

Using an Environmental Data Warehouse to Integrate Analytical Data, GIS, and the Web Presentation

Prepared by
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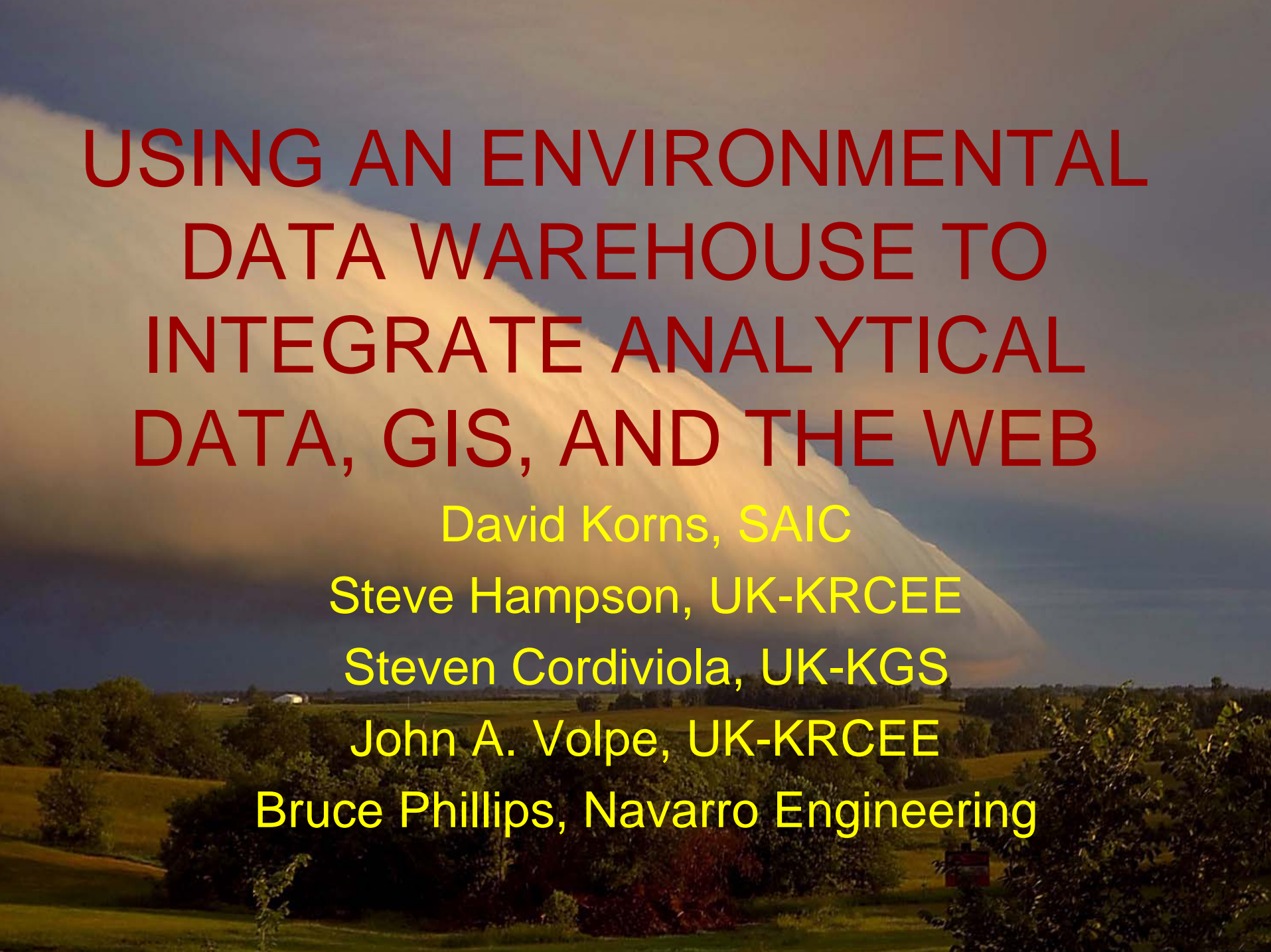
April 2005

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Poster Presentation
Steve Cordiviola
Geological Society of America Meeting
Knoxville, Tennessee

April 2005



USING AN ENVIRONMENTAL DATA WAREHOUSE TO INTEGRATE ANALYTICAL DATA, GIS, AND THE WEB

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What Is The Problem?

