ERDC/CERL TR-00-21

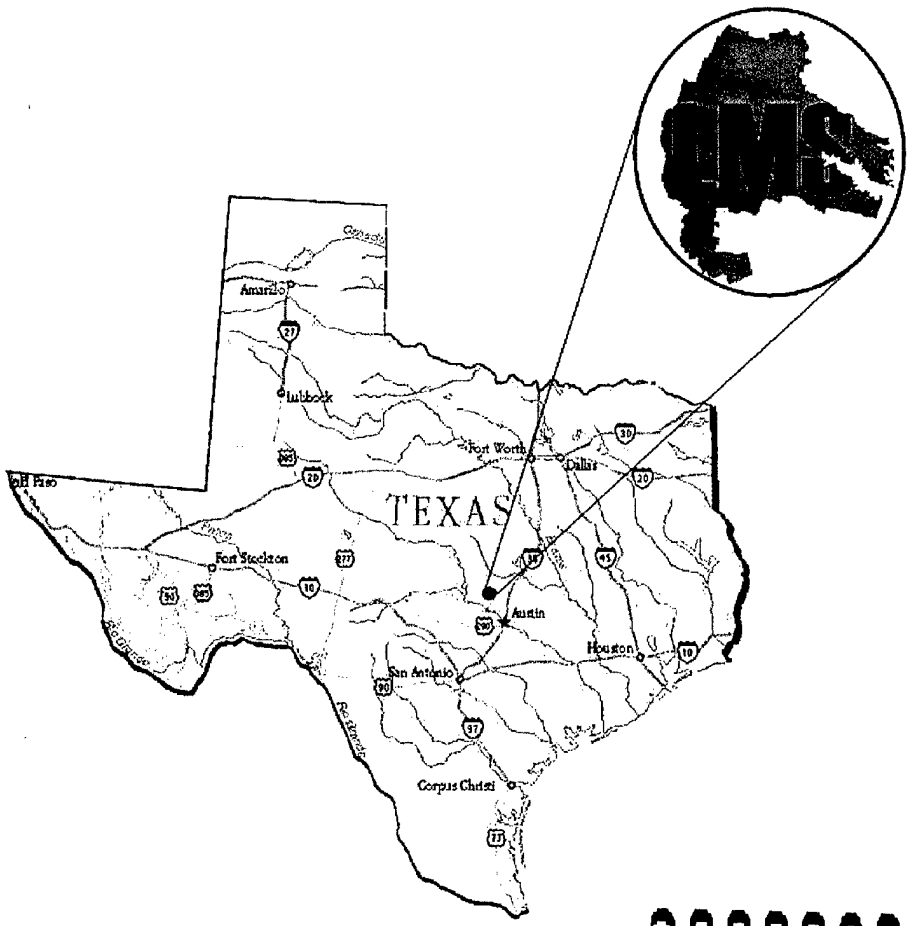
Construction Engineering Research Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

# Fort Hood Land Management System (LMS) Military Field Application Site FY00 In-Progress Review

by Bruce A. MacAllister, Alan B. Anderson and William Goran

July 2000

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# Foreword

This study was conducted for the U.S. Army Corps of Engineers Research and Development Directorate, which established the LMS Special Project Office in March 1997. The proponents are Dr. Lewis E. Link, Director of Research and Development for the U.S. Army Corps of Engineers (CERD-Z), and Dr. Donald Leverenz, Deputy Director of CERD.

The work was performed by the Ecological Processes Branch (CN-N) of the Installations Division, Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Alan B. Anderson. Part of this work was done by Bruce MacAllister, Oak Ridge Institute for Science and Education. Thanks to Don Jones for leading the Fort Hood IPR field trip. The technical editor was Gloria J. Wienke, Information Technology Laboratory. Stephen Hodapp is Chief, CEERD-CN-N, and Dr. John Bandy is Chief, CEERD-CN. The associated Technical Director is Mr. William D. Goran. The Acting Director of CERL is Dr. Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Director of ERDC is Dr. James R. Houston and the Acting Commander is LTC William R. Loven, OD.

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The findings of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

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# 1 Introduction

## Background

### *The Land Management System*

The Land Management System (LMS) is an initiative of the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) focused on improving landscape analysis and landscape management capabilities in several of the Corps of Engineers major mission areas. These mission areas include the U.S. Army Civil Works Programs (navigation, flood control, water supply and quality, recreation, etc.), military installations operations and management (specifically military land management), and military engineering and terrain related operations (trafficability analysis, military hydrology, littoral operations, line of sight analysis, etc.).

The purpose of LMS is to provide relevant science, tools, and information to land and water resource managers and decisionmakers with the goal of enhancing their ability to understand and communicate past, current, and potential impacts of management actions on land and water resources. LMS was established, in part, to improve synergism in technology development across each of these mission areas, to improve USACE'S and the Department of Defense's (DoD's) ability to represent landscape processes and features, and forecast future landscape conditions, based upon alternative scenarios.

The LMS initiative had its roots in a study initiated in autumn 1995 of modeling and simulation capabilities developed or used by the Corps of Engineers, related to landscape or geoprocesses. After this study, the Director of Research and Development, in consultation with the laboratory directors and others, decided to establish the LMS initiative.

To accomplish the goals of LMS, a Special Project Office for LMS was established, with representatives from most of the ERDC Laboratories, the Hydrologic Engineering Center of the Water Resources Support Center, and several Corps of Engineer Districts. The project director, associate directors, and the various organizational representatives comprise the LMS Development Team. Researchers throughout the ERDC laboratories (and their partners) form work teams to

perform specific tasks associated with LMS; these efforts are dovetailed into numerous existing technology programs.

Plans for the LMS Initiative are available (and updated) on the LMS website (http://denix.osd.mil/LMS) under the Defense Environmental Network Information eXchange (DENIX). For more information please see the ERDC/CERL Technical Report 99/60, *Plans for the Land Management System (LMS) Initiative* on the LMS website.

### *The LMS Field Application Program*

The LMS Field Application Program has four major purposes:

1. To provide problem-solving and partnering relations between the Corps of Engineers scientists, technology developers, and interested and innovative landscape/natural resource managers in USACE's major mission areas.

2. To provide site-specific and problem-specific input into the design of LMS2000 functional capabilities.

3. To provide technology test environments where scientists, technology developers, and resource managers/analysts together can tackle issues, test solutions, adjust approaches, capture costs and benefits, and "demonstrate" the results to interested parties.

4. To provide a framework for planning the transfer of LMS technology to land/water resource managers, both at the sites for demonstrations and other similar sites.

Field application sites were selected based on the following criteria:

1. Interest from land/water resource managers in infusing new capabilities into their business practices, and developing collaborative partnerships with scientists and technology providers.

2. Representative land/water resources management issues — such as high levels of use, sensitive resources, competing multiple uses and stakeholders, and other problems and issues identified by user groups as important.

3. Importance of the site or problem set to the mission.

4. Support and concurrence for LMS Field Applications not only at the local level, but also from across the organizational management.

5. Synergism with existing programs/efforts.

The original sites selected for field applications were Fort Hood, TX, and in three locations in the Upper Mississippi River Basin: 1) Redwood Basin, along the Minnesota River in Southern Minnesota, 2) Pool 8 on the Mississippi River near LaCrosse, WI, and 3) Peoria Lakes, on the Illinois River at Peoria, IL. In 1999, the Marine Corps Air Ground Combat Center at Twentynine Palms, CA, was added as another military installation site. Fort Benning, GA, was added in 2000.

Dr. John Barko serves as the LMS Field Application Program Director. In addition, there is a Field Application Site Coordinator for each site. Mr. Alan Anderson serves in this capacity for the Fort Hood site. Fort Hood has three user points of contact (POCs): Mr. Jerry Parusinski from the Range Control Division, Mr. Dennis Herbert is acting LMS POC for the Department of Public Works (DPW), Natural Resources Management Branch in place of Mr. Emmett Gray (who has been temporarily detailed away from that assignment), and Mr. John Cornelius from the Environmental Branch at Fort Hood.

### *The Fort Hood Military Field Application Site*

Fort Hood is the only post in the United States capable of stationing and training two Armored Divisions. Fort Hood is approximately 340 square miles (217,337 acres) in size. The rolling, semiarid terrain is ideal for multifaceted training and testing of military units and individuals. Fort Hood is "The Army's Premier Installation to train and deploy heavy forces." Fort Hood is residence for the Headquarters Command III Corps. III Corps major units are the 1st Cavalry Division, 4th Infantry Division, 3rd Armored Cavalry Regiment, the III Corps Artillery, and the 13th Corps Support Command.

Some of the enduring land and resource management issues that Fort Hood faces are monitoring impacts that training has on Threatened and Endangered Species (TES) populations and testing TES population viability under alternative land management strategies. Land managers are also responsible for ensuring sustained usefulness of the training areas by minimizing erosion and sediment runoff. Land managers need to know estimates of erosion potential, trafficability problems, and flooding hazards in order to ensure safe and excellent training today, while making sure that future training will be accommodated on the same landscape.

### *LMS Field Application Program Transitions*

The field application program for LMS both shapes the development of new LMS capabilities and tests these capabilities to help solve management and landscape analysis problems in the field. The field application efforts provide opportunities to test, evaluate, modify, and document how LMS capabilities help to address specific user problems and how LMS results and capabilities fit into decision processes at user sites.

Field Application Site In-Progress Reviews (IPRs) are designed to ensure that the stages of evaluation, modification, and documentation are fulfilled. These reviews also allow other interested parties to look over the shoulders of those involved at the host site and evaluate the value of applying LMS investments and results at other sites.

A workshop was held at Fort Hood, TX, during September 1997 to identify and prioritize land/water resource management issues at the site. A plan was then developed and projects initiated to address these plans. The first Fort Hood LMS Military Field Application IPR was held 10-11 March 1999 in Killeen, TX. The objective of this IPR was to evaluate the progress of individual projects. Emphasis of the presentations and discussions were on the technical aspects of each project. In general, the meeting was very informative and gave participants a better understanding of the LMS initiative. A number of technical concerns and unresolved issues were identified. Taskings were developed to address identified concerns. Specific issues of concern included a need for better communication and interaction among project personnel, better dissemination of information about LMS, and an LMS user advisory committee made up of installation personnel.

## Objectives

The objectives of this project were to bring personnel involved with each Fort Hood Land Management System Military Field Application project to one location to discuss the progress of each effort, identify the relationships between projects, and solicit input from potential users of the resulting products. This report documents the IPR, user recommendations, and post-IPR follow-up actions.

## Approach

A second annual IPR workshop was held 4-5 April 2000, at the Park Inn International Hotel in Killeen, TX. The IPR consisted of presentations on LMS and individual projects. Following project presentations, inputs from installation, major command (MACOM), and Headquarters, Department of the Army (HQDA) personnel were obtained. Following the meeting, user input was discussed and actions were defined to address each issue. Results of the IPR are documented in this report to ensure project improvements and adjustments occur and to assist with the next IPR.

## Scope

The Fort Hood LMS Military Field Application IPR only addresses projects associated with the Fort Hood LMS Military Field Application. This report does not attempt to address projects and issues associated with other military and civil works LMS field applications.

## Mode of Technology Transfer

This report documents the presentations and discussions of the Fort Hood LMS Military Field Application IPR. Technical concerns and unresolved issues associated with individual projects are being addressed by the project investigators on an individual project basis.

# 2 Agenda for the FY00 Fort Hood LMS Military Field Application Site IPR

The agenda for the Fort Hood LMS Military Demonstration FY00 IPR is provided below.

**Tuesday, 4 April 2000**

| | |
|---|---|
| 8:15-8:35 | Overall LMS Introduction, Bill Goran |
| 8:35-9:30 | Fort Hood Introduction, Alan Anderson<br>Inter-connection of projects<br>Addressing last year's issues<br>User requirements |
| 9:30-10:15 | LMS System, Jeff Jorgeson |
| 10:15-10:30 | Break |
| 10:30-11:30 | Data Quality, Kelly Dilks<br>Repository, Marilyn Ruiz<br>Web Mapping Testbed, James Rogers |
| 11:30-12:45 | Lunch |
| 12:45-13:30 | TES Related Projects<br>Dave Price, Paul Loechl, Jean O'Neil |
| 13:30-14:15 | Erosion and Sedimentation<br>Rich Scholze, Dick Gebhart |
| 14:15-15:00 | Watershed/Soil Moisture Modeling and Monitoring<br>Jeff Jorgeson, Mark Leipnik, Alan Anderson |
| 15:00-15:15 | Break |

15:15-16:45 Carrying Capacity
Alan Anderson, Dave Price

16:45-17:15 Computer-based Project Demonstrations

17:15-17:30 Closing remarks for day 1. Discussion of day 2 agenda.

**Wednesday, 5 April 2000**

8:15-9:45 Feedback from Fort Hood POCs
Specific projects
General direction on Fort Hood military demo
Future direction
Prioritization of future projects

9:45-10:00 Break

10:00-11:30 Input from other participating organizations
HQDA/MACOMs
Other participants

11:30-12:15 IPR conclusion

12:30-15:00 Optional Field Trip to Fort Hood LMS sites

# 3 Fort Hood LMS Military Field Application Site IPR Attendees

The following individuals attended the FY00 Fort Hood LMS Military Field Application Site IPR.

| NAME | ORGANIZATION |
|---|---|
| Alan Anderson | ERDC/CERL |
| John Barko | USACE-WES-EB-E, ERDC/EL |
| P.B. Black | ERDC/CRREL |
| John Brent | Fort Benning |
| Tim Buchanan | Fort Hood |
| Jim Carter | TRIES |
| Kelly Dilks | ERDC/CERL |
| Dick Gebhart | ERDC/CERL |
| George Gertner | University of Illinois |
| Bill Goran | ERDC/CERL |
| Susan Graff | Environmental Resource Services |
| Emmett Gray | Fort Hood |
| Cecil Hallum | TRIES |
| Paul Harwick | Pacific Meridian |
| Dennis Herbert | Fort Hood |
| Robert Holst | SERDP |
| Cheryl Huckerby | Fort Hood |
| Don Jones | Fort Hood |
| Jeff Jorgeson | ERDC/CHL |
| Karl Kleinbach | Fort Hood |
| Mark Leipnik | TRIES |
| Kim Michaels | AEC |
| Allan Morton | Fort Hood |
| Allison Newcomb | ERDC/ITL |
| L. Jean O'Neil | ERDC/EL |
| Tony Palazzo | ERDC/CRREL |
| Gordon Plishker | TRIES |
| Jerry Paruzinski | Fort Hood |
| David Price | ERDC/CERL |

| | |
|---|---|
| Ted Reid | FORSCOM |
| Marilyn Ruiz | ERDC/CERL |
| Richard Scholze | ERDC/CERL |
| Fred Schrank | USDA NRCS |
| John Shrader | Fort Hood |
| Gary Smith | TRIES |
| Carlos Solis | USACOE Fort Worth |
| Dick Strimel | Fort Sam Houston/Camp Bullis |
| Jerry Thompson | Fort Sam Houston/Camp Bullis |
| Charlotte Trahan | Environmental Resource Services |
| Jason Walters | Fort Hood |
| Steve Wente | University of Illinois |
| J. Williams | TRIES |

# 4 Fort Hood LMS Military Field Application Site IPR Project Presentations

The following pages provide briefing materials presented at the Fort Hood LMS Military Field Application Site IPR. Each section provides the presenter's name, the abstract provided in the IPR read-ahead package, and the presentation materials.

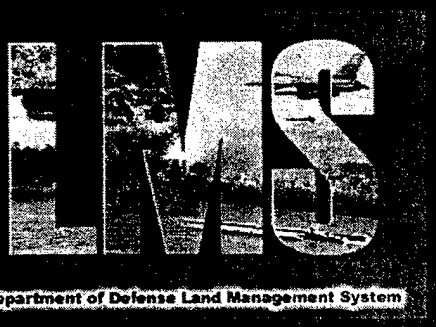
## The Land Management System

PRESENTER: Bill Goran

ABSTRACT: The Land Management System (LMS) is an effort of the U.S. Army Corps of Engineers Engineer Research and Development Center to develop, support, and apply an integrated capability for modeling and decision support technologies relevant to DoD and other agency management of land, seas, and airspace. The concept of LMS uses these integrated capabilities to predict the impacts of anthropogenic activities and evaluate alternative management scenarios. LMS seeks to build and manage a framework for delivery and use of information technology-based research and development products. It is designed to support a broad range of mission emphases across a wide spectrum of land and water resources, for both civil works and military applications.

PRESENTATION: The Land Management System

## Bringing Together Tools for Managing our Land and Water Resources

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## LMS Vision

- Build/Manage Frameworks for Delivery and Use of IT-based R&D Products
- Support of a Broad Range of Mission Emphases across the Land and Water Resources Management Spectrum
- Exploit Synergism Across Civil Works and Military Applications

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## Business Approach

- Create Special Project Office (Goran, Barko, Holland)
- Build Team from Across ERDC and Corps of Engineers and Build Partnerships with other Agencies
- Develop standard practices across the partnership
- Create Resources by Horizontal Planning Across Programs, not Separate Program
- Establish Network of Field Application Sites to Involve End Users in Building LMS Capabilities

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## Technical Approach

Create Catalog of computational tools

Develop rules/protocols for interactions between tools in LMS

LMS 2000: Build Integrating framework for land management tools

Test Projects at Network of Field Applications Sites

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## Status

- Published Plans Document (June 1999)
- Established Public Website (May 1999)
- Completing Version 2.0 of Tool Catalog (CERL lead, HEC, CHL, EL, CRREL Testbed)
- Established Protocol Testbeds for Level II and III (CRREL lead, ITL, CHL, EL, CERL, Rock Island Participants)
- Established Five Field Application Sites (CERL and EL lead)
- Built Initial LMS 2000 Framework (CHL & ITL leads)
- Established Academic, Industry and Agency Partnerships (Through Contracts, MOA, etc)

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## LMS Partnerships (Academic and Industry)

- Through 5 Year Tasking Contract
  - University of Illinois (ESRI, Menzie-Cura, Environmental Resources)
  - Kansas State (Intergraph Corp, Aqua-Terr, LLC)
  - Pacific Meridian
  - Shepherd-Miller
  - Tetra Tech (ESRI, U of I GMS Lab, Univ. of Mississippi Field Station (UMFS), University of Virginia)
- Through Congressional Initiative
  - Sam Houston State University

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LMS Partnerships
(Agencies and Organizations)
• Through Collaborative and Partnering Arrangements
– Inter-Agency Group for Decision Support
– Open GIS Consortium
– CADD/GIS Center
– SERDP
– Army Research Office
– DOE Labs
– EPA Labs
– ARS/NRCS
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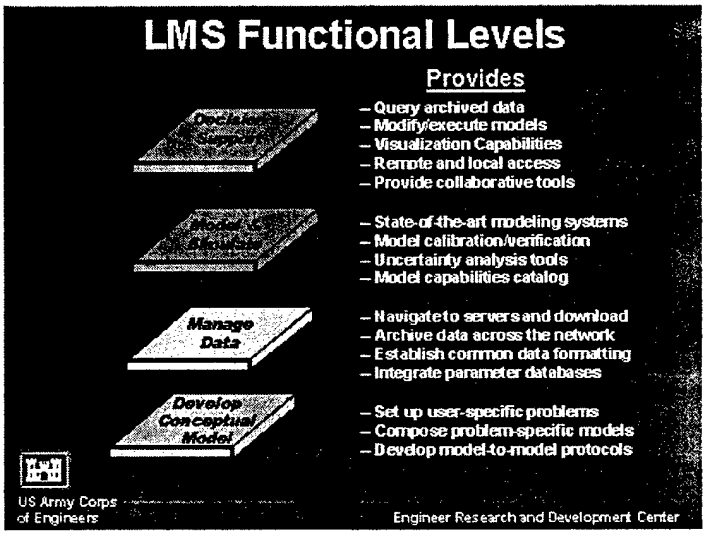
LMS Functional Levels
Provides
– Query archived data
– Modify/execute models
– Visualization Capabilities
– Remote and local access
– Provide collaborative tools
– State-of-the-art modeling systems
– Model calibration/verification
– Uncertainty analysis tools
– Model capabilities catalog
Manage Data
– Navigate to servers and download
– Archive data across the network
– Establish common data formatting
– Integrate parameter databases
Develop Conceptual Model
– Set up user-specific problems
– Compose problem-specific models
– Develop model-to-model protocols
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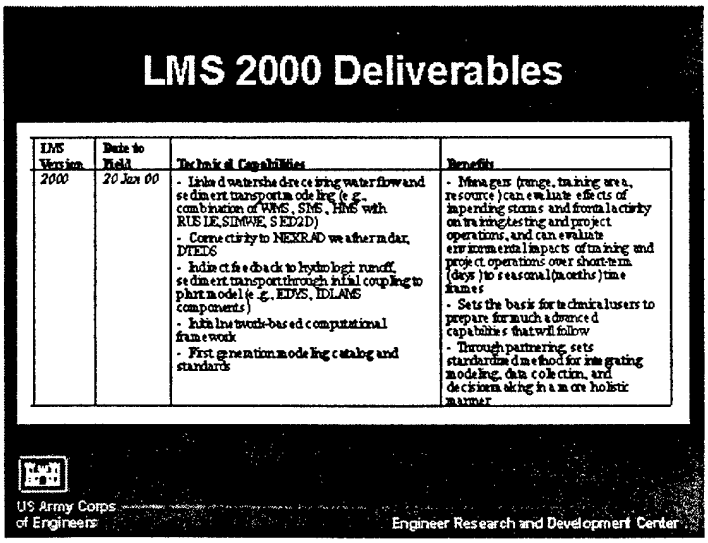
LMS 2000 Deliverables
LMS Version
Date to Field
Technical Capabilities
Benefits
2000
20 Jan 00
- Linked watershed receiving water flow and sediment transport modeling (e.g., combination of WMS, SMS, HMS with RUSLE, SIMWE, SED2D)
- Connectivity to NEXRAD weather radar, DTED
- Indirect feedback to hydrologic runoff, sediment transport through initial coupling to plant models (e.g., EDYS, IDLAMS components)
- Initial network-based computational framework
- First generation modeling catalog and standards
- Managers (range, training area, resource) can evaluate effects of impending storms and frontal activity on training/testing and project operations, and can evaluate environmental impacts of training and project operations over short-term (days) to seasonal (months) time frames
- Sets the basis for technical users to prepare for much advanced capabilities that will follow
- Through partnering, sets standardized method for integrating modeling, data collection, and decision making in a more holistic manner
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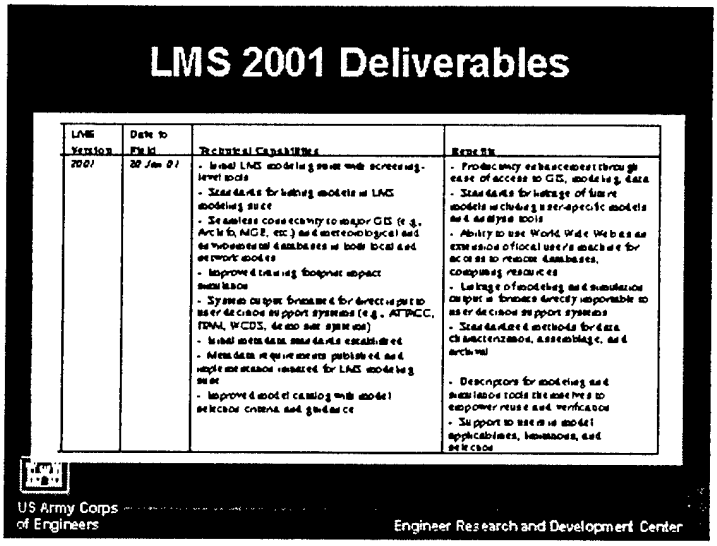
LMS 2001 Deliverables
LMS Version
Date to Field
Technical Capabilities
Benefits
2001
20 Jan 01
- Initial LMS modeling environment screening-level tools
- Standards for linking models in LMS modeling suite
- Seamless connectivity to major GIS (e.g., ArcInfo, MGE, etc.) and meteorological and environmental databases in both local and network models
- Improved training footprint impact assistance
- System output formatted for direct input to user decision support systems (e.g., ATPCC, TRAC, WCDS, decision aid systems)
- Initial metadata standards established
- Metadata requirements published and implementation required for LMS modeling suite
- Improved model catalog with model selection criteria and guidance
- Productivity enhancement through ease of access to GIS, modeling, data
- Standards for linkage of future models including user-specific models and analysis tools
- Ability to use World Wide Web as an extension of local user's machine for access to remote databases, computing resources
- Linkage of modeling and simulation output in formats directly importable to user decision support systems
- Standardized methods for data characterization, assemblage, and archival
- Descriptors for modeling and simulation tools that serve to empower reuse and verification
- Support to identify model applicabilities, limitations, and selection
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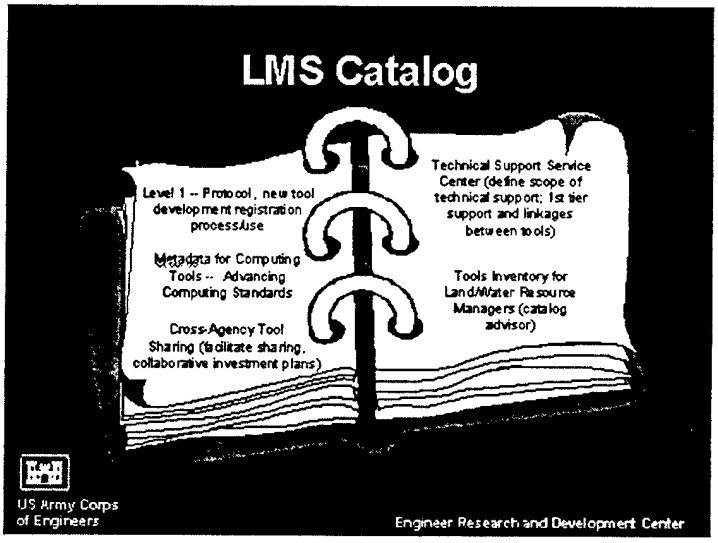
LMS Catalog
Level 1 -- Protocol, new tool development registration process/use
Metadata for Computing Tools -- Advancing Computing Standards
Cross-Agency Tool Sharing (facilitate sharing, collaborative investment plans)
Technical Support Service Center (define scope of technical support; 1st tier support and linkages between tools)
Tools Inventory for Land/Water Resource Managers (catalog advisor)
US Army Corps of Engineers
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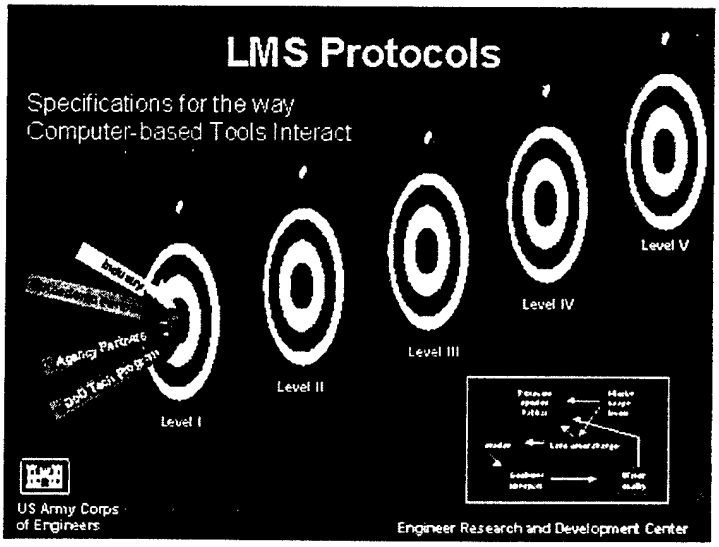
LMS Protocols
Specifications for the way Computer-based Tools Interact
Level I
Level II
Level III
Level IV
Level V
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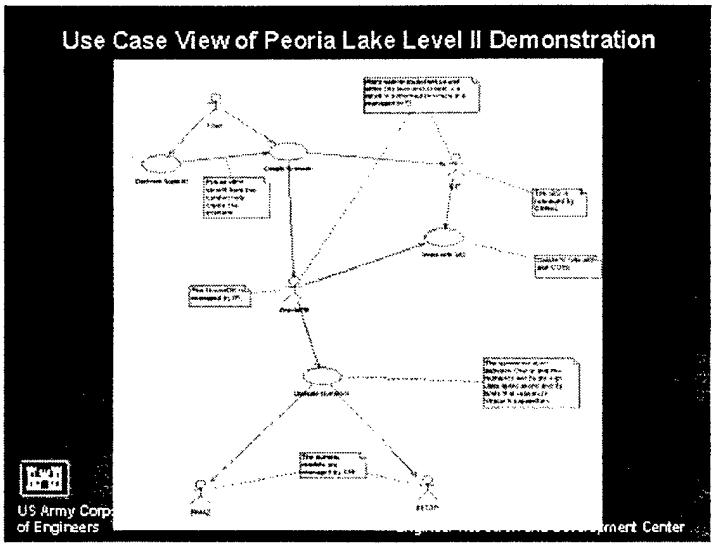
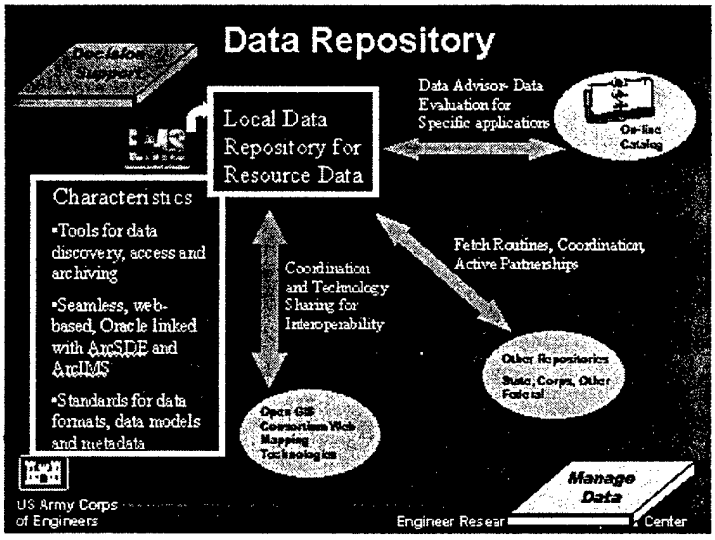
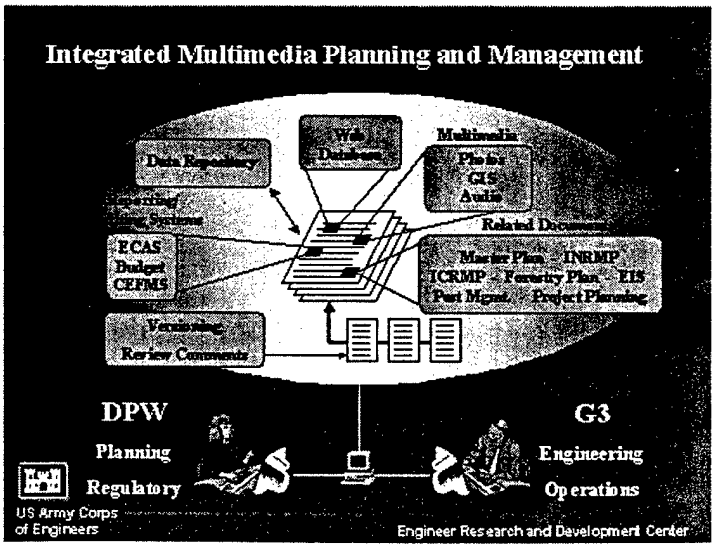

