



UTILIZATION OF MOBILE COMPUTING AND GIS TO EVALUATE RECLAIMED LANDS IN MISSOURI

Missouri Department of Natural Resources

Location Map



ABSTRACT: Global Positioning System (GPS) integrated mobile geographic information system (GIS) technology has become increasingly important in coal mining and reclamation regulatory programs because of its ability to provide instant and accurate data updates and ways to verify inspection results. Many state and federal regulatory programs have begun using or are considering use of the mobile GIS concept to provide timely, reliable information to regulators (e.g., verification of permit boundaries), identifying soil probe and water sample locations, and assessment of mine site status. The concepts of the mobile GIS in coal mining related field work, inspection results, and mine site status verification of the reclaiming land area and reclamation status on reclaimed lands were conducted by the Office of Surface Mining and Conservation (OSM/OMCR) in Missouri are used as case studies in this paper.

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Project Description, CCM

- Cottonwood Creek Mine (CCM), Permit 2003-01, was granted to Continental Coal Inc. (CCI) by the Office of Surface Mining on November 18, 2003.
- The permit area covers 344 acres and is located in Bates County, Missouri.
- OSM/OMCR staff conducted monthly partial and quarterly comprehensive site visits from 08/22/03 to 01/31/06.
- In the spring of 2005, Alter Field Division of OSM/OMCR initiated protocol of mobile inspection, which adapted the mobile GIS concept into mine inspections.

Equipments and Softwares

- Satellite radio computer by Fujitsu
- Garmin WAAS enabled GPS[®] card w/ 3 meter accuracy
- ArcMap by ESRI
- ArcPad by ESRI
- ArcPad Builder

Study Areas

- Regraded area topsoil depth verification
- Surface disturbance area verification
- Surface water sample data entry

¹WAAS - Wide Area Augmentation System - is a system of satellites and ground reference stations that provide GPS signal corrections.
²Global Positioning System - is a satellite-based navigation system.
³Environmental Systems Research Institute.

Cottonwood Creek Premining View



Cottonwood Creek Permit 2003-01

CCM Regraded Soil Sample Locations



Fujitsu Stylistic 5011 Tablet



- Ultra Low Voltage Intel® Pentium® Processor 1.8 GHz
- Microsoft Windows XP Table PC Edition
- 10.4" XGA TFT with resolution 1280x800
- 256 MB - 2 GB DDR 333 SDRAM memory
- 40 GB 5400 rpm hard drive
- Built-in IEEE 1394a Bus/3/TX
- Ethernet
- One-year International Limited Warranty

View of Permit Boundary and Soil Sample Locations on 2005 Aerial Photo (Site Visited in 2006)



GPS Data Collection



Top Soil Depth Measurement



Tablet Computer w/ GPS Card



Surface Water pH Measurement



Data Preparation

(ArcMap, ArcPad, and/or AutoCAD)

Data Collection

(ArcPad w/ GPS)

Data Update

(ArcPad, ArcMap, and/or AutoCAD)

Report

(ArcMap or AutoCAD)

**EVALUATING THE EFFECTS OF TALL FESCUE ON
ARTIFICIAL VS. NATURAL WILDLIFE HABITAT USING LAND
TYPE ASSESSMENTS AND MOBILE COMPUTING TECHNOLOGY**

Kentucky-31 (KY-31) tall fescue (*Festuca arundinacea*) produces an effective ground cover and can be a valuable forage crop; however, it has been implicated in several negative effects on the environment. These include colonization of bare ground, suppression of other valuable plants, and the toxic nature of seeds and vegetative matter to wildlife species. Because of these concerns, Kentucky-31 tall fescue is considered a noxious weed in many states. KY-31 has been a concern and problem for surface mine reclamation. The objective of this study is to assess the suitability of approximately 541 ha acres of reclaimed wildlife habitat created by surface mining at Bee Veer, Prairie Hill, and Nemo mines (the AECL), Prairie Hill Mine is north central Missouri. Land type assessment models were used to assess wildlife habitat suitability. Models were used to predict the presence or absence of habitat based on environmental distribution, and favorable environmental conditions to wildlife species that collection was accomplished with real time mobile mapping GPS through the use of spatial technologies. Wildlife models produced a score under optimal conditions as well as applied a rating to both KY-31 seeded and natural areas. The scores were compared to the desired target value for each area. The results showed that KY-31 had a negative impact on all areas. However, when the fence areas were tested with the wildlife mitigation tracks the habitat suitability exceeded the target values given by the land type model. This study demonstrated the site specific effects of KY-31 on different soil types and how land type and provides field assessment techniques to measure suitability. Through the use of adapted wildlife habitat models and new techniques such as ArcPad mobile GIS, the effects of KY-31 can be quantified, allowing appropriate mitigation to offset resource losses.

