document Format***

An Adobe Corporation proprietary format which converts documents to viewable images independent of computer platform or software other than the free Adobe pdf Reader. (http://www.adobe.com).

Primary Data

Data that have been compiled and QA/QC reviewed.

Raw Data

Raw data are the original, unmodified field sampling and laboratory results that are maintained by the data originators. These data have not been compiled or have had a QA/QC review.

SGML ***Standard Generalized Markup Language***

This language, or rather metalanguage, was first defined by the International Standards Organization in 1986. SGML is still viewed mostly as a format used in publishing printed documents and multimedia, such as CD-ROMs. Publishing was the original purpose of the standard, but it was soon apparent that it had far greater potential outside the publishing industry.

SUTRS ***Simple Unstructured Text Record Syntax***

One of several record syntaxes used by Z39.50 to support the presentation of query results.

Thick Client

In a thick client/server architecture, the client does the majority of the processing.

Thin Client

In a thin client/server architecture, most of the processing is handled by the server and all the browser has to do is process the display.

USEPA ***U.S. Environmental Protection Agency***

US FS ***U.S. Forest Service***

USGS ***U.S. Geological Service***

Watershed

A geographic area within which water flows to a common point.

XML ***Extensible Markup Language***

Extensible Markup Language (XML) is an Industrial Standards Organization compliant subset of SGML (Standard Generalized Markup Language). XML is extensible because it is a metalanguage that enables someone to write a Document Type Definition (DTD) such as HTML 4.0, and define the rules of the language so the document can be interpreted by the document receiver. The purpose of XML is to provide an easy-to-use subset of SGML that allows for custom tags to be processed. Custom tags will enable the definition, transmission, and interpretation of data structures between organizations.

Z39.50

The Z39.50 standard is an "Application Service Definition and Protocol Specification" for information retrieval. It is the protocol that is used to search the Federal Geospatial Data Clearinghouse, the NBII, or a library catalog using USMARC standards (http://lcweb.loc.gov/z3950/agency/).

Appendix B: Operations and Maintenance Plan

The Operations and Maintenance Plan including additional System Documentation has been designed to function as a stand-alone document for practical use as well as for the purposes of this report. This document is referenced in the body of the final report and is included as an appendix to this document to fulfill EVOS project requirements.

Cook Inlet Information Management and Monitoring System

(CIIMMS)

System Documentation, Operations, and Maintenance Strategy

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Executive Summary

This document presents four major aspects of CIIMMS operations and maintenance: program management, system operation, configuration management, and software maintenance. Overall Program Management for the CIIMMS project is the responsibility of the Department of Natural Resources (ADNR). The Department of Environmental Conservation (ADEC) shares in many project management duties and has equal responsibility for marketing CIIMMS. System operation involves administrative control procedures, computer center support, user interaction, and application software operation. Configuration management defines system maintenance as corrective, functional, or adaptive and describes procedures for reviewing, approving and implementing these types of maintenance. Following the decision to modify the system, several important aspects must be considered for implementing the changes. This includes the procedures for updating the documentation; ensuring source code standards are maintained, and implementing, reviewing, and testing source code changes. These represent important functions of software maintenance.

The Cook Inlet Information Management/Monitoring System (CIIMMS) is a three-year project, funded by the *Exxon Valdez* Oil Spill Trustee Council, which will deliver a website with tools for accessing, contributing and sharing of information for the Cook Inlet watershed. This site and its associated graphical user interface will support monitoring, management and restoration of resources and services injured by the *Exxon Valdez* Oil Spill, as well as provide access to data sets and tools valuable to addressing the ecological health of a watershed. This system is unique in that it will provide access to a broad spectrum of timely data and visualization tools via the Internet. CIIMMS will allow regulators, resource managers, planners, and others to approach decision-making from a watershed perspective.

The vision for CIIMMS is to develop a comprehensive information system based on the latest Internet technologies that will enable a wide range of users to contribute, identify, share, and access valuable information about the Cook Inlet watershed and Cook Inlet related activities. This vision was established after extensive background investigations and culminated in a 2-day user needs workshop held in Anchorage, Alaska, on January 26-27, 1999.

The CIIMMS Project Team consists of technical staff from the Alaska Department of Natural Resources, Alaska Department of Environmental Conservation, US Environmental Protection Agency, US Geological Survey, US Forest Service, and the Alaska Resources Library (ARLIS). In addition, a system integration contractor, Science Applications International Corporation (SAIC) provides consulting services to the Team.

Achieving the CIIMMS vision requires the cooperation of many entities. The project team will provide coordination, outreach, and user training to CIIMMS contributors in order to help build links necessary for success. The CIIMMS Advisory Group, made up of a broad group of data providers and stakeholders, will ensure that there is a bridge

between technical, management, and end-user concerns. This group will help ensure that the system will remain usable in the future. Since a large portion of software management costs are expended managing existing systems, it is important for the CIIMMS Project Team and Advisory Group to have a systematic, consistent understanding of the important concepts involved with operating and maintaining these systems.

The CIIMMS system will require regular maintenance to ensure up-to-date data and information. Maintenance will be required for the CIIMMS system and for the hardware on which the system resides. The two servers used in the prototype CIIMMS system architecture will be maintained by their respective agencies according to the procedures already established for those agencies. Each agency will ensure that the servers are operational and functioning at an optimal level. Additional servers incorporated into the CIIMMS framework will be operated and maintained per protocols established by the source agency or organization. As necessary, operation and maintenance guidelines will be prepared and distributed by the CIIMMS Project Team and CIIMMS Advisory Group.

There are three major aspects of the CIIMMS system that will require regular updates and maintenance: the CIIMMS metadata database, the links to Z39.50 compliant servers, and the links to outside Internet sites.

The CIIMMS metadata database will be updated regularly by participants who submit metadata to CIIMMS. Procedures will be established that will allow for quality assurance (QA) of metadata that are submitted to ensure accuracy and appropriateness for inclusion in the database. The Project Team will carry out these QA procedures on a regular basis. The criteria for metadata to be submitted to the database will be easily available to CIIMMS users to ensure awareness of CIIMMS metadata standards.

The Project Team will check links to Z39.50 compliant servers on a regular basis to ensure that the links are correct and functioning properly. Links to outside Internet sites also will be checked and updated on a regular basis. This will minimize "dead links" and maximize the quality of information available through CIIMMS.

The CIIMMS site will provide an easily accessible area for users to provide direct feedback on the operation of the system. User feedback will help to ensure that the system is operating properly and will provide additional checking of system functions and content. The feedback will be checked frequently and the system will be maintained accordingly.

Introduction

Purpose

The purpose of this document is to present the major aspects of managing the Cook Inlet Information Management and Monitoring System (CIIMMS) during the Operations and Maintenance Phase of the system life cycle. This document will assist the CIIMMS Project Team and Advisory Group in recognizing the various concerns that need to be addressed in operating and maintaining this existing system.

Maintenance is playing an increasingly more important role in system operations. This document was developed in response to the recognized need for formal guidance that addresses the day-to-day performance of system operations and maintenance activities. Maintenance efforts for CIIMMS may be initiated by several conditions. These include:

- A new set of mission functions mandated by government agencies requiring the modification to an existing system
- The CIIMMS Project Team or Advisory Group has decided to perform a new function on the current system
- An existing application has been evaluated as being efficient or ineffective
- Users request enhancements to the current system by requesting new functions or outputs
- Operational or data problems are reported by system users
- Enhancements to the operating system necessitate modifications to applications software

Background

The Cook Inlet Information Management/Monitoring System (CIIMMS) provides an interactive website that links to a geographically distributed system of information providers. Through the CIIMMS website, users are able to identify and access (e.g., download and print) information ranging from primary data (geospatial and tabular) to reports, project descriptions, and other documents across a variety of themes, such as habitat, land use, resource management, pollution, and water-quality information. CIIMMS will also provide (on-line) tools to make it easy to contribute information to the CIIMMS network. In the long term, CIIMMS will use integrated information resources and tools to create a virtual community center for Cook Inlet learning, resource management, and related activities.

CIIMMS not only comprises the hardware, software, and information contact components of the Cook Inlet information management system; it also establishes a framework for managing information resources more efficiently. Two important components of CIIMMS development are (1) establish an advisory group made up of data providers and users to oversee implementation and (2) publish guidelines on how to implement various aspects of the framework (e.g., compile metadata). By providing the

tools and the framework that enable a unified approach to information management throughout the watershed, CIIMMS will help agencies and organizations use existing resources more effectively.

Physical Characteristics

Physical Location

CIIMMS is a "virtual organization" and as such does not have a single physical location. ADEC and ADNR each provide office space and equipment space for their own personnel and assigned equipment. In the event that the State of Alaska or the individual departments suffered from budget shortfalls that required them to reduce or cancel their involvement, the physical location requirements would be as follows:

- Office space, 200 - 400 sq. ft, class A business space. (Currently $1.50/sq. ft in Anchorage).
- Conditioned server space, approximately 20 sq. ft. of space in a conditioned computing environment. (Commercially available for $6/ sq. ft. in Anchorage)

Physical Connectivity

The State of Alaska currently provides all connectivity (LAN/WAN) between the CIIMMS servers and the Internet (managed by the State Information Technology Group). There is not a line item cost in the department budgets for this service.

Similar to physical location requirements, we can estimate a cost for this service if CIIMMS suffered a reduction in contribution from the State of Alaska. At current load requirements we estimate an approximate cost of $1,500 per month

Bandwidth requirements will likely grow at an annual rate of 15-20%, but reductions in the cost of bandwidth will likely keep the cost the same for some time.

System Architecture Overview

In order to accomplish system functionality prioritized at the CIIMMS user needs workshop; the system architecture was designed and implemented as follows:

- A client-server architecture was implemented, based on an Internet browser (i.e., a thin client)

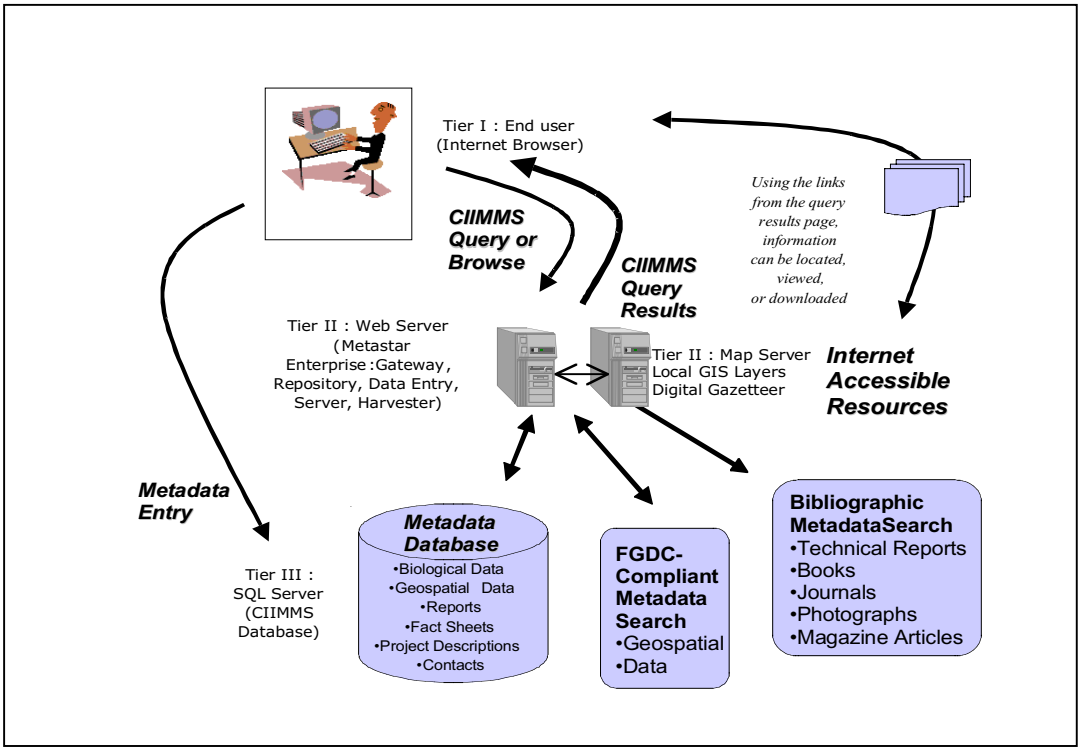
- The data and information is served in a hybrid environment — both centralized and distributed. For example, during the pilot phase, a centralized server was provided for metadata, summarized data, and some primary data, with links established to distributed servers for sources of the majority of primary data.

Figure 1 shows a high-level schematic of the CIIMMS system architecture. The system is structured into three tiers, as follows:

- **Tier I**: End user machine with an Internet browser, such as Netscape or Internet Explorer.
- **Tier II:** Web Server, which houses the Metastar Enterprise software for discovering and accessing metadata and information from all levels of the CIIMMS Information Pyramid, and the Map server, which provides the map-based metadata search function. This function displays local GIS layers and a digital gazetteer. The map presentation and GUI allow for bounding coordinates, place names and subject keywords to be passed to the MetaStar Enterprise software.
- **Tier III:** SQL Server, which houses the CIIMMS metadata, projects, and contacts database.

Identifying and accessing metadata and information is accomplished by using the Z39.50 standard client-server protocol for information retrieval and for focused web crawling of non-Z39.50 sites that contain web pages and hypertext relevant to Cook Inlet. A map-based query tool will be provided to facilitate the search and discovery of metadata. The system architecture also will provide for online linkages to the data and information through data downloads (via ftp), document viewing via portable document format (PDF) files, and image viewing through standard formats, such as graphics interchange format (GIF) files.

FIGURE 1. CIIMMS HIGH LEVEL SYSTEM ARCHITECTURE



Program Management

Overall Program Management for the CIIMMS project is the responsibility of the Department of Natural Resources (ADNR). The Department of Environmental Conservation shares in many Project Management duties and has equal responsibility for marketing CIIMMS. Program Management activities include:

- Organize and coordinate project work between contractors and member agencies
- Organize and coordinate information, discussion, and feedback to advisory group members
- Marketing of CIIMMS to interested parties
- Coordinate outreach and communications to participating agencies. Follow through on data provider requests, user requests, and education.

Outreach efforts will be viewed from multiple perspectives and target audiences that strategically fit CIIMMS' users' needs. The principal purposes will be to build support of the web-shared-accessibility concept so that the CIIMMS structures will be carried into the future of information management in Alaska.

Outreach activities will include:

- educating stakeholders on the use of CIIMMS.
- educating data providers on the steps necessary to make their data available via the CIIMMS site, or, preferably, from their own server.

Outreach efforts will specifically support the population of the FGDC-compliant metadata databases (State and Federal) and CIIMMS database (non-FGDC-compliant metadata) for priority datasets for the watersheds throughout the Cook Inlet basin.

Long-term ADNR Role

The Alaska Department of Natural Resources (ADNR) is committed to the long-term operation and maintenance of CIIMMS as part of its routine programmatic functions. CIIMMS has functioned during the prototyping phase, as an integral part of our Support Services Division while reporting directly to the Commissioner's Office. This organizational structure ensures high-level support for CIIMMS yet provides for a broad agency wide base for implementation and coordination within the agency.