Use Case View of Peoria Lake Level II Demonstration
US Army Corps of Engineers


Data Repository
Local Data Repository for Resource Data
Data Advisor- Data Evaluation for Specific applications
On-line Catalog
Characteristics
•Tools for data discovery, access and archiving
•Seamless, web-based, Oracle linked with ArcSDE and ArcIMS
•Standards for data formats, data models and metadata
Coordination and Technology Sharing for Interoperability
Fetch Routines, Coordination, Active Partnerships
Other Repositories
State, Corps, Other Federal
Open GIS Consortium Web Mapping Technologies
Manage Data
US Army Corps of Engineers
Engineer Research and Development Center


Integrated Multimedia Planning and Management
Web Database
Multimedia
Data Repository
Plots
GIS
Audio
Related Documents
ECAS
Budget
CEFMS
Master Plan
INRMP
ICRMP
Forestry Plan
ITS
Port Mgmt.
Project Planning
Reviewing
Review Comments
DPW
Planning
Regulatory
G3
Engineering
Operations
US Army Corps of Engineers
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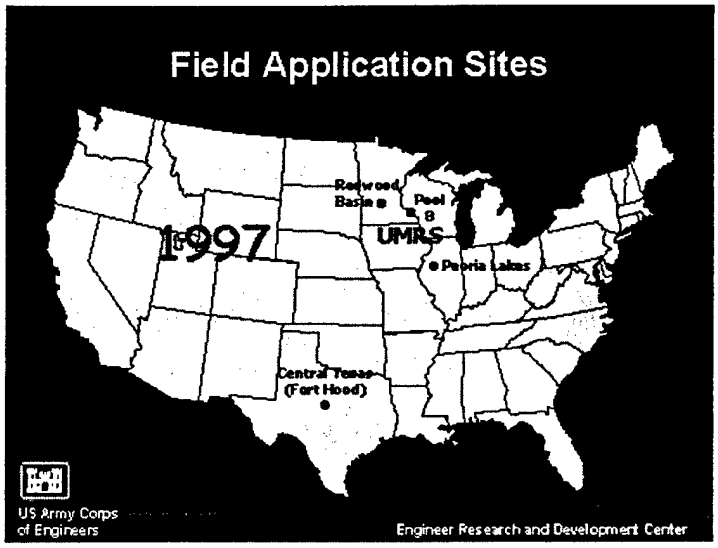
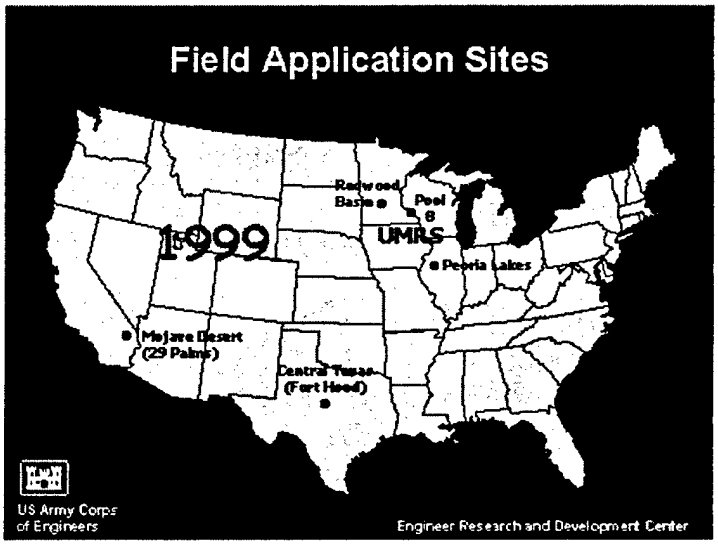
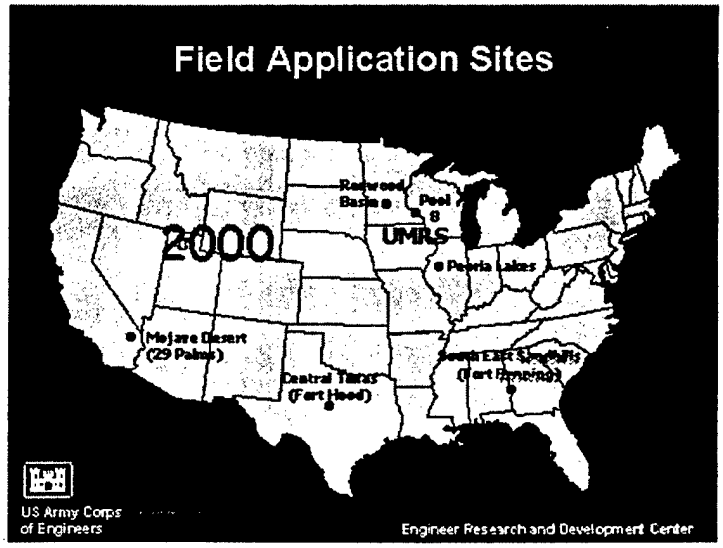
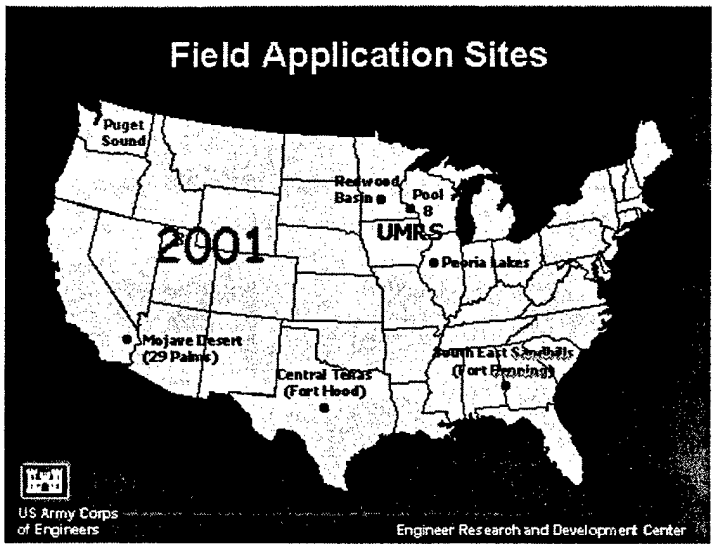

Field Application Sites
1997
Redwood Basin
Pool 8
UMRS
Peoria Lakes
Central Texas (Fort Hood)
US Army Corps of Engineers
Engineer Research and Development Center


Field Application Sites
1999
Redwood Basin
Pool 8
UMRS
Peoria Lakes
Mojave Desert (29 Palms)
Central Texas (Fort Hood)
US Army Corps of Engineers
Engineer Research and Development Center


Field Application Sites
2000
Redwood Basin
Pool 8
UMRS
Peoria Lakes
Mojave Desert (29 Palms)
Central Texas (Fort Hood)
US Army Corps of Engineers
Engineer Research and Development Center


Field Application Sites
Puget Sound
Redwood Basin
Pool 8
UMRS
2001
Peoria Lakes
Mojave Desert (29 Palms)
Central Texas (Fort Hood)
US Army Corps of Engineers
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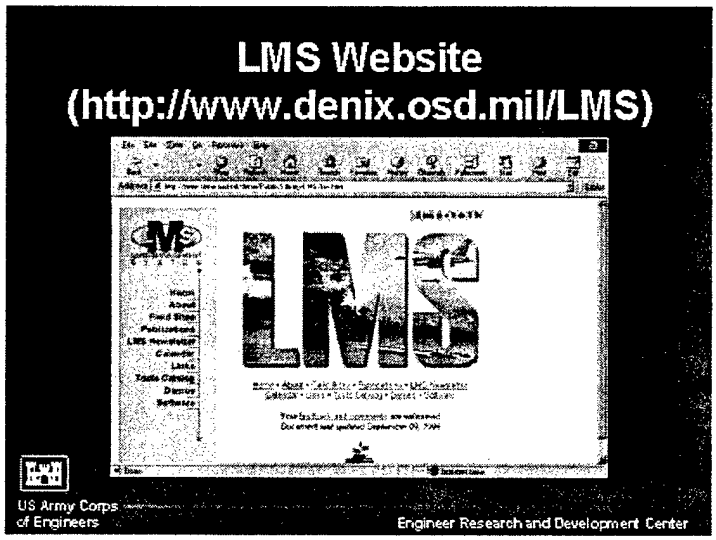
LMS Website
(http://www.denix.osd.mil/LMS)
LMS
US Army Corps of Engineers
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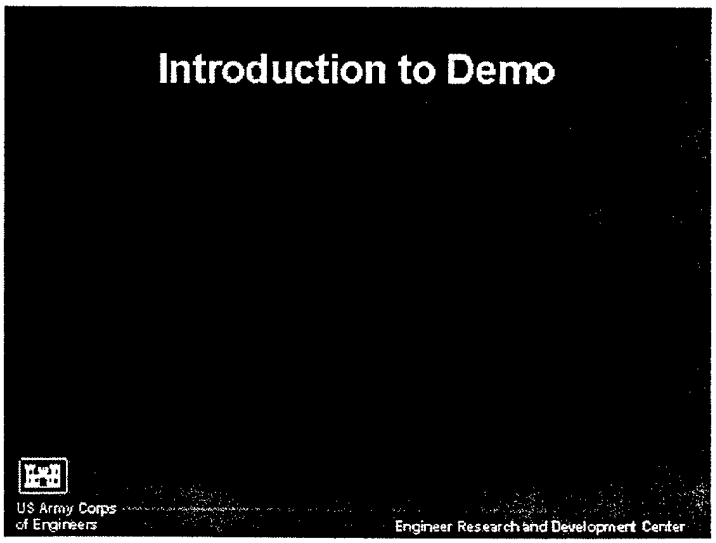
Introduction to Demo
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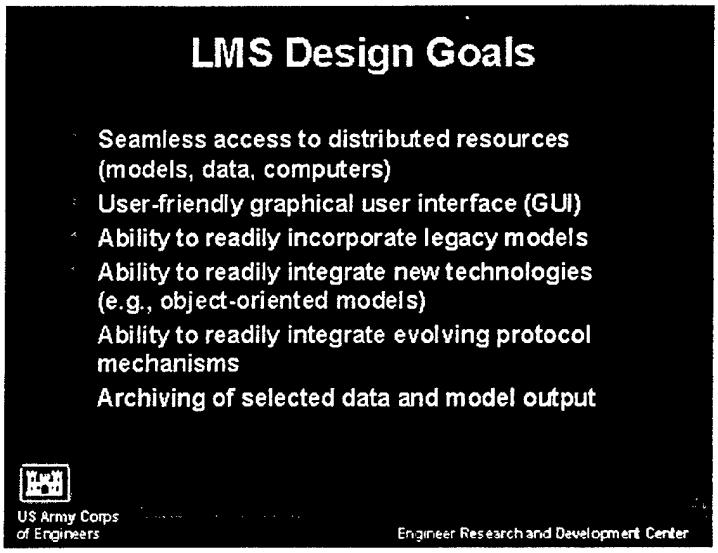
LMS Design Goals
Seamless access to distributed resources (models, data, computers)
User-friendly graphical user interface (GUI)
Ability to readily incorporate legacy models
Ability to readily integrate new technologies (e.g., object-oriented models)
Ability to readily integrate evolving protocol mechanisms
Archiving of selected data and model output
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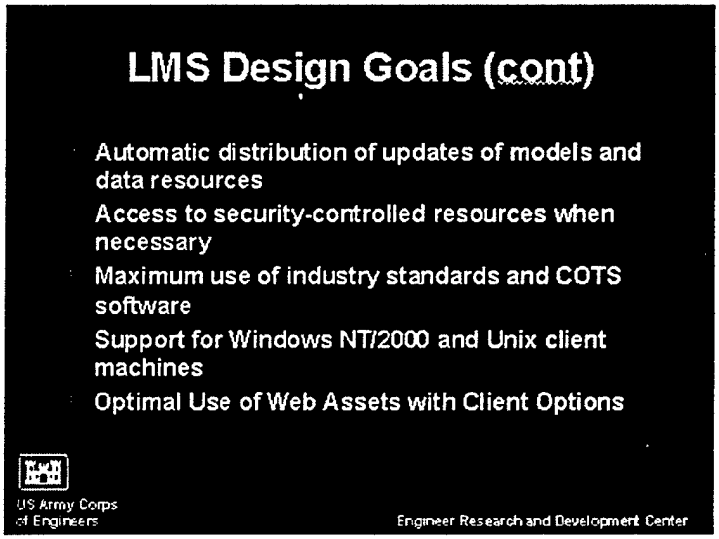
LMS Design Goals (cont)
Automatic distribution of updates of models and data resources
Access to security-controlled resources when necessary
Maximum use of industry standards and COTS software
Support for Windows NT/2000 and Unix client machines
Optimal Use of Web Assets with Client Options
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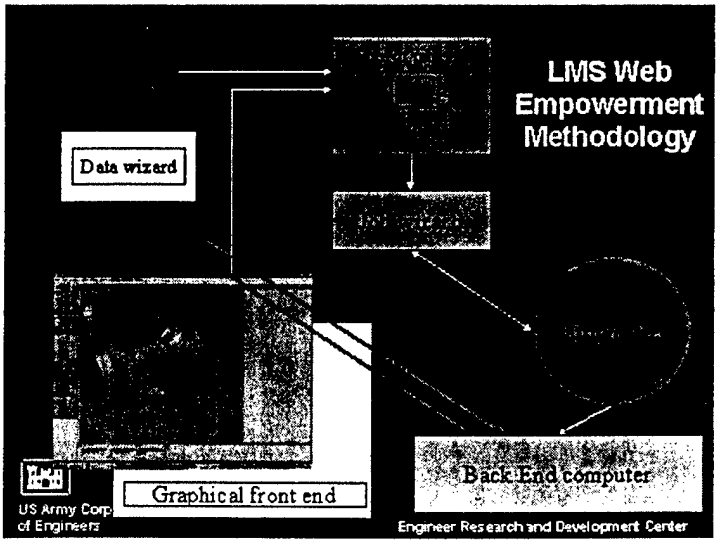
LMS Web Empowerment Methodology
Data wizard
Graphical front end
Back End computer
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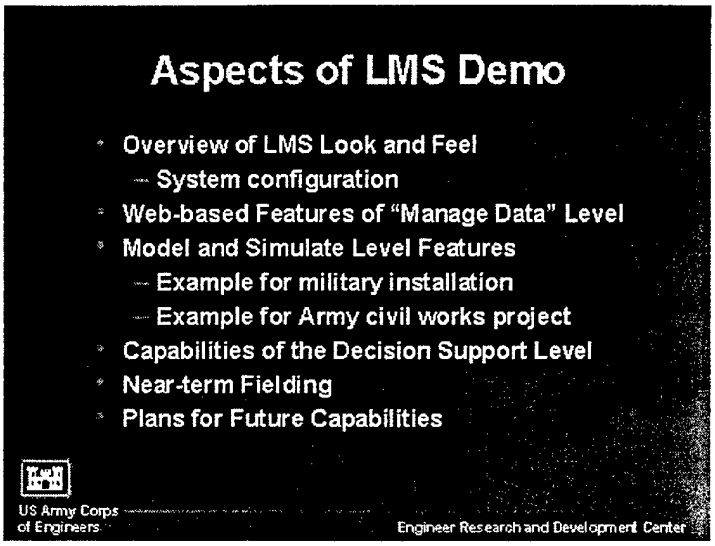
Aspects of LMS Demo
Overview of LMS Look and Feel
System configuration
Web-based Features of "Manage Data" Level
Model and Simulate Level Features
Example for military installation
Example for Army civil works project
Capabilities of the Decision Support Level
Near-term Fielding
Plans for Future Capabilities
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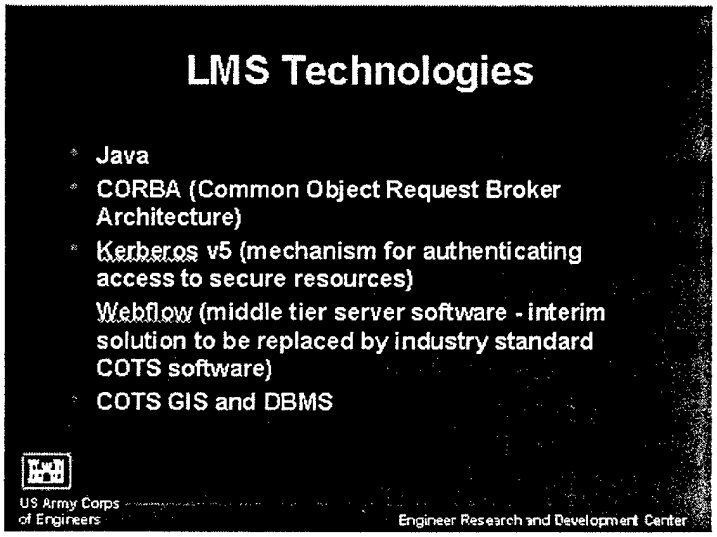
LMS Technologies
Java
CORBA (Common Object Request Broker Architecture)
Kerberos v5 (mechanism for authenticating access to secure resources)
Webflow (middle tier server software - interim solution to be replaced by industry standard COTS software)
COTS GIS and DBMS
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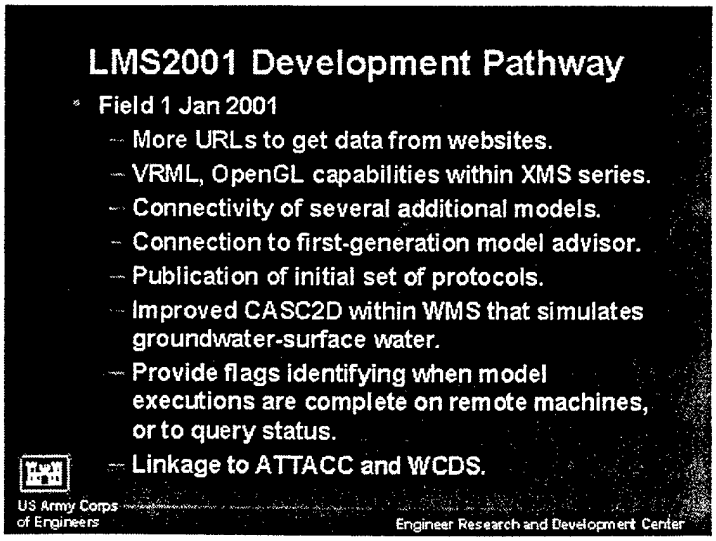
LMS2001 Development Pathway
Field 1 Jan 2001
More URLs to get data from websites.
VRML, OpenGL capabilities within XMS series.
Connectivity of several additional models.
Connection to first-generation model advisor.
Publication of initial set of protocols.
Improved CASC2D within WMS that simulates groundwater-surface water.
Provide flags identifying when model executions are complete on remote machines, or to query status.
Linkage to ATTACC and WCDS.
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## LMS2001 Development Pathway - continued

LMS2001

- Initial conceptual modeling environment.
- Improved training distribution modeling
- Initial decision support tools, including ability to archive model results, query them.
- Integration of several additional models.
- Complete link to OO-IDLAMS with feedback from its models to/from LMS hydrology codes.
- Ability to log into LMS data repository from non-local machine into LMS servers.
- Initial capability to manipulate key variables of calibrated/verified user model and execute.

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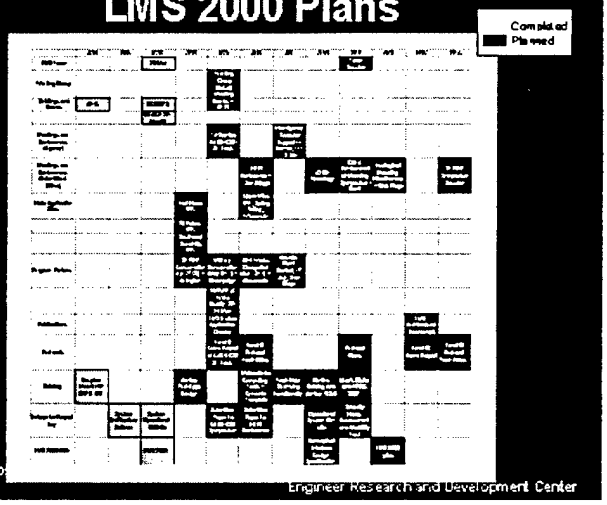
## LMS 2000 Plans

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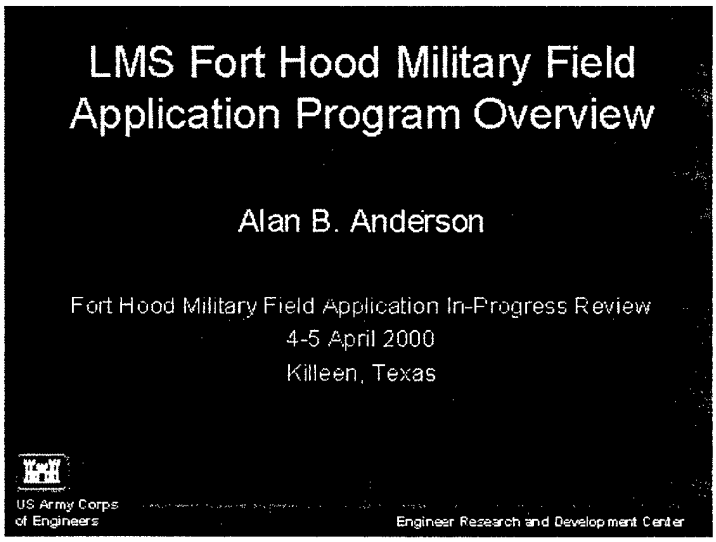
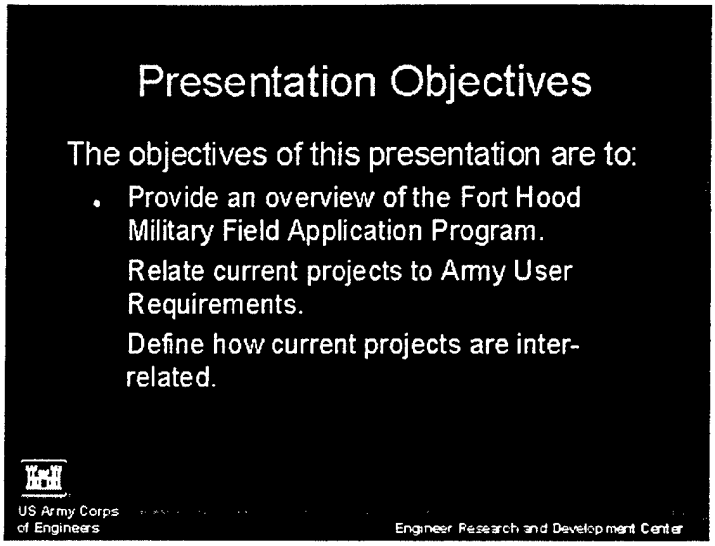
## LMS Fort Hood Military Field Application Program Overview

PRESENTER: Alan B. Anderson

ABSTRACT: The Land Management System (LMS) is an initiative of the U.S. Army Corp of Engineers (USACE) Engineer Research and Development Center (ERDC) focused on improving landscape analysis and management capabilities in several USACE mission areas. LMS Field Application sites were established to: (1) provide a site/problem specific input into the design of LMS, (2) provide a technology test environment, and (3) provide a framework for planning the transfer of LMS technologies to resource managers. Fort Hood was the first LMS Military Field Site established. The objective of this presentation is to: (1) provide a general overview of the Fort Hood LMS Military Field Site Program, (2) relate current LMS projects with Army User Requirements, and (3) define how LMS projects are interrelated and coordinated.

PRESENTATION: LMS Fort Hood Military Field Application Overview




Presentation Objectives
The objectives of this presentation are to:
Provide an overview of the Fort Hood Military Field Application Program.
Relate current projects to Army User Requirements.
Define how current projects are inter-related.
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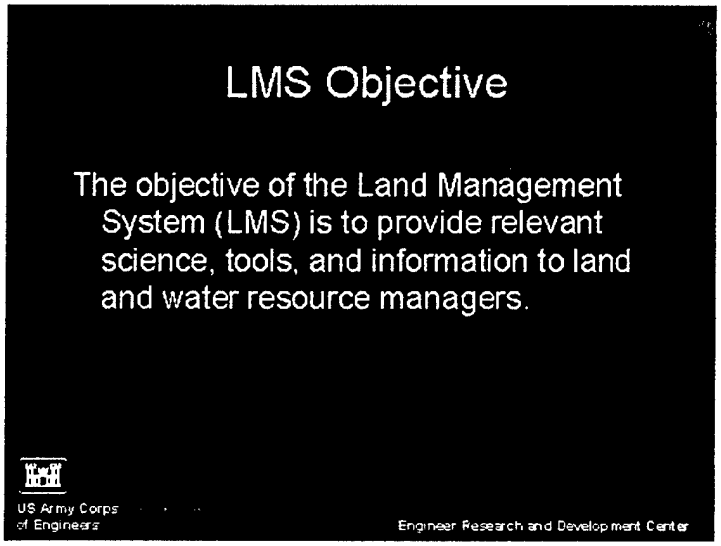
LMS Objective
The objective of the Land Management System (LMS) is to provide relevant science, tools, and information to land and water resource managers.
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Field Site Objectives
The objectives of the Fort Hood LMS Military Field Site Program are:
Provide partnering relations between COE and resource managers.
Provide site-specific and problem-specific input into LMS design.
Provide technology test environments.
Provide a framework for transfer of LMS technology to resource managers.
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## LMS Fort Hood Military Field Application POC's

- Fort Hood LMS Field Site Coordinator
  - Alan B. Anderson
- Fort Hood Installation Field Site POC's
  - Emmett Gray/Dennis Herbert
  - Jerry Paruzinski
  - John Comellius

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## History

- Workshop at Fort Hood (1997) to identify and prioritize land management issues. (Site plan, projects defined)
- Follow on visit by Fort Hood Site POC to refine objectives (1998).
- First Fort Hood Site In Progress Review (1999)
- Second Fort Hood In Progress Review (2000)

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## Past IPR Comments

The following comments were received after the last IPR:

- Need better coordination, cooperation, interaction between individual projects...
- Information about LMS needs to be more clearly explained ...
- Need to know where projects are going ...

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## Field Site Projects

- Soil Moisture Stream Stage Modeling
- Data Repository
- Data Quality
- Web Mapping
- Vegetation Mapping
- Carrying Capacity Modeling
- Uncertainty Analysis
- Ecological Dynamics Simulation Model (EDYS)
- Erosion Model Comparison
- LBCC Dem/Val (C, LS, Dist, EDYS)

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## Field Site Project Funding

- Congressional Funds
- COE Direct Funds
- SERDP
- Dem/Val Funds (AEC)
- Reimbursable
- Other

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## User Input Processes

- LMS Review Process
- ITAM IISC
- SERDP R&D Review
- ISTAB
- CNTT
- LMS Field Site IPR's
- Geospatial R&D FA Group
- Other

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## Project Inter-Connection

**How are LMS Field Site projects related to other Field Site projects?**

- Data Requirements
- Data Flow

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## User Requirements Example

**How do LMS Field Site projects relate to Army R&D User Requirements?**

- DoD/Tri-Service User Requirement #4 - Land Capability/Characterization. "There is a research need to determine to what extent given parcels of land are suitable and contain the carrying capacity for sustaining specific activities. It should address the type, magnitude, frequency, and duration of activities, as well as spatial and temporal parameters."

- DoD/Tri-Service User Requirement #3 - Land Capability/Characterization. Research and development required to improve ATTACC to meet training requirements.