AECI: Bee Veer, Nemo, and Prairie Hill Mines

Teletype Bluetooth 16 Channel GPS

- WAAS Enabled, 16-Channel GPS Receiver
- Bluetooth receiver option up to 100 feet from GPS receiver and PDA or PC
- Compatible with Bluetooth and standard serial
- Rechargeable rechargeable lithium battery
- Small enough to fit in pocket and fits like a cigarette pack

Accuracy: Within 10 meters (90%)
Within 5 meters (90%)
Within 1.3 meters (90%)
Within 4.19 meters (95%)

Suitability assessment of reclaimed wildlife habitat (Prairie Hill Mine - Red Area)

Screen Shot of the ArcPad Layer Form Used for Field Data Collection

GIS Interface

- In order to create the ArcPad layer form, ESRI shapefiles were created and projected using ArcGIS.
- Once the shapefiles were created, they were imported into ArcPad for layer form creation and then to ArcPad for field data collection.
- After field data collection feature class information was updated in ArcPad.
- Upon completion of the field work:
- Quantification of wildlife habitat suitability scores
- Wildlife habitat acreages
- Land use distance calculations & spatial arrangement of affected environments
- Analysis of adjacent land uses for comparison

Fescue Seeded and Mitigation Area Results

- Area around park #30, 40+ acres, mostly fescue, ranging from 12 in the northern end to 20 acres in the southern end.
- Average was a factor, but other wildlife habitat attributes emerged as important in determining habitat quality.
- Landscape analysis of park #30 due to poor species diversity, plant cover, composition, and habitat diversity, invasive population.
- Land use analysis of park #30, mostly fescue, with some grasses mixed with KY-31.
- Mitigation areas scores in the upper range of total wildlife parks
- Each mitigation area had significant variation when using the field data models.
- KY-31 acres = 204 acres + Mitigation areas @ 251 acres = 355 exceeding the target value.

Conclusions

While KY-31 can be an effective ground cover and forage when managed the following conclusions were drawn:

- KY-31 adversely affected woody and herbaceous plant diversity; therefore, reducing wildlife habitat suitability.
- When predominantly seeded with other grass and legume species KY-31 will show dominance within the stand diversity.
- Mobile computing and ArcGIS software were well suited for collection and analysis of information.

Other mobile computing activity at AECI

AECI Bond Status

- MCR assessed and approved a number of bond release applications for the AECI permits.
- Bond release maps were scanned and digitized to create a GIS layer in late 2004.
- Mobile computing technology was used in field evaluation.
- In January, 2005, the AECI GIS bonding layer was updated to include bond releases approved under the OSM-MCR federal program.
- MCR transferred the bond data to Missouri.

Summary of AECI Bond Release Approved by OSM/MCR

- From August, 2003 to January, 2006
- 35 Bond Release Applications
- Acres released
 - 404.8 acres Phase I
 - 3158.71 acres Phase II
 - 1900.7 acres Phase III
 - 298.1 acres Complete/Undisturbed
- Total dollar released - \$ 2,723,450

Areas proposed for bond release may have few landmarks that stand out.

Crack four feet from highway face.

Survey grade mobile computing (linked to known point) can be used to locate problems needing work.

Legend: Bond Status Jan. 06

- Concrete
- Unrestored
- Phase I
- Phase II
- Undisturbed

RECOMMENDATIONS FOR FUTURE WORKS

- Use wireless technology to download GIS data in the field.
- Use mobile computing devices that have GPS receiver built-in to the device. One recommendation showed that the initial GPS activation time is much shorter.
- Experiment with options to build applications that can perform simple calculations in the field.
- Update bond status to incorporate various types of audience applications into ArcPad projects. Ex. Wind or Water flow, soil moisture, soil salinity, soil infiltration rates, Sprinklers to view water and/or soil data, Photo viewing software to view pictures and more.
- Find ways to make the mobile computing devices for collecting audience information easier and less time consuming, affordable, ergonomic, smaller, light weight, durable, and inexpensive.