- Large, complex sites/facilities have a multitude of reports, extensive data, technical information and drawings related to:
 - Engineering,
 - Environmental Sciences
 - Biological Sciences
 - Safety

Examples

- CERCLA/RCRA (superfund) Sites
- Defense Installations
- Industrial Sites
- Hazardous Waste Storage Facilities
- Disaster Areas such as New Orleans

What are the Issues?

- Sites have many years of activity and research.
- Multiple contractors, researchers, and regulatory agencies hold “pieces” of complete data sets & technical information.
- Accumulated knowledge not readily accessible

As knowledge is gained so do concerns

Engineering Challenges

- Site & Facility Plans are not created equal
 - Details vary from one technical drawing to another depending on
 - » scopes of work for individual projects
 - » or areas of interest and
 - » contractor
- Variety of coordinate systems
 - Evolves over time
- Symbols and scales are not uniform
 - Different ways to represent same features

Scientific Challenges

- Data Generated from a Wide Range of Studies
 - Geotechnical and geophysical
 - Surface and Ground Water Studies & Modeling
 - Environmental Analyses
 - Emergency Response
 - Fauna and Flora Habitats
 - Land Use
 - Risk Assessment

Scientific Challenges

- Unique databases
 - From index cards to high-end relational dbs
 - Variety of field names representing same type of data or data collection locations
 - Unique naming of the same features
- Different levels of reporting standards
 - Always improving detection limits
 - Data Quality erratically reported
 - Data Validation erratically reported
 - Each researcher handles & reports data quality “exceptions” differently

Security, Safety, and other Regulatory Challenges

Federal, State, and Local Agencies

- Data Reporting Requirements differ between regulatory agencies
 - Multiple submissions of same data in different formats
- Security Issues
 - New levels of security bureaucracy in Post 9-11 era
 - New security rules in Post 9-11 era
 - Access to classified data?
- Paper, paper, paper
 - submission, tracking & storage via traditional reporting mechanisms

SOLUTION?

The Concept of an Integrated Data Management/Retrieval System

- A systematic and consistent approach
 - Ability to retrieve and display data, maps, and models in a consistent and easy-to-use format
 - Automatic and customized reformatting of data from a variety of inputs
 - Appropriate Security Access to data depending on security clearance

Who Will Benefit?

- Site/Facility Owners
- Contractors
- Researchers
- Regulators
- Public

Components of an Integrated Data Management/Retrieval System

- Data Warehouse
- Geographic Information System
- Web access
 - Intranet
 - Internet

Data Warehouse

- Analytical data from all known sources of data integrated into a single database.
 - Spatially-enabled data tables (likened to a master sample location feature table in GIS)
 - Unified parameter names, units, dates, and location names.
 - Consistent, rule-based loading of data applied
 - Detection limits,
 - Missing data,
 - Non-detects

Geographic Information System

- Uses geodatabase concept
 - Centralized spatial and attribute data storage
 - Line and polygon topology models
 - Easy-to-use customizing and validation rules
 - Available Standards for a variety of features

Geographic Information System

- Integrate features from a variety of GIS and CAD datasets
 - Consistent coordinate system
 - Layers converted to feature classes
 - Versioning abilities
 - Include raster datasets