CIIMMS has taken steps to integrate and work closely with the Alaska State Geographic Data Clearinghouse, which resides at ADNR and will be supported as a clearinghouse node of the National Spatial Data Infrastructure into the future. ADNR's Support Services Division has committed to the routine housing, operation, and maintenance of a map server operating in a UNIX environment as part of the State network operated and maintained by the State of Alaska Department of Administration. This map server will provide a critical component of the CIIMMS geographic search capability.

ADNR's Division of Water participates with ADEC and the US Environmental Protection Agency (EPA) through the Performance Partnership Agreement (PPA) in place with ADEC. ADNR Division of Water is committed to serving well log data and working toward an online data entry system accessible via CIIMMS.

The relationships developed over the previous two years will ensure that CIIMMS provides a viable tool for contributing and discovering information relative to Cook Inlet and ultimately the State through SWIMMS.

Long-term ADEC Role

The Alaska Department of Environmental Conservation (ADEC) has taken significant steps to integrate the long-term operation and maintenance of CIIMMS into its routine programmatic functions. Specific actions have been implemented to assure the long-term viability of CIIMMS. Long-term internal support commitments were developed with the ADEC Division of Administration's Information Services (IS) section and the Division of Air & Water Quality's Water Quality program (WQ) to assure the continuance of CIIMMS development, operation and maintenance into the foreseeable future.

- ADEC's IS section has committed to the routine housing, operation and maintenance of CIIMMS server hardware operating in a Microsoft NT environment. Providing a stable, secure, server-friendly environment for both production and test platforms to provide information over the State of Alaska's backbone is an essential component to the reliability of CIIMMS. The State's network is operated and maintained by the State of Alaska Department of Administration.

- ADEC's WQ Program participates with the US Environmental Protection Agency (EPA) through the Performance Partnership Agreement (PPA). The PPA is a contract that incorporates an objective for the continued development of a web-accessible, water quality information system. CIIMMS and its continued expansion is integral to the successful completion of this information system. An additional task related to fulfillment of the PPA objective is the development of an ORACLE web server to house the new water quality STORET (STOrage and RETrieval) database, an EPA developed archival system for water quality data.

- Integral to the continued development of CIIMMS, is the development and integration of an interface for on-line water quality data entry and query through a web-enabled STORET interface. The successful deployment of new STORET through CIIMMS serves as a firmly anchored component that will garner long-term commitment and support from EPA. EPA supported past and current CIIMMS development through the PPA and continues to demonstrate its long-term CIIMMS administration and maintenance programming support with financial resources and technical support.

- The WQ Statewide Database section provides CIIMMS administrative support and programming for both development and maintenance. Other than routine operation

beyond FFY01, continued development of CIIMMS will necessitate specialized project funding.

- In May, 2000, the Alaska Legislature increased ADEC's authority to receive federal funding with one goal of expanding CIIMMS geographically to a statewide information management and monitoring system (SWIMMS). The necessary EPA support to accomplish the expansion was triggered through the approval of a $315K capital improvement project funded with federal EPA grant monies. SWIMMS resources will be applied over a multi-year period beginning in October, 2000. Access to data from the Copper River Delta/Prince William Sound area, the Interior and the Northern Panhandle will be developed, along with appropriate tools to enhance the functionality and provide some basic analytical tools for SWIMMS.

The institutional and fiscal mechanisms established over the past two years, and as described above, will work to assure a self-sustaining operational environment for CIIMMS. CIIMMS has the resources to continue to thrive in a self-sustaining manner with broadening purpose and support. CIIMMS has demonstrated its ability to produce opportunities with which it can continue to evolve through enhancements and expanded geographic focus.

Coordination and the CIIMMS Advisory Group

Achieving the CIIMMS vision requires the cooperation of many entities. The project team provides coordination, outreach, and user training to CIIMMS contributors in order to help build links necessary for success. The CIIMMS Advisory Group, made up of a broad group of data providers and stakeholders, ensures that there is a bridge between technical, management, and end-user concerns. This group ensures that the system will remain usable in the future.

Membership of the advisory group is derived from an existing group, known as the Cook Inlet Coalition (CIC), supplemented by representatives from stakeholder groups that are not a part of the coalition but represent the larger CIIMMS community. The advisory group represents the following:

- A broad array of stakeholders and potential users of CIIMMS information, from public citizens to government agencies

- Providers of spatial and non-spatial data (*all* data-providing agencies and organizations should be represented, to the greatest extent possible)

- Providers of summary-level information, such as public outreach materials.

The CIIMMS Advisory Group provides direction, evaluations, and feedback to the CIIMMS Project Team to ensure CIIMMS' effective implementation. Because CIIMMS was developed to address the needs of a wide range of system users and to promote the efficient sharing of different types of information managed by different entities, it is important to establish some guidelines for uniform information management. In addition, it is essential that CIIMMS is coordinated closely with ongoing information management initiatives, such as the Alaska Geographic Data Committee (AGDC) and SWIMMS, to avoid redundancy and to take advantage of synergistic opportunities with regard to data and information sharing. For example, data standards have yet to be fully established for water quality and biological resources, and will need to be addressed as CIIMMS migrates to a fully distributed system.

The CIIMMS project is represented on the Alaska Clearinghouse Working Group, a subcommittee formed under the auspices of the Alaska Geospatial Data Committee (AGDC). The AGDC is responsible for overseeing and coordinating geospatial data activities in the Alaskan community, and for carrying out the broad objectives of the Federal Geographic Data Committee (FGDC). CIIMMS supports the expansion of FGDC-compliant metadata clearinghouses, and is providing more robust tools for accessing and contributing to Alaska's clearinghouse nodes. Currently, there are two FGDC clearinghouse nodes in Alaska: the Alaska Geospatial Data Clearinghouse (AGDC), and the Alaska State Geospatial Data Clearinghouse (ASGDC). The Municipality of Anchorage Geospatial Data Clearinghouse node is currently under development.

Effective implementation of CIIMMS requires the efficient sharing of information among disparate information generators and data users and across different operational environments. This will happen only if all participants agree to move in the direction of adopting uniform standards and reporting conventions, employing effective metadata, and using compatible software and information management systems.

Overview of ADNR/ADEC Shared Maintenance Activities

The previous chapters provided the background information and summary level review of the CIIMMS project and system architecture. The next set of chapters (which follow the guidance in EPA directive 2181, EPA Operations and Maintenance Manual) provide a discussion of the detailed system operation, configuration, and software maintenance activities that will be shared by ADNR and ADEC. Prior to this detailed discussion, a summary table, presented below, lists the anticipated level of effort for the major CIIMMS operation and maintenance tasks as they relate to the following Operations and Maintenance discussion.

TABLE 1. ANTICIPATED LEVEL OF EFFORT FOR MAJOR CIIMMS OPERATION AND MAINTENANCE TASKS [1]

Task	ADNR Hours/Week	ADEC Hours/Week
1. Administrative Control (page 12)		
User Comments and Feedback Processing (Change Control Administrator)		5
• Add new users • Process feedback items		
Data Upload Processing and Maintenance/QA (Project Manager)	2	
• Process new data to be loaded on site • QA user submitted metadata/links		
Security Measures/Audit (Systems Manager)		3
• The State of Alaska maintains security over their LAN/WAN system. Additional security measures must be maintained by CIIMMS member agencies to ensure data integrity.		
Hardware/Software Performance Analysis – Quarterly (Systems Manager)		1
• Quarterly the CIIMMS team will review performance data for the system and measure it against quality standards developed by the advisory board and the Project Management team.		
New Technology Analysis (Project Manager)	2	1
• We anticipate advances in technology will require substantial modifications to CIIMMS. Considerable time will be required reading related literature, networking, and meeting with other professionals to keep the system current.		
2. Computer Center Support (page 14)		
IIS Server and Software Maintenance (Computer Center, System Manager)		2
• Run backup tapes daily • Install Service packs and hot patches (system and security) • Modify user rights and security permissions as needed		
UNIX Map Server Maintenance (Computer Center, System Operator)	2	
• Hardware Maintenance • Software Maintenance • Map Server Maintenance		

Network Troubleshooting (includes routers, switches, firewalls, etc.) (Computer Center, LAN Administrator)		2
• The State of Alaska provides all network troubleshooting over the State owned LAN/WAN from router to router. The individual agencies are responsible for connectivity to each machine, and overall connectivity for the system.		
3. User Interaction (page 16)		
Web Site Maintenance (Project Manager)	2	
• Maintain Static HTML pages • Add new links • Change graphics, update style • Change and maintain news items/features		
Outreach (Project Manager)	12	2
• Educating stakeholders and users • Educating data providers on steps necessary for data contribution. • Coordinate/Facilitate CIIMMS Advisory Group		
4. Application Software Operation (page 17)		
MS-SQL Server and Software Maintenance (Database Administrator)		2
• Run Backup tapes daily • Install Service Packs and hot patches • Modify user rights and security permissions as needed • Compact and repair databases		
Blue Angel Enterprise Software Maintenance (Database Administrator)		4
• Z39.50 Server maintenance • Z39.50 Search Gateway maintenance • Data repository maintenance • Data entry maintenance • Web Harvest maintenance • Non Z39.50 data access connection maintenance		
• **Total Hours per week (note quarterly task)**	20	21

[1] The CIIMMS Project Team anticipates a lifecycle rate of 24 months for hardware and 18 months for software.

System Operation

This chapter addresses system operations requiring management and control on a day-to-day basis in four functional areas:

- Administrative Control - details the responsibilities and activities associated with the overall control and administration of CIIMMS.
- Computer Center Support - describes the various tasks and activities, which are provided by the computer center to ensure the daily operation of CIIMMS.
- User Interaction - defines the access techniques and operating procedures that should be followed by an end user of CIIMMS.
- Application Software Operation - describes the activities associated with maintaining the stability of the CIIMMS application software for the user community.

Each of these areas will be presented and discussed in this chapter.

ADMINISTRATIVE CONTROL PROCEDURES

Administrative control procedures are necessary to ensure correct operation of the system from a managerial standpoint. These procedures include:

- Designation of authorized system users
- Specification of system parameters and tables
- User support
- Supervisory control of system operation and report production.
- Archiving

Responsibility for administrative control procedures will be shared by the System Manager (to carry out the system management functions) and Database Administrator to support the database management requirements). This division of responsibilities is not absolute. Supplemental staff may be utilized to handle specific responsibilities, such as responding to user inquiries or controlling system access.

Control of System Access

A primary system management responsibility is the control of procedures for system access in order to maintain data integrity, availability and confidentiality. The person in charge of system access will assign access capabilities based on an individual user's authority to perform specific application functions. System access will be granted based on job requirements and security clearances. Some users may have authority only to enter or look at data, while others may need to update and delete data. Access to system outputs such as reports or statistical information may also need to be controlled.

Parameter and Table Specification

An important area of system control involves parameter specification and table maintenance. A parameter is defined as an individual variable or constant stored in a file, while a table is a file containing multiple parameters having similar characteristics. Parameters and tables that are external to individual programs are often used to vary a system's operation. These may also be used to control a user's functional access authority. Without the use of these parameters and tables, program source code would require

modification every time a variable needed to be changed. There are four benefits to using parameters and table files to control system performance:

- The authority to specify and control these flexible system attributes can be a tightly controlled system administration function.
- Changes can be made universally for all users by the modification of a single item of information.
- Programs can be developed independent of the data and do not need to be modified to change system operational characteristics.
- A host of user-specific information does not need to be entered by the users each time the software is accessed.

User Support

The growth of user computing and the resulting high investment in computing resources has identified the need to ensure proper user support in order to maximize productivity and the overall return from this investment. The primary purpose of any support service is to raise the user's productivity by making them more comfortable with available technology and improving their skill at using the software to update, access and manipulate information. In this regard, the person tasked with the administrative system management responsibilities, the System Manager, should generally become the first point of contact concerning user-support issues. For CIIMMS, the System Manager will become the user's interface with a specific system or application. This will promote consistency and coordination of resources. In order to provide effective user support, the System Manager will be responsible for:

- Responding to and tracking user inquiries about system operation (via mail, E-mail, phone)
- Dealing with system access procedures
- Addressing software and hardware problems
- Hosting user conferences
- Providing appropriate training.

The System Manager may also assist users by providing necessary system documentation, publishing a newsletter to disseminate system information, and moderating user groups. The system manager should also assist the user in acquiring appropriate training in such areas as web access, browser compatibility, etc.

Supervisory Control of the Production Process

Supervisory control of the production process refers to a system of administrative checks, which ensure proper utilization, and operation of the system. Supervisory controls are established to assist in monitoring the day-to-day operation of a system. They assure valid, proper entry and maintenance of data, accurate performance of input/output procedures, authorized user interaction and special processing requests. They are constructed to ensure that maintenance transactions are handled properly, verification and

approval procedures are in place, and if necessary, monitor disaster recovery. Supervisory controls can either be built-in functions of the software itself or documents designed for this use. Examples of these include job request forms, system manuals, procedural checklists, audit trails, and system performance/exception reports.

Archiving

Archiving refers to the creation of data for historical reference purposes. Unlike the philosophy that governs the backing up of files, where a copy of a master transaction, or table file is made to ensure a copy is available daily if anything should happen to the original, the philosophy of archiving is to ensure that copies are created for long-term storage of data.. The storage medium for the long-term storage of a specific application is an important decision made during the system design phase. The archival medium decision should be reevaluated periodically in light of changing technology.

COMPUTER CENTER SUPPORT

Since individual system operation is impacted by computer center operations, it is important to understand the activities and controls provided by the computer center. In the context of this document the concept of a "computer center" relates to the hardware and software necessary to support a system application. Computer center support refers to the activities performed by the technical support staff within the computer center environment, which help ensure each system will operate properly on a daily basis. The elements of computer center support include:

- Computer Operations
- Production Control
- Backup and Recovery
- Disaster Planning and Recovery

Computer Operations

Computer operations encompass those activities that are carried out to maintain a viable system environment. The system environment is comprised of computer hardware, system software, and communication devices. Computer hardware consists of the computer and an array of input and output devices including printers, tape drives, terminals, and disk drives. System software includes the operating system and other required software. Communication devices include the modems and communication lines that allow access between computers for sharing data and processing capabilities.

In a Local Area Network (LAN) environment, a LAN Administrator is assigned the responsibility of operating and maintaining the LAN. The LAN Administrator's responsibilities include overseeing or performing the following:

- Installing the LAN
- Training users
- Maintaining the hardware and software
- Performing system backups
- Managing network security.

Production Control

Production control operations refer to the activities that support the implementation and periodic processing of various systems. Typical production control activities include:

- Backup and recovery
- Disaster planning and recovery
- Routine submission of batch jobs
- Maintenance of all appropriate security measures

Two production control activities that stand out in terms of their significance to the protection of an application system are backup and recovery, and disaster planning and recovery. These are discussed in the following sections.

Backup and Recovery

Backup procedures should be designed to protect against any possible loss of data. Duplicate copies of data are made periodically to ensure that a copy of the generated work will always exist, even if the master copy of the data are damaged or destroyed. There is always a chance data can be lost either by human error, hardware or software failure or by catastrophic disaster (discussed in Disaster Planning and Recovery).