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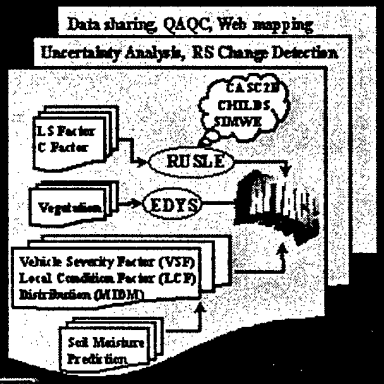
## User Requirements




Land Characterization Conservation User Requirement

FY99
- Improve RUSLE LS and C Factors
- Identify the distribution of training impacts

FY00
- Develop protocols that reflect probable range of results in ATTACC
- Integrate sedimentation modeling
- Develop preliminary wind erosion models for ATTACC
- Improve Local Condition Factor implementation
- Account for multi-year model use

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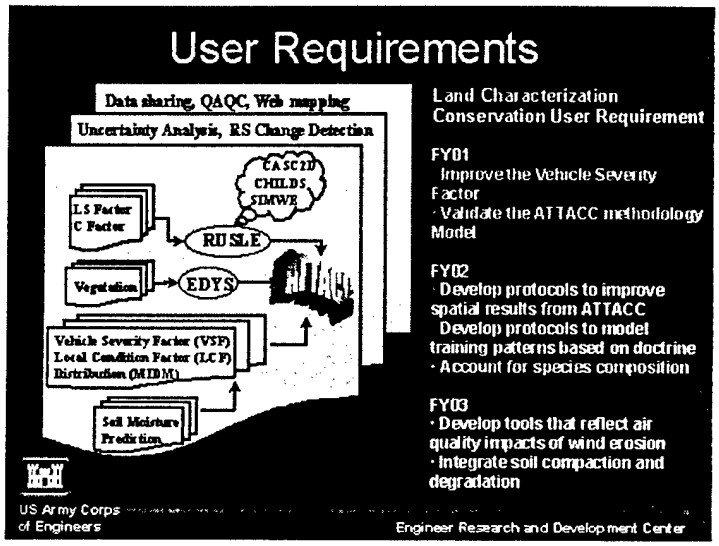
User Requirements
Data sharing, QAQC, Web mapping
Uncertainty Analysis, RS Change Detection
CASC2D
CHILDS
SIMWE
LS Factor
C Factor
RUSLE
Vegetation
EDYS
Vehicle Severity Factor (VSF)
Local Condition Factor (LCF)
Distribution (MDM)
Soil Moisture Prediction
Land Characterization Conservation User Requirement
FY01
Improve the Vehicle Severity Factor
· Validate the ATTACC methodology Model
FY02
· Develop protocols to improve spatial results from ATTACC
Develop protocols to model training patterns based on doctrine
· Account for species composition
FY03
· Develop tools that reflect air quality impacts of wind erosion
· Integrate soil compaction and degradation
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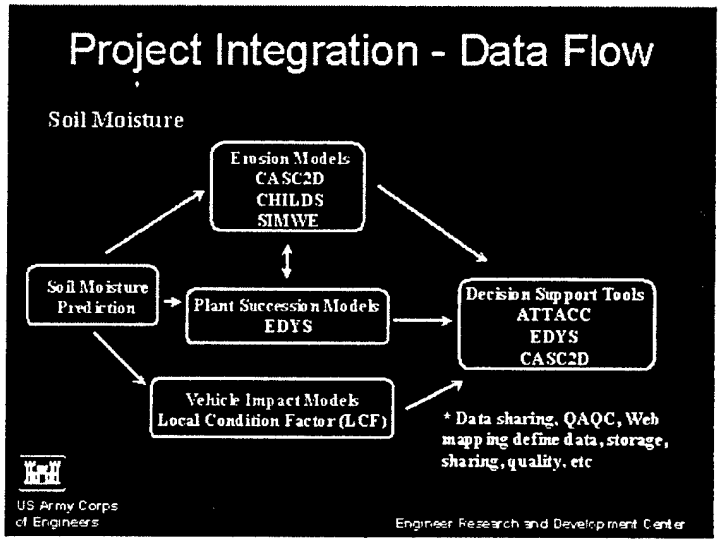
Project Integration - Data Flow
Soil Moisture
Erosion Models
CASC2D
CHILDS
SIMWE
Soil Moisture Prediction
Plant Succession Models
EDYS
Decision Support Tools
ATTACC
EDYS
CASC2D
Vehicle Impact Models
Local Condition Factor (LCF)
* Data sharing, QAQC, Web mapping define data, storage, sharing, quality, etc
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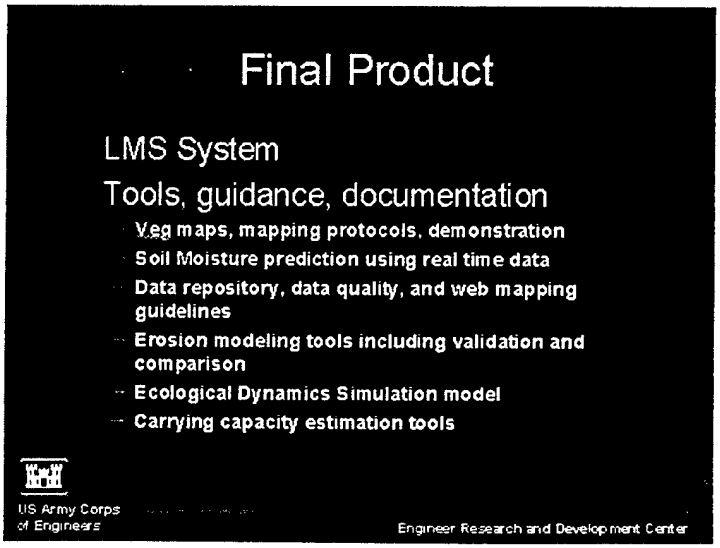
Final Product
LMS System
Tools, guidance, documentation
Veg maps, mapping protocols, demonstration
Soil Moisture prediction using real time data
Data repository, data quality, and web mapping guidelines
Erosion modeling tools including validation and comparison
Ecological Dynamics Simulation model
Carrying capacity estimation tools
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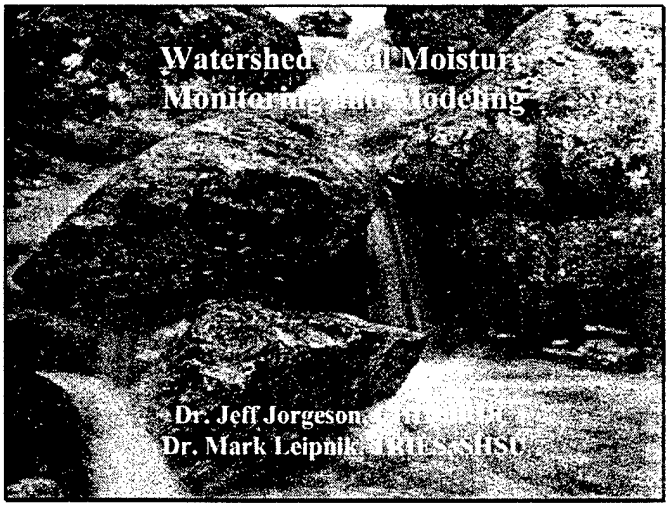
## Watershed/Soil Moisture Monitoring and Modeling

PRESENTERS: Jeff Jorgeson, Mark Leipnik

ABSTRACT: During FY99 an effort was initiated as one of the Land Management System (LMS) Demonstration Projects to perform real-time stream stage and soil moisture modeling at the Fort Hood Military Reservation. This effort is currently underway and involves the installation of telemetered weather, stream stage, sediment, and soil moisture instrumentation on three watersheds, and the installation of a flood warning system at a dangerous low water road crossing where several fatalities have occurred due to flood waters washing over the road. Using the data collected by the watershed sensors in conjunction with existing GIS coverages, each of the three study watersheds is being modeled with the CASC2D watershed model using the Watershed Modeling System (WMS). The watershed models will ultimately use real time data from the telemetered instrumentation in the watersheds to provide stream flow and soil moisture estimates.

PRESENTATION: Watershed/Soil Moisture Monitoring and Modeling



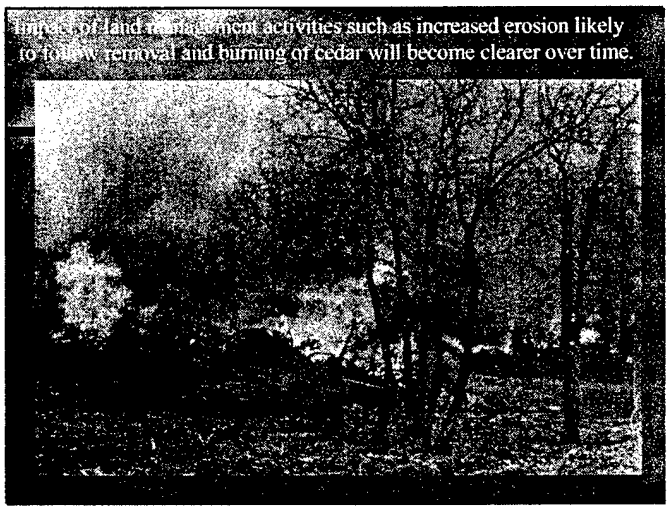
## Purpose

- Provide a means of estimating and predicting streamflow and watershed soil moisture conditions using real-time data.

## Approach

- Install instrumentation for stream flow, sediment, soil moisture, and meteorology on 3 representative watersheds
- Model basins with the CASC2D model
- Incorporate telemetered data
- Integrate radar data into models
- Provide soil moisture maps of basins

Normally placid spring-fed streams are subject to impacts of training activities and are flash-flood prone.




## CASC2D Overview

- Distributed, physically based watershed model
  - 2-D overland flow
  - 1-D channel flow
  - Long-term simulations
  - Overland erosion

Current Research / Development

- Surface Water - Groundwater Interaction
- Improved Modeling of Hydraulic Structures

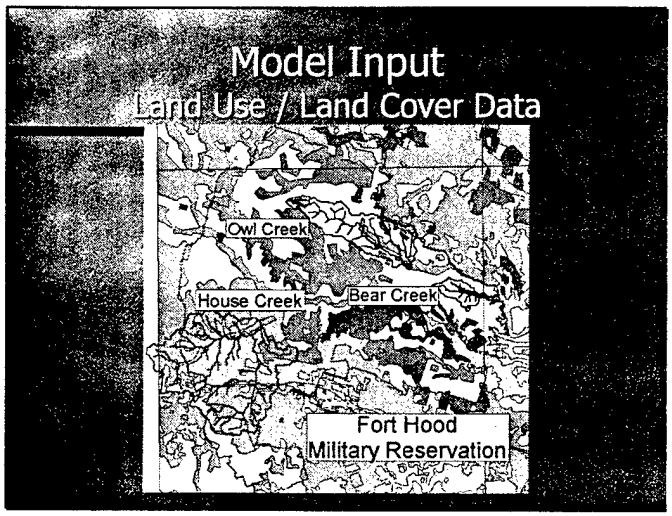
## Watershed Modeling

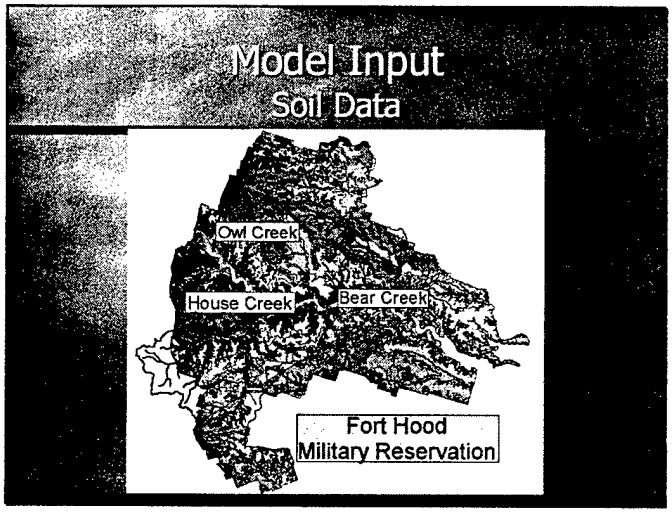
- CASC2D Model
  - Distributed Watershed Model
  - Erosion / Sedimentation
  - Long Term Simulations
- Watershed Modeling System (WMS)
  - Extensive GIS Linkages
  - Weather Radar Data Support

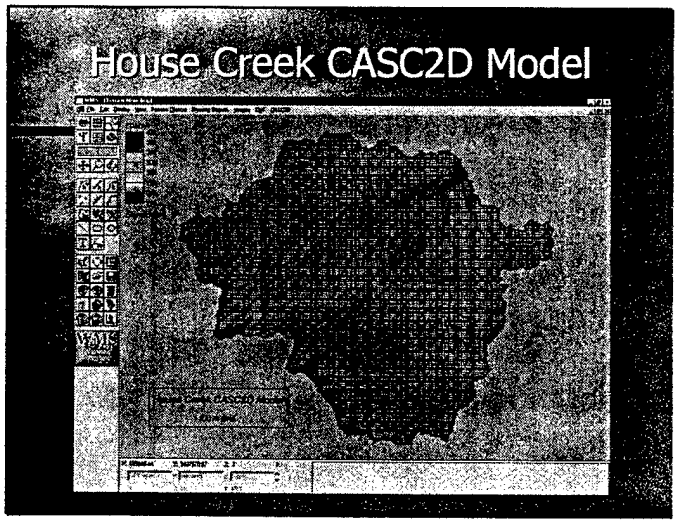
## CASC2D Input / Output

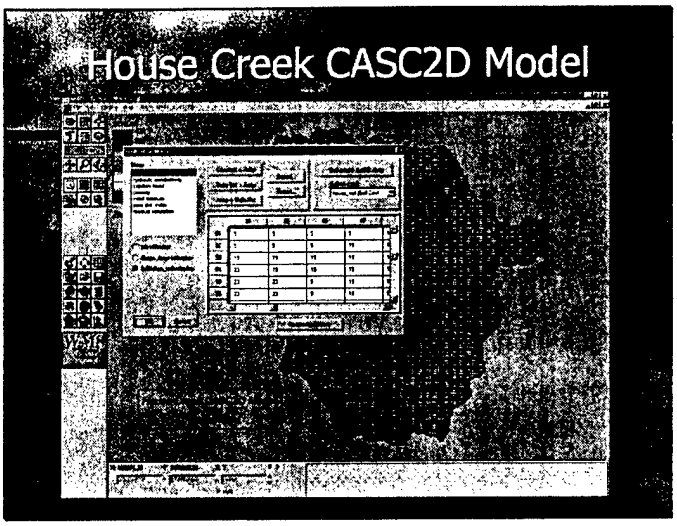
- Input Requirements
  - Elevation
  - Land Use
  - Soil
  - Channels
  - Precipitation
- Output
  - Outflow Hydrograph
  - Net Erosion / Deposition
  - Soil Moisture

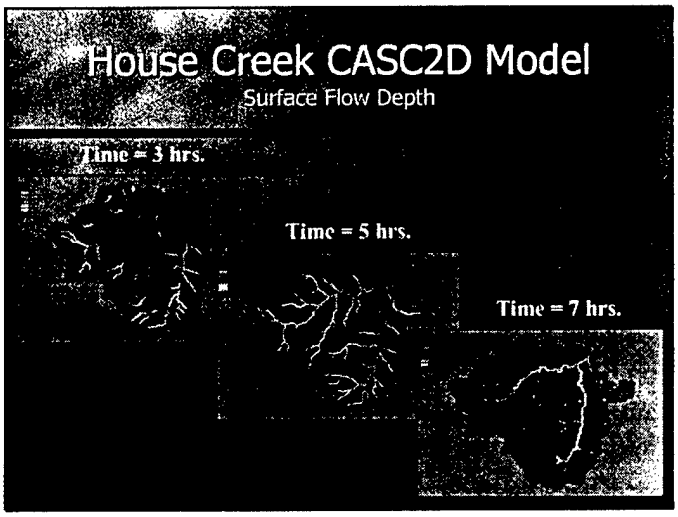
## Model Input
### Digital Elevation Data

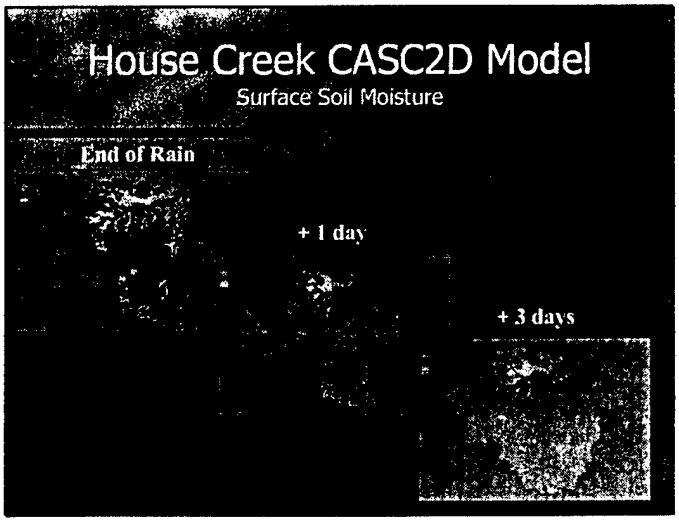

Model Input
Land Use / Land Cover Data
Owl Creek
House Creek
Bear Creek
Fort Hood
Military Reservation

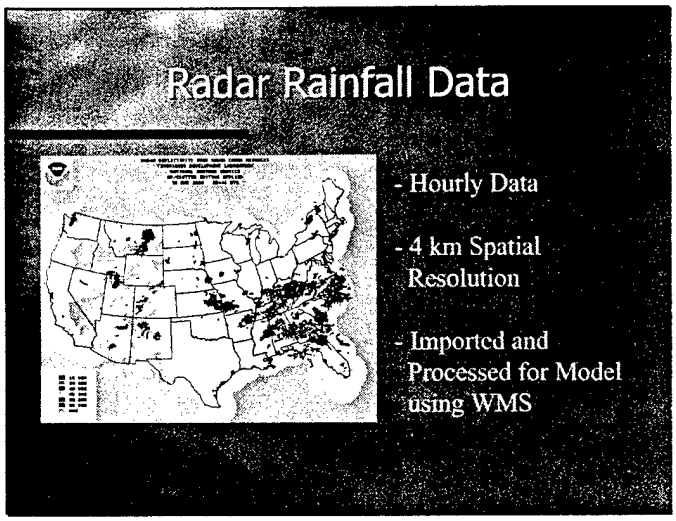

Model Input
Soil Data
Owl Creek
House Creek
Bear Creek
Fort Hood
Military Reservation

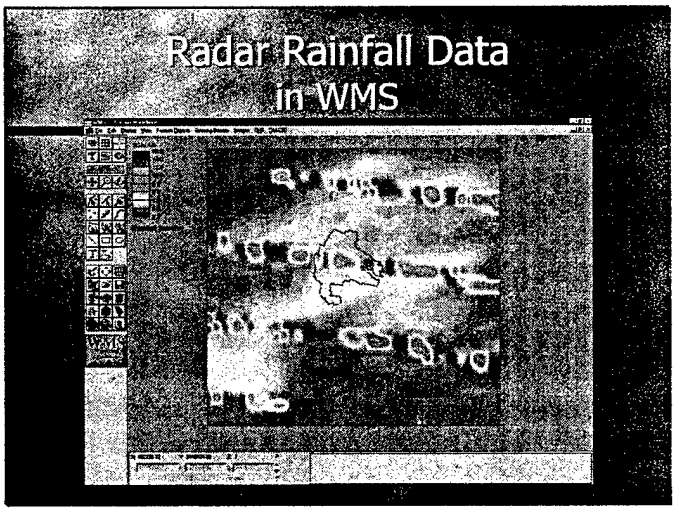

House Creek CASC2D Model

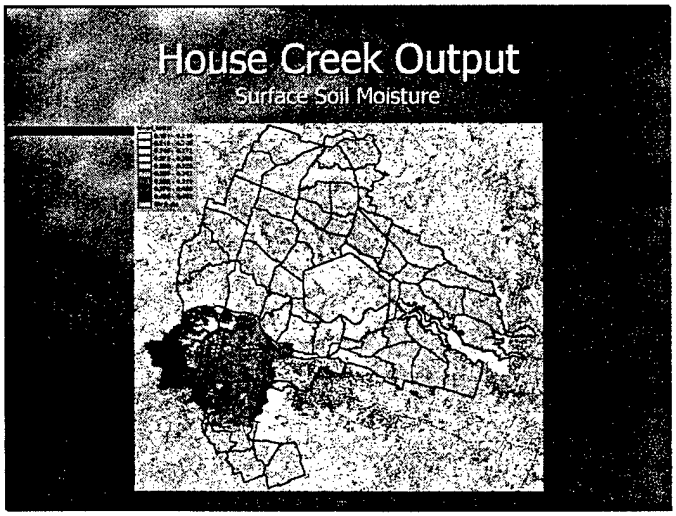

House Creek CASC2D Model

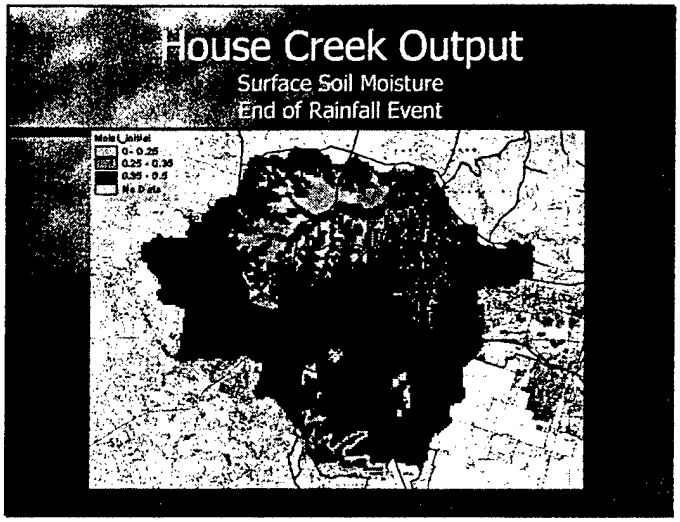

House Creek CASC2D Model
Surface Flow Depth
Time = 3 hrs.
Time = 5 hrs.
Time = 7 hrs.

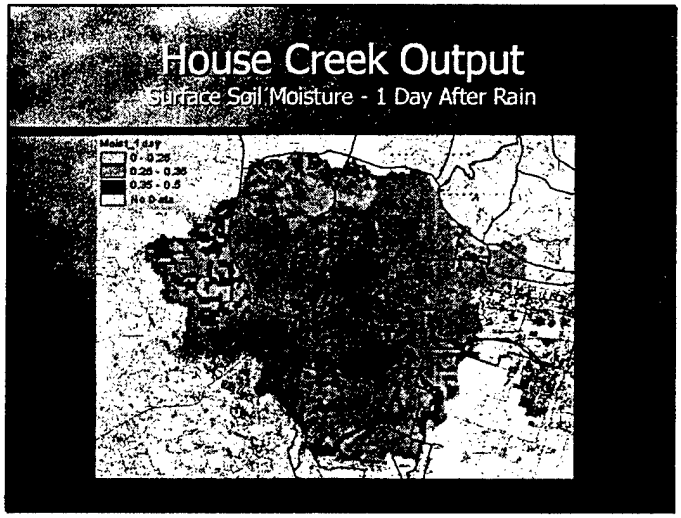

House Creek CASC2D Model
Surface Soil Moisture
End of Rain
+ 1 day
+ 3 days

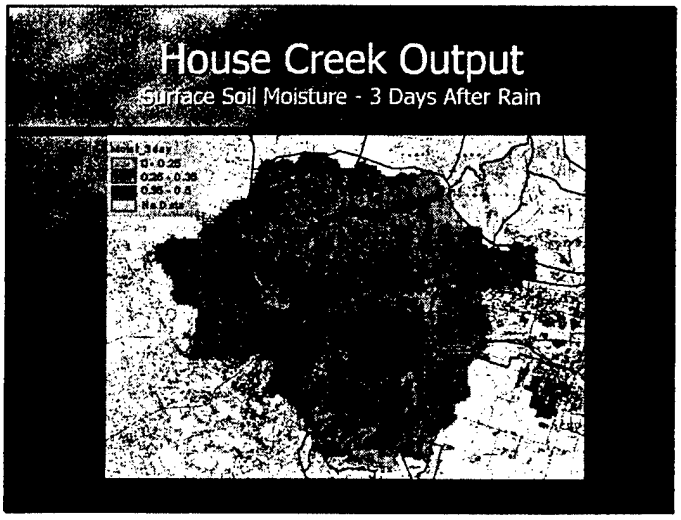

Radar Rainfall Data
- Hourly Data
- 4 km Spatial Resolution
- Imported and Processed for Model using WMS

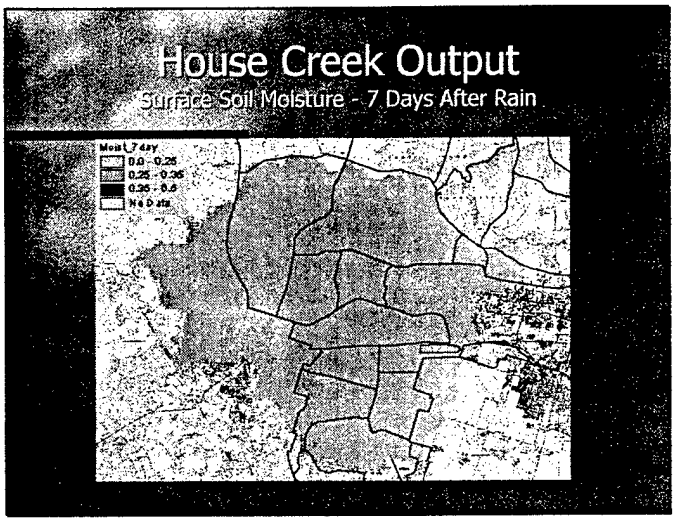

Radar Rainfall Data in WMS


House Creek Output
Surface Soil Moisture


House Creek Output
Surface Soil Moisture
End of Rainfall Event

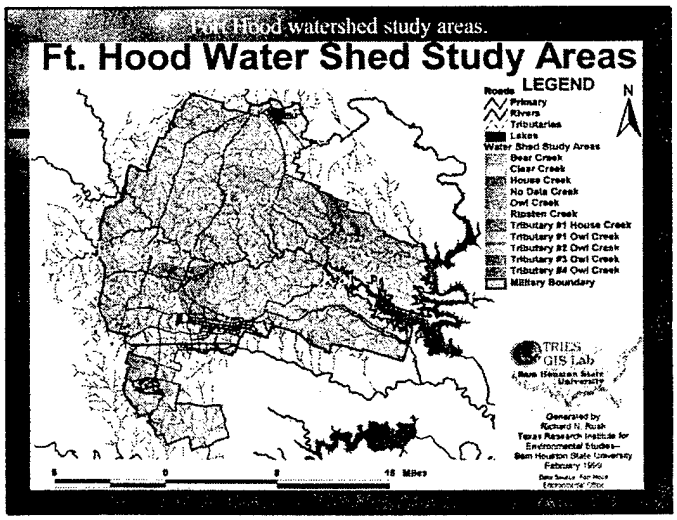

House Creek Output
Surface Soil Moisture - 1 Day After Rain


House Creek Output
Surface Soil Moisture - 3 Days After Rain




## Selection/mapping of Study Watersheds

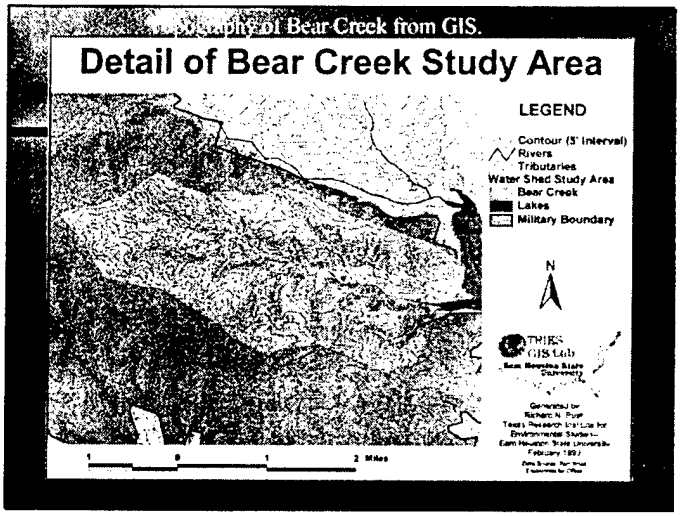
- Three watersheds contained in Base with varying levels of disturbance have been selected.
- Appropriate locations on each stream have been chosen.
- GIS data on watersheds and delineation of watersheds is complete.

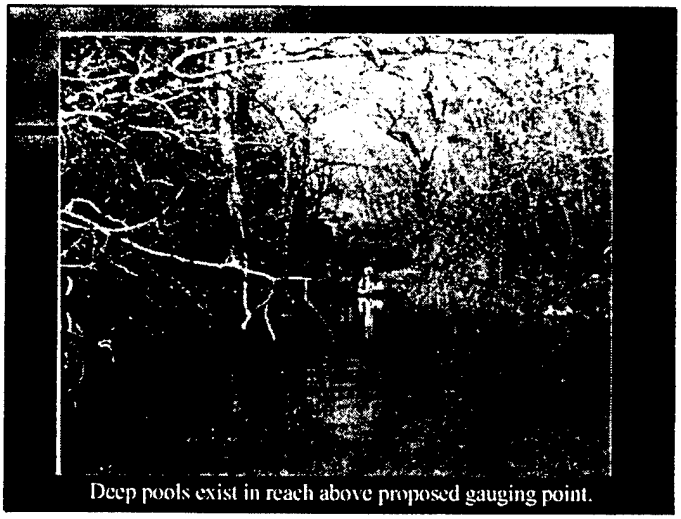


## Bear Creek Watershed.

- Bear Creek Watershed: smallest watershed, flows to Lake Belton.
- Protected from disturbance, due to endangered species & remoteness.
- Most difficult to monitor/telemeter due to lack of access, irregular cross-section and no utilities.
- Base-line for training impact analysis.

Topography of Bear Creek from GIS.