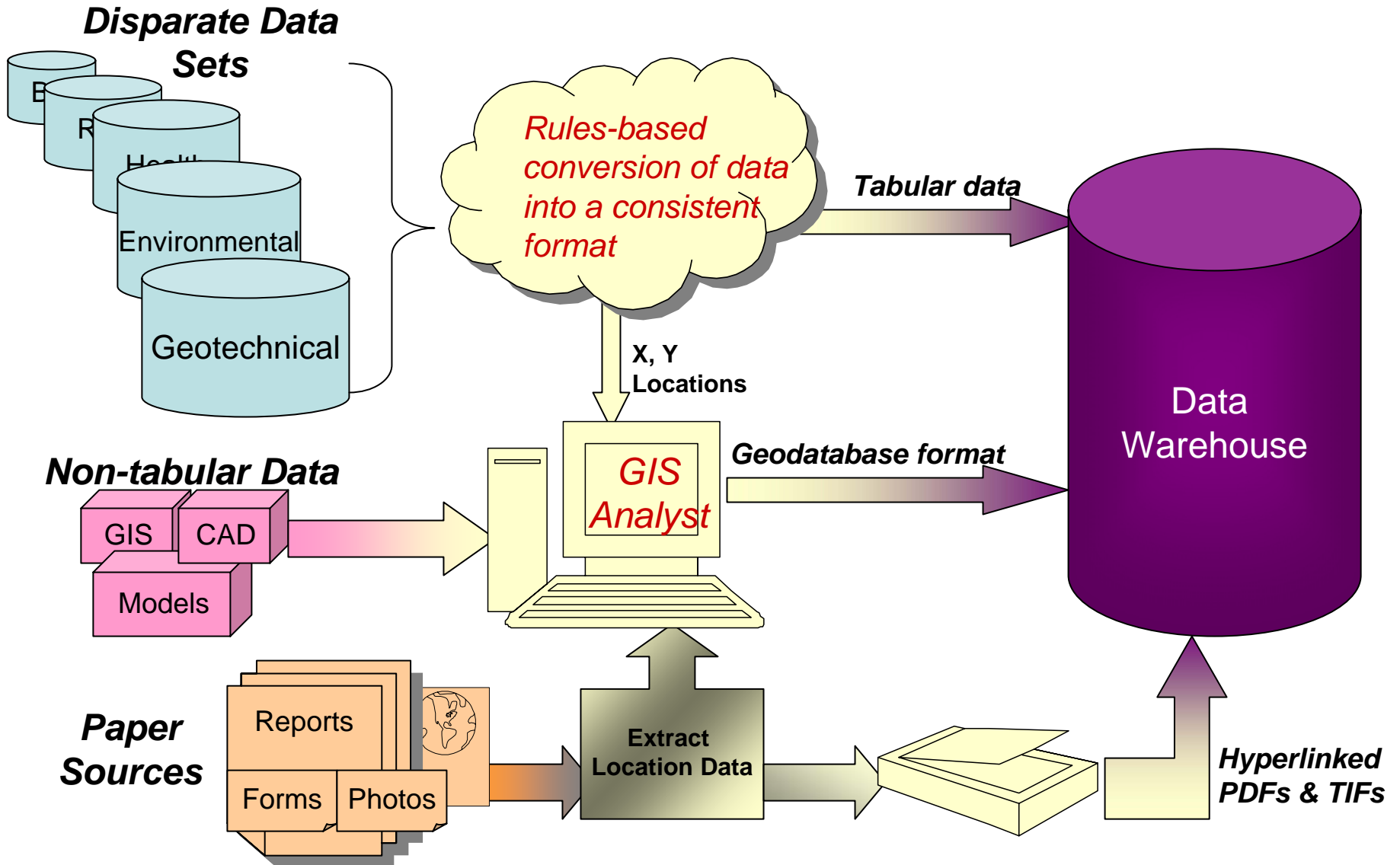
WEB Access

- Multiple query options
 - By form (drop-down lists)
 - By Map (point and click)
 - SQL queries (text-based)
- Multiple Views
 - Documents
 - Tabular data
 - maps