System developers should always assume the worst-case scenario when designing any backup system. This backup system will consist of procedures, which are established to maintain and store recent versions of the information residing within a system.

Details of specific data backup and recovery methods for the various types of systems will be unique to each particular agency. ADEC uses a 21-tape GFS (grandfather-father-son) rotation on all of its servers. This includes 5 daily back ups, 4 weekly and 12 monthly tapes. The recovery of lost or damaged files works back to the latest tape with an undamaged copy of the file. ADNR conducts daily incremental backups Monday through Thursday. Friday's backup provides a full backup of all servers, which is retained for 52 weeks, with one backup per quarter retained for a second year.

Disaster Planning and Recovery

Disaster planning and recovery refers to the plan or set of procedures that is designed to counter any physical destruction or damage of the hardware resources or to the building in which the computer center is located.

The computer center has the primary responsibility for developing any disaster recovery plan. These plans should contain procedures for dealing with various aspects of emergency response, immediate backup, and long-term backup. The procedures should be as specific as possible and all appropriate responsibilities clearly defined.

As with the recovery plans, which address data recovery, each computer center should have a separate restoration plan, which will assist, in restoring the physical computer center site. This plan should establish responsibilities for the following activities:

- Assessing the time required to restore the damaged facility or to locate, obtain, and set up a new processing facility
- Physically restore the damaged site
- Reestablish the original data processing environment by moving from the backup facility to the restored site, or a new processing facility.

Once the risks are identified and the recovery procedures are detailed in the disaster recovery plan, the plan must be tested and periodically reviewed to ensure that time and events do not change the situation and that all procedures are still applicable.

USER INTERACTION

The third area of daily system operation involves user interaction, which consists of access techniques and operating procedures to be followed by a user of the system. The specific topics addressed in this section are:

- System access techniques
- Data entry and update procedures
- Analysis/reporting options

System Access Techniques

System access techniques are the means by which a user interacts with an automated system. These techniques vary depending on the type of system, the type of computer, and the input and output required. In order to ensure that users are able to utilize CIIMMS with ease, system access techniques must be developed and clearly and simply documented for users.

Step-by-step procedures for gaining access to a system must be developed and made available to the user. If several communications or machine access methods are available, the user must be given instruction in their use. For example, if a number of different types of terminals, workstations or personal computers may access a system, procedures for system access using each machine must be delineated.

Data Entry and Update Procedures

Data entry for CIIMMS is accomplished through an on-line (password protected) metadata entry tool. Contributor guidelines have also been published to facilitate data entry. Data input and update schedules, procedures, and security requirements are governed by the volatility and sensitivity of the data being processed. The timing of data input is tied directly to the nature of the system. This allows the designated System Manager to establish an appropriate archival schedule.

Systems can have several levels of data entry or update approval. Some users may have authority only to enter or look at data, other users to update and delete data. The System Manager controls procedures for each type of access in order to maintain data integrity, availability, and confidentiality.

APPLICATION SOFTWARE OPERATION

The operation of the application software is the responsibility of the System Operator or operations personnel, either within the computer center or in a program office. These personnel are responsible for systems operation activities, including operating the hardware and maintaining the stability of the application software for the user community.

The following specific activities of application software operation are described in this section:

- System initialization/re-initialization
- Error detection and recovery
- System interfacing

System Initialization/Re-initialization

During system implementation, internal files and tables are initialized with a baseline of data and operational parameters. In some cases, this initial implementation is sufficient to establish and support operations for the life of the system. In other cases, it may be necessary to re-initialize the system files and tables at the start of a new operating interval (e.g., day, pay period, month, fiscal year). A step-by-step process for initialization, including a list of the required input parameters and a description of the update procedures will be developed and documented. The System Manager will have the responsibility for defining and specifying system parameters and re-initialization requirements.

Error Detection and Recovery

Among the responsibilities of the software operations personnel are error detection and recovery procedures. A variety of system failures can result in system malfunction. Such failures occur as a result of data errors, program errors, or equipment malfunctions. The

System Operator can determine the type and seriousness or errors, if any, that have occurred as a result of a system failure by reference to system error messages and other diagnostics.

Each part of the system, which can fail, should have specific, documented error messages designed to explain the error and its proper resolution. For example:

- Program or data errors --program error messages are displayed on the operator's terminal screen or user's screen.
- Equipment errors/failures -- hardware malfunctions produce error messages either displayed by the hardware itself or by the operating system, if applicable. These are described in the operating guide supplied with the hardware at time of purchase.

Effective system restart procedures in response to application software or hardware failures should be documented. To the extent that data is lost or damaged as the result of a software and/or hardware failure, the provisions outlined in the Backup and Recovery Section should be utilized.

System Interfacing

System interfacing procedures become more critical in system operations as increasing numbers of systems interface for data exchange and storage purposes. Procedures for performing or maintaining system interfaces are documented in the CIIMMS Implementation Plan and in Appendix B, System Architecture.

OPERATIONAL BASELINE

The Operational Baseline represents the completely implemented and tested software system. It is the basis for future maintenance changes and enhancements. It is established following a successful Operational Test and Evaluation Review and after it has been placed in production.

CONFIGURATION MANAGEMENT

Configuration management involves system maintenance or enhancement performed following initial system implementation. Configuration management includes the evaluation methodology and approach to be followed when considering a partial system redesign or determining software obsolescence. Generally speaking, management must apply the same evaluation criteria to the system maintenance function that are applied to the original system design.

This chapter contains configuration management definitions and responsibilities and describes the activities, which comprise the configuration management process. It

includes information on the management structure, decisions, and tools to support the evaluation, determination, and implementation of changes to an operational software application. The first section covers types of system maintenance and their respective responsibilities. The second section addresses the procedures necessary for proper configuration management.

DEFINITIONS AND RESPONSIBILITIES

This section includes configuration management definitions, as well as the responsibilities of those individuals who implement system maintenance.

System Maintenance

System maintenance includes three categories of changes made to software: corrective, functional, and adaptive maintenance. Each category represents a different set of problems or reasons for performing system maintenance.

Corrective Maintenance

Corrective maintenance is performed to correct abnormal and/or debilitating system performance that was not detected during system testing. This can happen because the system testing process is generally designed to verify system performance under "normal" operating conditions. Once a system has been put into production, it undergoes the stress of both expected and unexpected user interaction and activity, which can precipitate previously, undetected system problems.

The users may be able to adapt to inconveniences such as report labeling inaccuracies, peculiarities of report sequencing, or unsatisfactory data display formats. Other problems, such as incorrect calculations and acceptance of invalid data, are of a more critical nature as they affect the accuracy of the information processed and result in incorrect system operation. The user community or managers may be the first to notice inaccurate data or functions, and they should be encouraged to submit problem reports.

These types of problems tend to receive intensive management attention. Regardless of the management pressures for rapid implementation of changes, corrective maintenance tactics need to be evaluated, planned, and controlled to ensure that the ramifications of changes are known and accepted, the changes perform as required, and users are informed of the change implementation schedule.

Functional Maintenance

Functional maintenance addresses proposed system changes that will provide users with enhanced system performance and capabilities that were not specified in the system design phase of the software life cycle. Enhancements may be proposed through submission of change requests by any of the following:

- Active users who want changes to increase efficiency or to expand the scope of system function
- Managers who recognize a change in the mission needs of the Agency or a sub-organization
- System designers and managers who recognize operating inefficiencies based on actual system utilization.

Unlike changes that are forced by corrective and adaptive conditions, proposed functional maintenance changes should undergo benefit-cost scrutiny to ensure that a new version of the system is warranted rather than continuing the current system or planning a totally new implementation.

Adaptive Maintenance

Adaptive maintenance refers to system modifications imposed upon the system by external forces. For example, the computer center may install an upgraded computer or operating system, or an affiliated system may be re-written with accompanying changes in system interfaces. These modifications could easily apply to personal computers as well, such as an upgraded PC operating system or a new version of commercial software that requires modification of in-house systems or data input procedures. In these cases there is no prerogative to accept or reject the required changes. Instead, the pending operating environment should be examined to determine if there are opportunities for upgrading the functionality and efficiency of the system at the time the system is being adapted. The implementation schedule for adaptive maintenance is often defined by the system or installation that is initiating the change in processing environment.

Configuration Management Responsibilities

An individual should be designated to establish and execute system change control procedures. This person is referred to as the Change Control Administrator and is generally recognized to be the System Manager. The responsibilities of the Change Control Administrator are described in the following paragraphs.

Review of System Functionality

Periodically, the Change Control Administrator should review the system and its documentation to ensure that the system is meeting current user needs. Policies and procedures may change over time to reflect a change in overall agency missions, shift in programmatic emphasis, or modification of job tasks. Because of this, the alignment of the system with the goals and job tasks it was designed to support may deteriorate. The Change Control Administrator must determine when the system is not providing adequate support or is obsolete and initiate a study to define options, which include:

- No change to the system
- Partial system redesign(new version of the system)
- Complete system redesign (new system)

- System determination.

The study could include:

- Evaluation of the continuing need for the functions provided by the system
- Assessment of successful execution of system functions
- Analysis of workload and utilization of the system for comparison to estimates made at the time the system was designed.

This type of study could be accomplished through an individual's observation, a user survey, or interviews with managers.

Coding Standards Enforcement and System Testing

The Change Control Administrator has oversight responsibility for ensuring that the coding standards and system testing procedures established during the initial system design phase are observed by the System Manager, Database Administrator, and technical support staff during subsequent maintenance cycles. The coding standards and testing procedures were established to promote software quality and maintainability and overall system integrity. The applicability of these standards and procedures to the software maintenance process is addressed in the next chapter. Circumventing the established procedures could lead to degradation of the system due to undetected errors, undocumented coding changes, or inconsistent operating or processing procedures.

CONFIGURATION MANAGEMENT PROCESS

This section addresses the following activities, which comprise configuration management:

- System change requests and problem reports
- Analysis of system change requests and problem reports
- Benefit-cost analysis
- Change approval
- Software improvement increment
- Maintenance cycles
- Return to prior software version
- Documentation.

The Change Control Administrator has the responsibility to evaluate, plan, and control the required system changes through this process to ensure that they perform as required and to assess the ramifications of such changes. The user community must also be notified of the implementation schedule and any procedural changes. Throughout the system maintenance process, the system manager must be aware of the impact that proposed software changes may have on the entire system and the eventual effect on the user community.

Provisions should be made in the configuration management process to accommodate the rapid system changes required to respond to detected errors. These provisions may include elimination of the benefit-cost analysis or reducing the change request review and approval requirements, if appropriate. However, error corrections should still be verified, tested, and documented. Abbreviated procedures should not be used to circumvent the normal functioning of the formal change process though they may be used to speed it up.

System Change Requests/Problem Reports

Requests for changes to the software may originate from any of the users of the system. A formal procedure should be established to process and document requests for system changes and reports of system problems. The procedure should include submission and tracking of problem reports and change requests, to ensure that all reports/requests are addressed in a standard manner, and that none are overlooked by mistake. Problem reports and change requests should consist of at least the following information:

- Functional description of the problem or the requested change
- For a problem, a description of the conditions under which it occurs
- For a change request, the benefit(s) to the user/organization/Agency of the change.

Problem reports and change requests should be logged by the Change Control Administrator upon receipt for tracking purposes and categorized as corrective or functional maintenance. (Although adaptive maintenance is not initiated through a problem report or a change request, it is important to manage and track the maintenance process in the same manner that system problems and changes are handled.) The main purpose of tracking problem reports and change requests is to ensure that the defined action plans are followed and scheduled maintenance is correctly performed as planned and on time.

The actual content and format of the problem report/change request form should be determined by management in order to correspond to standard local procedures.

Analysis of Problem Reports and Change Requests

Problem reports and change requests must be analyzed to determine the action to be taken in response. Problem reports must be analyzed to determine the severity of the problem and to prioritize problems if several are awaiting correction. Problem reports usually indicate system corrections, which must be made as soon as possible in order to ensure proper system operation. System change requests do not always require immediate resolution. Instead, they must be subjected to additional discussion and analysis, including benefit-cost analysis, before specific action is taken.

When a change request is received, the Change Control Administrator consults with the System Manager, Database Administrator, and technical support staff, as appropriate, to

refine the definition, necessity, and consequences of each proposed functional change. The outcome of these discussions may be several software options for achieving the desired performance goals. Each option is then assessed to determine:

- The expected level-of-effort required to implement the change
- The relationships between the programs, modules, and interfaces affected by the change
- The impact on the user community.

For both functional and corrective maintenance, system changes must be fully evaluated. The impact of the changes must be viewed in terms of the total cost of a proposed change and any adverse effects on overall system quality. As noted above, the decision to perform adaptive maintenance does not usually reside with a local system administrator or manager, so this evaluation is not necessary in such cases. However, adaptive maintenance may require evaluation of various options for performing the maintenance.

Benefit-Cost Analysis

Proposed system modifications that fall into the functional maintenance category are subject to life cycle benefit-cost analysis techniques. Functional maintenance changes in particular must be thoroughly analyzed because they are optional in the sense that failure to implement them will not adversely affect system performance, as with corrective and adaptive maintenance changes. Attention should be paid to assessing the benefits of functional changes since these benefits may be either small or large in relation to the cost of implementation. Because corrective and adaptive maintenance is optional, benefit-cost analysis is most appropriately used to determine the best option for applying required changes. The depth and formality of the benefit-cost analysis should be determined by the size of the system and the complexity of the proposed modifications.

Change Approval and Action Plan Development

Changes in all maintenance categories must be approved by the Change Control Administrator in consultation with the System Manager and program management where appropriate. Even though changes in the corrective and adaptive maintenance categories are usually not elective, the Change Control Administrator should determine the approach and timing of changes.

Some requested changes will be rejected because they are trivial or not worth the cost and system disruption caused by their implementation. Other changes, which are more fundamental, will be rejected on the principle that it would be more cost effective and functional to re-design the system than to adapt the desired functions to the current software.

The Change Control Administrator is responsible for evaluating the proposed software changes with regard to the following:

- The total cost of the proposed modifications
- The maintenance burden of the current and proposed systems
- The functional requirements of the organization/Agency
- The overall effectiveness of the system
- The efficiency and productivity gained from a re-designed system
- The effects on system security.

The result of this analysis is a determination to complete the proposed functional maintenance, to develop a new version of the software, or to declare software obsolescence.

Once the approval decision has been made, the Change Control Administrator must develop an action plan for effecting the change. The action plan is based on the information developed in the decision-making process, and includes a schedule for implementation, design documents, and staff assignments. Throughout the maintenance process, the action plan should be monitored for timeliness and accuracy. If it is determined that a new version of the system is warranted, a software improvement increment and an accompanying maintenance schedule is defined. Declaration of system obsolescence will begin a new software life cycle for the system re-design. Procedures for initiating this system redesign are similar to those utilized during the system design phase.

Although adaptive maintenance is not initiated through use of either a problem report or a change request, the procedures for analyzing such maintenance are quite similar. An action plan must be developed, scheduled, and implemented, and maintenance progress must be monitored as for corrective and functional maintenance.