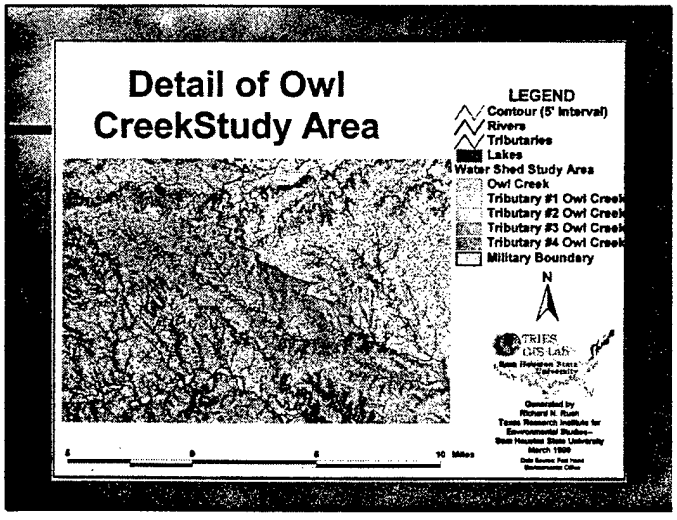


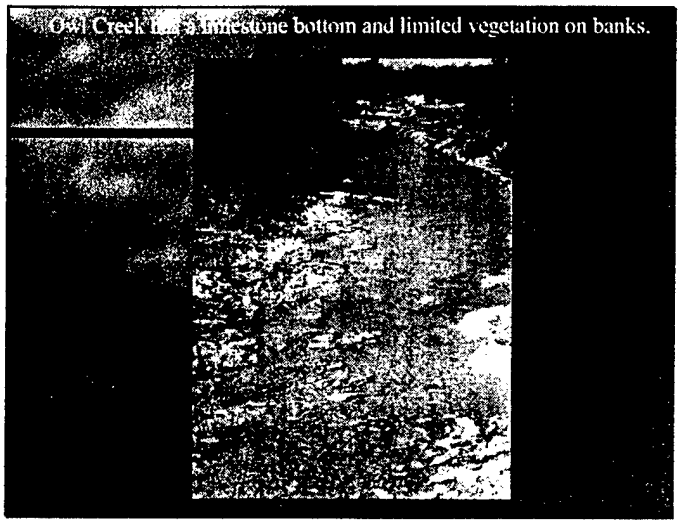



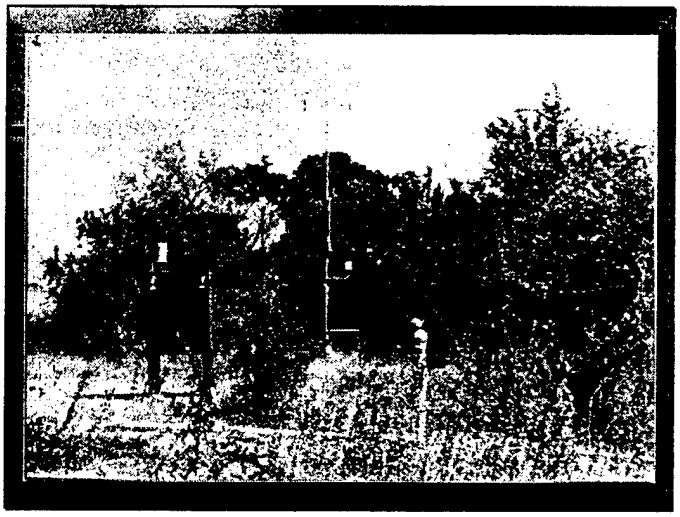
Deep pools exist in reach above proposed gauging point.

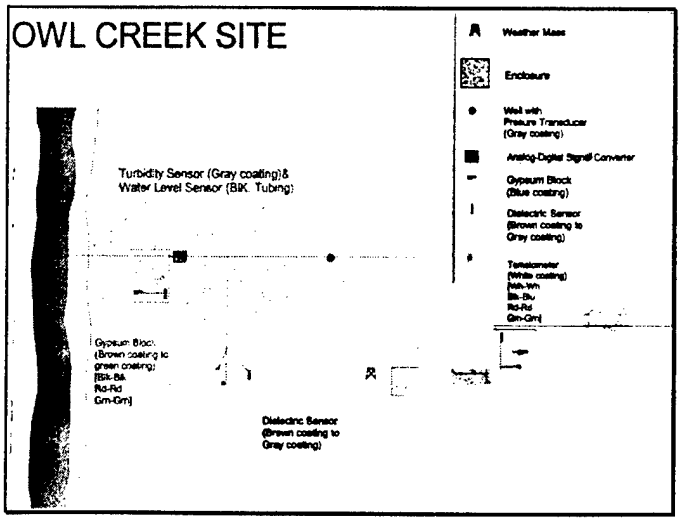
## Owl Creek Watershed.

- Moderate level of disturbance.
- Limited tank training/some portions of basin in artillery impact/live fire areas.
- Intermediate flow.
- 5 sub-sheds, flows to Lake Belton.




Owl Creek has a limestone bottom and limited vegetation on banks.



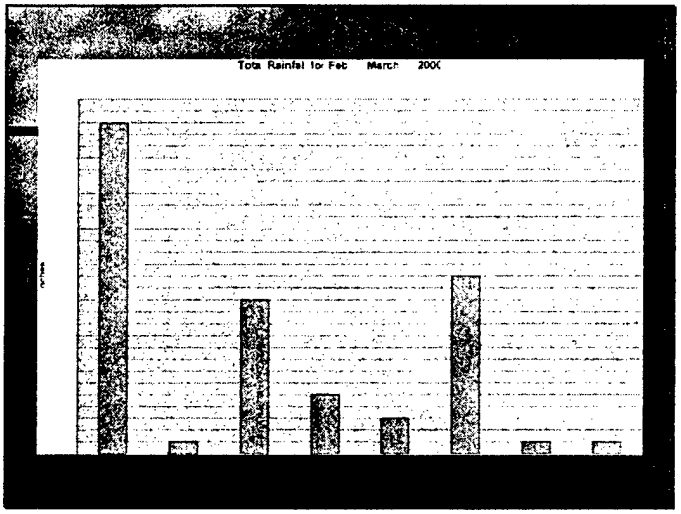

OWL CREEK SITE
Weather Mast
Enclosure
Well with
Pressure Transducer
(Gray coating)
Analog-Digital Signal Converter
Gypsum Block
(Blue coating)
Dielectric Sensor
(Brown coating to
Gray coating)
Tensiometer
(White coating)
Turbidity Sensor (Gray coating)&
Water Level Sensor (BK Tubing)
Gypsum Block
(Brown coating to
green coating)
Dielectric Sensor
(Brown coating to
Gray coating)

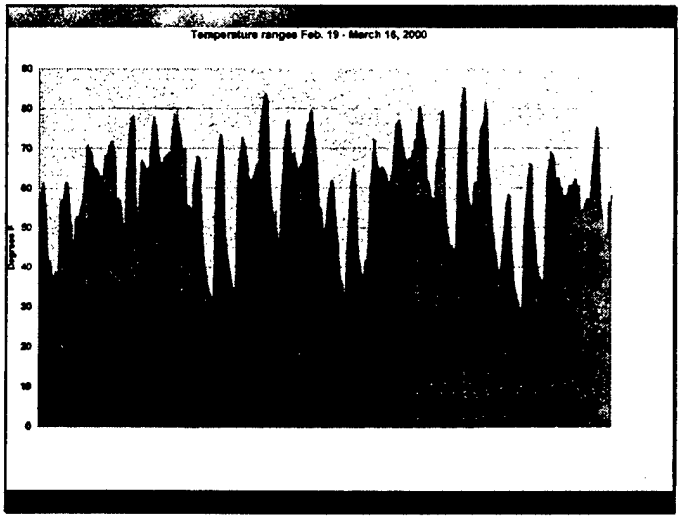
## House Creek

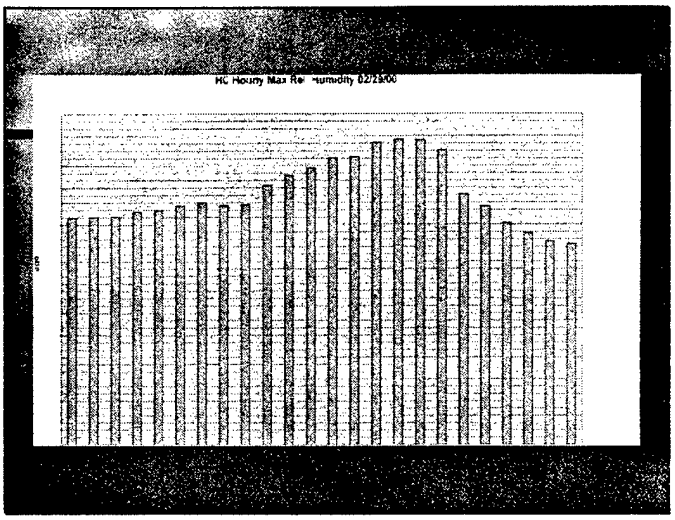
- Greatest level of disturbance, tank training areas in basin.
- Largest flow and watershed.
- Subject to serious flooding.
- Low-water crossing of public road (West Range Road ) is a flood hazard.

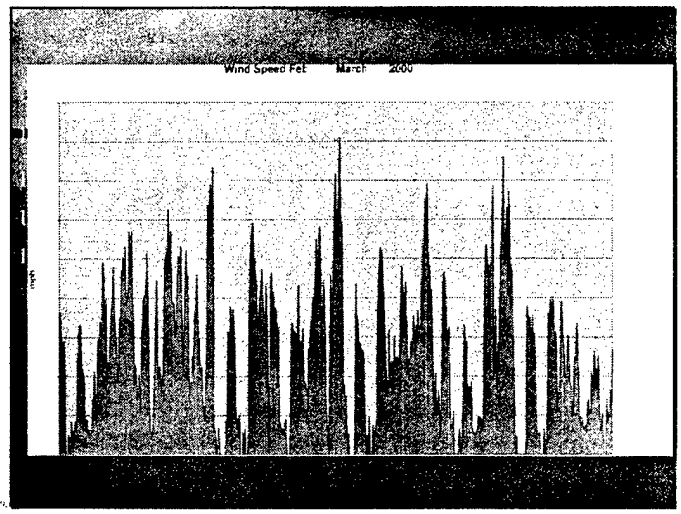
## Weather Data Monitoring and Analysis

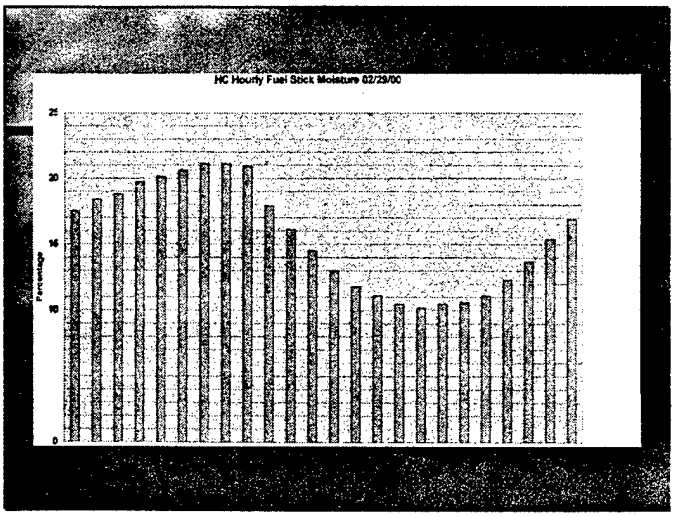
- FTS weather stations installed in each watershed.
- Supplement two existing FTS weather stations (at Airfields) with East-West & North-South gradients.
- Fire weather estimation capability will help fire control and minimize likelihood of wildfires, also assist prescribed burning program.

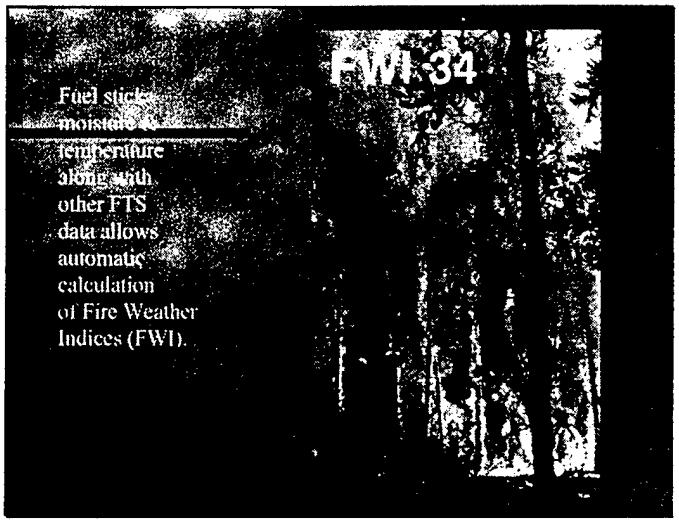






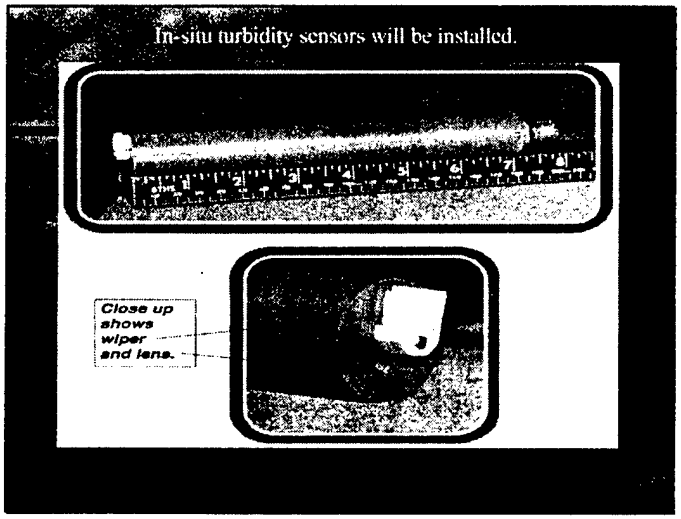

Wind Speed Fet
March
2000

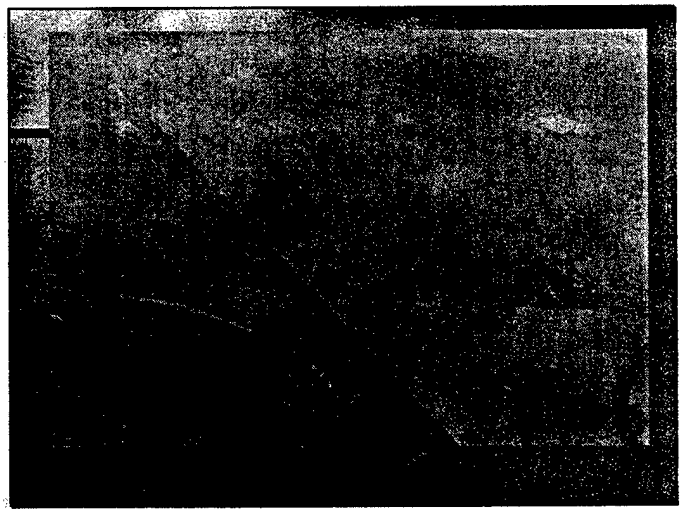

HC Hourly Fuel Stick Moisture 02/29/00
Percentage
25
20
15
10
0

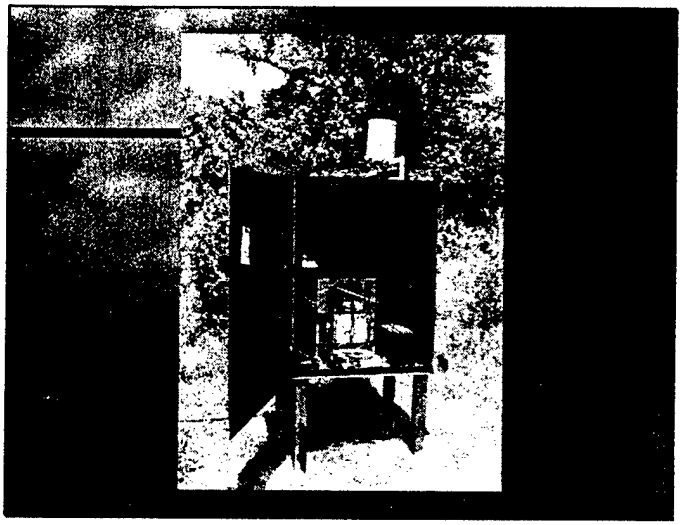



## Stream Stage Monitoring

- Stream stage monitoring sites with bubbler/pressure transducers installed.
- Real time turbidity monitoring in place.
- Data logging capability running.
- Designed to resist loss in flood events.
- All telemetered & solar powered.

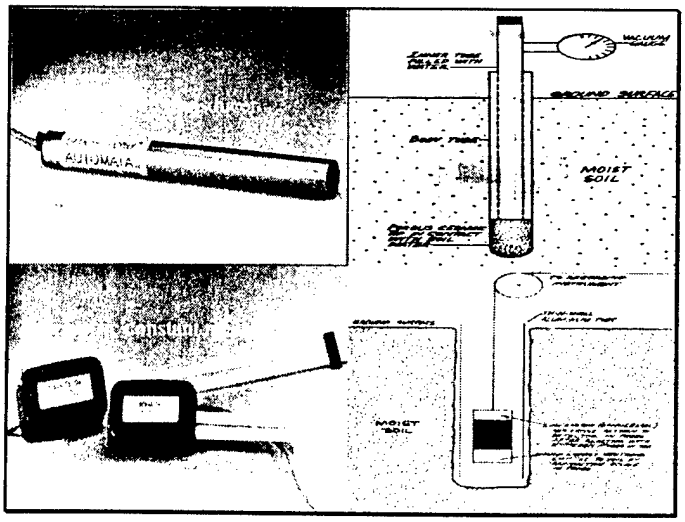




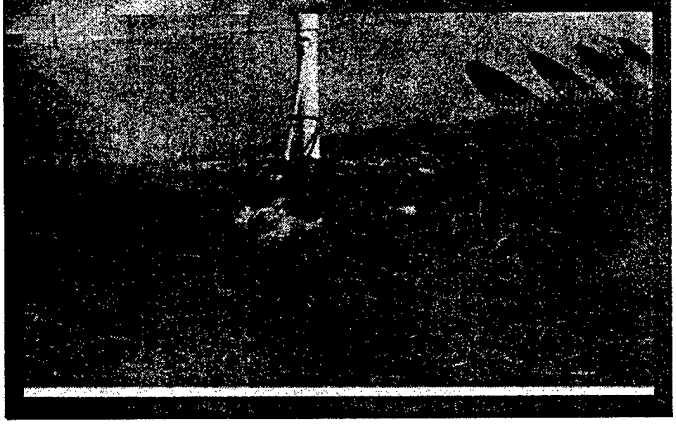


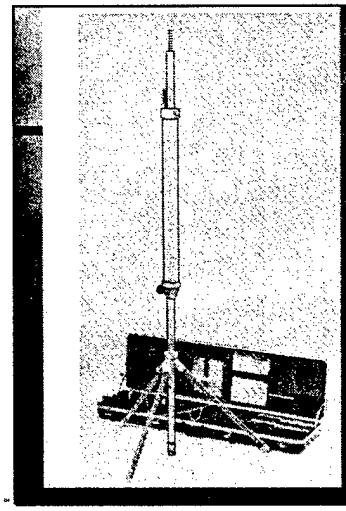
## Soil Moisture/groundwater Monitoring

- Soil moisture/groundwater monitored at each gauging station in upland, mid-slope & riparian zones using:
  - Shallow monitoring wells with PT's.
  - Tensiometers, dielectric constant & resistively soil moisture measurement.
  - Calibrated by neutron probe and lab. soils analysis.



Groundwater monitoring wells installed and monitored with pressure transducer based water level sensors in each watershed. Shallow Groundwater has been absent since January 1999 due to drought.





Guelph Permeameter:
Most accurate method for determination of hydraulic conductivity in the field.
will be used to better characterize watersheds.

## Current Status:

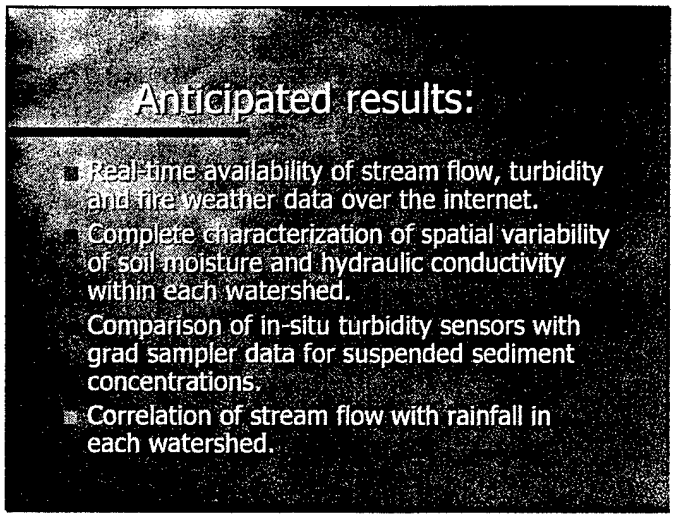
- GIS data analysis is complete.
- Cross-sections and gradients mapped.
- Analysis of existing stream stage and meteorological complete.
- Installation of soil moisture monitoring wells, stream stage, turbidity and meteorological sensors complete.
- Meteorological data from all sites being recorded.
- Next step: telemetry & calibration of sensors.

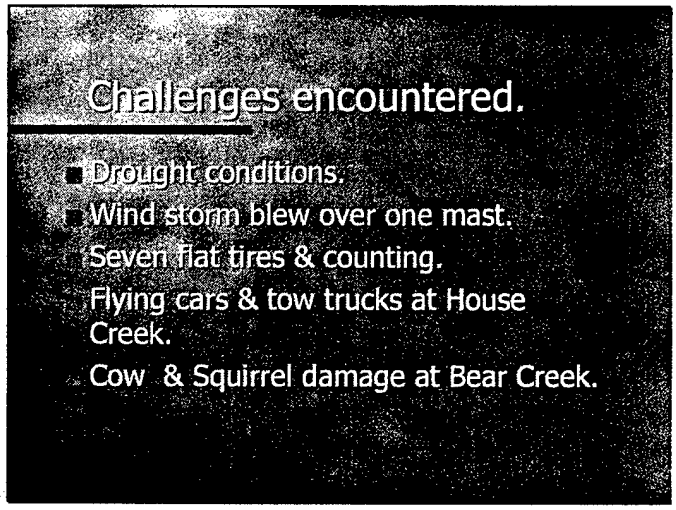
## Coordination Issues:

- Coordination with base facilities management personnel is underway on connection of gauging station telemetry.
- Installation of computer into Base environmental office underway.

## Tasks Remaining.

- Use of Guelph permeameter to characterize HC of watersheds.
- Soil sampling and testing in watersheds.
- More cross-sections to be surveyed with total station.
- Installation of grab sampler.



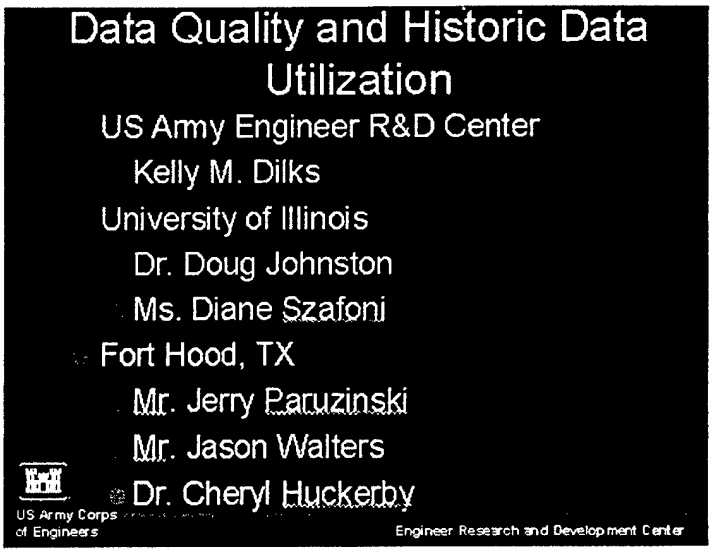



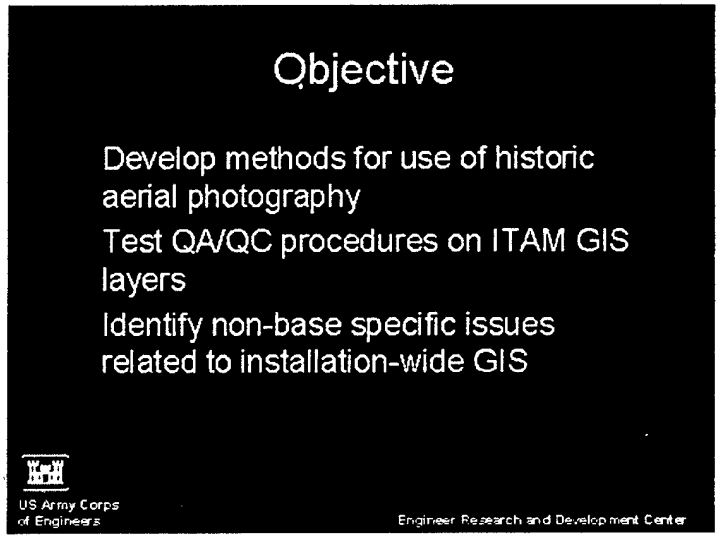

## Data Quality and Historic Data Utilization

PRESENTER: Kelly M. Dilks

ABSTRACT: Information is a key element in all of the Army's Conservation User Requirements. Decisions based on quality data are necessary for each aspect of these user requirements. These data include the exact location of threatened and endangered species habitat, burial grounds, and soil properties for carrying capacity. This presentation discusses the research related to the development of methods for utilization of historic aerial photography, the testing of quality assurance and quality control procedures of geographic information systems data, and issues related to the installation-wide GIS implementation.

PRESENTATION: Data Quality and Historic Data Utilization


Data Quality and Historic Data Utilization
US Army Engineer R&D Center
Kelly M. Dilks
University of Illinois
Dr. Doug Johnston
Ms. Diane Szafoni
Fort Hood, TX
Mr. Jerry Paruzinski
Mr. Jason Walters
Dr. Cheryl Huckerby
US Army Corps of Engineers
Engineer Research and Development Center


Objective
Develop methods for use of historic aerial photography
Test QA/QC procedures on ITAM GIS layers
Identify non-base specific issues related to installation-wide GIS
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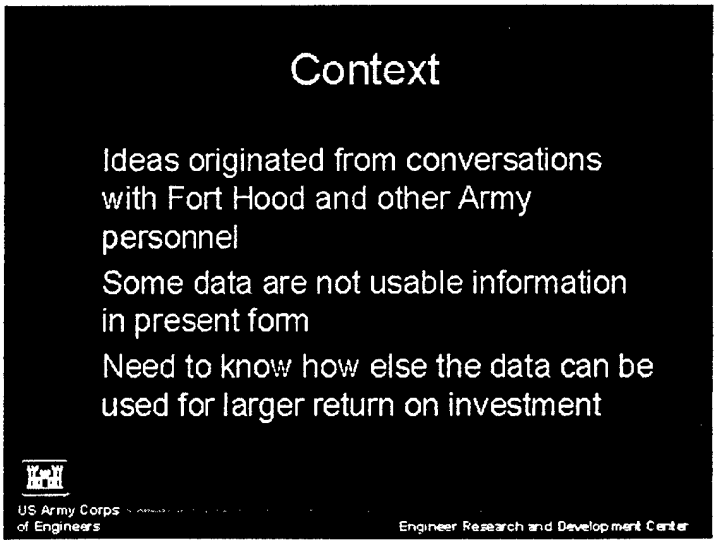
Context
Ideas originated from conversations with Fort Hood and other Army personnel
Some data are not usable information in present form
Need to know how else the data can be used for larger return on investment
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## Final Product

- Methods for quality assurance / quality control for geospatial data
- Methods for usability of historic aerial photography
- Products are not installation specific, but applicable in many environments

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## Integration

- Provide quality data for repository, mapping efforts, and analysis projects
- Provide improved digital data for multi-purpose applications
- Provide guidelines on the potential utilization and applicability of historical data

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## Project Schedule

- Methods and Usability of Historic and Recent Data
  - Scheduled for 30 July 2000
- White paper on technical and infrastructure issues
  - Completed December 1999
- Data accuracy method testing
  - Scheduled for 30 July 2000

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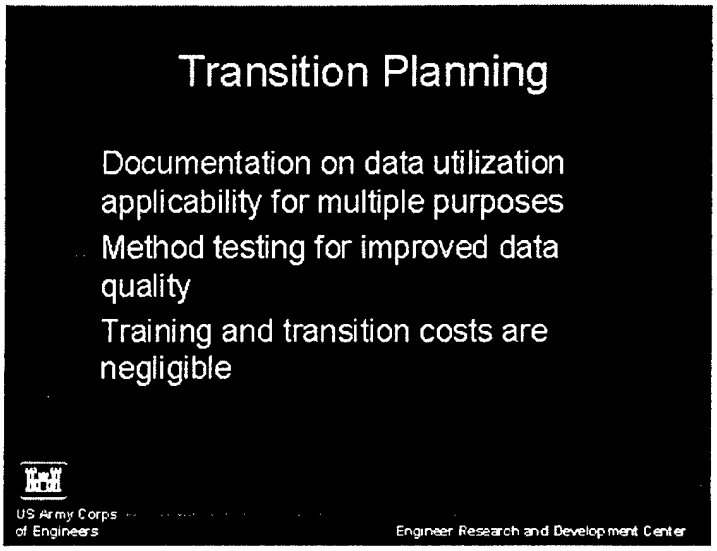
Transition Planning
Documentation on data utilization applicability for multiple purposes
Method testing for improved data quality
Training and transition costs are negligible
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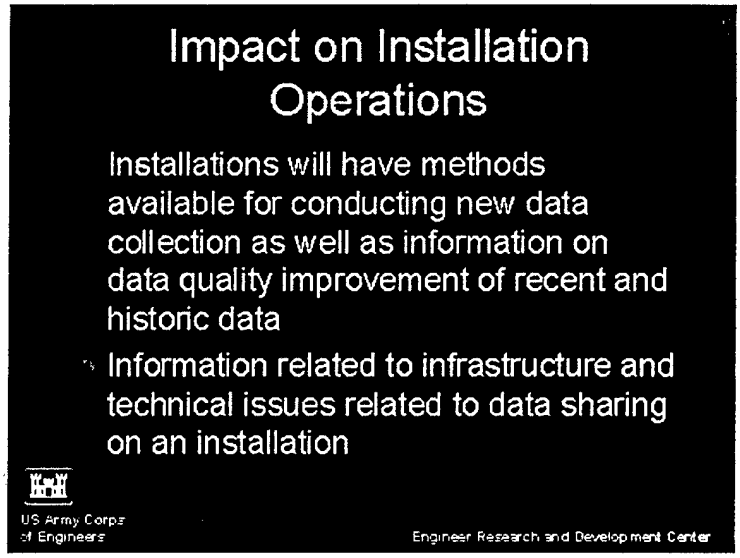
Impact on Installation Operations
Installations will have methods available for conducting new data collection as well as information on data quality improvement of recent and historic data
Information related to infrastructure and technical issues related to data sharing on an installation
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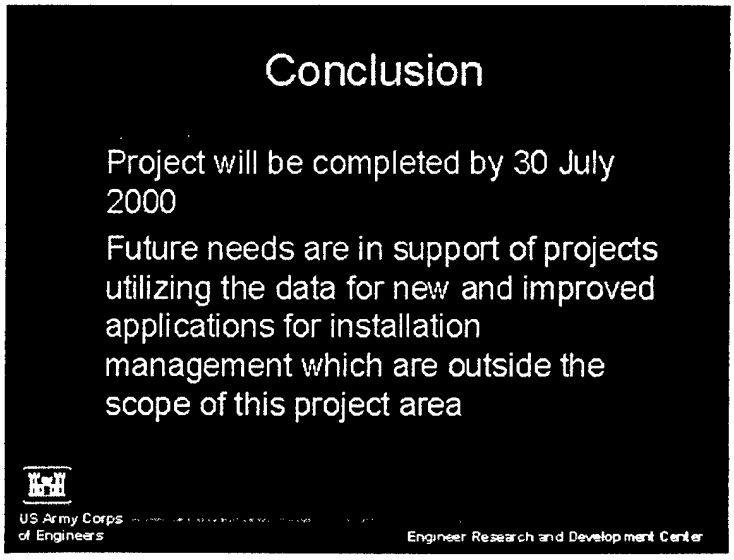
Conclusion
Project will be completed by 30 July 2000
Future needs are in support of projects utilizing the data for new and improved applications for installation management which are outside the scope of this project area
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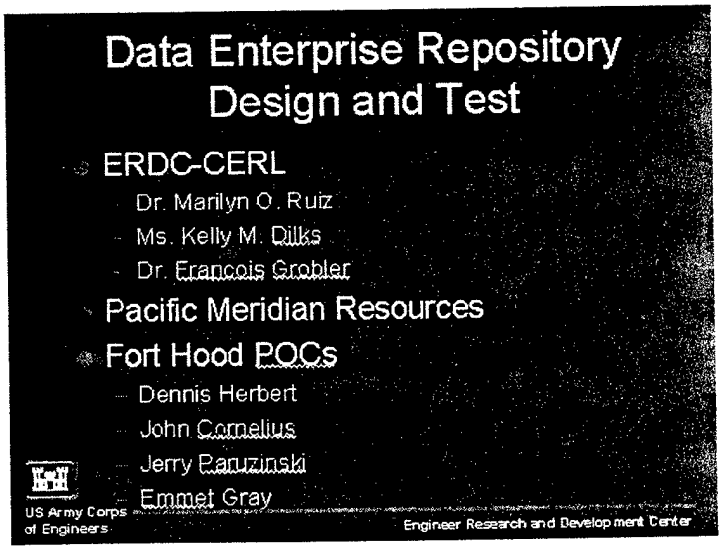
Engineer Research and Development Center