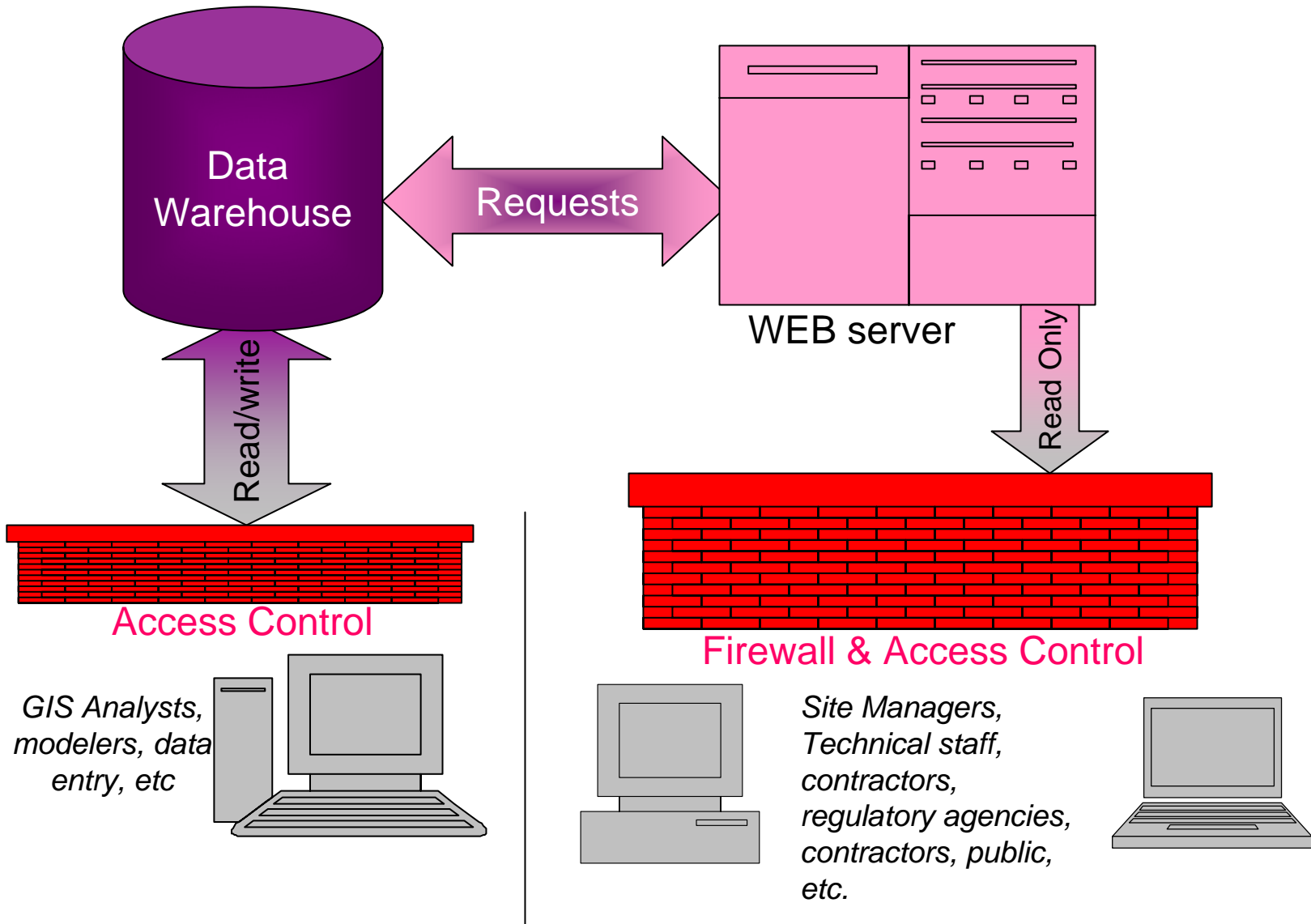
WEB Access

- INTRAnet OR INTERnet
- Variety of export features
 - To spreadsheets
 - Predefined models or applications
 - To reports
- Secure Access
 - Username and Password
 - “Public” access

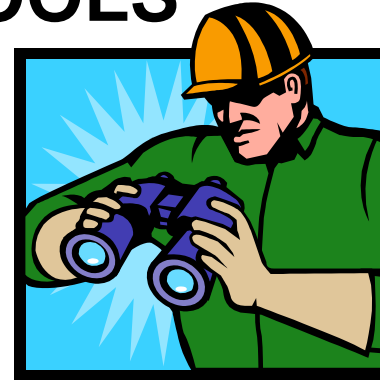
Input & Conversion



End-User Access



WEB Products SEARCH TOOLS



By Map

A screenshot of a web browser displaying the Paducah GIS search interface. The page has a blue header with the "Paducah GIS" logo. Below the header are several dropdown menus for "LOCATIONS", "ANALYTES", "MEDIA", and "FRACTION". There are also input fields for "SAMPLING EVENT" and "ENDING DEPTH". A "CAUTION" note is visible on the left side, warning that queries may take several minutes to complete. At the bottom, there are buttons for "Submit Query to View Data in Table" and "Submit Query to Excel Spreadsheet".