Software Improvement Increment

The software improvement increment groups a finite number of enhancements and modifications to be incorporated into the system software. This refers to a group of proposed system changes that have successfully passed through the formal change request review and approval process. Definition of the scope of the software improvement increment is based on the projected level of effort, expected utility gains, budgetary constraints, and organizational pressures to improve the system. The documented and communicated release of a new version of the system concludes the software improvement increment.

Maintenance Cycles

One goal of configuration management is to provide a stable system for the user community. Systems that are in a continual state of flux, due to a constant flow of changes, will precipitate user frustration, anger, and, ultimately, rejection of the system. In order to confine system changes to orderly schedules, a formal maintenance cycle should be established. The maintenance cycle does not necessarily refer to routinely

scheduled maintenance but rather controlled maintenance. For example, a cycle could be established in which maintenance is performed only after a threshold of demand for system modification, such as a specific number of problems or requests for one change or a specific number of changes, has been reached. Another alternative is to establish a maintenance cycle in which changes are made to only one module or program of a system at a time. In any case, pending system changes should be grouped together and accomplished at one time as part of a software improvement increment. The intention is to provide users with periods of stable operation and known performance characteristics. This will also allow the Change Control Administrator time to inform the users of pending changes and instruct them in new operating procedures and/or functional capabilities.

Return to a Prior Software Version

Problems with newly implemented modifications occur occasionally. In most cases, additional problem reports are submitted which begin the software maintenance process again. However, in rare cases, a change that has been implemented has an extremely adverse operational effect on the users and the system output. In such a case, the new version may need to be removed and replaced with the version of the system that was in place prior to the change. This return procedure should be performed as soon as possible after a change is identified as being incorrect and the return to the prior software version is identified as the best means for correcting the problem. The Change Control Administrator should make the final decision concerning the need for and timing of the procedure.

Documentation

The analysis and decision-making process that precedes system software modification must be supported by adequate documentation, which includes the following items:

- Software Change Request/Problem Report
- Notification of adaptive maintenance, if applicable
- History of analysis and relevant decisions
- Level-of-effort estimates
- Action plan and maintenance schedule
- Evaluation of maintenance effects on system security
- Approval signature
- Statement of Strategy for Software Improvement Increment, which may include the following items:
    - A summary of the analysis undertaken in the determination that a new system version is warranted
    - An evaluation and benefit-cost analysis of alternative implementations
    - An overview of the hardware, software, and file changes that will be implemented.

This documentation should be maintained by the Change Control Administrator, and made available to the System Manager, the Database Administrator, and computer center manager or staff.

Documentation of system maintenance is an important part of the configuration management process since it ensures that correct information on use and operation of the system is available to system users and operators at all times. The documents, which are prepared during system maintenance, are the tools for ensuring an orderly software maintenance process. The maintenance documentation, as described above, also becomes part of the total accumulation of system documentation since details of changes must be appended to (and in some cases, must replace) the existing documentation to form a complete documentation package for the system. In addition, this documentation is an important means for justifying maintenance costs to internal and external auditors.

SOFTWARE MAINTENANCE

Software maintenance refers to the actual modification of software and related documentation. This occurs during the final phases of the system life cycle and is often precipitated by:

- Identification of program "bugs"
- Demand for additional capabilities/features
- Changing functional requirements
- Increase/decrease in scope of a system.

System modifications are often especially difficult to implement because of the constraints imposed by the operational characteristics of the existing system and the need for continuity of system operations.

Orderly modification of a system is necessary to maintain a stable operational environment for its users. When changes are made to a system, they must undergo testing and acceptance in a non-production environment to determine whether they do in fact perform as desired. Once thorough testing is completed, a pre-production quality assurance step is required to ensure that the results of the changes do not adversely affect other parts of the system and that the changes correctly address the original problem. Strict adherence to the procedures described below will ensure that modifications are implemented in a correct, predictable, and orderly manner with minimal adverse effects on the users of the system.

This chapter will discuss the following topics:

- Maintenance Procedures - discusses the relationship of the various procedures and standards established during initial system development and their use during system enhancement.

- Documentation - highlights the different system documents that either must be changed with a system modification or at least must be reviewed for accuracy.

MAINTENANCE PROCEDURES

This section discusses the maintenance procedures and tools established at the time of system development and installation, which also facilitate the implementation of any new software modifications, or enhancements. Management of the maintenance process will be carried out by the Change Control Administrator and will be concerned with the following areas:

- Documentation update
- Source code standards
- Coding and review process
- Testing standards and procedures.

Documentation Update

Maintenance should focus on modification of the entire application including documentation and not on the source code modification alone. System documentation problems occur when changes to source code are not reflected in the design documentation or user-oriented manuals.

Whenever a change to data flow, software structure, module procedure, or any other related characteristic is made, supporting technical documentation including security documentation must be updated. System documentation that does not accurately reflect the current state of the software is probably worse than no documentation at all. Major problems occur when innocent use of unchanged system documentation leads to incorrect assessments of software characteristics.

The side effects from documentation shortfalls can be reduced substantially if all applicable documentation is reviewed prior to any further release of the software. In some instances, maintenance requests may require no change in software design or source code, but indicate a lack of clarity in user documentation. In such cases, the maintenance effort should focus on redefining and clarifying existing documentation.

Source Code Standards

The same set of coding standards used during the initial design and development of the system application should again be instituted. A general set of minimum program design and coding standards, which should be, used either when designing a new system application or modifying an existing one. These standards promote productivity and maintainability as well as software sharing and reuse. The important characteristics of the standards are:

- Use of structured programming constructs to control the flow of execution
- Elimination or significant reduction in the use of "branching " statements
- Applicability to 3rd and 4th Generation Language programming
- Modularity in source program design and coding
- Good documentation practices such as:
    - Naming conventions
    - Symbolic parameters
    - Paragraphing
    - Blocking
    - Indentation of source code
    - Single statement per line
    - Intelligent use of comments
    - Error messages.

Source code standards should be reviewed prior to beginning programming of any modifications.

Coding and Review Process

Before the actual coding can begin, a detailed design of what the modified application will look like must be completed. If a major system overhaul is being accomplished, then the detailed design should be formulated using the procedures outlined in the CIIMMS Implementation Plan. If the planned changes are smaller in scope, such as adding a new function or correcting a "bug" in the system, then the changes can occur without a large amount of analysis and design documentation. Managers should be aware that ANY change might have a rippling effect through the entire application. It is particularly important to review the effects these changes may have on system security.

Once the detailed design is completed, then the production and programming functions can be accomplished. At the completion of this task, all of the coding, controls, databases, user procedures and operations procedures will have been developed. Some of the major activities for this evolution include:

Develop Software System

- Code new software units
- Review software unit codes
- Unit test new software
- Produce unit test reports
- Perform subsystem integration testing
- Prepare subsystem test reports

Preliminary reviews are accomplished as each piece of new software is added to the original application. These reviews will confirm the new software product performs according to all requirements and specifications.

Testing Standards and Procedures

The use of testing standards and procedures during the maintenance phase of the system life cycle should be consistent with the standards and procedures set forth during the initial system development. A test plan should be developed for each system and used as a guide to ensure that any modification made to the application is tested thoroughly and the results properly documented.

The testing team must be aware of any "rippling effects" which newly developed software will have on related applications. Testing should not be limited only to the new piece of software; ALL software even remotely related to the modified software should be identified and included in the testing.

DOCUMENTATION

This section discusses the system documentation prepared during initial system development. The following documents should be reviewed periodically or when software is modified in order to determine if they need to be changed and updated during the maintenance phase of the system life cycle. At the very minimum, they should be reviewed for accuracy.

- Software Maintenance Manual
- Data Dictionary
- Source Code.

Software Maintenance Manual

The object of the Software Maintenance Manual Document is to provide program maintenance staff with both general and specific information on the system configuration and application software. This manual should present guidelines and procedures for performing maintenance. Some areas, which should be addressed, include:

- Source code standards
- System manual update
- Change control process
- Testing standards and procedures
- Maintenance tools
- Security

Data Dictionary

A data dictionary is a collection of information about the data used in a system. Although in some cases a data dictionary must be developed manually, the term itself usually refers to a dictionary maintained by special data dictionary software. It is very important during the maintenance phase of a system life cycle that the data dictionary is updated if changes

are made to the structure or definition of data in the system. If updated properly, the data dictionary will provide a consistent official description of data as well as maintaining consistent data names required for programming and retrieval. The dictionary should contain such information as the following:

- Name
- Description
- Source
- Users of the data, including screens, reports programs and organizations that access and use the data
- Key words used for categorizing and searching for data item descriptions
- Format
- Quality
- Precision
- Defaults
- Edit criteria
- Security requirements

Data dictionaries may be used by the database administrator to enforce standards for names and descriptions, ensuring that those who create data follow the standards.

Source Code

The final element of system documentation, which should be revised at the conclusion of any maintenance effort, should be the complete listing of the application system source code.

References

Parent Documents

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Microsoft Windows NT Server 4.0, Administrator's Pocket Consultant, Microsoft Press, 1999, Redmond, WA.

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http://issaic.saic.com/Infocapital/si/commitment/common3/Vol_I/6-scm.html

Thayer, R.H. and Dorfman, M., 1990, System and Software requirements Engineering, IEEE Computer Society Press, Los Alamitos, CA

Unix System Administration Guide, 1993. Osborne McGraw-Hill, Berkley, CA.
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Blue Angel Technology Documents

Metastar Data Entry Administrator's Guide, Version 2.3.0, Blue Angel Technologies, Valley Forge, PA

Metastar Gateway Administrator's Guide, Version 3.5.0, Blue Angel Technologies, Valley Forge, PA

Metastar Server Administrator's Guide, Version 1.3.0, Blue Angel Technologies, Valley Forge, PA

Metastar Repository User Guide, Version 5.3.0, Blue Angel Technologies, Valley Forge, PA

ESRI Documents

ARCIMS Features and Functions, ESRI Whitepaper, May 2001
http://www.esri.com/library/whitepapers/arcims_lit.html

WMS Connector, version 3.0
http://arconline.esri.com/arconline/downloads/ims_/WMS_Connector.html

Microsoft Documents

Microsoft SQL Server documentation MS SQL 7.0
http://www.microsoft.com/technet/index/default.asp

Web server: Microsoft IIS
http://www.microsoft.com/technet/index/default.asp

Windows NT 4.0 Server,
http://www.microsoft.com/ntserver/web

Miscellaneous Documents

BEA Weblogic JDBC KONA SQL 4 JDBC driver,
http://www.bea.com/products/weblogic/drivers_platforms.html

Carbon Copy 32 Version 5.1 Users Guide, Compaq Computer Corporation, 1998, Norwood, MA

Web Sites

http://info.dec.state.ak.us/ciimms/
http://www.asgdc.state.ak.us/
http://agdc.usgs.gov/

Appendix A: Status and Schedule

Short-term (Year 1 and prototype) priorities included in the prototype:

- Categorical indexes for Cook Inlet information inventory
- Keyword and Boolean searching capabilities
- Restoration project activities
- Ability to view, download, and print static maps and web documents (for not more than 10 priority data themes selected for use in the prototype)
- Data documentation (metadata) records linked to actual data and summary information (e.g., fact sheets)
- Hotlist of related offsite links
- Form for suggesting information and links to add to CIIMMS
- Data documentation (metadata) entry tool to populate CIIMMS
- On-line help

In the Initial Production Phase of CIIMMS (FY 00), with the prototype "framework" in place, the CIIMMS project team will focus on making additional datasets and information available to the CIIMMS community. The specifications for this phased-in approach to data and information integration will be implemented according to the specifications developed from the results of the prototype evaluation. Medium term priorities, as identified at the January 1999 user needs workshop (and refined with feedback gained from prototype), will be integrated into the CIIMMS system during FY 2000 (CIIMMS year 2).

Medium-term (FY2000) priorities include the following:

- Expansion of access to knowledge, information, and data, including traditional ecological knowledge, building on the datasets available via the prototype, to include data for various watersheds throughout the Cook Inlet basin (see Step 4, page 11-12, for details);

- Expansion of search capabilities to include a tool to find different types of information for one geographic area (map based search tool); this may be a gazetteer, built according to the emerging standards for geospatial libraries (National Research Council, 1999).

- Expansion of the browse capabilities to include more refined categories, and a locational and originator browse tree;

- Support the population of the FGDC-compliant metadata databases (state and federal) and CIIMMS database (non-FGDC-compliant metadata) for priority datasets for the watersheds throughout the Cook Inlet basin;

- Coordination with Alaska ADNR and the ASGDC to get metadata training for the appropriate data providers (metadata training costs provided by separate Federal grant, awarded to ADNR in FY2000);

- Coordination with the EVOS Principle Investigators who have been involved with TEK projects as well as data collection within the Cook Inlet basin; to identify those data/databases which might be made available;

- Coordinate with the Alaska Geographic Data Committee (AGDC) on their work towards implementation of an on-line mapping tool;

- Refinement of data provider and contributor guidelines, in cooperation with the AGDC;

- Replace the search of the WorldCat database with a search of the Anchorage Municipal Libraries' server, which includes the ARLIS holdings, and all the EVOS project reports;

- Add the capability to search the UAF Library server when in becomes available early in 2000;

- Add the capability to search EPA's Envirofacts data warehouse (on-line access to environmental information from EPA databases on Air, Chemicals, Facility Information, Hazardous Waste, Superfund, Toxic Releases, Water Permits, Drinking Water, and Drinking Water Contaminant Occurrence, just to name a few)

- Add the capability to search the Capital City Library server, which includes the Alaska State Library, when it becomes available;

- Coordinate efforts by ADEC to develop an on-line water quality data management system, and make it accessible via CIIMMS;

- Outreach activities will include educating the stakeholders on the use of CIIMMS, as well as educating data providers on the steps necessary to make their data available, via the CIIMMS site, or preferably from their own server.

CIIMMS Long-Term Vision (FY2001 and beyond)

CIIMMS will mature into a geographically distributed decision support system with tools for data visualization and analysis and information synthesis. CIIMMS will provide a framework for collaboration, access to and sharing of data. As an information resource, providing access to both current and historical data and information, CIIMMS can contribute to the success of many future projects within the spill area including the Gulf Ecosystem Monitoring project being funded with the Restoration Reserve.

CIIMMS cannot be realized overnight. As people benefit from CIIMMS, the incentive to contribute to CIIMMS will increase. Agencies will realize cost savings associated with the dissemination of information and distribution of data as more information and data is made available through CIIMMS. CIIMMS will provide a valuable tool for past and future EVOS funded efforts by providing access to data and information related to EVOS funded projects as well as providing a nexus for future research and restoration collaborations.

Appendix B: Detailed System Architecture

Introduction

The CIIMMS prototype system architecture is based on a commercial-off-the-shelf (COTS) software solution, MetaStar Enterprise, developed by Blue Angel Technology. MetaStar Enterprise integrates database, search engine, and web technologies in a single solution that provides for the search and discovery of metadata and information via the Internet. Enterprise is a bundle of the MetaStar Data Entry, Repository, Gateway, and Server components. The architecture also includes the Metaharvester, which is a software robot that gathers selected information from designated websites. This tool gathers and parses XML and HTML, extracting designated elements such as HTML tags and META tags (e.g., title, body, meta, etc.). The Map server component provides the map-based metadata search function. This tool will display local GIS layers, selected boundary files (HUC, Quad, Borough) and a digital gazetteer to generate place name keywords and bounding rectangle coordinates.