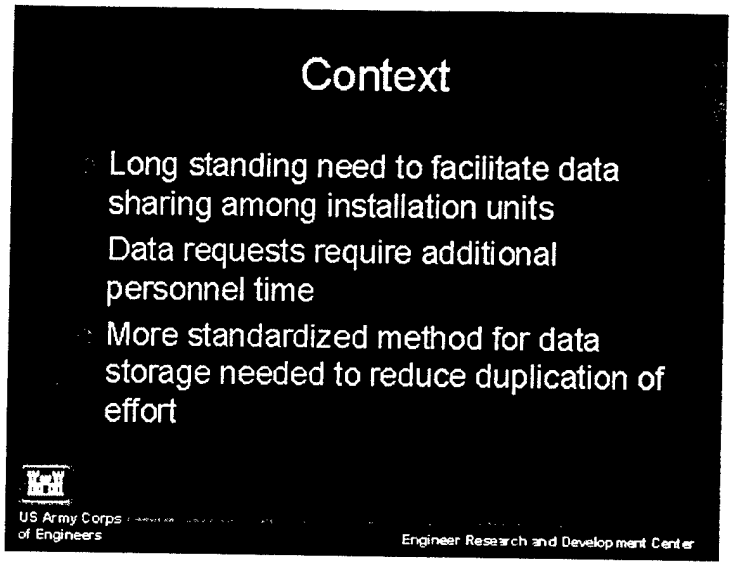
## Data Enterprise Repository Design and Test

PRESENTER: Marilyn Ruiz

ABSTRACT: The Data Enterprise Repository (DER) is a web-based repository of natural resource data for Fort Hood, TX. The repository will facilitate access to diverse land management datasets located across Fort Hood. The repository will provide a common focus for data collection, archiving, and access efforts. This will reduce the need for each data collection site to create disparate collection and archiving methods for geospatial data, and better ensure the long term and widespread usefulness of the information used for land management decisions. Much of the critical information is stored as digital geospatial data sets, such as digital maps, satellite and aerial images, elevation models, and extensive relational databases. The data come from a variety of sources, and are generally in a state of flux, as new data sets are collected and existing data are updated. The data will be used for a diverse range of studies, including those concerned with protection of threatened and endangered species, long term ecological monitoring, and assessment of training impacts. This effort will help facilitate data sharing and will help to ensure the long term and widespread usefulness of the information used for land management decisions, and protect the often extensive investment in data development.

PRESENTATION: Data Enterprise Repository Design and Test




Context
Long standing need to facilitate data sharing among installation units
Data requests require additional personnel time
More standardized method for data storage needed to reduce duplication of effort
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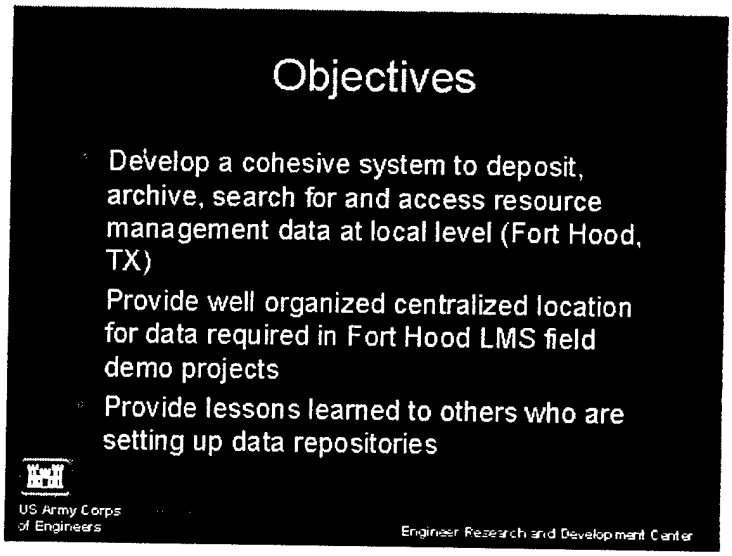
Objectives
Develop a cohesive system to deposit, archive, search for and access resource management data at local level (Fort Hood, TX)
Provide well organized centralized location for data required in Fort Hood LMS field demo projects
Provide lessons learned to others who are setting up data repositories
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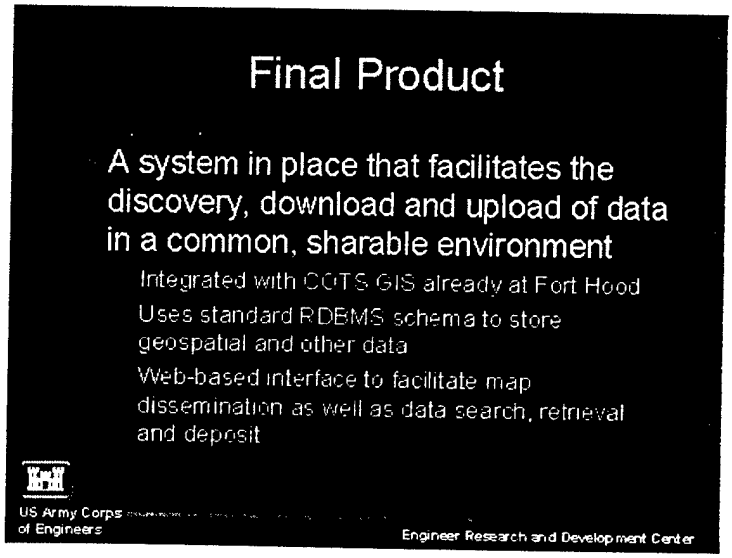
Final Product
A system in place that facilitates the discovery, download and upload of data in a common, sharable environment
Integrated with COTS GIS already at Fort Hood
Uses standard RDBMS schema to store geospatial and other data
Web-based interface to facilitate map dissemination as well as data search, retrieval and deposit
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Engineer Research and Development Center

## Final Product

- Includes guidance for system usage and a plan for full system implementation

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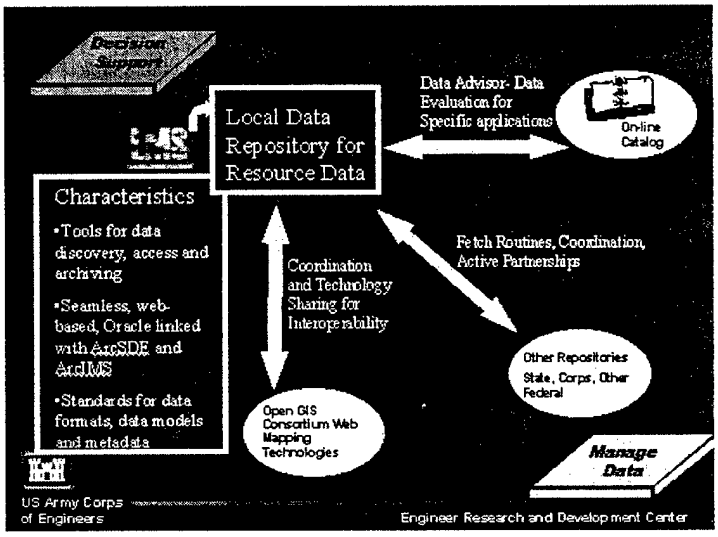


## Integration

- Provide a common data source for LMS integration & Field Demo activities
  - soil moisture monitors
  - design is adaptable to all data formats
- Response to recommendations of the QA/QC work
- Data collection guidelines from QA/QC project are coordinated with repository

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## Project Schedule

- Award contract for Pilot Project
  - 27 Sep 1999 (1 November start date)
- System Architecture Defined
  - Feb 2000
- System Operational off-site
  - Mar 2000

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## Project Schedule - cont

- Data Inventory and Documentation
  - October, 1999 - May, 2000
- Tech Transfer meeting
  - May 2000
- System Operational in testing on-site
  - Aug 2000
- Security Needs Assessment and Usability Test Report
  - Aug 2000

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## Transition Planning

- Phase II includes more complete tech transfer with tutorial and complete user documentation
- Plugs into ArcSDE/RDBMS, ArcIMS and Microsoft Com-based products
- All major components are beneficial to GIS and data sharing. One database instead of two or more.

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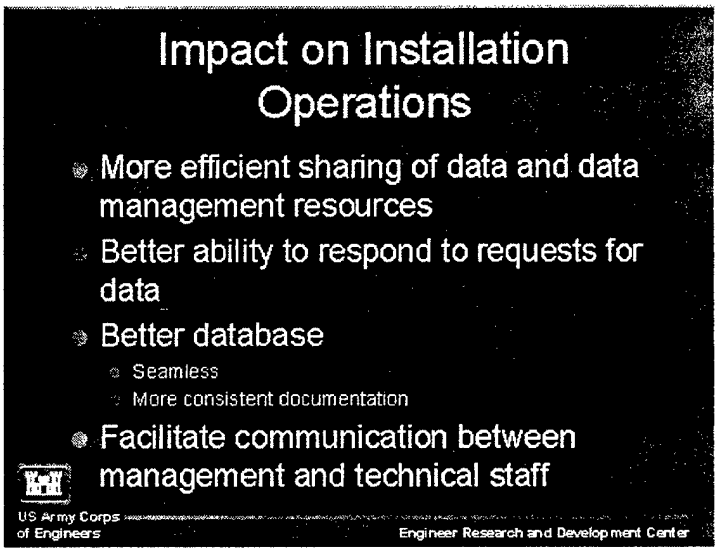
Impact on Installation Operations
More efficient sharing of data and data management resources
Better ability to respond to requests for data
Better database
Seamless
More consistent documentation
Facilitate communication between management and technical staff
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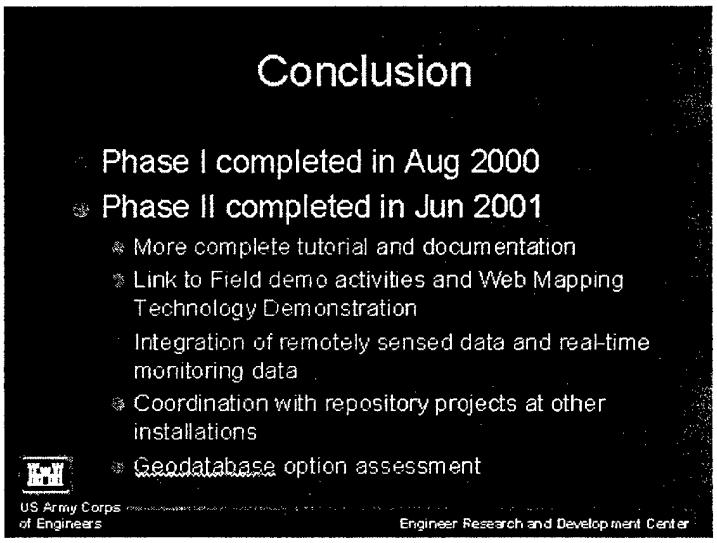
Conclusion
Phase I completed in Aug 2000
Phase II completed in Jun 2001
More complete tutorial and documentation
Link to Field demo activities and Web Mapping Technology Demonstration
Integration of remotely sensed data and real-time monitoring data
Coordination with repository projects at other installations
Geodatabase option assessment
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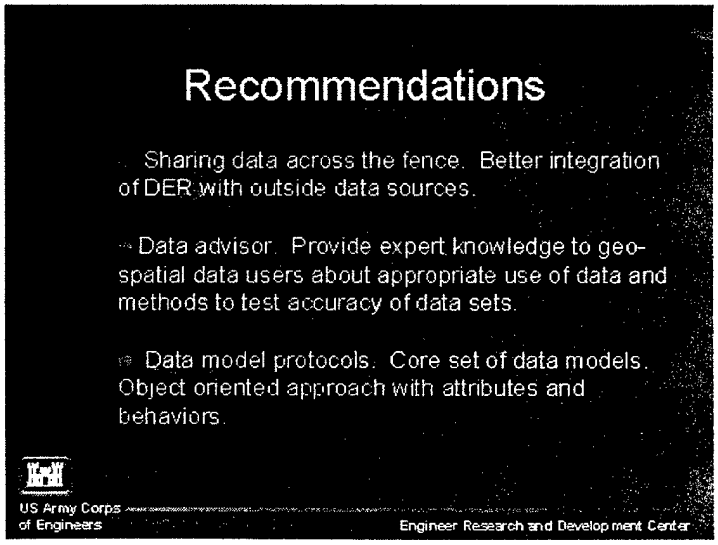
Recommendations
Sharing data across the fence. Better integration of DER with outside data sources.
Data advisor. Provide expert knowledge to geo-spatial data users about appropriate use of data and methods to test accuracy of data sets.
Data model protocols. Core set of data models. Object oriented approach with attributes and behaviors.
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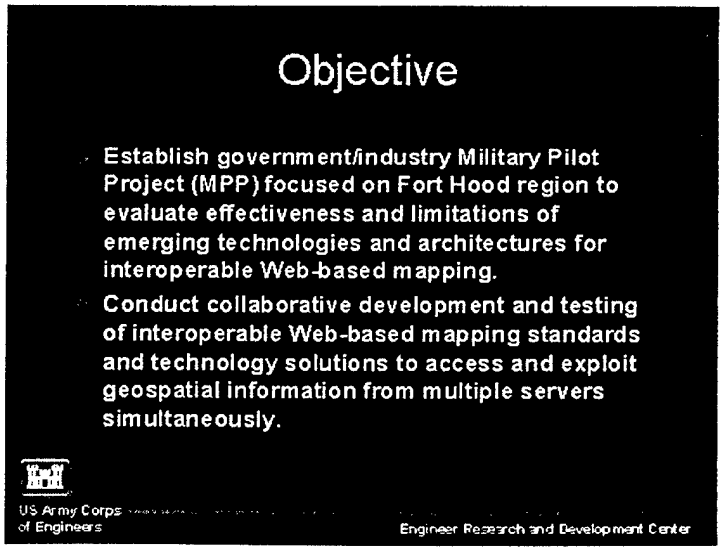
## Web Mapping Testbed

PRESENTERS: Marilyn Ruiz and James Rogers

ABSTRACT: The Web Mapping Technology (WMT) effort will facilitate display (on a web browser) of an integrated view of geospatial data that is stored in various data formats. In May 2000 we will demonstrate prototype commercial off-the-shelf (COTS) web-based mapping clients, middleware catalog and integration tools, and servers. We will integrate (i.e., stack) data layers from various servers and display them on a web browser. These COTS products will share internet/intranet access protocols and an XML language for vector data.

PRESENTATION: Web Mapping Testbed



## Context

- Growing number of online spatial databases. Spatial databases often in a proprietary format
- In 1999, TEC and other agencies, through the OGC, coordinated with industry to develop the Web Mapping Testbed (WMT)
- Initial WMT capabilities successfully demonstrated on 10 September 1999. Pilot projects to follow.
- Upper-Susquehanna Lackawanna Pilot project is first in series. Demonstration in May 2000.

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## Final Product

- Tested, viable standards-based commercial web mapping technology to locate, access, and exploit geospatial information from multiple servers simultaneously using web-based mapping clients, middleware, and internet/intranet access and protocols
- Provides rapid & dynamic on-line access and dissemination to web-based Geospatial Information

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## Integration

- LMS prepares to use OGC Web Map Server Interface and to serve data using the XML (from W3C) and GML (from OGC) specifications
- Fort Hood repository coordinates with TEC to serve required data
- LMS provides modeling capabilities for pilot project application

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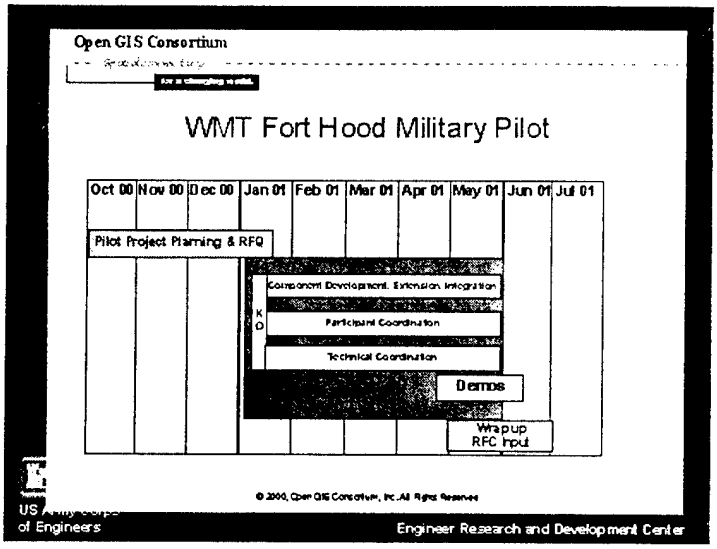
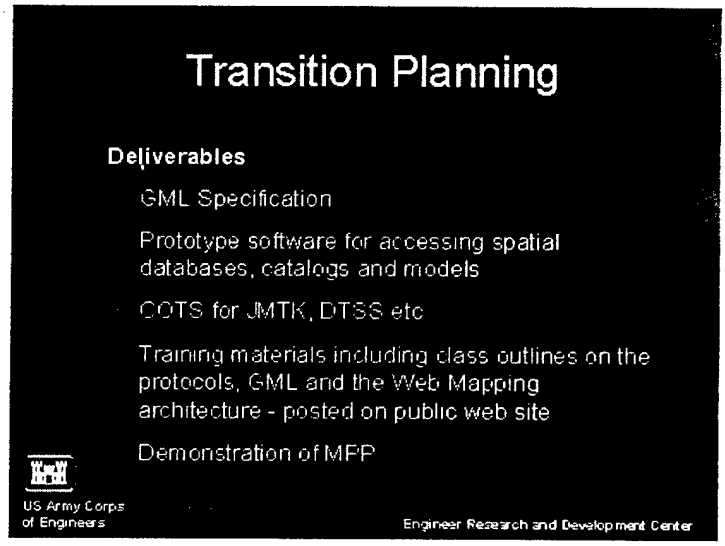

Open GIS Consortium
WMT Fort Hood Military Pilot
Oct 00
Nov 00
Dec 00
Jan 01
Feb 01
Mar 01
Apr 01
May 01
Jun 01
Jul 01
Pilot Project Planning & RFQ
Component Development, Extension, Integration
KO
Participant Coordination
Technical Coordination
Demos
Wrap up
RFC Input
US Army Corps of Engineers
Engineer Research and Development Center


Transition Planning
Deliverables
GML Specification
Prototype software for accessing spatial databases, catalogs and models
COTS for JMTK, DTSS etc
Training materials including class outlines on the protocols, GML and the Web Mapping architecture - posted on public web site
Demonstration of MPP
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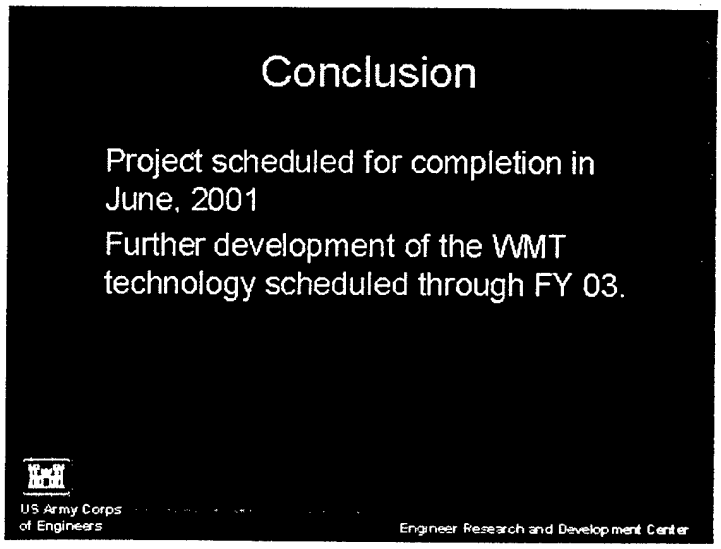
Conclusion
Project scheduled for completion in June, 2001
Further development of the WMT technology scheduled through FY 03.
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## Multi-tiered Vegetation Mapping

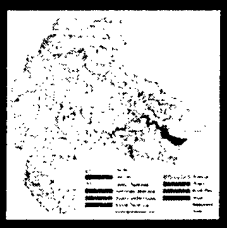
PRESENTERS: Paul Loechl and Jean O'Neil

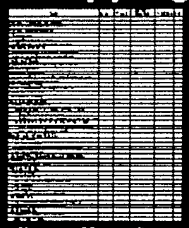
ABSTRACT: Military land managers require maps of vegetation to maximize the long-term use of mission lands and maintain readiness, including the characterization and extent of vegetative communities. A vegetation mapping project started in October 1998 is culminating with a vegetation map due to be ready in April of 2000. The purpose of the project was to: (1) produce a vegetation map useful to all land managers at Fort Hood, TX, (2) demonstrate the applicability of the Protocols for Vegetation Mapping on Military Installations document as a guide and planning tool, and (3) produce a prototype computer tool visually explaining the vegetation mapping parameters outlined in the Protocols document. In addition, vegetation map development costs for this and two other projects were detailed and summarized.

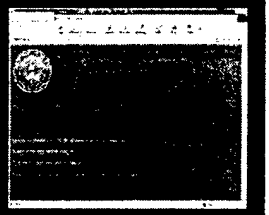
User requirements from land managers in the Department of Public Works (TES and Environmental Resources) and in the G3 office (ITAM) were used to develop map and data requirements as well as a process for producing the vegetation map. The resultant multi-tiered map supplies vegetation map information useful to all land managers. This multi-tiered approach to vegetation mapping, as outlined in the Protocols document, was demonstrated to be useful and applicable to the military process through its complete consideration of user needs and the nature of limited funds. The prototype computer tool, still in development, will aid land managers in understanding the many parameters that need to be considered when developing a vegetation map. Finally, costs from producing this map, and from two other vegetation maps at other locations, have been detailed by task and summarized. They provide a clearer examination of costs that may be useful in the scoping and planning phase of future mapping efforts, including developing appropriate government estimates related to contracting.

PRESENTATION: Multi-tiered Vegetation Mapping

## Multi-tiered Vegetation Mapping


Vegetation Map


Vegetation Mapping Costs


Hierarchical Prototype Tool

- Paul Loechl and Jean O'Neil, PhD (ERDC)
- Fort Hood DPW and G3 Office
  - John Cornelius (TES)
  - Jason Walters (ITAM)
  - Dennis Herbert (Natural Resources)

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## Project Objectives

Multi-tiered Vegetation Map

Produce a vegetation map useful to all installation users (varied costs, time, level of effort, geographic area, detail)

Test of methodology in "Guidelines for Mapping Vegetation on Army Installations"

Hierarchical Prototype

Simplified & graphical tool for scoping veg maps

Vegetation Mapping Costs

- Develop data relationships of costs and mapping parameters

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## Vegetation Mapping: Fort Hood and the Army

Vegetation map requirements

- Planning Level surveys, mission related work
- Modeling efforts/LMS program
- Basic data layer supporting land management

Fort Hood requirements

- Need to map TES habitat structure
- Provide vegetation patterns for training
- Data input for EDYS, ATTACC, soil erosion modeling, pest management modeling

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# Final Products

Vegetation Map:

- TES habitat structure (juniper, live oak, post oak)
- Training veg patterns (grassland/herbaceous/open areas, juniper, and deciduous stands

Hierarchical Prototype:

- Visual tool of vegetation mapping parameters based upon NVCS classification hierarchy
- Scale, detail, time, cost, level of effort, user need, data need

Vegetation Mapping Costs

- Fort Hood, Lake Clark NP, and USFS Region 5
- Summary breakout of costs and time by task and person

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# Integration

- Vegetation Map
  - Basic data layer for land management activities
    - TES documentation and management
    - ITAM
    - pest management
    - planning level survey and management plans
  - Data input to modeling
    - carrying capacity (ATTACC)
    - plant succession (EDYS)
    - soil erosion (C-factor, comparative soil erosion model testing)
    - change detection (vegetation dynamics)
    - training land usage patterns (MIDM)
  - Demo of "Guidelines for Mapping Vegetation"
    - multi-tiered user requirements
    - multi-tiered vegetation classification (NVCS)

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# Integration

- Hierarchical Prototype Tool
  - Tool for future vegetation map projects
  - Collaborative work with other agencies and TNC
- Vegetation Costs
  - Data for future vegetation map projects DoD-wide
  - Data input for the "Guidelines for Mapping Vegetation on Military Installations"

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# Project Schedule

**Vegetation Map**

| Milestone | Project Date | Actual Date |
|---|---|---|
| 1. Planning and scoping meeting | October 1998 | October 1998 |
| 2. Data acquisition | Feb 1999 | June 1999 |
| 3. Pilot study | April-May 1999 | April-May 1999 |
| 4. Field work | June-August 1999 | July-October 1999 |
| 5. Accuracy assessment | September 1999 | December- March 2000 |
| 6. Preliminary maps | September 1999 | March 2000 |
| 7. Final maps and report | September 1999 | April 2000 |

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# Project Schedule

**Hierarchical Prototype**

| Milestone | Project Date | Actual Date |
|---|---|---|
| 1. Planning and scoping meeting | October 1998 | October 1998 |
| 2. Interagency coordination | November 1998 | November 1998 |
| 3. Prototype concept demonstration and review | March 1999 | March 1999 |
| 4. Database design and field collection | July 1999 | September 1999 |
| 5. Draft prototype | August 1999 | March 2000 |
| 6. Demonstration of draft prototype | September 1999 | April 2000 |
| 7. Final hierarchical prototype | September 1999 | April 2000 |

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# Project Schedule

**Vegetation Map Costs**

| Milestone | Project Date | Actual Date |
|---|---|---|
| 1. Project start-up meeting | October 1999 | October 1999 |
| 2. Cost compilation for completed veg maps | December 1999 | March 2000 |
| 3. Fort Hood veg map costs compilation report | March 2000 | March 2000 |
| 4. Cost analysis report | May 2000 | May 2000 |

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## Transition Planning

- Fort Hood
  - Vegetation map (paper, ArcInfo and Erdas Imagine)
  - Vegetation mapping methodology report
  - Hierarchical prototype tool (web enabled)
- Army
  - Vegetation methodology report
  - Vegetation mapping cost information
  - Hierarchical prototype tool (web enabled)

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## Impact on Installation Operations

- Land managers and trainers
  - richer data for management of TES habitat
  - defined vegetation patterns for the training mission
  - refined data for modeling land use and for developing management plans
  - fundamental data layer as input to most land management activities.
  - demonstration of the utility of identifying user requirements and matching them to map requirements
  - demonstration of using a standard hierarchical classification system.