By Form

A screenshot of an ArcIMS HTML Viewer web browser. The main area shows a map of a facility with various colored overlays. On the right side, there is a search results panel with a list of categories like "INSULATION", "LIQUID_EMULSION", "METAL_SHMPRODS", etc. Below the map, there are search filters for "SELECT MEDIA" and "SELECT FRACTION". At the bottom, there is a "LOCATE GROUNDWATERSAMPLES HAVING SELECTED ANIONS - DETECT OR NON-DETECT" section with a dropdown menu and buttons for "Submit Query to View Data in Table" and "Submit Query to Excel Spreadsheet".

WEB Products

Display Results

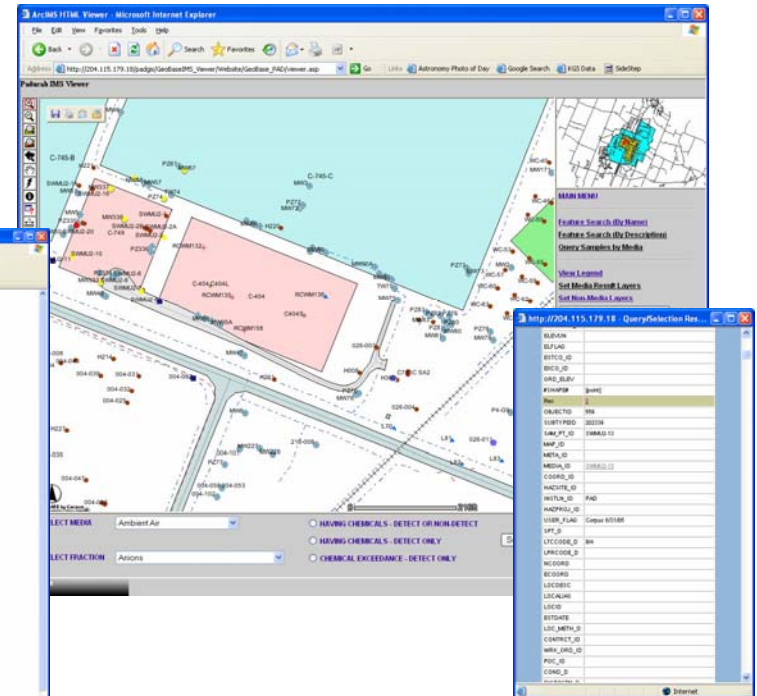
Tabular

Paducah GIS

The query generated 3972 record(s).

STATION	DATE COLLECTED	ANALYTE	SAMPLE TYPE	RESULT	UNITS	RESULT QUALIFIER	VALIDATION QUALIFIER	PRIORITY QUALIFIER	DETECTION LIMIT	RAD ERROR	RAD ERROR	BOTTOM SAMPLE DEPTH	FRACTION
Temporal Plot	004-020	09/11/1999	Suspended Solids	REG	2.63E7	ug/L	X	10	84.0	WETCHEM			
Temporal Plot	004-021	09/11/1999	Suspended Solids	REG	1919000.0	ug/L	X	10	85.0	WETCHEM			
Temporal Plot	004-022	12/02/1999	Suspended Solids	REG	9553000.0	ug/L	X	10	85.0	WETCHEM			
Temporal Plot	004-028	09/07/1999	Suspended Solids	REG	276000.0	ug/L	X	10	89.0	WETCHEM			
Temporal Plot	004-029	09/11/1999	Suspended Solids	REG	800000.0	ug/L	X	10	89.0	WETCHEM			
Temporal Plot	004-037	09/10/1999	Suspended Solids	REG	2154000.0	ug/L	X	10	45.0	WETCHEM			
Temporal Plot	005-013	09/27/1999	Suspended Solids	REG	876000.0	ug/L	X	10	73.0	WETCHEM			
Temporal Plot	005-015	07/26/1999	Suspended Solids	REG	700000.0	ug/L	X	10	80.0	WETCHEM			
Temporal Plot	005-018	12/16/1999	Suspended Solids	REG	1.336E7	ug/L	X	10	85.0	WETCHEM			
Temporal Plot	005-026	09/24/1999	Suspended Solids	REG	1.647E7	ug/L	X	10	83.0	WETCHEM			
Temporal Plot	006-016	07/13/1999	Suspended Solids	REG	1127000.0	ug/L	X	10	37.0	WETCHEM			
Temporal Plot	006-018	07/14/1999	Suspended Solids	REG	3.94E7	ug/L	X	0.01	27.0	WETCHEM			
Temporal Plot	006-019	02/01/2000	Suspended Solids	REG	3696000.0	ug/L	X	10	86.0	WETCHEM			
Temporal Plot	006-024	09/21/1999	Suspended Solids	REG	937000.0	ug/L	X	10	83.0	WETCHEM			
Temporal Plot	006-025	09/16/1999	Suspended Solids	REG	497000.0	ug/L	X	10	90.0	WETCHEM			
SP TANK	02/28/2003	Suspended Solids	REG	11100.0	ug/L	X	10	100	WETCHEM				
SP TANK	05/13/2003	Suspended Solids	REG	49000.0	ug/L	X	25	20	WETCHEM				
SP TANK	06/04/2003	Suspended Solids	REG	82000.0	ug/L	X	20	20	WETCHEM				
746W-TB1	11/29/2001	Suspended Solids	REG	36000.0	ug/L	X	22	20	WETCHEM				
746W-TB1	09/20/2002	Suspended Solids	REG	342000.0	ug/L	X	111	20	WETCHEM				
746W-TB1	09/02/2003	Suspended Solids	REG	30000.0	ug/L	X	20	20	WETCHEM				
746W-TB2	11/08/2001	Suspended Solids	REG	57000.0	ug/L	X	22	20	WETCHEM				
746W-TB2	09/20/2002	Suspended Solids	REG	300000.0	ug/L	X	100	20	WETCHEM				
746W-TB2	02/20/2003	Suspended Solids	REG	30000.0	ug/L	X	21	20	WETCHEM				
746W-TB2	09/02/2003	Suspended Solids	REG	24000.0	ug/L	X	20	20	WETCHEM				
746W-LP	09/19/2001	Suspended Solids	REG	55000.0	ug/L	X	20	20	WETCHEM				
746W-LP	11/29/2001	Suspended Solids	REG	44000.0	ug/L	X	20	20	WETCHEM				
Temporal Plot	014-008	02/29/2000	Suspended Solids	REG	80000.0	ug/L	X	10	80.0	WETCHEM			