An optional system component, the Compusult Metamanager software suite, also is included in the architecture. This optional component acts as a direct access point to information stored within Oracle or SQL Server databases (resident on non-Z39.50 servers).

The system architecture is structured into three tiers, as follows:

Tier I: End user machine with an Internet browser, such as Netscape or Internet Explorer

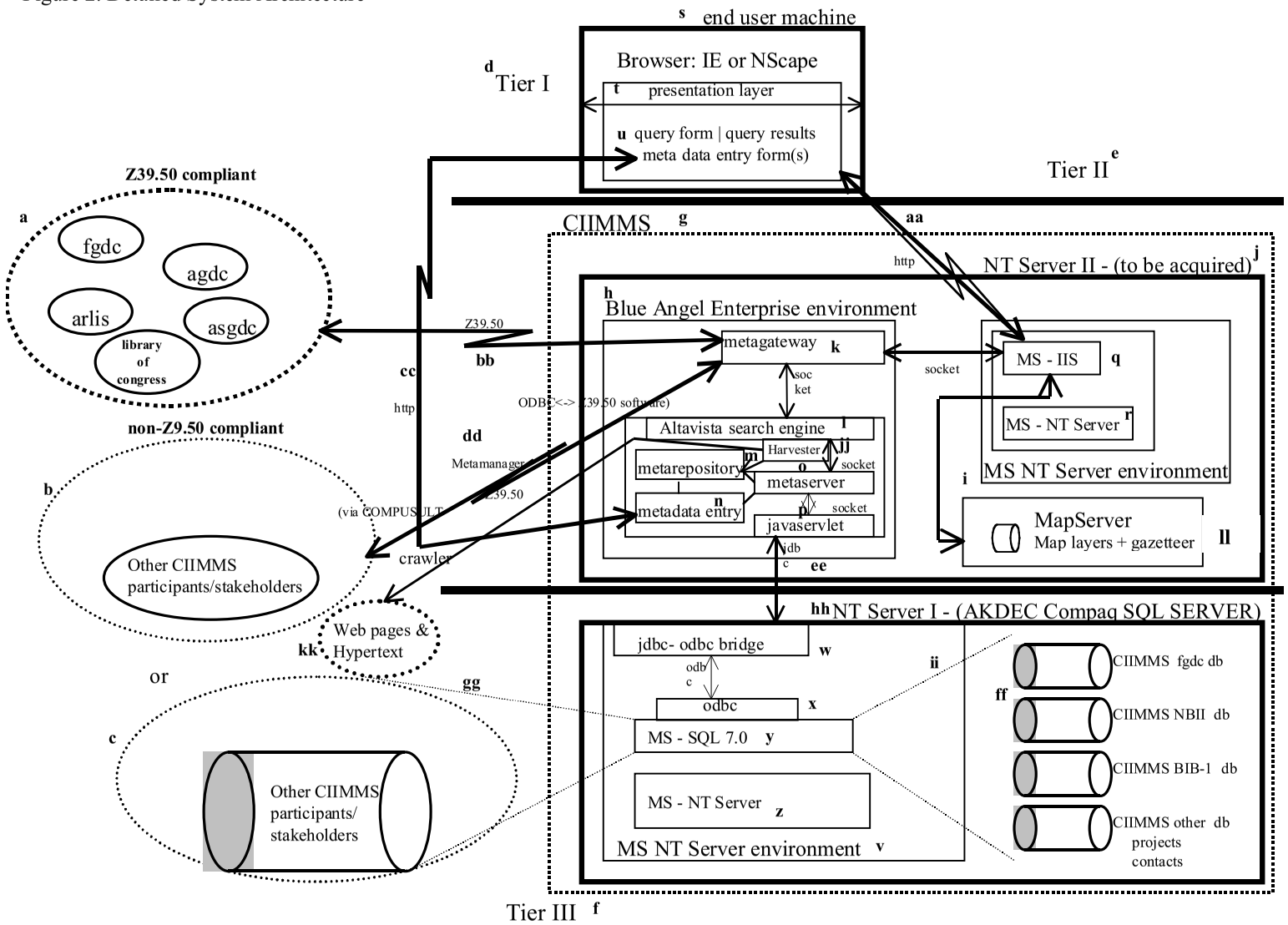
Tier II: Web server, which houses the MetaStar Enterprise software for discovering and accessing metadata and information; and the Map server, which provides the map-based metadata search function. This function displays local GIS layers and a digital gazetteer. The map presentation and GUI allow for bounding coordinates, place names and subject keywords to be passed to the MetaStar Enterprise software.

Tier III: SQL Server, which houses the CIIMMS metadata, projects, and contacts database.

Component Descriptions

The following paragraphs describe the components shown in the detailed system architecture diagram. Each component in the exhibit is labeled (a), (b), (c), etc. Corresponding descriptions follow the exhibit shown in Figure 2.

Figure 2. Detailed System Architecture



- *(a)* ***Web Z39.50 Complaint Servers***

CIIMMS acquires metadata from other non-CIIMMS metadata servers via Z39.50 standard protocol. These servers include, but are not limited to, USGS FGDC, Alaska AGDC, Alaska ASGDC, ARLIS, and the Library of Congress.

The Z39.50 standard specifies formats and procedures governing the exchange of messages between a client and a server, enabling the user to search remote databases, identify records that meet specified criteria, and retrieve some or all of the identified records. It is concerned, in particular, with the search and retrieval of information in databases. One of the major advantages of using Z39.50 is that it enables uniform access to a large number of diverse and heterogeneous information sources.

- *(b)* ***CIIMMS community of participants and stakeholders (non-Z39.50 compliant data providers)***

CIIMMS stakeholders are (in some cases) also data providers. Data providers that do not physically house their data holdings and corresponding metadata within the CIIMMS data warehouse (see item f) may export (or present) their data onto the World Wide Web (or ALASKA State Intranet) as Z39.50 data sources. This is the optimal method for data not warehoused at the CIIMMS data warehouse. Currently, the most straightforward approach to presenting any ODBC compliant database is to acquire a license for the COMPUSULT META MANAGER Software Suite.

The META MANAGER software suite provides a complete solution for creating and defining new and/or mapping existing geospatial metadata definitions and geospatial data sets according to the U.S. Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Metadata. This Geospatial Metadata Profile (GEO) is based on ANSI/NISO Z39.50, the American National Standard for Information Retrieval Application Service.

- ***(c) CIIMMS community of participant and stakeholders (as database providers)***

CIIMMS stakeholders are (in some cases) also data providers. Data providers that do not physically house their data holdings and corresponding metadata within the CIIMMS data warehouse (see item f) may export (or present) their data as an extension to the CIIMMS MS SQL 7.0 Database Engine. This would be limited to data providers within the ALASKA State Intranet that have a direct, stable, 128K (nominal) band width connectivity or better. While this method will work and has no extra software purchase associated with it, the Blue Angel development staff does not recommend it. Overall, CIIMMS performance can be affected adversely. This approach may be a good interim solution that will facilitate bringing the participant/stakeholder data provider online quickly in a "test mode," with the integration as a Z39.50 server as the final goal (as funding permits).

- ***(d) TIER I CIIMMS end user layer (browser)***

The CIIMMS workshop participants decided that a client-server architecture should be implemented based on an Internet browser (i.e., a thin client). The CIIMMS end user(s) will be able to query and/or enter metadata from any workstation that supports MS Internet Explorer or Netscape. This would include most hardware/OS environments currently in use, such as Microsoft Windows 95 and NT, Apple Macintosh System 7 or greater, and most Unix platforms (Solaris, Linux, and AIX). The users will be required to keep the browser version up to date to ensure compatibility with Java-based browser applets.

- ***(e) TIER II CIIMMS middleware layer***

The TIER II middleware layer is the communication and data "traffic cop" between the end user (TIER I) and the data warehouse (TIER III). The TIER II middleware layer software components will be physically housed on the NT Server II hardware unit (yet to be acquired). Most of the Blue Angel Software suite will reside in TIER II.

- ***(f) TIER III CIIMMS metadata warehouse/metadata server layer***

The TIER III layer is a data warehouse layer. The TIER III software components reside on NT Server I (a Compaq SQL Server System), currently located at ALASKA ADEC.

- ***(g) CIIMMS physical hardware environment***

The CIIMMS hardware environment is housed within the ALASKA ADNR and ADEC offices. CIIMMS hardware systems have direct/dedicated Ethernet to the ALASKA State Intranet backbone.

- ***(h) Blue Angel enterprise environment***

The Blue Angel software suite provides an integrated system for delivering and managing information on the Internet. The tools provide off-the-shelf solutions for each step in the information management process. They provide out-of-the-box support for a number of standard record formats and also permit the development and deployment of custom record formats without requiring any programming.

Blue Angel software suite components for the CIIMMS prototype include MetaGateway, AltaVista search engine, MetaRepository, MetaData Entry, MetaServer, and the Blue Angel JDBC interface (see items k, l, m, n, o, p, and ee).

All MetaStar components work together to address each step of the information management process. Information is entered, imported, or gathered into the repository by an administrator. Once ready to be published, the server provides quick search and retrieval access to the information via the Internet or local intranet. Remote users can then search and retrieve the records using the search client and/or gateway, or browse the results from their desktop Web browser. Each tool can be operated independently of another, or can be used as plug-and-play components of an integrated metadata system.

- ***(i) MS NT Server operating system environment***

The MS NT Server operating system is designed to support high throughput, multi-user multiprocessing applications. NT Server is the most optimum and cost-effective operating system to support the CIIMMS requirements.
(j) NT Server II physical hardware unit

NT Server II is a hardware system to be configured with the MS NT Server Operating System. The CIIMMS administrator(s) customize, tune, and provide user accounts and online support via NT Server II. This system also houses the TIER II CIIMMS layer, which is the "traffic cop" for all queries, and data transactions in the CIIMMS architecture. NT Server II is physically and directly connected via high bandwidth Ethernet to the ALASKA State Intranet backbone.

- ***(k) Blue Angel MetaGateway component***

Gateway provides the ability to simultaneously search one or more physically distributed Z39.50 servers with a single query and merge the results from the servers into one set of search results. Gateway provides a web-based query interface and customizable HTML templates for configuring both the query and search results pages. The gateway is implemented in Java and interfaces to most web servers.

- ***(l) Blue Angel AltaVista search engine plug-in***

The MetaServer is integrated with a number of popular off-the-shelf search engines (e.g., AltaVista, Fulcrum, etc.) and is configurable for both full-text and structured searches.

- ***(m) Blue Angel MetaRepository component***

Repository is an administrative tool for capturing, importing, managing, and exporting metadata in a variety of file formats. The tool accommodates repeating, hierarchical, and locally defined elements, and integrates with third-party relational database management systems (e.g., Microsoft Access, Oracle) using the ODBC industry standard interface. It also provides a limited ability to crosswalk between different metadata standards.

- ***(n) Blue Angel MetaData Entry Tool component***

Data Entry is a Java Applet used to remotely enter metadata records directly from a Java-enabled web browser. The tool handles data entry for hierarchical and repeating metadata elements, and verifies compliance with the metadata standard requirements.

- ***(o) Blue Angel MetaServer component***

Server is used to make metadata available for searching and retrieving on the Internet or intranet using the ANSI/NISO Z39.50 protocol. The server is integrated with a number of popular off-the-shelf search engines (e.g., AltaVista, Fulcrum, etc.) and is configurable for both full-text and structured searches. The search functionality provided by the server is dictated by the search features available in the search engine. The server returns records in SUTRS, GRS, and USMARC formats.

- ***(p) Blue Angel Java Serverlet component***

The Java Serverlet is a server side NT component that enables communication between MetaServer (see item o) and any ODBC compliant database engine.

- ***(q) MS IIS standard web server component***

IIS 4.0 provides a high level of integration with Windows NT Server. Windows NT Server and IIS 4.0 will provide CIIMMS with an integrated platform for network, web, and application services. Security - IIS 4.0 includes an integrated certificate server that is tightly integrated with the Windows NT Server security model, allowing organizations to issue and manage Internet standard X.509 digital certificates. Search Engine - IIS 4.0 includes integrated searching capabilities that allow users to create custom search forms with Active Server Pages, ActiveX Data Objects, and SQL queries to search for information on the web server.

- ***(r) MS NT Server Operating System component***

Windows NT Server 4.0 incorporates Internet Information Server 4.0 (IIS) to provide a cohesive platform that combines applications services with web services.

- ***(s) CIIMMS end-user (customer) hardware environment***

CIIMMS' end user hardware environment can be any computer connected to the Internet that also supports MS Internet Explorer or Netscape browsers. Minimum hardware specifications are 32MG RAM, 1GB available disk space. End user hardware performance is also a function of Internet/intranet bandwidth available to the users' workstations.

- ***(t) Presentation layer component***

The presentation layer component is software and/or processes that reside on the end user's computer and its browser. This process translates results returned from CIIMMS TIER II (middleware) into formatted information that the end user interacts with. The presentation layer component is tightly coupled to item u (below).

- ***(u) CIIMMS query form or query results or metadata entry form(s)***

The end user(s) are presented with the following selectable graphical user interfaces (GUIs): (1) a query form to request a search through CIIMMS, (2) a query results set, or (3) a metadata entry form to post metadata onto CIIMMS.

- ***(v) MS NT Server operating system environment***

Windows NT Server 4.0 incorporates Internet Information Server 4.0 (IIS) services that provide a cohesive platform that combines applications services with web services.

- ***(w) Java Database Connectivity – Open Database Connectivity (JDBC-ODBC) bridge component***

The JDBC-ODBC Bridge allows Java programs to use JDBC with many existing ODBC drivers. The Bridge is itself a JDBC driver defined in the class `sun.jdbc.odbc.JdbcOdbcDriver`. The Bridge defines the JDBC subprotocol odbc.

- ***(x) ODBC Driver to MS SQL 7.0 component (exports CIIMMS metadata database(s) through standard ODBC Driver***

MetaRepository interfaces with MS SQL 7.0 using the ODBC standard, such that any ODBC-compliant RDBMS could be used to store the metadata records. ODBC is an industry standard developed by Microsoft and a number of other companies, and it is used to provide a standard interface to many popular relational databases.

- ***(y) MS SQL 7.0 Database Engine Environment component***

MS SQL 7.0 is Microsoft's relational database management system. SQL Server delivers a flexible, powerful platform that scales up to terabyte-size and provides the most cost-effective environment for customizing and building applications tailored to CIIMMS.
SQL Server 7.0 integrates with Windows NT and its Internet Information Server (IIS) technology to provide the CIIMMS data warehouse component. SQL Server 7.0 provides manageability, text searching, English query, web publishing, scalability, and security.

- ***(z) MS NT Server Operating System component***

Windows NT Server 4.0 incorporates Internet Information Server 4.0 (IIS) services that provide a cohesive platform that combines applications services with web services.