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## Conclusion

- Project complete May 2000
- Future needs
  - Leaf-on imagery collection
    - break out deciduous categories
    - higher accuracy on classing deciduous vs evergreen
  - Fire history data
  - Vegetation map cost monitoring and estimator tool for hierarchical tool

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## Recommendations

- Collect 1 m. leaf-on data to break out deciduous classes
- Additional field work to class grasses to association level
- Develop a fire history GIS layer

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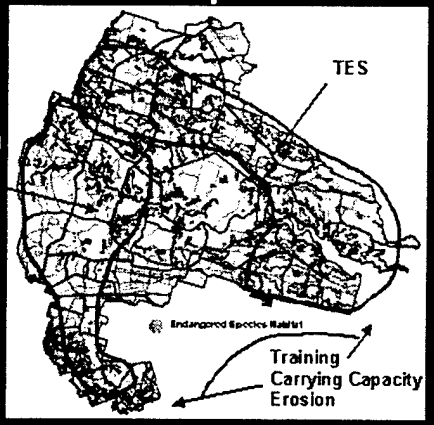
## User Requirements

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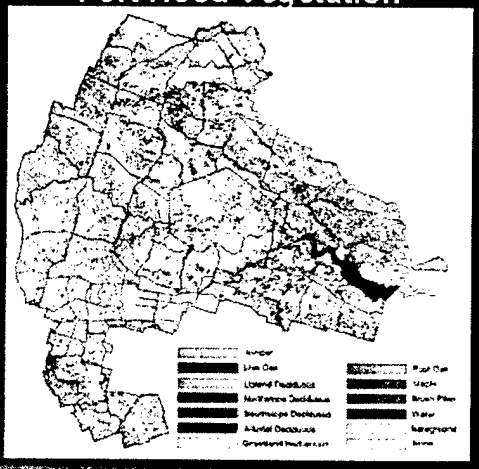
## Fort Hood Vegetation



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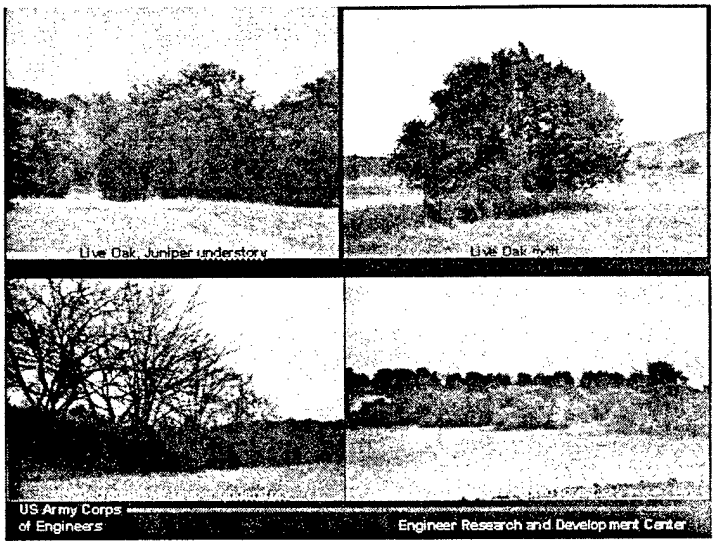
Live Oak, Juniper understory
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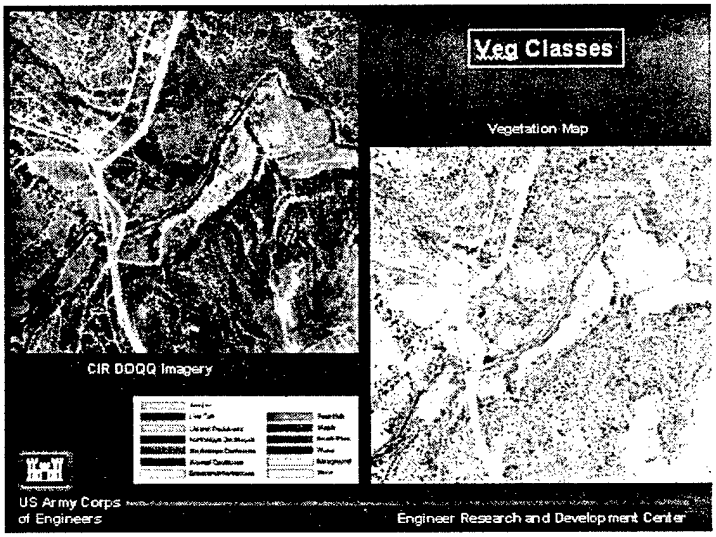
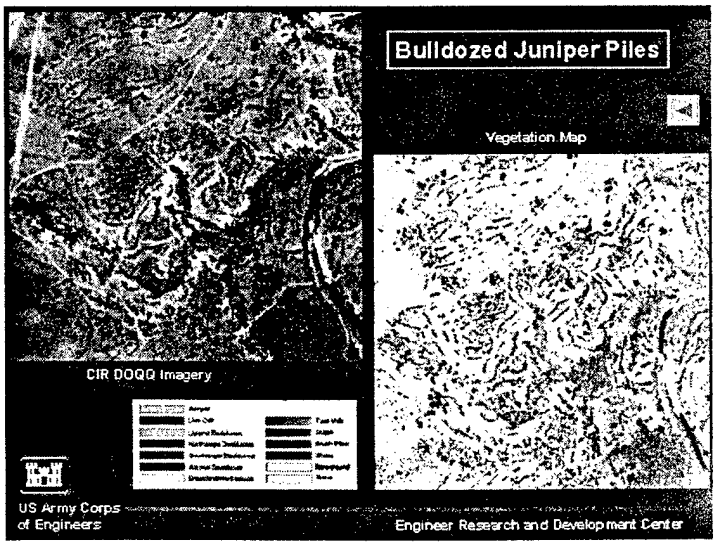
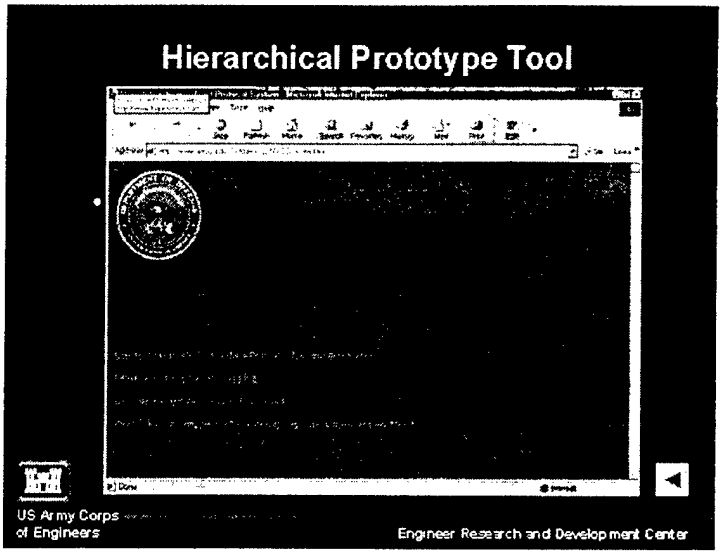
Engineer Research and Development Center


Veg Classes
Vegetation Map
CIR DOQQ Imagery
US Army Corps of Engineers
Engineer Research and Development Center


Bulldozed Juniper Piles
Vegetation Map
CIR DOQQ Imagery
US Army Corps of Engineers
Engineer Research and Development Center


Hierarchical Prototype Tool
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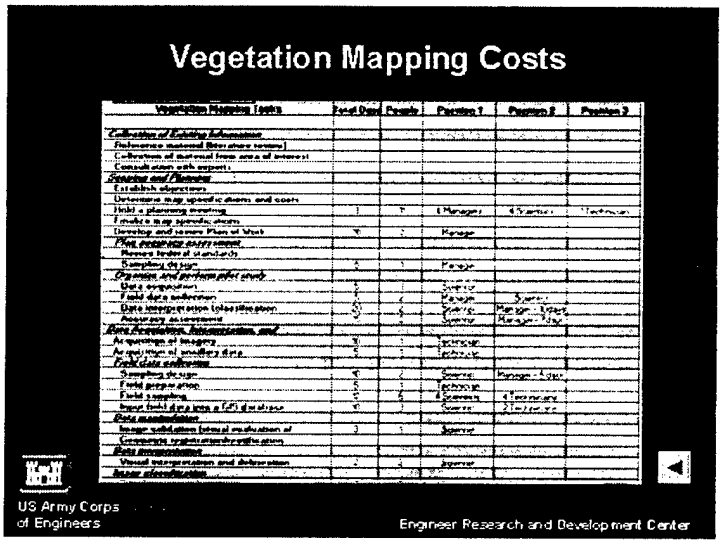
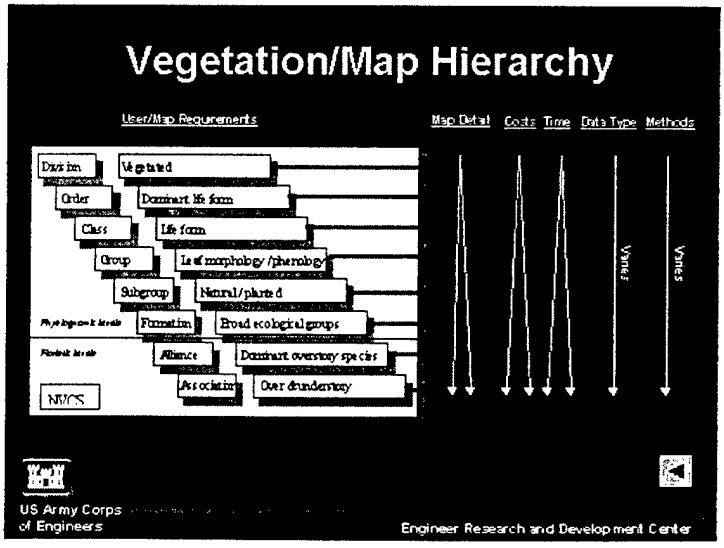

Vegetation Mapping Costs
US Army Corps of Engineers
Engineer Research and Development Center


Vegetation/Map Hierarchy
User/Map Requirements
Map Detail
Costs
Time
Data Type
Methods
Division
Vegetated
Order
Dominant life form
Class
Life form
Group
Leaf morphology /phenology
Subgroup
Natural/planted
Formation
Broad ecological groups
Alliance
Dominant overstory species
Association
Over & understory
NVCS
Varies
Varies
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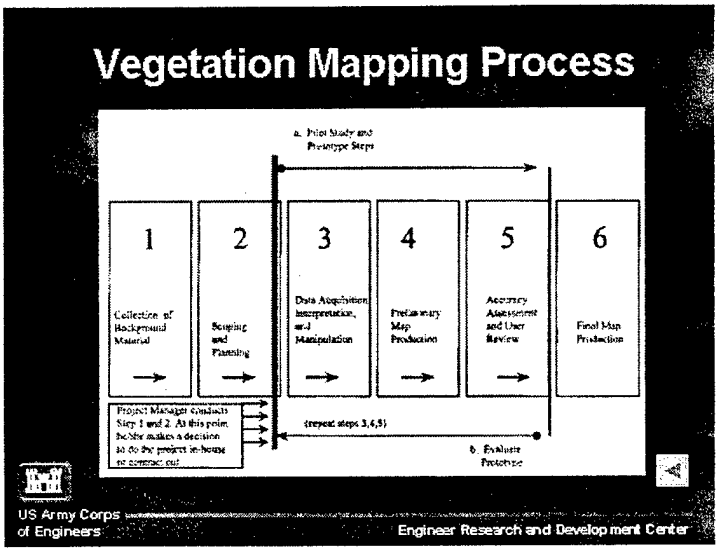
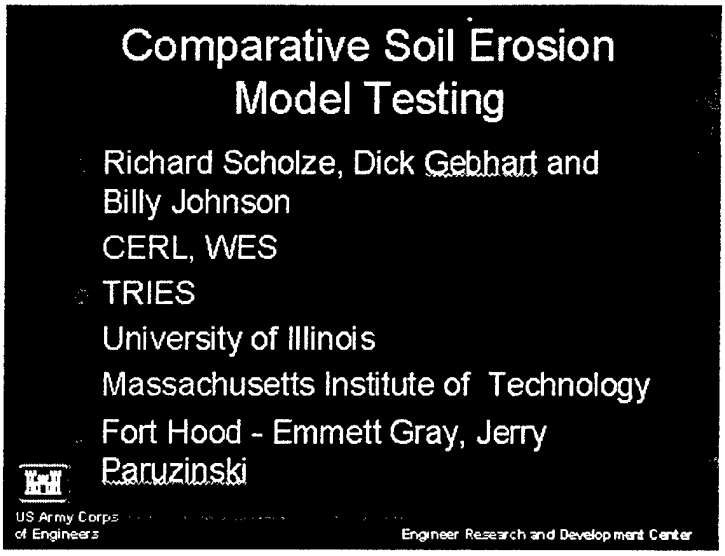


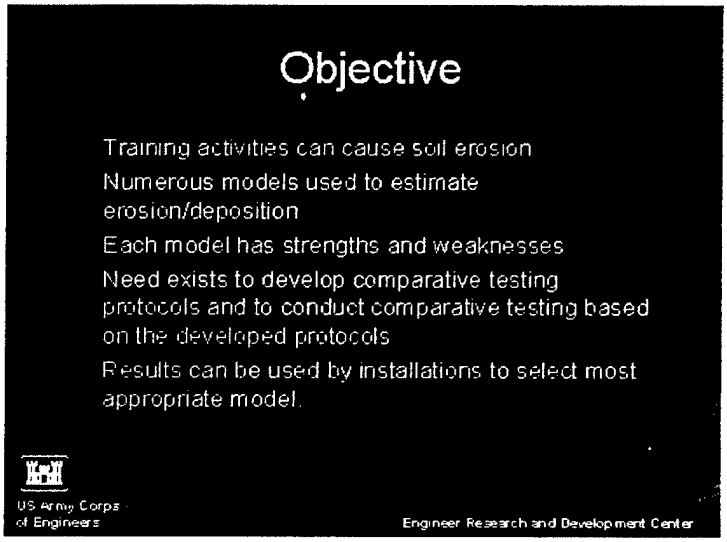

## Comparative Soil Erosion Model Testing

PRESENTERS: Rich Scholze, Dick Gebhart

ABSTRACT: The Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL) conducts research regarding soil erosion on Department of Defense properties around the world. Excessive runoff, soil erosion, and consequent sedimentation of waterways may create unsafe and/or unrealistic military training environments. Off-site damage may occur as a result of flooding or sedimentation. To mitigate the potential damages from runoff, erosion, and sedimentation, numerous predictive erosion and sedimentation models such as Simulated Water Erosion (SIMWE), Universal Soil Loss Equation (USLE), Two Dimensional Cascading Runoff (CASC2D), and Channel Hillslope Integrated Landscape Development (CHILD) have been developed by several organizations independently from one another. Each model has respective strengths and weaknesses depending on site specific characteristics and data availability. Because of inherent differences between models and their abilities to accurately estimate soil erosion/deposition under a given set of environmental conditions, there is a need to: (1) develop protocols for comparatively testing different models, and (2) conduct comparative soil erosion/deposition model testing based upon the protocols developed. Protocol development and model testing will occur using common test sites where digital elevation models (DEM) of variable resolution exist (1m, 5m, 10m). Through this effort it will be determined how the various models perform both within and between DEM's and under differing terrain and military usage.

PRESENTATION: Comparative Soil Erosion Model Testing


Comparative Soil Erosion Model Testing
Richard Scholze, Dick Gebhart and Billy Johnson
CERL, WES
TRIES
University of Illinois
Massachusetts Institute of Technology
Fort Hood - Emmett Gray, Jerry Paruzinski
US Army Corps of Engineers
Engineer Research and Development Center


Objective
Training activities can cause soil erosion
Numerous models used to estimate erosion/deposition
Each model has strengths and weaknesses
Need exists to develop comparative testing protocols and to conduct comparative testing based on the developed protocols
Results can be used by installations to select most appropriate model.
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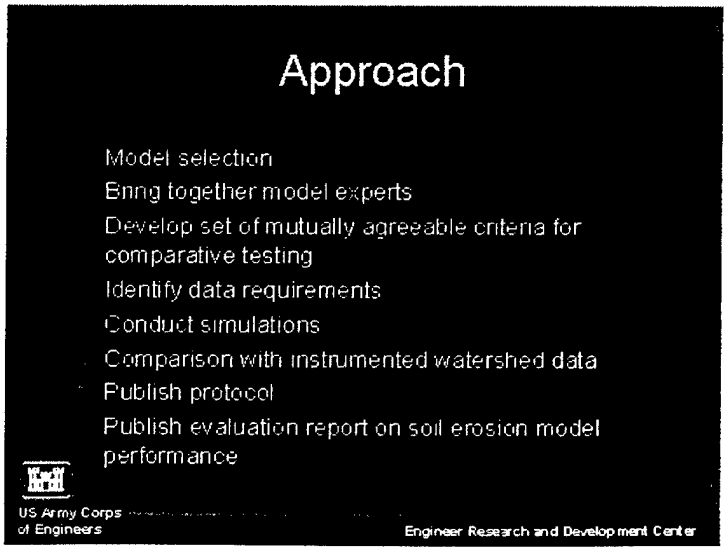
Engineer Research and Development Center


Approach
Model selection
Bring together model experts
Develop set of mutually agreeable criteria for comparative testing
Identify data requirements
Conduct simulations
Comparison with instrumented watershed data
Publish protocol
Publish evaluation report on soil erosion model performance
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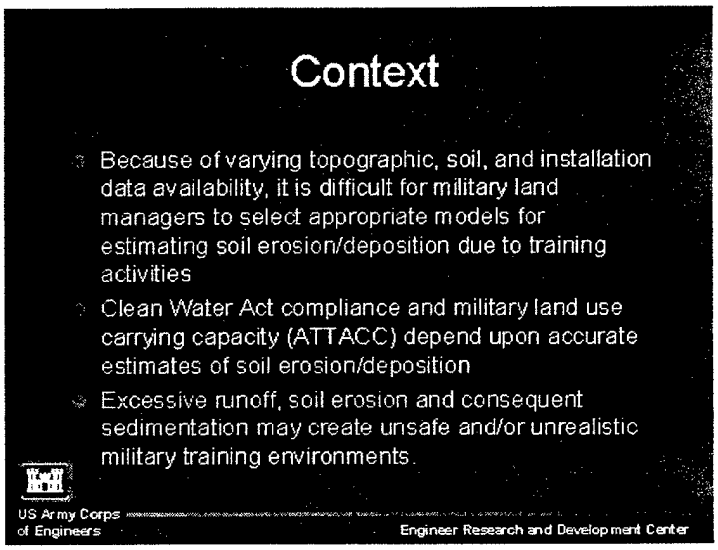
Context
Because of varying topographic, soil, and installation data availability, it is difficult for military land managers to select appropriate models for estimating soil erosion/deposition due to training activities
Clean Water Act compliance and military land use carrying capacity (ATTACC) depend upon accurate estimates of soil erosion/deposition
Excessive runoff, soil erosion and consequent sedimentation may create unsafe and/or unrealistic military training environments.
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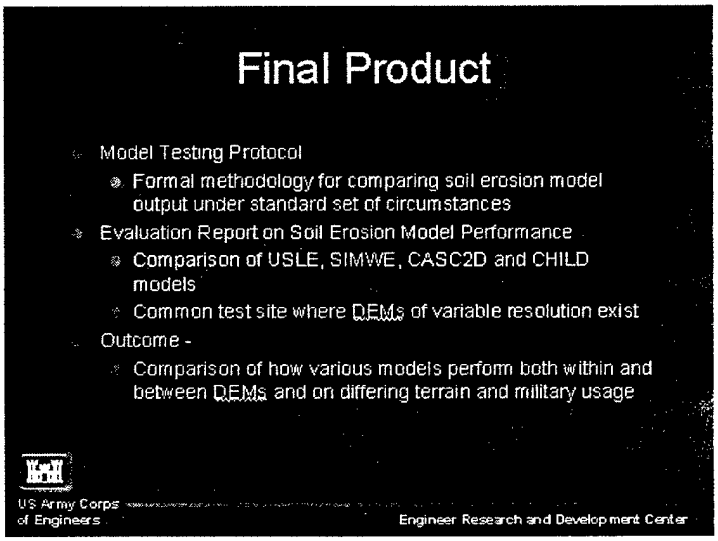
Final Product
Model Testing Protocol
Formal methodology for comparing soil erosion model output under standard set of circumstances
Evaluation Report on Soil Erosion Model Performance
Comparison of USLE, SIMWE, CASC2D and CHILD models
Common test site where DEMs of variable resolution exist
Outcome -
Comparison of how various models perform both within and between DEMs and on differing terrain and military usage
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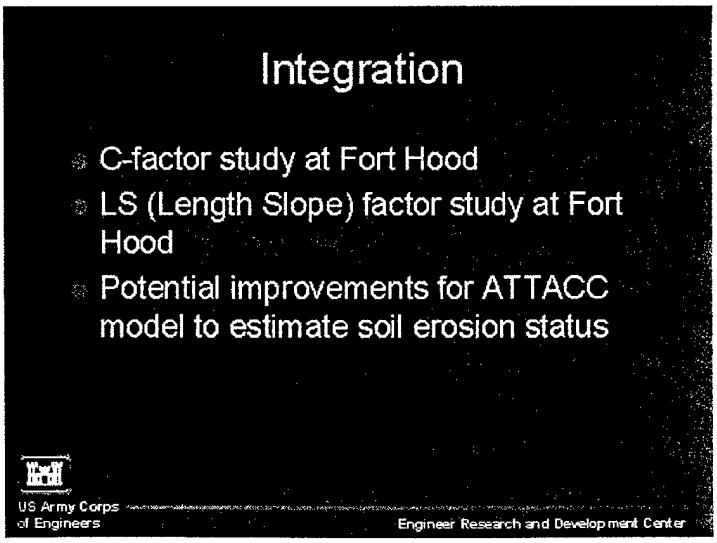
Integration
C-factor study at Fort Hood
LS (Length Slope) factor study at Fort Hood
Potential improvements for ATTACC model to estimate soil erosion status
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Engineer Research and Development Center

## Project Schedule

Develop Testing Protocol 3Q FY00

Model Comparisons Underway 4Q FY00

Evaluation Report 3Q FY01

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## Transition Planning

- Guidance for selecting most appropriate soil erosion/deposition model based on a user-defined set of site data

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## Impact on Installation Operations

Appropriate/accurate choice of model given military installation specifics and available data

Value of the product – "Smart User"

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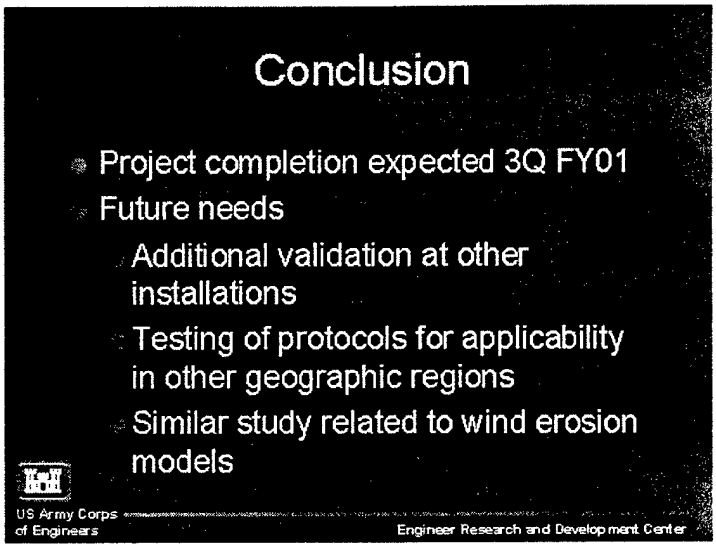
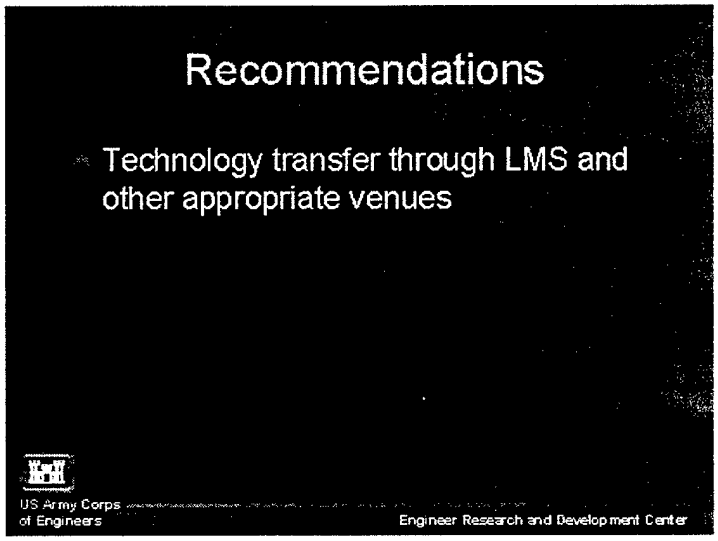


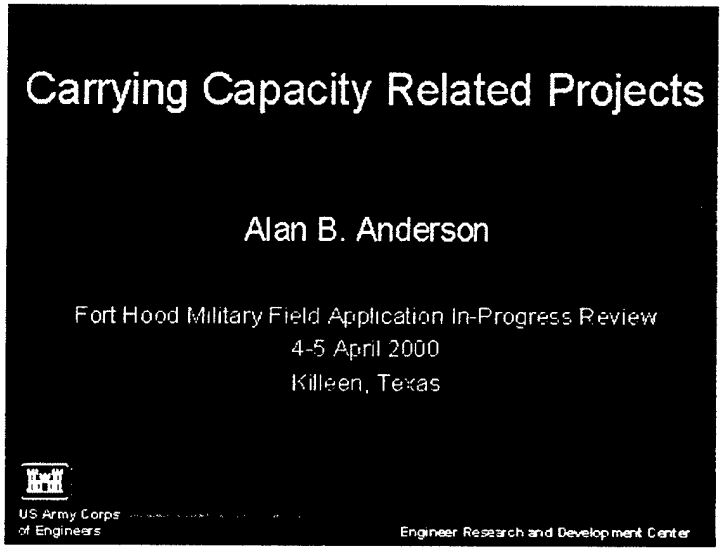

## Carrying Capacity

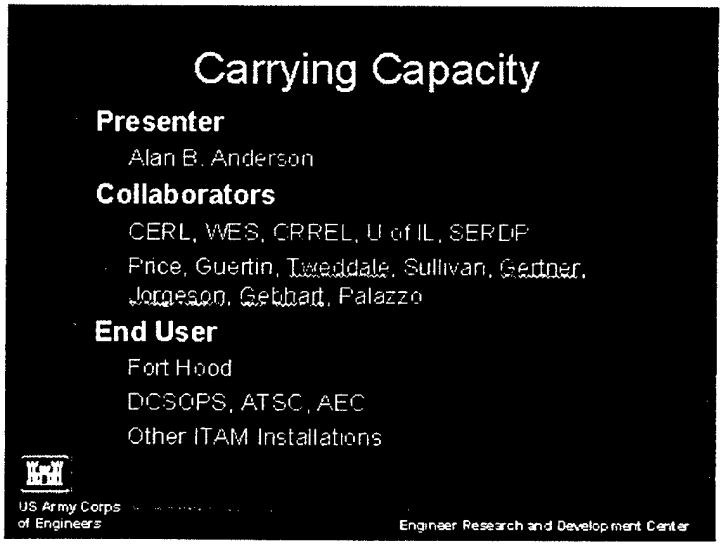
PRESENTER: Alan B. Anderson

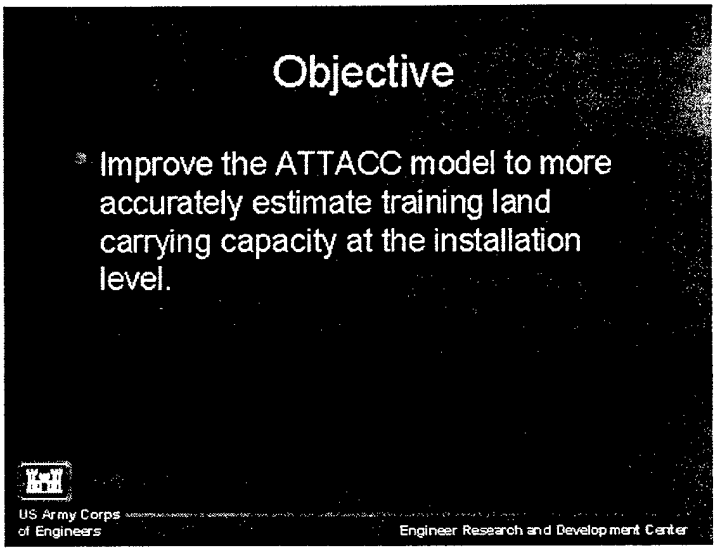
ABSTRACT: The Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL) conducts research in support of training land carrying capacity. Research initiatives support the recent update of the Army's Conservation User Requirements. This update indicates a need for research to support the Integrated Training Area Management (ITAM) program's Army Training and Testing Area Carrying Capacity (ATTACC) methodology. Research in support of this user requirement also supports related natural resources land management issues. This presentation will summarize R&D projects related to training land carrying capacity conducted as part of the LMS

Fort Hood Military Demonstration. Summarized R&D efforts include improved methodologies for C Factor, LS Factor, Distribution, Local Condition Factor, and Vehicle Severity Factor in support of the ATTACC program.