Graphical



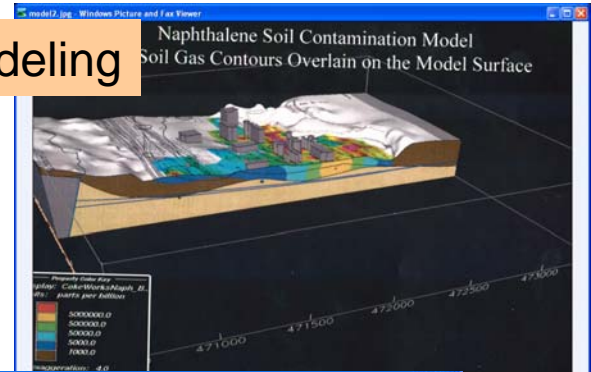
WEB Products

Ancillary Output Possibilities

Spreadsheet

Name	Boring#	Easting	Elevation	Remarks
CF1-1	30367.2	111424.2	444.0	Ground @ stake. No boring at this location.
CF1-2	30469.8	111340.2	347.0	Ground @ boring.
CF1-3	30466.4	111459.9	402.0	Ground @ stake. No boring at this location.
CF1-3A	30479.0	111469.7	405.0	Ground @ boring.
CF1-4	30551.0	111269.4	359.0	Ground @ boring.
CF1-5	30607.4	111379.3	358.0	Ground @ boring. "30 FT SP" written on stake by boring.
CF1-6	30660.0	111362.9	361.2	Ground @ boring.
CF1-6A	30662.7	111367.9	359.0	Ground @ boring.
CF1-7	30424.5	111504.4	309.0	Ground @ boring.
CF1-8	30501.9	111504.9	345.0	Ground @ boring. "20 FT SP" written on stake by boring.
CF1-9	30619.7	111464.2	345.0	Ground @ boring.
CF1-10	30570.4	111513.3	345.7	Ground @ boring.
CF1-11	30586.5	111513.3	344.0	Ground @ boring.
CF1-12	30612.7	111595.3	326.0	Ground @ boring.
CF1-13	30529.3	111523.1	350.7	Ground @ boring. "30 FT SP" written on stake by boring.
CF1-14	30420.4	111911.5	352.0	Ground @ boring.
CF1-15	30627.7	111498.1	349.0	Ground @ boring.
CF1-16A				---
CF1-16	30579.3	111821.4	349.7	Ground @ boring.
CF1-17	30429.3	111263.5	344.0	Ground @ boring.
CF1-18	30608.0	111479.9	345.7	Ground @ boring.
CF1-19	30526.0	111919.2	344.4	Ground @ boring. "30 FT SP" written on stake by boring.
CF1-20	30589.3	111304.4	345.4	Ground @ stake. "20 FT SP" written on stake. No boring at this location.
CF1-20A				---
CF1-21	30589.3	111304.4	345.0	Ground @ boring.
CF1-22	30369.4	111492.7	354.0	Ground @ boring.