- ***(aa) http communication (remote and/or direct) link between end user(s) and CIIMMS***

Communication between the end users' web browsers and CIIMMS TIER II middleware is accomplished through standard Internet http protocol. All Internet browsers already utilize this protocol.

- ***(bb) Z39.50 remote communication link between Z39.50 compliant metadata providers and CIIMMS***

CIIMMS will access non-CIIMMS metadata resources using the Z30.50 protocol.

The Z39.50 standard: specifies formats and procedures governing the exchange of messages between a client and a server; enables the user to search remote databases; identifies records that meet specified criteria; and retrieves some or all of the identified records. It is concerned, in particular, with the search and retrieval of information in databases. One of the major advantages of using Z39.50 is that it enables uniform access to a large number of diverse and heterogeneous information sources.
(cc) http communication (remote and/or direct) link between end-user-data-provider(s) and CIIMMS

Communication between the end users' browsers and CIIMMS TIER II middleware is accomplished through standard Internet http protocol. All Internet browsers already utilize this protocol. The Metadata Entry component utilizes a direct path into the MetaServer engine rather than communicating through the MS-IIS component. (See items n and q, respectively.)

- ***(dd) Z39.50 communication (remote and/or direct) link between Cook Inlet watershed participant/stakeholder data providers and CIIMMS (alternative 1 - optimal)***

Z39.50 communication to CIIMMS participant/stakeholder data providers is the optimal method for data publication/participation in CIIMMS. This requires a commercial purchase of software to bridge the gap between the data providers database engine and Z30.50 communication protocol. (See item b.)

- ***(ee) Blue Angel JDBC interface component***

JDBC is a standard SQL database access interface, providing uniform access to a wide range of relational databases. JDBC also provides a common base on which higher level tools and interfaces can be built (such as the Blue Angel software suite). The current JDK software bundle includes JDBC and the JDBC-ODBC bridge and is available from the SUN JAVA website at no cost. These packages are also available separately (http://java.sun.com/products/jdbc/)for use with JDK 1.0.

- ***(ff) CIIMMS metadata database(s) residing on the CIIMMS NT Server I within the MS SQL 7.0 database engine environment***

- ***(gg) MS SQL 7.0 communication (remote and/or direct) between Cook Inlet watershed participant/stakeholder data providers database(s) and CIIMMS (alternative 2 – sub-optimal)***

A less-optimal (low-cost) method of integrating participant/stakeholder data providers is to "associate" their database(s) with MS SQL 7.0's ability to support a distributed database architecture. While this method will work and has no extra software purchase associated with it, the Blue Angel development staff does not recommend it. Overall, CIIMMS performance can be affected adversely. This approach may be a good interim solution that will facilitate bringing the participant/stakeholder data provider online quickly in a "test mode," with the integration as a Z39.50 server as the final goal (as funding permits).

- ***(hh) NT Server I physical hardware unit (Compaq Unit residing at AK ADEC)***

NT Server I is a hardware system to be configured with the MS NT Server Operating System. This unit serves as the data warehouse for CIIMMS. MS SQL 7.0, MS IIS (for remote system tuning development only), and the physical CIIMMS metadata database(s) reside on the hardware unit.

- ***(ii) Direct online within MS SQL 7.0 Database Engine Environment and CIIMMS metadata database(s)***

MS SQL 7.0 interfaces to the CIIMMS databases through its native high-performance database engine.

- ***(jj) MetaHarvester is a software robot that gathers selected information from designated websites. This tool gathers and parses XML and HTML, extracting designated elements such as HTML tags and META tags (e.g., title, body, meta, etc.).***

- ***(kk) Web pages and hypertext – selected web pages containing HTML documents with Cook Inlet information. These sites will be "crawled" by the Metaharvester. Specific information associated with metatags and HTML tags will be extracted and presented to the user during a search.***

- ***(ll) The MapServer provides the map-based search for metadata through display of local GIS layers, a digital gazetteer, a rectangle drawing tool, and selection of hydrologic units, quad boundaries, or borough boundaries.***

Appendix C: Hardware and Software Inventory

CIIMMS Production Server:

Hardware:

- Compaq Proliant
- 400 MHz Pentium II
- Three Raid 5 (4gb) drives
- 196mb RAM
- Operating System: NT

Software:

- Web server: Microsoft IIS
- Application Software: Blue Angel Metastar Enterprise (interfacing with MS SQL 7.0 which is located on the same box)
- DBMS: MS SQL 7.0
- 10 user copy of Windows NT 4.0 Server
- 15 concurrent user BEA Weblogic JDBC KONA SQL 4 JDBC driver
- Blue Angel Technology Enterprise Software Suite
- Carbon Copy 32
- Component Software Ltd.'s Revision Control Software

Development Server

ADEC will provides a computer that serves as the development platform, with the following specifications:

Hardware

- Compaq Deskpro EN Minitower
- 500 MHZ Pentium III processor
- 10 GB EIDE Hard Drive
- 256 MB of 100 MHZ SDRAM
- Travan TR-5 10/20 GB tape drive
- 32X CD ROM
- 10/100 TX PCI WOL UTP NIC

Software

- 10 user copy of Windows NT 4.0 Server

- Microsoft Internet Information Server
- 15 concurrent user BEA Weblogic JDBC KONA SQL 4 JDBC driver
- Blue Angel Technology Enterprise Software Suite
- Carbon Copy 32
- Component Software Ltd.'s Revision Control Software

The development server will initially be located at the ADEC office in Juneau, Alaska. Because of the configuration of the State's Internet access this will have the same access bandwidth as the ADEC office in Anchorage, Alaska. The Blue Angel Software will connect to the ADEC development SQL server located in Juneau. (JNU-SQL)

Revision Control

CIIMMS will use Component Software Ltd's Revision Control software to track changes to both the Blue Angel Software environment and changes to the web site. All changes will be made to the files on the Development Server. Changes will be moved to the production server on a planned basis after a commitment to a version change has been made. All developers will check out files before making any change.

Appendix D: Blue Angel Technologies Software

MetaStar

The MetaStar Product Suite provides a complete end-to-end solution specifically designed to gather, capture, manage, publish, search, retrieve, and use metadata on your local intranet or Internet. Although each component operates as a standalone application, they also operate together through the use of well-known Internet standards. As shown in the figure below, the MetaStar Suite consists of the following tools: Harvester, Repository, Server, Gateway, Data Entry, and Software Development Kits.

Harvester

Harvester is a software robot that gathers information from designated Web sites. This tool is extremely powerful in that it gathers and parses HTML/XML, extracts designated elements such as XML, HTML tags and META tags (e.g., title, body, etc.). This tool has a rich set of configuration options that direct Harvesters behavior in addition to simple templates that format the gathered information (e.g., as HTML, XML, or some other format).

Repository

MetaStar Repository is an administrative tool for managing your metadata records. Repository allows you to build, store, update, import and export metadata in a variety of file formats (including XML). The tool accommodates repeating, hierarchical, and locally-defined elements, and operates with third-party relational database management systems (e.g., Microsoft Access, Microsoft SQL, Oracle) using the ODBC industry standard interface. Repository's true power lies in that it lets users operate at the logical XML level while completely managing the underlying physical database - that's right, no programming!

Server

MetaStar Server is used to make metadata available for searching and retrieval on the Internet or intranet using the ISO 23950 search and retrieval protocol, which supports publishing data in XML form. The server is integrated with a number of popular off-the-shelf search engines (e.g., AltaVista, Fulcrum, etc.) and is configurable for both full-text and structured searches.

Gateway

MetaStar Gateway provides the ability to simultaneously search one or more physically distributed servers with a single query and merge the results from the servers into a single set of search results. Gateway provides a Web-based query interface and customizable HTML templates for configuring both the query and search results pages. Gateway is implemented in Java and interfaces to most popular Web servers on both UNIX and Windows NT.

Data Entry

MetaStar Data Entry provides the ability for users to insert, delete, and update XML records directly through desktop Web browser. Once entered, records can be configured to follow a workflow process before being automatically published to the Web. The best part of Data Entry is that it does not require any programming to deploy! Data Entry is fully customizable through HTML templates. Data Entry is implemented in Java and interfaces to most popular Web servers on both UNIX and Windows NT. Since Data Entry is tightly integrated with a number of other MetaStar components, it is only available through the MetaStar Enterprise software bundle.

Appendix E: CIIMMS ALASKA Dynamic Web Browse

Overview

The proposed addition to the system at CIIMMS in Alaska is intended to be a stand-alone component. Its purpose is to enable users to input their own hyperlinks, along with user information and a description, and create a dynamic web browse tree that is accessible through the Metastar new architecture using the Gateway and DataEntry API's.

Methods

A single JSP page will dynamically create an HTML page that references the Metastar API's. All HTML search, data entry, and results elements will be dynamically written through JSP. There will be two interfaces to the system based on the user's logon. End users will have access to the user section only. Administrators would have access to the user and administrator screens.

Page Layout

The CIIMMS browse tree page layout is very simple, consisting of only two pages. A login page is used to determine what privileges a user has. Once successfully logged in, a user is presented with the browse tree page. Depending on the user login mode, the Browse Tree is displayed in user or admin mode. If logged in as administrator, the interface will be almost identical. However it will contain links to maintain pending and rejected records as well as a link to export URL's.

FIGURE 3. PAGE LAYOUT

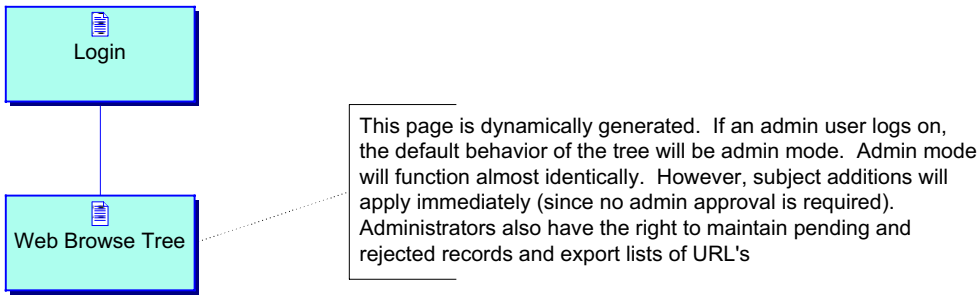
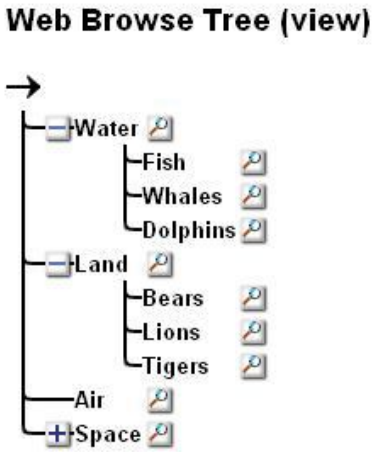


FIGURE 4. BROWSE TREE IN USER VIEW

•

- ***CIIMMS Dynamic Web Browse Tree***



Browse Tree – User Functions

User mode allows searches for records that correspond to a given subject, the insertion, editing and deleting of those records and the ability to suggest new subject headings.

- **Expand/Contract Subject Nodes**
  End user can expand and contract nodes in the tree view on the left in order to view various subject levels in the tree. The tree will be capable of expanding an infinite number of levels.
- **Add Subject Nodes**
  By clicking a button to the right of a subject entry, the end user will be presented with a text box at the bottom of the screen to enter a new subject. The new subject will be a child of the node where the add subject button was selected. This subject will not immediately be added to the subject list, as it will be subject to approval by the administrator.

  It must be noted that this is directly altering the map, which the entire system depends on for record location. All changes should be additive, and all changes should be made carefully. Once a subject has been added, Data Entry alters the recordset to allow the proper path to be generated. If mistakes are made, these changes have to be manually removed to remedy the problem. This also means finding any records that would contain the path that is to be altered or deleted, and making changes to them as well

- **Search Subjects**
  Clicking the search button to the right of a subject entry will cause a list of results to appear on the right hand side of the screen. Through the use of a drop down box, the user has the option to select whether the search will conform to the exact subject path or whether results will be returned as long as the subject for the immediate node appears anywhere in the subject path. From the results page, the end user can view, insert, edit or delete records that correspond to the subject. The root node, all, allows the end user to return a list of all records in the system.
- **View Records belonging to a Subject**
  From the search results displayed on the right site of the page, the user can select to view the record. This will display all of the record's fields on the bottom of the page.
- **Add Records to a Subject**
  From the search results displayed on the right site of the page, the user can select to view the record. This will display all of the record's fields on the bottom of the page. Each record will be allowed an infinite number of paths to be added to it.
- **Edit Records Belonging to a Subject**
  Similar to the view record function, but requires selecting the edit button in the results list on the right side of the page. Allows an end user to make modifications to the record and submit them.
- **Delete Records Belonging to a Subject**
  Deletes a record displayed in the record result list after a confirmation message is displayed on the bottom of the screen.

Browse Tree – Administrator Functions

The administrator mode is capable of everything the user can do in user mode. However, there are three additional functions end users can't do and one user function that is expanded in administrator mode.

- **Add Subject Nodes**
  This functions similarly to adding subject nodes in user mode. However, as already stated, the admin user doesn't have to wait for approval for his changes to take effect. Changes in admin mode are immediately available.
- **Maintain Pending Subject Additions**
  Clicking on this link allows the administrator to view a list of all pending subject additions. Buttons to the right of each pending addition allow the administrator to view and edit the addition just as if he were viewing or editing the record in user mode. Deleting the record removes it from the pending queue. There are also buttons for accepting or rejecting the record. Accepting the record makes it live, and instantly available to all users of the system. Rejecting it puts it in the rejected queue.

- **Maintain Rejected Subject Additions**

  You can view, edit, delete and accept this record just as you can a pending record. The main difference here is pending records will ultimately be purged from the system after a period of time specified by the administrator.
- **Export URLs to a text file**

  Clicking this link at the top of the page will export all of the URL's in the system to a text file on the server side. It will then prompt the administrator for a location to save the file on the local system and, upon confirmation, download the file from the server to the administrator's local machine.

Appendix F: Map Tool Software

Original by Shumei Wei, SAIC 3/1/2001
Updated 10/17/2001 by Russell Kunibe

Introduction

The Map Tool Software is a web-based mapping application, which uses the ArcIMS map server and OpenGIS Consortium Web Mapping Standard (OGC WMS) connector. The client side software (Map Tool Viewer) is based on ESRI's example code that can be downloaded from http://arconline.esri.com/arconline/downloads.cfm?PID=6. Changes have been made to this software to support different browser versions and to fix bugs identified during development and testing of the Map Tool. Also some new functions have been added. The server side software includes Java classes and Servlets for supporting Albers to Geographic coordinate transformation and the Gazetteer function.