PRESENTATION: Carrying Capacity




Objective
Improve the ATTACC model to more accurately estimate training land carrying capacity at the installation level.
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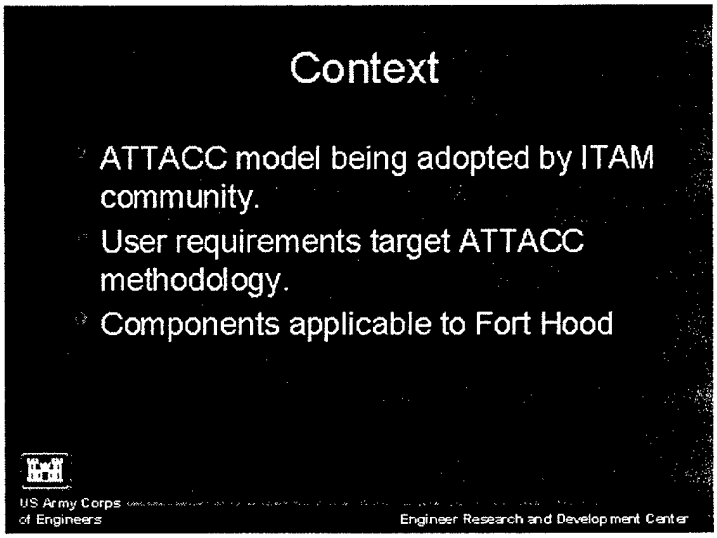
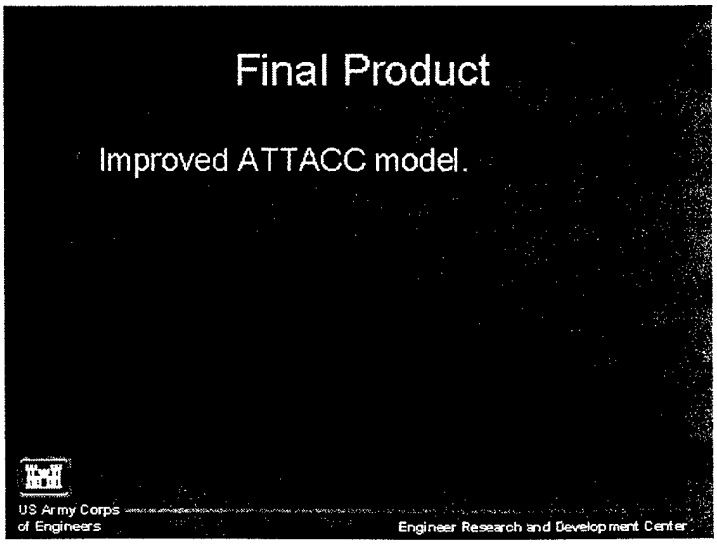
Engineer Research and Development Center


Context
ATTACC model being adopted by ITAM community.
User requirements target ATTACC methodology.
Components applicable to Fort Hood
US Army Corps of Engineers
Engineer Research and Development Center


Final Product
Improved ATTACC model.
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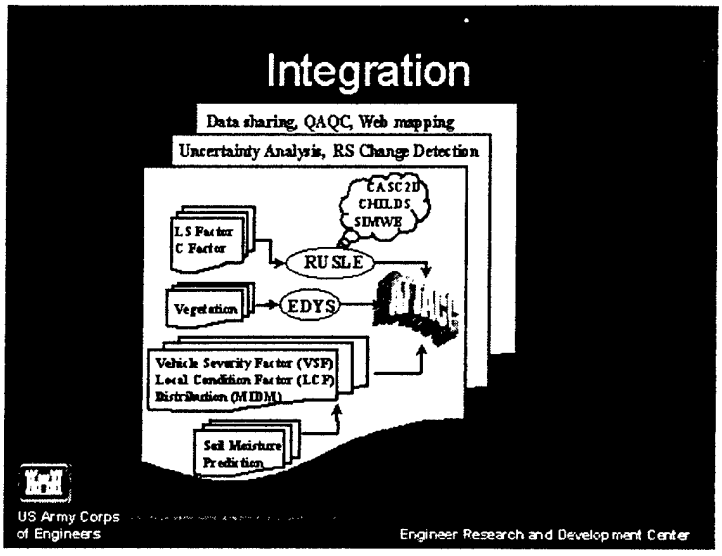
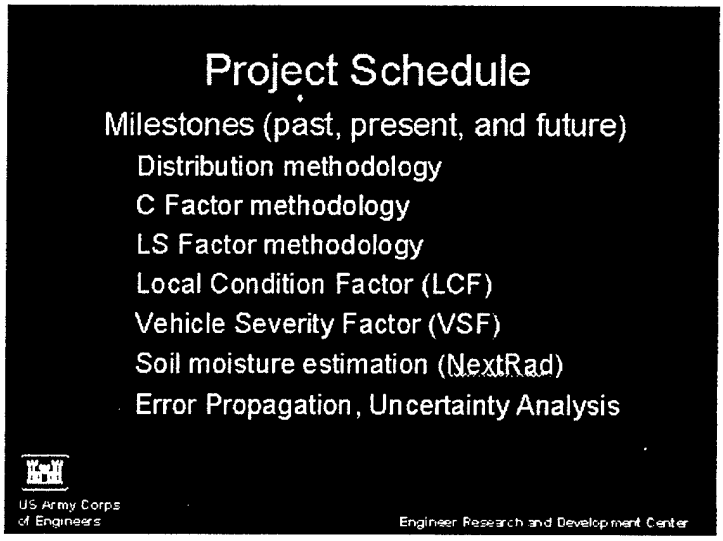

Integration
Data sharing, QAQC, Web mapping
Uncertainty Analysis, RS Change Detection
CASC2D
CHILDS
SIMWE
LS Factor
C Factor
RUSLE
Vegetation
EDYS
Vehicle Severity Factor (VSF)
Local Condition Factor (LCF)
Distribution (MIDM)
Soil Moisture
Prediction
US Army Corps
of Engineers
Engineer Research and Development Center


Project Schedule
Milestones (past, present, and future)
Distribution methodology
C Factor methodology
LS Factor methodology
Local Condition Factor (LCF)
Vehicle Severity Factor (VSF)
Soil moisture estimation (NextRad)
Error Propagation, Uncertainty Analysis
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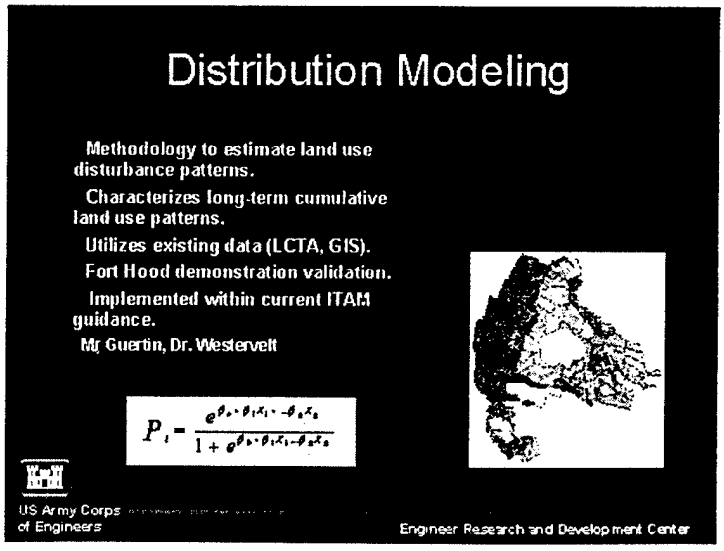
Distribution Modeling
Methodology to estimate land use disturbance patterns.
Characterizes long-term cumulative land use patterns.
Utilizes existing data (LCTA, GIS).
Fort Hood demonstration validation.
Implemented within current ITAM guidance.
Mr Guertin, Dr. Westervelt
$P_i = \frac{e^{\beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n}}{1 + e^{\beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n}}$
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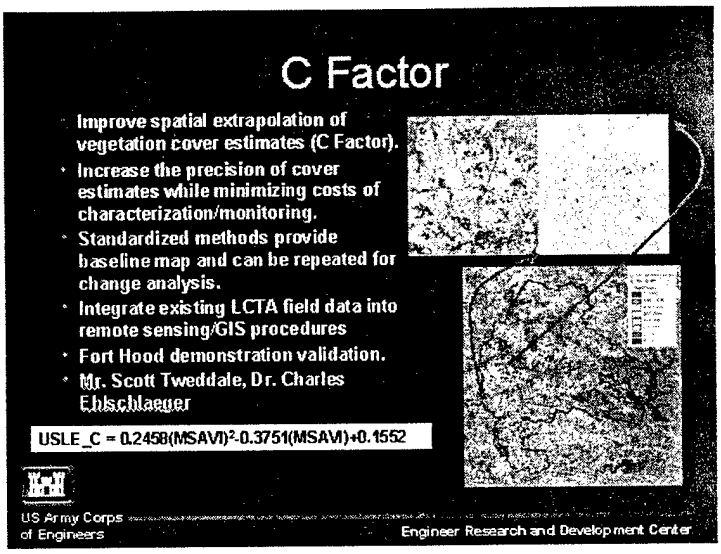
C Factor
Improve spatial extrapolation of vegetation cover estimates (C Factor).
Increase the precision of cover estimates while minimizing costs of characterization/monitoring.
Standardized methods provide baseline map and can be repeated for change analysis.
Integrate existing LCTA field data into remote sensing/GIS procedures
Fort Hood demonstration validation.
Mr. Scott Tweddale, Dr. Charles Ehlschlaeger
USLE_C = 0.2458(MSAVI)²-0.3751(MSAVI)+0.1552
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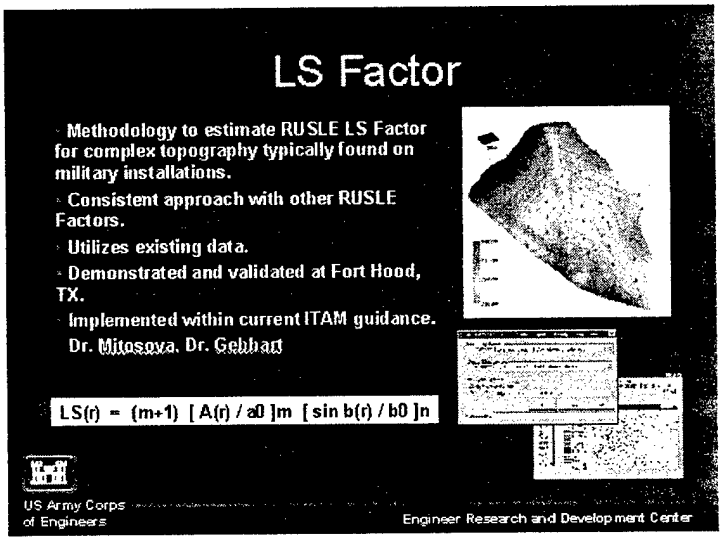
LS Factor
Methodology to estimate RUSLE LS Factor for complex topography typically found on military installations.
Consistent approach with other RUSLE Factors.
Utilizes existing data.
Demonstrated and validated at Fort Hood, TX.
Implemented within current ITAM guidance.
Dr. Mitasova, Dr. Gebhart
LS(r) = (m+1) [ A(r) / a0 ]m [ sin b(r) / b0 ]n
US Army Corps of Engineers
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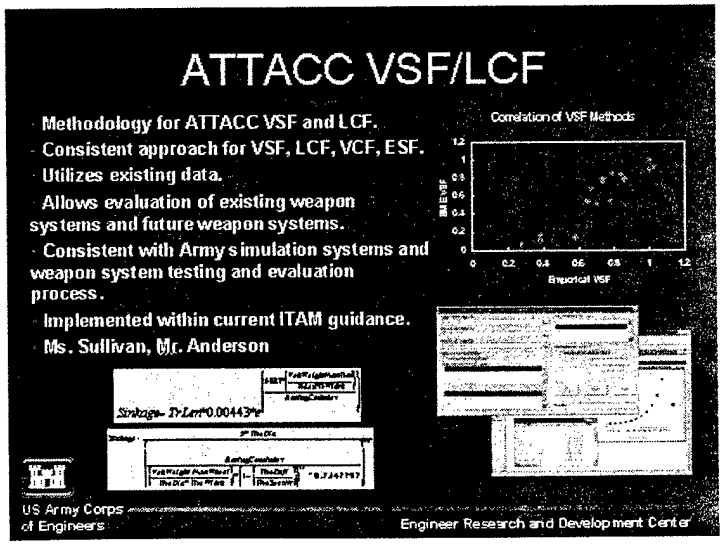
ATTACC VSF/LCF
Methodology for ATTACC VSF and LCF.
Consistent approach for VSF, LCF, VCF, ESF.
Utilizes existing data.
Allows evaluation of existing weapon systems and future weapon systems.
Consistent with Army simulation systems and weapon system testing and evaluation process.
Implemented within current ITAM guidance.
Ms. Sullivan, Mr. Anderson
Correlation of VSF Methods
Empirical VSF
US Army Corps of Engineers
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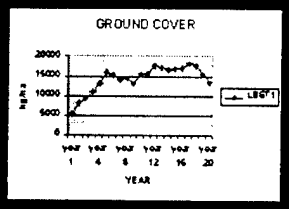
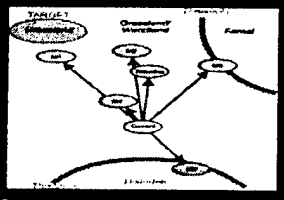
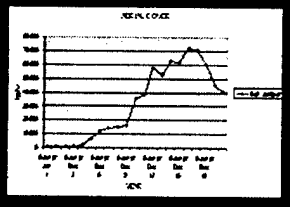
# EDYS Supporting ATTACC

- The EDYS model used to parameterize ATTACC with:
  - ground and aerial cover data.
  - Information on recovery times
  - different management scenarios





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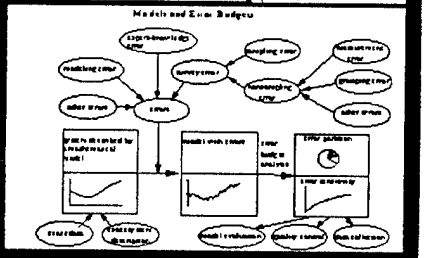
# Uncertainty Analysis

- Methodology to account for the uncertainty in natural resources, model predictions and to identify the sources of uncertainty.
- Provide a means to rationally prioritize R&D and land management investments.
- Currently developing uncertainty budgets for LS, C, K, R, RUSLE, Distribution, ATTACC.
- Dr. Gertner, Dr. Wang, Dr. Wente, Mr. Anderson



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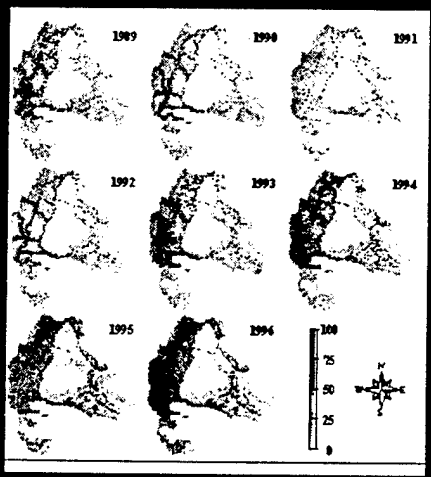
# Uncertainty Analysis Example

- Percent Disturbance data for Fort Hood.
- Derived from LCTA data.
- Extrapolated across installation using installation GIS data.
- Typical LCTA data analysis reported in LCTA reports.
- Distribution used in ATTACC.

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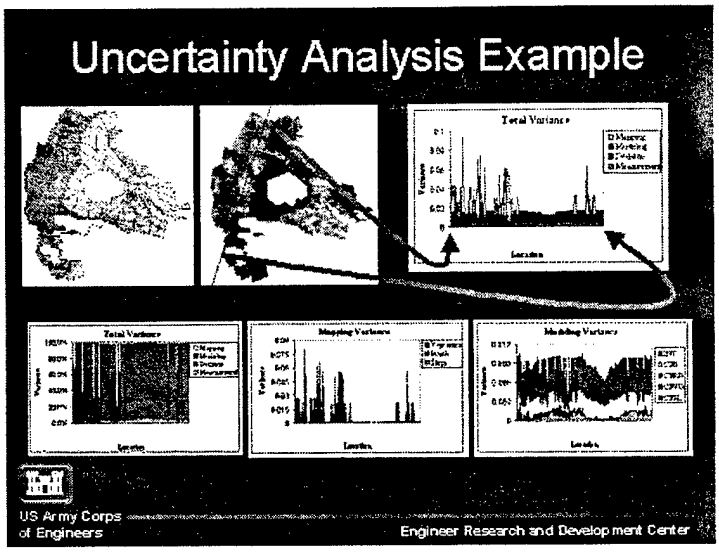
Uncertainty Analysis Example
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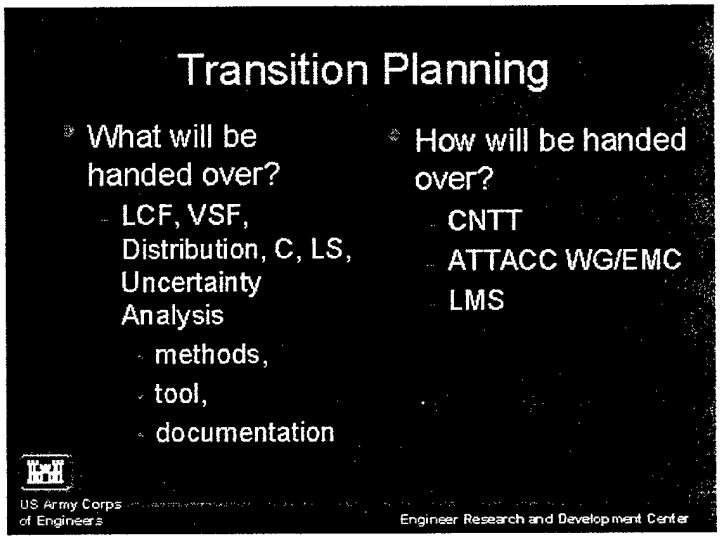
Transition Planning
What will be handed over?
LCF, VSF, Distribution, C, LS, Uncertainty Analysis
methods,
tool,
documentation
How will be handed over?
CNTT
ATTACC WG/EMC
LMS
US Army Corps of Engineers
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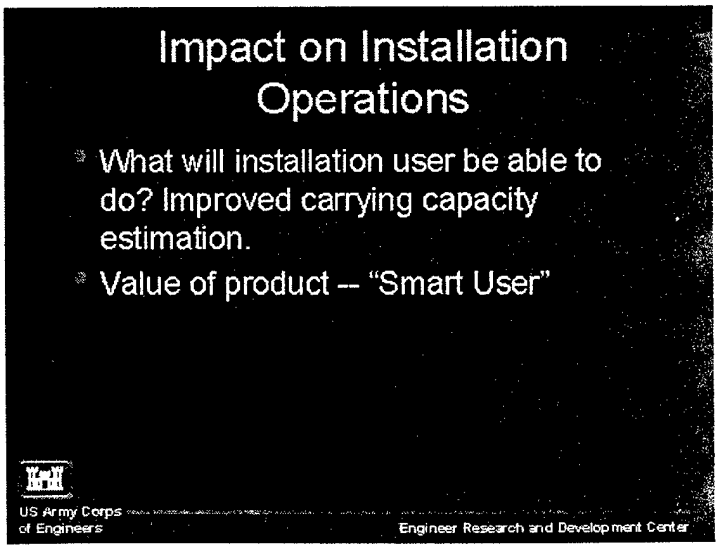
Impact on Installation Operations
What will installation user be able to do? Improved carrying capacity estimation.
Value of product -- "Smart User"
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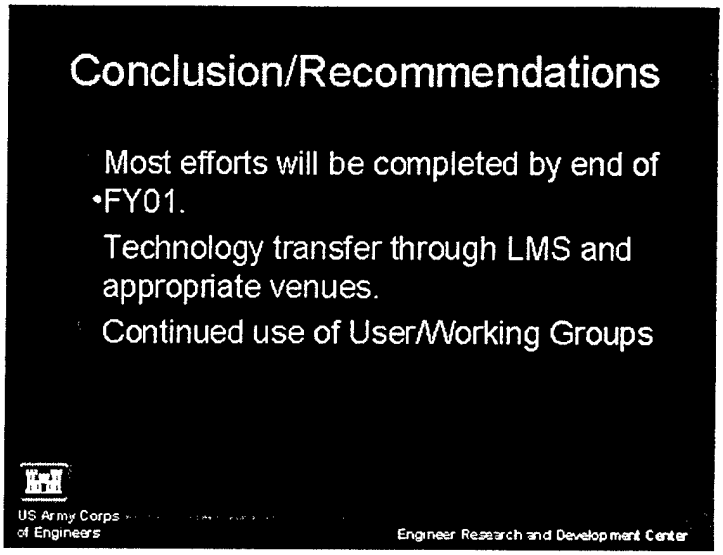
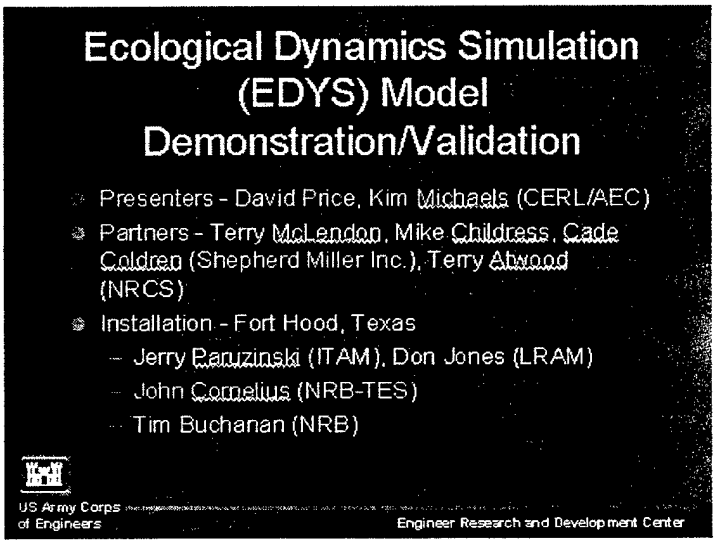


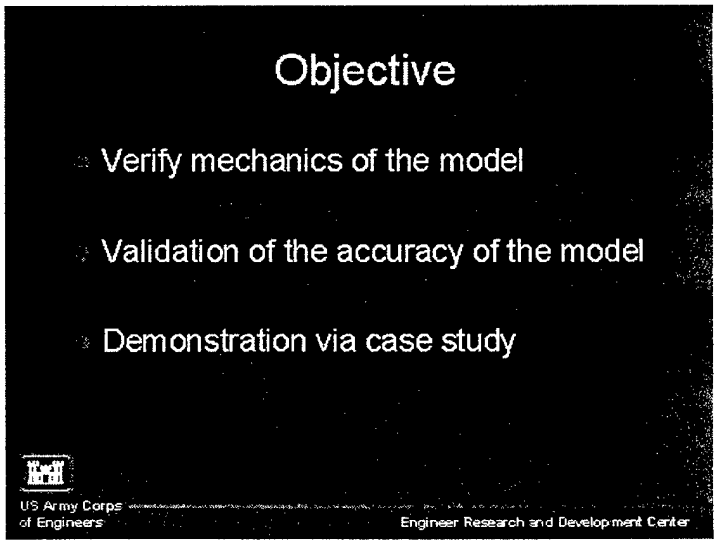

## The Ecological Dynamics Simulation (EDYS) Model

PRESENTER: David L. Price

ABSTRACT: The EDYS (Ecological Dynamics Simulation) model has been designed as a general ecosystem model for use in a wide range of applications for the Army, other government agencies, and the private sector. Applications include land management, natural resource management, environmental impact assessment, ecological risk assessment, revegetation planning, and mitigation planning. Because it implements all important components in the ecosystem, mechanistic simulations of all relevant processes, and multiple spatial and temporal scales, EDYS is adept at projecting long-term dynamics of ecological systems under a variety of different climatic, management, and disturbance scenarios. EDYS has been used in ecological risk assessments, impact assessments of environmental changes on erosion and water supply, and simulation of ecosystem responses to stressors at military installations, mines, national parks, and watersheds in the United States and Australia. The hydrological module was developed via a cooperative effort between the US Army Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL) and the USDA Natural Resource Conservation Service. CERL is currently in the process of developing a Cooperative Research and Development Agreement (CRADA) with Shepherd Miller Inc., and EDYS Version 3.0 will soon be available through their distribution center or through the Army's Land Management System (LMS). Demonstration and validation, and technology transfer of the EDYS technology is being supported by the Army Environmental Center.

PRESENTATION: Ecological Dynamics Simulation (EDYS) Model Demonstration Validation



## Context

- The effort was initiated as an application of the ITAM/LCTA programs and Land Based Carrying Capacity capability
- Tech Transfer via AEC and LMS
- Sustain training capability, compliance and TES, stewardship

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## Final Product

EDYS - 3 Ecological DYnamics Simulation Model

**Main Menu - Simulation Control Options**

Simulation Options

- Run Duration
- Precipitation
- Nitrogen
- Natural Fire
- Animal Module
- Training
- Vegetation Manipulations

Interface Options

- Print Outs
- Graphical Displays

Begin Simulation

Terminate EDYS - 3

Begin Simulation

## Integration

- Dynamic link with the Training Use Distribution Model (TUDM) in progress
- Dynamic link with CASC2D model in progress
- Installation digital and tabular data, e.g., DEM, Vegetation, LCTA, Soils, TES habitat

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## Project Schedule

- Establish validation sites, FY 97
- Collect validation data and apply nitrogen/water treatments, FY98-99
- EDYS verification/validation, FY 00
  - Final report, Jan 00 - now Mar 00
- Application of validated model in case study, FY00
  - In progress

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## Transition Planning

- What will be handed over?
  - Executable form of EDYS for simple landscape in TA 35 b and c
  - Workshop to train installation personnel in EDYS structure, data entry, re-parameterization, hands-on with various management scenarios

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## Impact on Installation Operations

Capability - Objectively project and evaluate the impacts of potential or perceived conflicting land uses and management strategies

Value - Facilitates stakeholder participation rather than divisive land use planning and management

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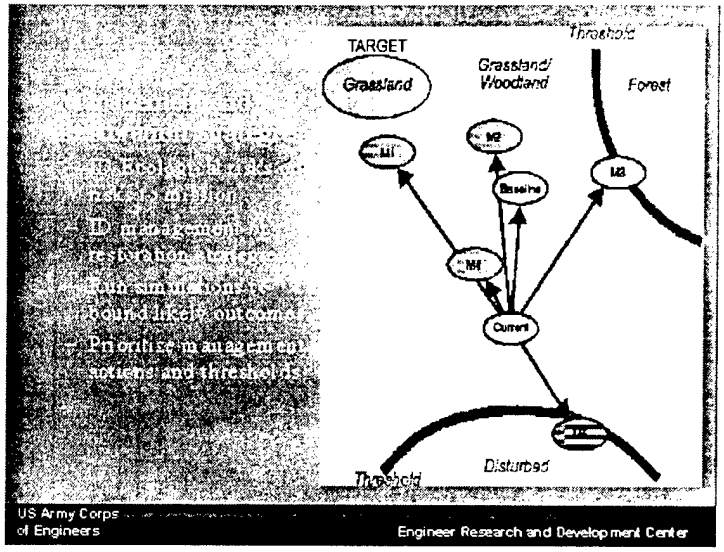


## Conclusion

Case study completion - planned Sept 00

Future needs - Implementation support and planning

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# 5 Status of Responses to Comments Made during Last Year's Fort Hood LMS Military Field Application IPR

Table 1 summarizes the status of responses to the FY99 IPR participant comments. The table lists each comment, organization making the comment, LMS planned response to the comment, and progress made over the past year to implement the response. Most issues have been addressed. A few issues are still being addressed. The status of each comment was reviewed during the workshop.