For Modeling



PDF Viewer

LITHOLOGIC LOG BORINGWELL NO: 004-020 PAGE 1 of 1

PROJECT: PADUCAH GASOLINE DISPENSER PLANT

CLIENT: THE B.A. AND ASSOCIATES, HILLIER ENGINEERS

DATE: 08/10/99 15:00

BY: VIRGINIA MULLINS

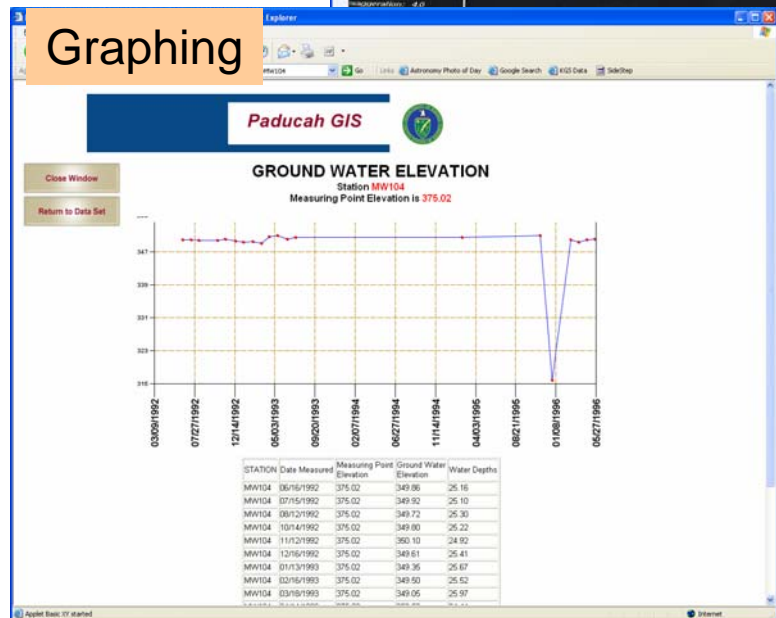
SCALE: AS SHOWN

DESCRIPTION: LITHOLOGIC LOG

LOG CONTENTS:

- 0-10' Sand, silt, and gravel (S&G)
- 10-15' Sand, silt, and gravel (S&G)
- 15-20' Sand, silt, and gravel (S&G)
- 20-25' Sand, silt, and gravel (S&G)
- 25-30' Sand, silt, and gravel (S&G)
- 30-35' Sand, silt, and gravel (S&G)
- 35-40' Sand, silt, and gravel (S&G)
- 40-45' Sand, silt, and gravel (S&G)
- 45-50' Sand, silt, and gravel (S&G)
- 50-55' Sand, silt, and gravel (S&G)
- 55-60' Sand, silt, and gravel (S&G)
- 60-65' Sand, silt, and gravel (S&G)
- 65-70' Sand, silt, and gravel (S&G)
- 70-75' Sand, silt, and gravel (S&G)
- 75-80' Sand, silt, and gravel (S&G)
- 80-85' Sand, silt, and gravel (S&G)
- 85-90' Sand, silt, and gravel (S&G)
- 90-95' Sand, silt, and gravel (S&G)
- 95-100' Sand, silt, and gravel (S&G)

Graphing



Advantages/Disadvantages

- Minuses

- DW **requires routine** updates
- Conversion to geodatabases
- Need to update security as users come and go
- Very sophisticated system

- Pluses

- 1 Stop Shopping for Site/Facility Data
- Ends redundancy of Site/Facility data mining activities
- Multiple Data format Output Capability
 - Each user does not have to convert data
 - Consistent formats
- Uniform interface