Map Tool Viewer

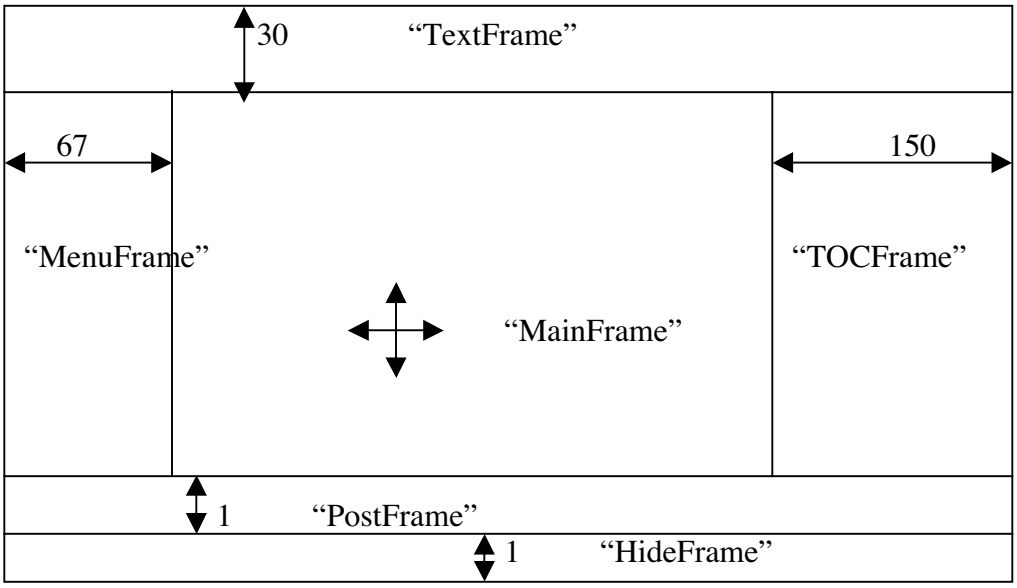
The Map Tool Viewer provides a framework for the map, toolbar, and layers of the web site. HTML and JavaScript files form the foundation of the Viewer. The following functions are available:

- Zoom In.
- Zoom out.
- Pan.
- FullExtent.
- Coordinate selection (passing Coordinates and Place Name of selected area to Search page).

File organization

- HTML and JavaScript files: Site directory (example DHTML_WMSClient).
- Image files: Site directory/images (example DHTML_WMSClient/images).
- Java classes and Servlet files: servlet Directory/ges (example servlet/ges).
- Place Name text file: Primary document directory/gnis_alb.txt (example docs/gnis_alb.txt).

FIGURE 5. MAP TOOL VIEWER FRAME LAYOUT



TextFrame

text.htm defines the content for TextFrame.

MenuFrame

menu.htm defines the content for the MenuFrame. MenuFrame contains a panel of buttons (toolbar) used to select the current Viewer tool. menu.htm includes JavaScript files wmtParam.js, wmtClick.js, and comm.js.
Modification: add a button (coordinate selection tool, see name="Img3").

MainFrame

mapframe.htm is loaded initially, and then for Netscape Communicator nblank.htm defines the content for MainFrame and for Internet Explorer blank.htm defines the content for MainFrame (comm.js does this function). blank.htm includes JavaScript file dragBox.js. nblank.htm contains JavaScript functions.
Modification: rewrite   layer in blank.htm, which lets Map Tool work on the old version of Internet Explorer.

TOCFrame

toc.htm is loaded initially, and then the TOCFrame is dynamically rewritten by function writeLayer() (comm.js).

PostFrame

post.htm is loaded initially, then the AppletFrame.htm is written to define the content for TOCFrame (by JavaScript function doIt() from menu.htm). PostFrame is a hidden frame that contains JavaScript functions and Java applet jpost.class. This class requests to the OGC wms connector, gets XML response.

HideFrame

This is a new hidden frame for Albers transformation and Gazetteer function.
hide.htm is loaded initially, and then HideFrame is rewritten by servlet IpAlbers.class.

JavaScript function and files

wmtParams.js
Main parameter file that configures the Map Tool Viewer.
Modifications:

- Cancel out other services (example world and Canada); only one service (default) is used in Map Tool application.
- toolselected=3 to set coordinate selection tool be default (1 for zoomin tool; 2 for zoomout tool).
- Adding var vilayer, which controls the layer visibility of the initial map. vilayer = [f1, f2,……,fn] with "1" indicating visible and "0" invisible. Example: to make 5 layers on the Map, layer 1, 5 visible and 2, 3, 4 invisible, set var vilayer = [1, 0, 0, 0, 1].
- Adding var nolistlayer which controls the layers listed in the Table of Contents. (RK 10/17/2001)

comm.js
Functions for reading, processing XML and initializing Map Tool Viewer.
Modifications:

- functions getXmlValues(xmlFile), and writeLayer(), using flag "1" or "0" of vilayer array to implement layer visibility for initial map; using checkDocLoad() function instead of JavaScript
- function setTimeout to solve multi frame syncronization problem.
- Add the new function checkDocLoad(), which uses a checking loop until the frame is loaded.
- To writeLayer() added a check for the nolistlayer to see if the layer should be added to the table of contents. (RK 10/17/2001)

dragBox.js
Functions for interacting with the map, use Style Sheets compatible with Internet Explorer. Modifications:

- Functions InitPos(e), DragIt(), and getXY(), change .style.display and .style.visibility for Map Tool to work on the old version of Internet Explorer; add toolselected 3 to function getXY() for coordinate selection tool.
- Function ResizeMe(), modify to solve coordinate status problem.

nblank.htm
Functions for interacting with the map, use Style Sheets compatible with Netscape Browser.
Modifications:

- Function DragIt(e), modify to solve coordinate status problem.
- Functions InitPos(e), and getXY(e), change related to toolselected 3 and click event for implementing function of coordinate selection tool and solving click problem; don't use global variable in function getXY(e) to solve click problem and coordinate system problem for Netscape browser.

WmtClick.js
Functions for map navigation such as zooming and panning.
Modifications:

- Do not use functions updateService(), and mapclick(event).
- Functions createUrl(), createURLArray(), createAllmaps(), add JavaScript function replace() to make Map Tool work on old version Netscape Browser.
- Function toolmode(mode), adding mode 3 for coordinate selection tool.
- Rewrite function zoomtoEnvelope(), solve zoomin, zoomout distortion problems, add functionality of coordinate selection tool.

Java class and Servlet

Albers.class
Forward and Inverse Albers transformation.

Gazetteer.class
Gazetteer functions: giving rectangle of Albers coordinates, return the Place Names.

IpAlbers.class
Implement both Albers transformation and Gazetteer function. Print out JavaScript function to pass coordinates and Place Names to Search Page.

Appendix G: Welts Configuration Under IIS 4.0

Installation:

All files (excluding this file) and directories (images and pdf) are to placed in the same directory and a virtual directory from the Web server root needs to be created. That directory (I use the name "WELTS") and it path need to be coordinated with some of the ASP Application variables below.

Directories:

These Application variables define URL's and path and can be found and edited in the Global.asa file; these are as follows:

URL to Welts virtual directory
Application("RootURL") = "http://kathi_parker/WELTS/"

Name for physical path to welts directory
Application("BaseFS") = "c:\InetPub\wwwroot\WELTS\"

Name of pdf files directory relative to Welts virtual directory
Application("pdfDir ") = "pdf\"

Physical path to pdf DIRECTORY AS NEEDED BY THE Server.FileExists method
Application("pdPath") = "Projects\WELTS\pdf\"

Path to the generated files directory, these will be .txt and .xls (Excel) files
Application("GenFiles") = "e:\ProjectsWELTS\genFiles\"

URL extension for generated files directory relative to the web server root URL
Application("GenFileRelURLl") = "/welts/genfiles/"

Anything can be commented out (for ASP VBScript) by placing a " ' " character in front of it.

Database configuration:

The datastore.asp file contains the connection string required by ADO for connection to the database. As an example:

```
strConnection = "Provider=Microsoft.Jet.OLEDB.4.0;" &_
"Data Source=C:\database\WD010901.mdb;" & _
"Persist Security Info=False"
```

Edit the "Data Source=" String to be that of your desired path to the database.

Note that the "&" character is a string concatenator and the "_" character indicates the end of the line. The "_" character must appear at the end of the multi-line string if the string is to be read correct by ASP.

Database Notes:

The database is in Office 2000 format, but has been successfully run under Office 97.

The Database has been changed to exclude apostrophes and pound symbols from the OWNER, PDESC and DRILLER columns as these symbols interfere with the scripts.

The database contains stored queries (as it did before only now there are more). If the database is replaced these stored queries will need to be copied over to the new one.

Text and Excel Files Generated:

As the variables are set the Text and Excel files generated on the web server are saved to a subdirectory of /WELTS called "genFiles" (for generated files). Since it had been decided to save stated information while running Welts I was not able to explicitly abandon a session in order to run clean up code after the user has obtained the file output. What this mean is that files will build up in the genFiles directory. This would be (at most) on Excel file and one text file for each user session. What needs to happen is a service needs to be created to erase these files periodically or the files need to be manually deleted.

Also for the genFiles directory (or whatever you choose to call it) – makes the user impersonated has write permissions to the directory where the files are being created.

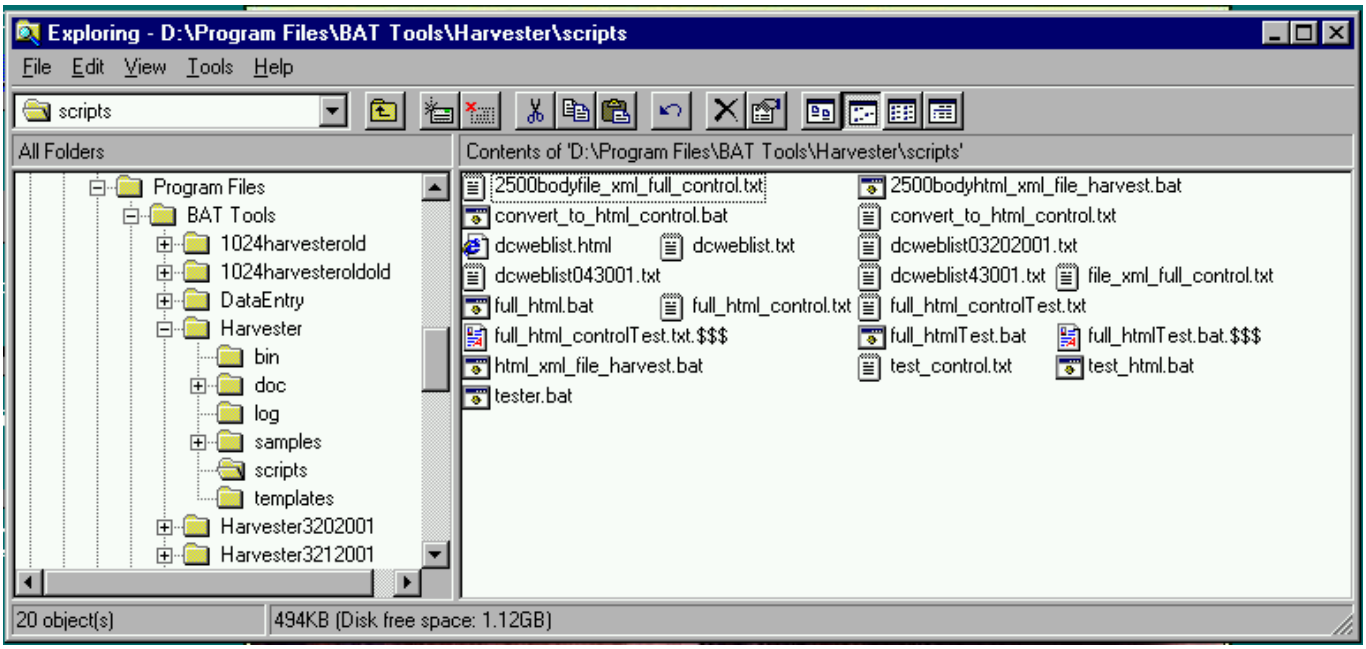
Appendix H: The CIIMMS Web-crawl Procedure

Step 1. Understanding directory structure of essential files.

Directory Structure.

- The required files are located in D:\Program Files\BAT Tools\Harvester\scripts on the WQMGIS computer. *See Figure 1*.

FIGURE 1. DIRECTORY STRUCTURE



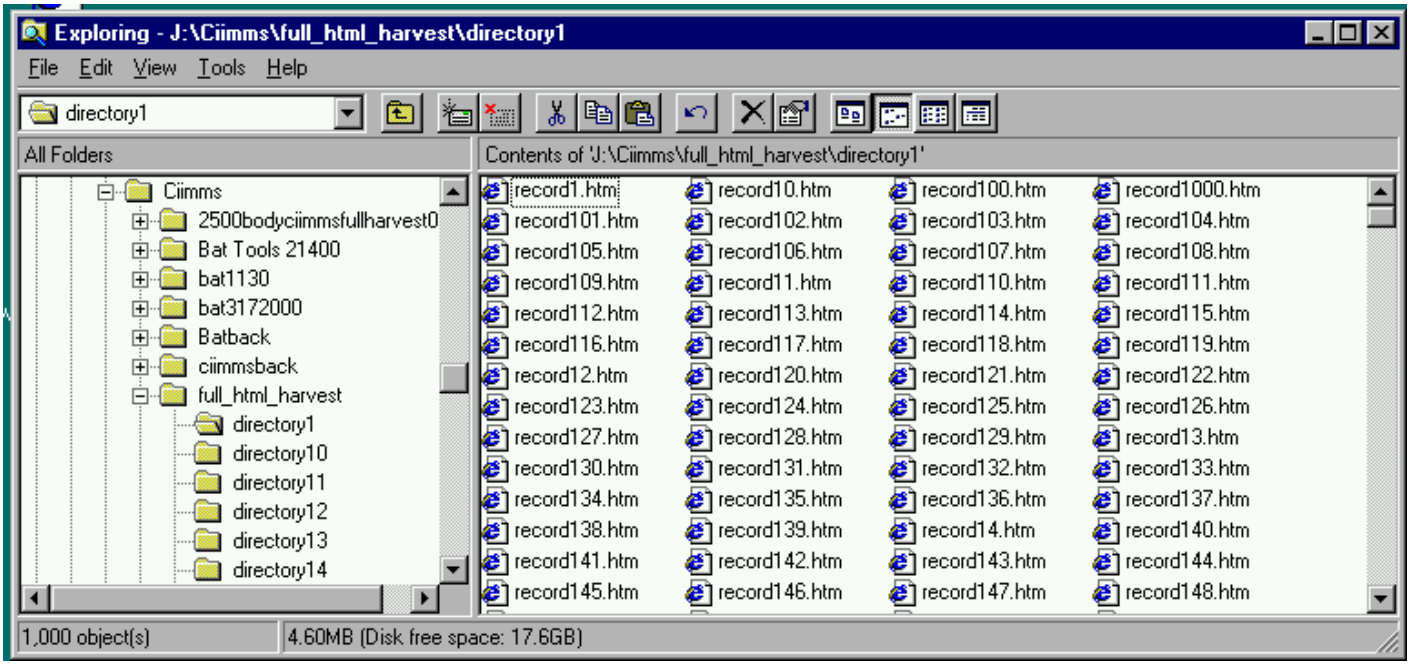
Required files:

1. Text file with a list of web links separated by hard returns (e.g. dcweblist.txt).
2. Text file that serves as configuration file for the harvest (e.g. full_html_control.txt).
3. .BAT file that deletes and creates the directory where harvested html files go (e.g. full_html.bat).