**Table 1. Status of responses to FY99 workshop comments.**

| No. | Organization | Comment | Response | Status |
|---|---|---|---|---|
| 1 | Fort Hood | Fort Hood requires something similar to ATTACC but which includes other stressors such as fire and cattle. Fort Hood needs to be able to assess grazing rotation plans on military carrying capacity. | Concur. Issue of multiple use carrying capacity is being forwarded to the Army Conservation Technology Team (CTT) because the carrying capacity user requirement is being redrafted. CTT leadership has been informed of the issue. However, some LMS projects like EDYS provide the underlying technologies partially required to address this issue. | This issue was referred to the CTT (currently CNTT). Requirement is currently captured in the 3rd priority conservation user requirement (Land Capability and Characterization). However, it is currently an out-year requirement. The EDYS LMS project is currently evaluating some aspects of this issue. This project was briefed at the 2nd Fort Hood LMS IPR. |
| 2 | Fort Hood | Some projects like the QAQC effort are being done by LMS and Fort Hood separately. Need improved coordination to ensure that there is not duplication of effort. | Concur. LMS project principal investigators will keep all three primary Fort Hood POCs informed of project status. Primary Fort Hood POCs are Mr. Gray, Mr. Cornelius, and Mr. Paruzinski. | All projects have been coordinating with the 3 Fort Hood POCs. In addition, some projects have additional technical POCs. Currently, Mr. Herbert has replaced Mr. Gray as a POC. Periodically the LMS CERL POC has contacted the Fort Hood POCs to determine if project coordination is adequate. |
| 3 | Fort Hood | The IPR was worthwhile to disseminate information to installation POCs. | Concur. No response required. | A second IPR was conducted at Fort Hood in FY00. |

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| 4 | Fort Hood | Need an evaluation of hyperspectral imagery applications in support of installation natural resources management. Fort Hood needs to know what information is available and which information can support land management issues. | Mr. Goran will forward to three Fort Hood POCs information on TEC's hyperspectral library. The WIARS team will also be provided this information. | Information on TEC's hyperspectral library provided to Fort Hood POCs. |
| 5 | Fort Hood | Need tank trail dust control alternatives to existing maintenance practices. | Concur. The new user requirement in compliance may address this issue. Issue will be communicated to Army CTT. | R&D requirement provided to CTT. |
| 6 | Fort Hood | Need management strategies for existing TES set aside lands. Need to be able to manage set aside lands for management objectives. | Concur. Issue needs more dialogue from Fort Hood POCs to more clearly define the issue. However this issue could evolve into a future LMS project. Ms. Trame and Mr. Price are tasked to pursue this topic. | Aspects of the EDYS LMS project address this issue. Status of the project was briefed at the FY00 IPR. |
| 7 | Fort Hood | Need better coordination with Fort Hood's primary POCs. Need to keep everyone aware of the big picture by keeping everyone updated on each project. | Concur. See response item 2. | See status of item 2. |
| 8 | Fort Hood | Resolution of vegetation mapping effort needs to be resolved. | Concur. Mr. Loechl tasked to address this issue with Fort Hood POCs. | Vegetation mapping issues resolved through meetings with Fort Hood, COE, and contractor personnel. Results of this meeting were presented at the FY00 IPR. |
| 9 | Fort Hood | Source of imagery for vegetation mapping effort needs to be resolved. | Concur. Mr. Loechl tasked to address this issue with Fort Hood POCs. | Source of imagery for vegetation mapping efforts resolved through meetings with Fort Hood, COE, and contractor personnel. Results of this meeting were presented at the FY00 IPR. |
| 10 | Fort Hood | LMS needs to be more integrated to match its mission statement. | Concur. See response item 2. Future LMS efforts at Fort Hood will focus more on integration as the demonstration project evolves and matures. | The FY00 IPR emphasized integration of individual projects and relationship to installation land management problems. This issue will continue to be addressed as additional projects are initiated within LMS. |
| 11 | FORSCOM | Need better coordination, cooperation, interaction between individual projects | Concur. See response item 2. | See status of items 2 and 10. |

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| | | and project managers. | | |
| 12 | FORSCOM | Need standard protocols for fielding LMS technologies. | Concur. A key goal of LMS is consistent delivery of technology to the user community. A new effort at Fort Hood will address model validation protocols preceding fielding. | The model validation protocols project was briefed at the FY00 IPR. |
| 13 | FORSCOM | Research needs to address future doctrine (activities and systems) not just existing doctrine. Need to keep current with Army XXI initiatives. | Concur. | Army User Requirements that are used to prioritize LMS efforts include this requirement. LMS continues to consider this issue as projects are initiated. |
| 14 | FORSCOM | Need to do a better job of disseminating information about LMS. Need clearly defined objectives, products, and approaches. | Concur. A report titled *Plans for the Land Management System (LMS) Initiative* is in draft form and should be published by late spring. This information will be available on the LMS website. (http://denix.osd.mil/LMS) under the Defense Environmental Network Information eXchange (DENIX). (Mr. Goran) | Additional LMS information provided on LMS web site including overview document, IPR summary reports, and copies of briefings. LMS briefings to SERDP, CNTT, and other Army organizations were conducted. |
| 15 | FORSCOM | Need a LMS field advisory group that meets regularly to broaden applicability of LMS investment. | Concur. Recommendations for LMS advisory forums are being presented to CERD at the June LMS review. (Mr. Goran) | An LMS advisory group at Corps of Engineer Headquarters is being developed. However the final make up of this group does not fully address this issue. LMS and/or individual LMS projects have been briefed to several user related groups including CNTT, SERDP, ITAM, ISTAB, and Geospatial R&D FA Group. |
| 16 | FORSCOM | Need to protect military information as LMS makes disseminating information easier. | Concur. LMS protocols will not define access to installation information or how that information is disseminated. Control of information will remain with the installation following MACOM/Service guidance. | This issue is being addressed as part of the Data Repository project. As this project is executed, mechanisms to protect installation data will be clarified. This project was briefed at the FY00 IPR. This project will be briefed at the FY01 IPR. |
| 17 | FORSCOM | Need to field more user friendly software and tools. | Concur. This is a key goal of LMS. | The LMS2000 software was demonstrated at the FY00 IPR. An objective of this presentation was to illustrate how LMS would look to installation users. This issue |

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| | | | | continues to be addressed with ongoing LMS projects. |
| 18 | FORSCOM | Need to address how much of a solution is required to solve a problem. The cost of the solution must be balanced with the benefit to the Army. | Concur. Affordability is a concern in designing and prioritizing projects and in transferring results. | Currently a project is being initiated to look at fielding and training costs associated with LMS. |
| 19 | FORSCOM | Need to involve military trainers into the research program. | Concur. | Efforts were made to identify military trainers that could be involved in the research program. Success limited at this time. |
| 20 | FORSCOM | Need to include noise land management issues into LMS. Need to investigate cumulative noise models to make tools more applicable to military land management problems. | Concur. Will attempt to resource integration of noise models and LMS in FY2000 program. (Mr. Goran) | Noise models (SARNAM and BNOISE) are being incorporated into LMS as part of the Integration Teams efforts. |
| 21 | ODCSOPS | Information about LMS needs to be more clearly explained and effectively disseminated. Need to clearly articulate objectives, purpose, and products. | Concur. See item 14 response. | See status of item 14. |
| 22 | ODCSOPS | Need to look at maturity of LMS technologies before they are fielded and incorporated into user products. | Concur. A validation protocol along with demonstrations should help ensure product maturity. | Validation protocols project has been initiated. Status of project briefed at FY00 IPR. |
| 23 | ODCSOPS | Research community needs to provide relevant information to prioritize what non-training impacts/stressors are most critical to quantify/model on military installations. | This issue is best handled through the Army Conservation Technology Team prioritization process. | Issue referred to CNTT. |
| 24 | ODCSOPS | LMS needs to address how much standardization is required/desired for LMS to be successfully implemented. How will LMS be successfully implemented to meet both Army wide standardization requirements and installation unique solution requirements? | Concur. LMS projects are selected to respond to Army wide issues. Solutions are intended to be for Army wide implementation with the least possible adaptation required. This does vary from project to project. | LMS2000 demonstration at FY00 IPR attempted to illustrate how much standardization is being incorporated into the system.<br>Demonstration also identified how LMS attempts to handle installation specific issues. |
| 25 | ODCSOPS | Army training simulations are in three domains: (1) Live, (2) Virtual, and (3) Constructive. Live simulations enhance training with live soldiers on the ground. | Concur. The NSC will be contacted. (Mr. Anderson) | Efforts have been initiated to look at how the specified systems can be incorporated into LMS activities. This issue is still under investigation. Efforts related to the |

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| | | An example is MILES. Virtual simulations replicate weapons with live soldiers in a virtual environment. An example is Close Combat Tactical Trainer (CCTT). Constructive simulation replaces units, weapons, and terrain with war-gaming. An example is Janus. Constructive simulation tools are what is required to model military training footprints. Land carrying capacity should access constructive simulations only. The combat developer for the Army's family of constructive simulations is the National Simulation Center (NSC) at Fort Leavenworth. CERL should consider the following constructive simulations: (1) Janus, (2) BBS, and (3) CBS. | | issue were included in the FY00 IPR. |
| 26 | ODCSOPS | The Center for Army Lessons Learned (CALL), also at Fort Leavenworth, archives AARs from the Army's Combat Training Centers (CTC). Some of these AARs may contain digitized files from CTCs showing actual unit maneuver patterns for various missions within CTC rotations. | Concur. The CALL will be contacted. (Mr. Anderson) | Efforts to acquire data have been initiated. This issue is still under investigation. |
| 27 | ODCSOPS | The army environmental research community must hire a military subject matter expert (SME) to help translate the military doctrine to the researchers. Such an SME should be a combat arms officer with experience with constructive simulation use. | Concur. | Efforts were made to identify military trainers that could be involved in the research program. Efforts have not been successful at this time. |
| 28 | ATSC | Need installation advisory group to ensure broader Army relevance. | Concur. See response to item 15. | See status of item 15. |
| 29 | ATSC | ATSC is encouraged by the training distribution modeling but would like more involvement in the process. Better guidance/procedures | Concur. ATSC will be kept informed of project efforts. Guidance will be developed. (Mr. Guertin) | Guidance documentation is under development. Status of documentation briefed at FY00 IPR. |

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| | | are required for developing and implementing training distribution models. | | |
| 30 | ATSC | LMS needs to be better interfaced with RFMSS. LMS needs to address the implementation windows and time frame constraints associated with the RFMSS development process. | Concur. A new project has been initiated to address this issue. (Mr. Anderson) | Integration mechanisms with RFMSS have been defined. Implementation issues will continue to be an issue but are being considered during LMS planning. |
| 31 | ATSC | Need to better disseminate details of LMS components to user communities. | Concur. See response to item 14. | See status of item 14. |
| 32 | AEC | LMS needs to coordinate efforts with Signal Command. | Concur. The Signal Command will be contacted. (Mr. Goran) | Issue not addressed at this time. |
| 33 | AEC | AEC needs to know where LMS projects are going to be able to estimate and allocate funding for AEC's Conservation Technology Team (CTT) responsibilities. AEC is responsible for validating, demonstrating, and transferring conservation related technologies. | Concur. This issue is being addressed through the Army Conservation Technology Team process. A team consisting of Mr. Thies, Mr. Goran, Ms. Dilks, and Ms. Michaels is addressing this issue. | CNTT has been briefed on LMS related projects and on the overall LMS program. Annual briefings to the CNTT will continue as requested by the CNTT. |
| 34 | Fort Bliss | LMS needs to address if integrating old models is efficient and if integrated models give significantly better results than using models that are not fully integrated. | Concur. This is not an easy issue to address. However, LMS is collaborating with the University of Illinois on a SERDP funded project that is attempting to partially address this issue. This project is using a number of the models being incorporated into LMS. The project is looking at the uncertainty of model predictions, sources of errors, and how these errors propagate through models. | The SERDP Error and Uncertainty project was briefed as part of the carrying capacity efforts at the FY00 IPR. Progress on this project will be briefed at subsequent IPRs. |
| 35 | Fort Bliss | LMS needs to look at cumulative impacts/stressors. | Concur. This is a key driver for LMS. | This issue has not been specifically addressed with current year's efforts. |
| 36 | Fort Bliss | User needs may be more for easier interfaces to existing products than for improved technologies. | Concur. This is a key driver for LMS. | This issue has not been specifically addressed with current year's efforts. However, as new projects are considered, this will be part of the evaluation criteria. |
| 37 | Fort Bliss | Resources to support LMS | Concur. This is a key | A project has been initiated |

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| | | type tools are often difficult for installations to acquire. LMS may need to address this issue if LMS is to be successfully implemented. | driver for LMS. | to look at LMS fielding issues including costs of implementation and training. |
| 38 | TRADOC | Need a systems approach to LMS. Individual research efforts need to be more tightly integrated. | Concur. See response to item 10. | See status of item 10. |
| 39 | TRADOC | Need a clearer definition of what LMS is. | Concur. See response to item 14. | See status of item 14. |
| 40 | TRADOC | LMS needs to be careful that research does not lead to a higher standard of compliance that military installations must adhere to. | Noted. | Issue considered as new projects are defined and initiated. |

# 6 Fort Hood LMS Military Field Application FY00 IPR Summary of Comments and Responses

During the workshop, each participant was asked to provide comments on specific projects, general direction of Fort Hood military demonstration, future direction and/or prioritization of future projects. This section summarizes the comments provided by the workshop participants. Table 2 lists each comment, who provided the comment, and the LMS response to the comment. Along with the response, the LMS person responsible for addressing the issue is provided.

**Table 2. Workshop participant comments and responses.**

| No. | Commenter | Comment | Response |
|---|---|---|---|
| 1 | Fort Hood | Who will serve as administrator for the Data Repository? Where will servers reside? What hardware and software are needed and who will purchase it? Who will be held accountable for the stored data? | As a result of the May meeting, both the administrator for the repository and the server will be located at Fort Hood. An NT server will be the primary additional hardware requirement. Software requirements for the server include Oracle, ArcIMS, ArcSDE, and Safe software FME. Hardware and software will be purchased by the stakeholders in the DPW and Range Control offices according to their internal agreements. The client side will be served by Arc8, ArcView8, or a web browser, depending on the needs of the user. Client side software/ hardware will be purchased by the individual offices that require access to the repository. There are eight different stakeholder groups defined for the repository. The accountability for the data will be spread among the groups through a process that is currently under development. A report will document the final results and process. (Ruiz) |
| 2 | Fort Hood | Project deliverables need to be clearly defined. We need to know what the final product will be when the project is completed. All involved parties need to know how far and through what steps the project will proceed to its conclusion. A clear scope of work must exist before project is awarded. Installation POC needs to see statement of work before a contract is awarded. | Concur. This has always and continues to be an objective of the implementation process. Apparently, some interfaces between two different projects (one within the LMS context, one outside) resulted in some plan changes on the historic data files. This issue is being addressed. We fully concur that all deliverables should be spelled out before work begins, and also that scopes of work should be reviewed before being awarded to contractors. We will follow this advice. (All) |

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| 3 | Fort Benning | Tools developed through LMS should be simple and have application to the site. You need to consider available installation manpower and resources. | Concur. We have a couple of deliverables in the near future (veg map, stream stage model/ data) and will hold ourselves to this standard for these and subsequent deliverables. (Goran) |
| 4 | Fort Benning | Need to address QAQC issues related to proper software/model use. Need to make sure products are used appropriately. Installation personnel need to know how to use tools properly for the intended application. | Concur. Projects related to LMS training and documentation will attempt to address this issue. (Goran) |
| 4 | Fort Benning | Other issues in the environmental arena need to be addressed. LMS appears to be focusing on soil conservation but not other areas such as water and air quality issues. | The current emphasis on soil conservation efforts is a result of the installation prioritization of projects (after ensuring the projects align with Army requirements). We agree that there are other issues, such as water and air quality, and we expect these issues to surface as we proceed along installation prioritized projects. For example, there is a water quality component to the stream stage modeling project. Some of these issues are also being addressed at other LMS demonstration sites and were not discussed at the Fort Hood IPR. |
| 5 | FORSCOM | Need to work with MACOM and HQDA representatives to disseminate LMS information. | Concur. An LMS fact sheet will be provided to MACOM and HQDA organizations to distribute to their installation personnel. (Goran) |
| 6 | FORSCOM | Need to be up front and accurate about the additional expenses that will be incurred when implementing LMS at an installation. LMS funding information in the LMS brochure appears to be misleading and does not fully detail the costs of LMS implementation. Need to put a priority on minimizing implementation costs. | To the greatest extent possible, our LMS architecture will shift software costs to servers, not clients, and minimize local costs. We do not yet know all the life cycle costs for training and data, and these will be highly variable – but we intend to provide more details about such costs at next year's IPR. (Goran) |
| 7 | FORSCOM | Need to disseminate IPR presentations to participants on CDs. | Concur. IPR information will be provided as requested. (Anderson) |
| 8 | FORSCOM | LMS models will ultimately be used by land management personnel and should be designed for use by those people. Simplicity of use should be the goal. | Concur. This is a very important point for LMS, although it may not always be the models themselves that are used by installation personnel. Sometimes, only the model results will be used by installation land management personnel. The total system is designed to better integrate off-site experts with local land managers. (Goran) |
| 9 | FORSCOM | Limited installation personnel and available time will limit usability of the LMS system. | Concur. An objective in developing LMS is to make the system as easy to use as possible. (Goran) |
| 10 | FORSCOM | End products should be delivered in a timely manner. | Concur. At this point, except for delays in obtaining the input data for the vegetation mapping, all LMS projects at Fort Hood have been on schedule. (All) |
| 11 | FORSCOM | How will installations get access to the LMS tools? | This issue is currently being evaluated. Several options are being considered. Installations may |

| | | | |
|---|---|---|---|
| | | | have access to LMS tools through several venues. Current options being evaluated include access to LMS tools through an LMS web site and CDs. These options include remote access and execution as well as local access and executions of models. This issue will be a topic for discussion at the next Fort Hood IPR. (Goran) |
| 12 | FORSCOM | Need to address how to train users to use LMS models and tools. Will you need to train each installation or provide training tools? If you need to train each installation user, this is not likely to be successful. | Concur. This issue is currently being investigated. A study by an outside organization will examine LMS implementation issues including training requirements and approaches. This project will include coordination with and input from the Fort Hood POCs. This project will be briefed at the next Fort Hood IPR. (Integration POC TBD) |
| 13 | FORSCOM | Model training and access to models is of great concern. There needs to be an Army-wide installation advisory group. Labs should work with HQ to disseminate LMS information to installations. | Concur. There is a need for better definition of training requirements at each level of LMS. This aspect of life cycle planning will be emphasized this year. (Goran) |
| 14 | SERDP | Land managers need quick answers to questions so they can spend more time in the field and less at the computer using the model. Simplicity issues need to be addressed. Models should have a GUI with point and click ease of use. Models should be "plug and play" to facilitate use. LMS output should be as graphic as possible. | Concur. The software should be easy and quick to use. Also, expertise should be easy and quick to access. LMS is intended to help provide both tools and expertise in a quicker and easier fashion. (Goran) |
| 15 | SERDP | Data repository, data security, and data standardization are critical to LMS implementation. These issues need to be addressed. | Concur. The data repository project is a start at addressing these issues. (Ruiz) |
| 16 | FORSCOM/ SERDP | Cumulative noise impacts are important and should be addressed within LMS. | Concur. Proposals to address this issue are currently being developed within the R&D community. (Pater) |
| 17 | Hood | Soil moisture maps for 1, 2, and 3 days following a rain event would be useful to demonstrate the potential for site damage and trafficability problems. | Concur. Soil moisture maps as specified can be provided. (Jorgeson) |
| 18 | FORSCOM | Where did the requirement for the web mapping project come from? Who is the POC? I would like someone to contact FORSCOM to clarify this project. | Concur. FORSCOM (Ted Reid) will be contacted to clarify issues related to this project. (McKenna) |

# Acronyms and Abbreviations

| | |
|---|---|
| AEC | U.S. Army Environmental Center |
| ArcIMS | Arc Internet Map Server |
| ArcSDE | Arc Spatial Database Engine |
| ARS | Agricultural Resource Service |
| ATSC | Army Training Support Center |
| ATTACC | Army Training and Testing Area Carrying Capacity |
| CADD | Computer-aided drafting and design |
| CALL | Center for Army Lessons Learned |
| CASC2D | Two Dimensional Cascading Runoff |
| CCTT | Close Combat Tactical Trainer |
| CEFMS | Corps of Engineers Financial Management System |
| CERL | U.S. Army Construction Engineering Research Laboratory |
| CHILD | Channel Hillslope Integrated Landscape Development |
| COE | Corps of Engineers |
| CORBA | Common Object Request Broker Architecture |
| COTS | Commercial off-the-shelf |
| CRADA | Cooperative Research and Development Agreement |
| CRREL | U.S. Army Cold Regions Research and Engineering Laboratory |
| CTC | Combat Training Center |
| CTT | Conservation Technology Team (currently CNTT) |
| DBMS | Database Management System |
| DCSOPS | Deputy Chief of Staff, Operations |
| DEM | Digital Elevation Model |
| Dem/Val | Demonstration/validation |
| DENIX | Defense Environmental Network Information eXchange |
| DER | Data Enterprise Repository |
| DoD | Department of Defense |
| DOE | Department of Energy |
| DPW | Department of Public Works |
| ECAS | Environmental Compliance Assessment System |
| EDYS | Ecological Dynamics Simulation Model |
| EIS | Environmental Impact Statement |
| EPA | Environmental Protection Agency |
| ERDC | Engineer Research and Development Center |
| ESF | Event Severity Factor |
| ESRI | Environmental Systems Research Institute |
| FA | Field Advisory |
| FORSCOM | U.S. Army Forces Command |
| FWI | Fire Weather Indices |

| | |
|---|---|
| FY | Fiscal year |
| GIS | Geographic information system |
| GUI | Graphical user interface |
| HC | Hydraulic conductivity |
| HQDA | Headquarters, Department of the Army |
| ICRMP | Installation Cultural Resources Management Plan |
| INRMP | Installation Natural Resources Management Plan |
| IPR | In-Progress Review |
| ISTAB | Installation Spatial Technology Advisory Board |
| ITAM | Integrated Training Area Management |
| LBCC | Land-based Carrying Capacity |
| LCF | Local Condition Factor |
| LCTA | Land Condition Trend Analysis |
| LMS | Land Management System |
| LS | Length Slope |
| MACOM | Major Command |
| MIDM | Maneuver Impact Distribution Map/Model |
| MOA | Memorandum of Agreement |
| MPP | Military Pilot Project |
| NRCS | Natural Resources Conservation Service |
| NSC | National Simulation Center |
| NVCS | National Vegetation Classification System |
| OGC | Open GIS Consortium |
| IDLAMS | Integrated Dynamic Landscape Analysis and Modeling System |
| POC | Point of contact |
| PT | Pressure transducer |
| QA/QC | Quality Assurance/Quality Control |
| R&D | Research and Development |
| RDBMS | Relational Database Management System |
| RFMSS | Range and Facility Management Scheduling System |
| RUSLE | Revised Universal Soil Loss Equation |
| SARNAM | Small Arms Range Noise Assessment Model |
| SERDP | Strategic Environmental Research and Development Program |
| SIMWE | Simulated Water Erosion |
| SME | Subject matter expert |
| TA | Training area |
| TBD | To be determined |
| TEC | U.S. Army Topographic Engineering Center |
| TES | Threatened and Endangered Species |
| TNC | The Nature Conservancy |
| TRIES | Texas Regional Institute for Environmental Studies |
| TUDM | Training Use Distribution Model |
| UMFS | University of Mississippi Field Station |
| URL | Uniform Resource Locator |
| USACE | U.S. Army Corps of Engineers |

| | |
|---|---|
| USDA | U.S. Department of Agriculture |
| USFS | U.S. Forest Service |
| USLE | Universal Soil Loss Equation |
| VCF | Vehicle Conversion Factor |
| VRML | Virtual Reality Modeling Language |
| VSF | Vehicle Severity Factor |
| WCDS | Water Control Data System |
| WES | U.S. Army Engineer Waterways Experiment Station |
| WIARS | Web Image Analysis and Remote Sensing |
| WMS | Watershed Modeling System |
| WMT | Web Mapping Technology or Web Mapping Testbed |
| XML | Extensible Markup Language |
| XMS | A generic modeling system; one of several created by WES |

# Appendix A: Fort Hood LMS IPR Field Trip

The FY00 Fort Hood LMS IPR included a field trip to a number of areas around Fort Hood that demonstrate typical problems land managers face at the installation. This field trip provided project managers with the opportunity to view those areas that will dictate the direction of their projects in the future, and allowed non-project IPR participants to see how the LMS system is working to solve the environmental problems faced by this and other military installations.

**Figure 1. Flow erosion causes deep gullies in the landscape.**

Figure 1 illustrates how concentrated flow erosion causes deep gullies to be formed in the landscape. Many of these gullies are large enough to impede training. Vehicles, both tracked and wheeled, are unable to cross many of he gullies. Land managers have resorted to building hardened crossings (see foreground in Figure 1). These crossings not only allow vehicles to navigate across this training area, they also catch sediment running off nearby slopes and prevents it from washing away during rain events. However, this process is expensive. Limestone from local sources is quickly crushed by vehicle traffic. As a result, harder rock must be trucked in from more distant sources.

**Figure 2. Vehicle traffic on steep slopes causes severe soil erosion.**

Sheet erosion is a problem on steeper slopes (Figure 2). Vehicle traffic on steep slopes causes severe soil erosion exposing underlying rock. Eventually vehicles can no longer use these slopes and alternate routes must be located.

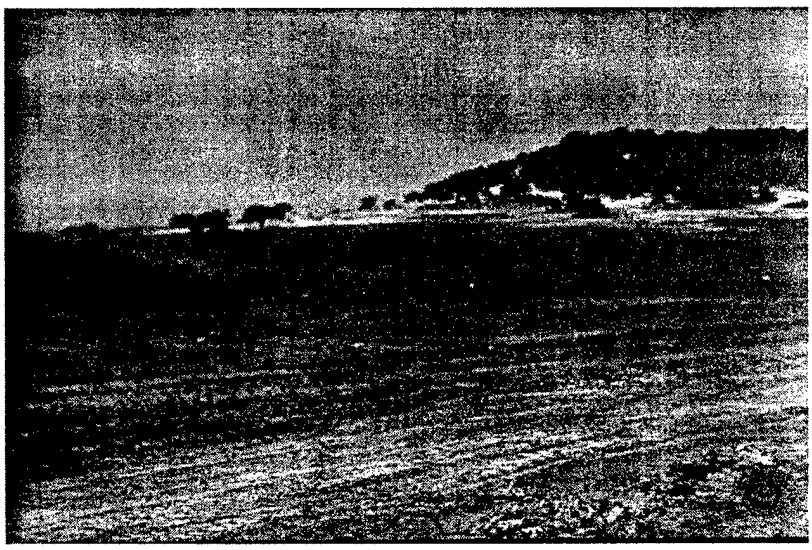

**Figure 3. Tank trails widen due to rutting and gullies formed by soil erosion.**

Widening of tank trails is a problem at Fort Hood (Figure 3). Tank trails that were originally 4 meters wide have been expanded by tracked vehicle traffic to over 40 meters in some areas, due to rutting and gully formed by soil erosion. In an effort to avoid such areas in the terrain, tank drivers skirt the ruts, gradually widening the trails that were originally designed to keep environmental damage caused by tracked vehicles to a minimum.

# Appendix B: Fort Hood LMS IPR Letter of Invitation and List of Invitees

CEERD-CN-C (70-1s)

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: FY00 In-Progress Review (IPR) for Fort Hood Land Management System (LMS) Military Field Application Site, April 4-5, 2000, Killeen, TX

1. The second IPR for the Fort Hood LMS Military Field Application Site will be held at the Park Inn International, 803 E. Central Texas Expwy., Killeen, TX. Thank you to all those who attended last year's IPR. We had a good meeting last year and we have incorporated suggestions for improvement into preparations for this year's meeting. The FY00 IPR is designed to update participants on LMS progress with specific focus on LMS projects underway at Fort Hood.

2. Attached is a draft agenda for the IPR with a list of presenters and projects that will be discussed. There will be an opportunity on Wednesday for Fort Hood personnel to furnish feedback on specific projects, relate information on the general direction of the Fort Hood military demo, and provide input for future LMS projects at Fort Hood. Other participating organizations, including MACOM and HQDA, will also have the opportunity to contribute their input.

3. The IPR is scheduled to end at 12:15 on Wednesday the 5th. An optional field trip is slated to follow the conclusion of the meeting. This field trip will last approximately 2 1/2 hours. It will afford everyone the opportunity to get out into the field and see some of those areas in which there are ongoing LMS projects.

4. A block of rooms has been reserved at the Park Inn International, 803 E. Central Texas Expwy. Rooms must be reserved by 21 March 2000 to ensure availability. Rooms are $59.00 plus tax. To make reservations contact (254) 526-4343. You must mention that you are taking part in the Fort Hood LMS meeting to receive this special rate.

CEERD-CN-C (70-1s)

SUBJECT: FY00 In-Progress Review (IPR) for Fort Hood Land Management System (LMS) Military Field Application Site, April 4-5, 2000, Killeen, TX

5. If you have any questions concerning the IPR, please contact Mr. Bruce MacAllister at 217/352-6511 ext. 7387. Mr. MacAllister is helping coordinate the IPR and can assist you with any issues.

Encl

WILLIAM D. GORAN
LMS Coordinator

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| | |
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| Kim Majerus | CERL |
| Dalton Murz | USDA NRCS |
| Paul "Kip" Otis-Diehl | MCAGCC |
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CEERD-CN-C (70-1s)
SUBJECT: FY00 In-Progress Review (IPR) for Fort Hood Land Management System (LMS) Military Field Application Site, April 4-5, 2000, Killeen, TX

DISTRIBUTION: (CONT)

| | |
|---|---|
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| Richard Scholze | CERL |
| Fred Schrank | USDA NRCS |
| Bill Severinghaus | CERL |
| John Shrader | Fort Hood |
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| Paul Thies | USAEC |
| Jerry Thompson | Fort Sam Houston/Camp Bullis |
| Scott Tweddale | CERL |
| Tom Vorac | AMC |
| Jason Walters | Fort Hood |
| Chuck Wright | HQDA ACSIM |

# Appendix C: Fort Hood LMS IPR Read-Ahead Packet

MEMORANDUM FOR ATTENDEES OF FY00 FORT HOOD LMS IPR

SUBJECT: Read-ahead packet for the FY00 In-Progress Review (IPR) for Fort Hood Land Management System (LMS) Military Field Application Site, April 4-5, 2000, Killeen, TX

1. The second IPR for the Fort Hood LMS Military Field Application Site will be held at the Park Inn International, 803 E. Central Texas Expwy., Killeen, TX.

2. This read-ahead packet will provide you with information regarding this years IPR meeting. Enclosed you will find the following:
   a. A copy of last years IPR report.
   b. The final agenda for this year's meeting.
   c. The invitation list for the In-Progress Review.
   d. Project summaries for those LMS projects to be presented at the meeting.
   e. A map of Killeen with the location of the Park Inn marked as the star in area D3 of the map.

3. As mentioned in the letter of invitation you received in February, a block of rooms has been reserved at the Park Inn International, 803 E. Central Texas Expwy. Rooms must be reserved by 21 March 2000 to ensure availability. Rooms are $59.00 plus tax. To make reservations contact (254) 526-4343. You must mention that you are taking part in the Fort Hood LMS meeting to receive this special rate.

4. If you need additional information or have any questions regarding the In-Progress Review, please do not hesitate to contact me at (217) 352-6511 ext. 7387.

Bruce MacAllister

LIST OF ATTENDEES:

| | |
|---|---|
| Alan Anderson | CERL |
| John Barko | USACE-WES-EB-E |
| P.B. Black | TEC |
| Malcom Boswell | TRADOC |
| John Brent | Fort Benning |
| Tim Buchanan | Fort Hood |
| Larry Chenkins | USAEC |
| John Cornelius | Fort Hood |
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| Mike Frnka | FORSCOM |
| Dick Gebhart | CERL |
| Bill Goran | CERL |
| Emmett Gray | Fort Hood |
| Pat Guertin | CERL |
| Tom Hart | DRD |
| Dennis Herbert | Fort Hood |
| Steve Hodapp | CERL |
| Jeff Holland | WES |
| Robert Holst | SERDP |
| Billy E. Johnson | WES |
| Don Jones | Fort Hood |
| Jeff Jorgeson | WES |
| Paul Loechl | CERL |
| Kim Majerus | CERL |
| Dalton Murz | USDA NRCS |
| Paul "Kip" Otis-Diehl | MCAGCC |
| Tony Palazzo | CRREL |
| Gordon Plishker | TRIES |
| Jerry Paruzinski | Fort Hood |
| Debbie Potter | TRADOC |
| David Price | CERL |
| Ted Reid | FORSCOM |
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| Marilyn Ruiz | CERL |
| Homer Sanchez | USDA NRCS |
| Richard Scholze | CERL |
| Fred Schrank | USDA NRCS |
| Bill Severinghaus | CERL |
| John Shrader | Fort Hood |
| Carlos Solis | USACOE Fort Worth |
| Dan Specht | TEC |
| Dick Strimel | Fort Sam Houston/Camp Bullis |
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| Jerry Thompson | Fort Sam Houston/Camp Bullis |
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**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**
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**5d. PROJECT NUMBER**
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20 Massachusetts Ave., N.W.
Washington, DC 20314-1000

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**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

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**14. ABSTRACT**

The purpose of the Land Management System (LMS) is to provide relevant science, tools, and information to land and water resource managers and decisionmakers with the goal of enhancing their ability to understand and communicate past, current, and potential impacts of management actions on land and water resources.

LMS field application site efforts provide opportunities to test, evaluate, modify, and document how LMS capabilities help to address specific user problems and how LMS capabilities fit into decision processes at user sites.

Field application site in-progress reviews are designed to ensure that the stages of evaluation, modification, and documentation are fulfilled. These reviews also allow other interested parties to be involved at the host site and evaluate the value of applying LMS investments and results to other sites.

This report documents the presentations, discussions, and results of the second Fort Hood Land Management System In-Progress Review.

**15. SUBJECT TERMS**
Army Training and Testing Area Carrying Capacity (ATTACC)
Carrying capacity Training Lands Modeling ITAM Land Rehabilitation

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