Created files:

1. HTML files are created in J:\Ciimms\full_html_harvest as shown in figure 2.

FIGURE 2. CREATED HTML FILES



Step 2. Customizing configuration and BAT files before harvesting.

Before the execution of the harvesting process is started by opening the BAT file, the process should be customized. Begin by right-clicking on the BAT file and selecting edit (alternatively, the file could be opened using a text editor such as PFE). The file will indicate where collected html files should go and what configuration control file should be used, as indicated in red/**bold**. See Figure 3.

FIGURE 3. BAT FILE

```
 @echo off
rem
rem
*****************************************************************
******
rem  CIIMMS WebHarvest full_html.bat
rem
rem  the control file used is full_html_control.txt
rem  the following are set in the control file:
rem    dcweblist.txt              -- the list of urls starting points harvested
rem    ..\templates\fullhtml.txt  -- the template file
rem    ..\log\fullhtml.log        -- the log file
rem    j:\ciimms\full_html_harvest           -- the output directory
rem
rem  edited by Russell Kunibe 2/10/2000 / 1/25/2001
rem           Scott Richmond 5/21/2001
rem
*****************************************************************
******
rem
echo Running the MetaStar Harvester script 'Dc_import.bat'.
echo.
rem
echo Removing old files.
echo Answering Y will remove all of the files from:
rmdir /s j:\ciimms\full_html_harvest
mkdir j:\ciimms\full_html_harvest
echo.
rem
echo Harvesting documents located at websites found in dcweblist.txt.
..\bin\harvester full_html_control.txt
echo.
@echo Harvesting complete.
@echo Harvested files are located in 'J:\ciimms\full_html_harvest'.
@echo Harvester log file output is located in '..\log\fullhtml.log'.
pause
```

The control file (e.g. full_html_control.txt) is pointed to by the BAT file. The control file indicates where html files should be harvested to, which should match the directory you deleted and recreated using the BAT file. The text file with all the web links should also

be referenced. These two parameters are indicated in red. See Figure 4. Other parameters can also be modified, please refer to MetaStar Harvester User's Guide.

FIGURE 4. CONTROL FILE

```
; Set up as the control file to test collecting full html bodies
; Copyright (c) 1996-1999, Blue Angel Technologies, Inc.
; All rights reserved.
;
;  full_html_control.TXT
;
; Sample Control File for web harvesting using
; a WEB_FILE to access multiple sites.
;

; The following are required commands.
; Web harvesting requires that there is at
; least one WEB_SITE or one WEB_FILE command
; provided in the control file.
HARVEST_TYPE        = web
WEB_FILE            = dcweblist.txt
;WEB_SITE        =http://www.state.ak.us/home.htm
OUTPUT_EXTENSION     = .htm
OUTPUT_DIRECTORY     = j:\ciimms\full_html_harvest
OUTPUT_TYPE         =HTML
RECORDS_PER_FILE     = 1
SAME_HOST           = no
FILES_PER_DIRECTORY= 1000
TEMPLATE_FILE       = ..\templates\fullhtml.txt

; The following are optional commands.
; Values provided are default.

Delete_All_Files = no
Search_Strings_Allowed  = no
Content_Type_Include    = text/html
Content_Type_Exclude    = image/*
File_Expression_Include = *.htm*
LOG_FILE            = ..\log\fullhtml.log
Link_Report_File     = ..\log\fulllinkreport.xml
LOG_FILE_APPEND      = no
MAXIMUM_LEVELS       = 2
use_robots_txt= no
MAXIMUM_AGENTS              = 35
```

Step 3. Harvesting metadata and links using MetaStar Harvester

Once the fields are customized and saved, you are ready to begin the harvest. Execute the BAT file you saved and an MS-DOS Window will appear. Confirm the deletion of the old directory to create another. The harvester will run for several hours if the web list is very large. Other tasks can be done while this occurs. Do not go to the next step, until the process is finished, as indicated in the MS-DOS window.

Creating keywords using Metabot

Step 1. Creating a new project from a directory.

Begin by opening Metabot from the Start menu. Create a new project from the File menu and customize the project settings and keyword option if required. Choose the directory option and select the directory where the html documents were harvested to (J:\Ciimms\full_html_harvest).

Step 2. Saving the project and updated html files.

Save the project and then begin to exit out. Choose the save modifications option and the html files will be updated with the new keywords if project/keyword preferences were set correctly. This process may take several hours, background tasks can be performed.

Creating xml files from the html files with keywords

Step 1. Customizing configuration and BAT files before harvesting.

As with harvesting html files from a web list, harvesting xml files from html files uses similar configuration and BAT files. The major customizable locations are indicated in red. See Figure 5.

FIGURE 5. CUSTOMIZATION

```
@echo off
rem
rem
*********************************************************************
rem  This is to run file_xml_full_control.txt
rem  I want to collect the entire body of the docs
rem    full_html_harvest
rem
*********************************************************************
rem
echo Running the MetaStar Harvester script 'html_xml_file_harvest.bat'.
echo.
rem
```

```
rem
echo Removing old files.
echo Answering Y will remove all of the files from:
rmdir /s j:\ciimms\ciimmsfullharvest
mkdir j:\ciimms\ciimmsfullharvest
echo.
rem if EXIST ..\output\dcimport\record1.txt del ..\output\dcimport\record*.txt
echo.
rem
echo Harvesting documents located at J:\ciimms\full_html_harvest.
..\bin\harvester file_xml_full_control.txt
echo.
@echo Harvesting complete.
@echo Harvested files are located in 'J:\ciimms\ciimmsfullharvest'.
@echo Harvester log file output is located in '..\log\filexmlfull.log'.
pause
```

The control file (file_xml_full_control.txt) also has customizable fields to indicate where new xml files should go and what directory to acquire the files from. See figure 6.

FIGURE 6. CONTROL FILE

```
; Set up as the control file to test collecting full html bodies
; Copyright (c) 1996-1999, Blue Angel Technologies, Inc.
; All rights reserved.
;
;  file_xml_full_control.txt
;
; Control File for web harvesting from the input directory
; J:\ciimms\full_html_harvest
; Output is to
; J:\ciimms\ciimmsfullharvest
;
; The following are required commands.
; Web harvesting requires that there is at
; least one WEB_SITE or one WEB_FILE command
; provided in the control file.
HARVEST_TYPE        = file
input_directory        =j:\ciimms\full_html_harvest
;WEB_FILE        = dcweblist.txt
;WEB_SITE        =http://www.state.ak.us/home.htm
OUTPUT_EXTENSION     = .xml
OUTPUT_DIRECTORY     = j:\ciimms\ciimmsfullharvest
RECORDS_PER_FILE     = 1
SAME_HOST        = YES
```

```
FILES_PER_DIRECTORY= 1000
TEMPLATE_FILE        = ..\templates\ciimmsxmlfullharvest.txt
; The following are optional commands.
; Values provided are default.

;Content_Type_Include    = text/html
File_Expression_Include = *.htm
LOG_FILE            = ..\log\filexmlfull.log
LOG_FILE_APPEND      = no
MAXIMUM_LEVELS       = 1
;use_robots_txt          = no
MAXIMUM_AGENTS              = 50
```

Step 2. Harvesting metadata and links using MetaStar Harvester

Once the BAT file and configuration file are edited and the full html web harvest directory is updated with keywords, the xml to html BAT file is ready to be executed. The process may take several hours depending on the directory size.

Moving xml file directory to test server

Step 1. Transfer xml file to test server to be indexed

Begin by opening two windows, one opened to the xml directory (e.g. J:\ciimms\ciimmsfullharvest), and one opened to the host server (either \\anc-iis or \\ciimmsdev). The host server window should be further opened to Program Files\BAT Tools\Harvester\Server\Fulcrum\Records. Drag the ciiimsfullharvest sml directory to the destination mentioned above. The process may take several hours. It may be necessary to delete the file it's going to replace first, to ensure enough room.

Step 2. Rename and remove any duplicates

Throw away the directory it is going to replace. Rename the copied directory to the directory name that was previously indexed.

Indexing database and reinitiatiating server

Step 1. Find the appropriate BAT file used for indexing

Locate the BAT files in CiimmsDev or Anc-iis under the BAT Tools\Server\Fulcrum\batch directory. Search for the correct BAT file to be executed by examining the file with edit. Refer to the server manual for configuration parameters. It may be necessary to reference the config.xml file located in BAT Tools\Gateway\instnaces\Search\config. Near the bottom of the file, databases are

referenced. Always save backup files before modifying configuration files. The config.xml file will indicate the name and location of the particular database.

Step 2. Begin indexing the database

This process should occur on the test Server (CiimmsDev) so the main server is not bogged down. Once the correct BAT file is located, execute it from the host computer (via CC if necessary) and the indexing process should complete. This process may take several hours. You can monitor its progress by examining the log files under BAT Tools\Server\Fulcrum\log. The most recent log file is located at the end that directory. The most recent progress will be at the end of the file also. The log will show indexing and encoding progress if the BAT file works. This process takes several hours, it might be done by the next day! Note: Indexes can be terminated by restarting the host computer.

Step 3. Reinitiating the server

If necessary change the server call to records with the config.xml file about 2/3 of the way down the file. The location is for the Ciimmsdev file is \\Ciimmsdev\Programm Files_DEV\BAT Tools\Gateway\instances\Search\config. When the previous step is complete, as indicated in the log files, you may reinitiate the server. Open a browser and go to http://infotest.dec.state.ak.us/servlet/ciimmssearch/admin for CiimsDev or http://info.dec.state.ak.us/servlet/ciimmssearch/admin for Anc-iis. Enter appropriate username and password and check the reinitiate checkbox. Submit and be patient when reinitiating. The server will respond with a confirmation page if reinitiating is successful. If errors occur, reboot may be required.

Step 4. Verify server and database operation

Log on to server and test the search engine. Verify that the databases work, even if marked "search successful".

Step 5. Move the appropriate indexed files to host server

There are two directories that need to be moved, the origin and destination directories are noted: \\Ciimmsdev\Fulcrum\fultext to \\Anc-iis\Fulcrum\fultext and \\Ciimmsdev\Program Files_DEV\BAT Tools\Server\Fulcrum\records to \\Anc-iis\Program Files\BAT Tools\Server\Fulcrum\records. To minimize the use of bandwidth, zip the files with maximum compression. Transfer during off-traffic hours. The zipping process will take several hours.

Step 6. Repoint test server to host server

Modify the config file at \\Ciimmsdev\Program Files_DEV\BAT Tools\Gateway\instances\Search\config and change to the appropriate ip address and database name.

Step 7. Repeat steps 3&4 to verify database works

Step 8. Reconfigure config file on host server

Assuming the previous step worked, use the config file at \\Anc-iis\Program Files\BAT Tools\Gateway\instances\Search\config to point at the host server by changing to the previously set-up ip address and database name.

Step 9. Repeat steps 3 & 4 to verify database works.

Further reading & modifications

Customizing search from multiple resources

There are a number of ways that you can modify the effectiveness of the crawl. From the Harvester you can modify the control file parameters. The template file referenced by the control file can also be modified. Consult the harvester manual for specific information. From the Metabot program, you can modify the keyword creation preferences. The makeup of the web list can also be modified. The profile configuration file can also be modified to change how the server indexes the particular database(es). See the Server manual for the profile configuration and server configuration guidelines. Note: The server configuration file doesn't need modification for databases to be updated.

Scheduling processes to run automatically

To schedule a program by using Task Scheduler, use the following steps:

- Double-click **My Computer**, and then double-click **Scheduled Tasks**.
- Double-click **Add Scheduled Task**, and then click **Next**.
- Click a program that you want to schedule, and then click **Next**.
- Click a scheduling option under **Perform This Task**, click **Next**, and then click **Finish**.

This tool can be used to operate batch files and .exe programs. Additionally, with the use of carbon copy, Programs → Carbon Copy 32 → Auto Pilot tab, automatic file transfers can be scheduled. The scheduled tasks should allow tasks with the heaviest computer processing to occur outside work hours. Document scheduled tasks to supervisor.

Pointing the Web Browse Tree (WBT) to the right databases.

After you finish the harvest process, you will need to update the config.xml file for the WBT, located at \\Cimmsdev\Program Files_DEV\Bat Tools\Gateway\instances\Wbt\config and \\Anc-iis\Program Files\BAT Tools\Gateway\instances\Search\config.

Repeat step 3 of "indexing the database and reinitiating the server".
Do the test server first to make sure it works, then update to the production server. The reinitialization can be done at http://infotest.dec.state.ak.us/servlet/CIIMMSWBT/admin and http://info.dec.state.ak.us/servlet/CIIMMSWBT/admin .

Havest Schedule

1. Scheduled Task

```
full_html.bat
*****************************************************************
******
rem  CIIMMS WebHarvest full_html.bat
rem
rem  the control file used is full_html_control.txt
rem  the following are set in the control file:
rem    dcweblist.txt              -- the list of urls starting points harvested
rem    ..\templates\fullhtml.txt  -- the template file
rem    ..\log\fullhtml.log        -- the log file
rem    j:\ciimms\full_html_harvest          -- the output directory
rem
rem  edited by Russell Kunibe 2/10/2000 / 1/25/2001
rem           Scott Richmond 5/21/2001 / 6/1/2001
rem
*****************************************************************
******
```

2. Manual Task

   Use Metabot application to generate keywords for the J:\Ciimms\full_html_harvest directory of html files.

3. Scheduled Task

```
html_sml_file_harvest.bat
rem
*****************************************************************
******
rem  CIIMMS WebHarvest html_xml_file_harvest.bat
rem
rem  the following are set in the control file:
rem
rem  The control file used is file_xml_full_control.txt
rem  the following are set in the control file:
rem    J:\ciimms\full_html_harvest          -- the input directory
rem    ..\templates\ciimmsxmlfullharvest.txt  -- the template file
rem    ..\log\filexmlfull.log               -- the log file
rem    j:\ciimms\ciimmsfullharvest          -- the output directory
rem
```

```
rem  I want to collect the entire body of the docs
rem    from full_html_harvest
rem
rem  edited by Scott Richmond 6/1/2001
rem
*****************************************************************
******
```

4. Scheduled Task

   Using Carbon Copy 32.

   AutoPiloted file transfer from WQMGIS to CIIMMSDEV. Moved ciimmsfullharvest directory from \\WQMGIS\j:\ciimms\ciimmsfullharvest to \\CIIMMSDEV\Program Files_Dev\BAT Tools\Server\Fulcrum\records\ciimmsfullharvest

5. Scheduled Task

   Using Scheduled Tasks.

   \\Ciimmsdev\Program Files_DEV\BAY Tools\Server\Fulcrum\batch Ciimmsweb.bat

```
rem
*****************************************************************
*************
rem CIIMMS WebHarvest Ciimmsweb.bat
rem
rem Indexes ciimms-web database using:
rem     \\Ciimmsdev\Program Files_DEV\BAT
Tools\Server\Fulcrum\records\ciimmsfullharvest -
rem         as input directory
rem
rem edited by Scott Richmond 6/1/2001
rem
*****************************************************************
*********
```

6. Manual Task

   Reinitiated server from http://infotest.dec.state.ak.us/servlet/ciimmssearch/admin

DONE