LAND USE MAPPING
FOR CONSTRUCTION SITES

STATEMENT OF THE PROBLEM

Monitoring of existing construction sites within the limits of the City of Columbia is a requirement of the city government for:

1) Control of construction site permits issued by the City,
2) Location of construction sites where the natural ground cover or pre-existing structures were removed and bare soil is exposed and becomes a potential source of sediments that will lower water quality in local watersheds,
3) Monitoring of construction progress at those sites.

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PRESENT SITUATION

The City of Columbia management would like to have a tool that would complemented its present monitoring of construction sites to provide accurate updates on the progress of building activities and would effectively show the amount of bare ground exposed to erosion.

POTENTIAL BENEFITS

Monitoring of construction sites in the City of Columbia will bring benefits to city management in reference to urban development and compliance with more strict EPA regulation of water quality in urban watersheds.

TECHNICAL APPROACH TAKEN

The project was carried out using as data source the four IKONOS-2 multispectral bands (0.45 – 0.53 μm, 0.52 – 0.61μm, 0.64 – 0.72 μm, 0.77 – 0.88 μm) with a 4 m spatial resolution. The IKONOS-2 data was obtained on 30 April 2000 at 10:48 AM. Sun azimuth was 138.74 degrees and sun elevation was 60.74 degrees. The nominal data collection azimuth was 352.42 degrees and the nominal data collection elevation was 62.89 degrees.

Figure 1. Color display of IKONOS multispectral image with 4-meter spatial resolution (RGB = 3,2,1) sharpened with IKONOS 1-meter panchromatic image showing the outline of City of Columbia.

A Supervised Maximum Likelihood Classifier was used to map active construction sites where bare ground was exposed. Training sites were defined for two types of bare ground (associated with different exposed soil horizons and poorly developed grass) and eight other major land cover classes within the project area. Other training classes included two types of grass (well and fairly well developed grassland), two types of water surface (separated by presence or absence of sediments in suspension), two classes of concrete surfaces (road and parking areas), asphalt surfaces and woodlands. Single-pixel training sets (Gong and Howarth, 1990) with approximately 100 pixels in each were established for each class.

A B

Figure 2. Some of the training sites used for supervised classification. A. Area where some of the bare soil types #1 and #2 and impervious surfaces (concrete) were selected. B. Area with some of the impervious surfaces (asphalt) training pixels.

Figure 3. Color IKONOS multispectral image (RGB = 3, 2,1; 4-m spatial resolution) of an area in southern Columbia showing several construction sites.

Figure 4. Color IKONOS multispectral image (RGB = 4, 3, 2; 4-m spatial resolution) of the same area in Figure 2 in southern Columbia showing several construction sites.

The classification results were combined into three major classes where two bare soil classes could be discriminated. One of them could be associated with urban and rural areas where the ground surface was in part covered by vegetation consisting of a mixture of poorly developed grass and stressed or dead crops and the other was associated with construction sites alone. The third class contained all other initially mapped classes.

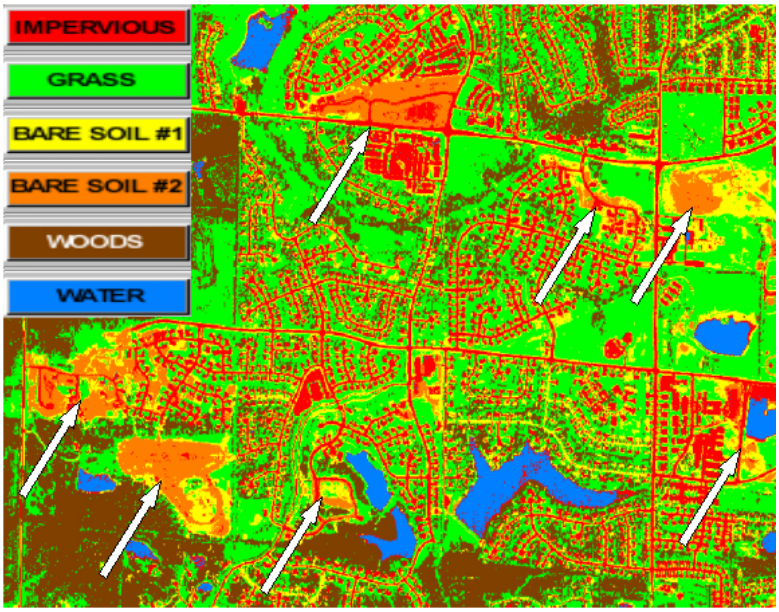

Figure 5. Result of supervised maximum likelihood classification with six classes. Areas with active construction sites shown by arrows.

Accuracy assessment was based on a priori selected known pure pixels selected in the image. The results indicated that an accuracy level of 94% had been reached for the entire area. For display purposes the final map has been filtered to show only those areas with more than one acre.

Raw Count Confusion matrix for:

Construction Site Mapping

Overall Accuracy: 94.479% from 163 observations

Kappa statistic: 0.917

Classified File\Reference File	others	baresoil-1	baresoil-2
others	53	0	0
baresoil-1	2	54	3
baresoil-2	0	4	47

Table 1 . Confusion or error matrix for the supervised classification of construction sites indicated by bare soil exposures in the City of Columbia.

At this time the City is only interested in tracking down those construction sites that have at least one-acre area. A display was produced (Fig. 6) showing only those areas with exposed soil with area equal or larger than 1-acre. This approach eliminated from the classification results those small areas that had exposed soil but do not represent construction sites.

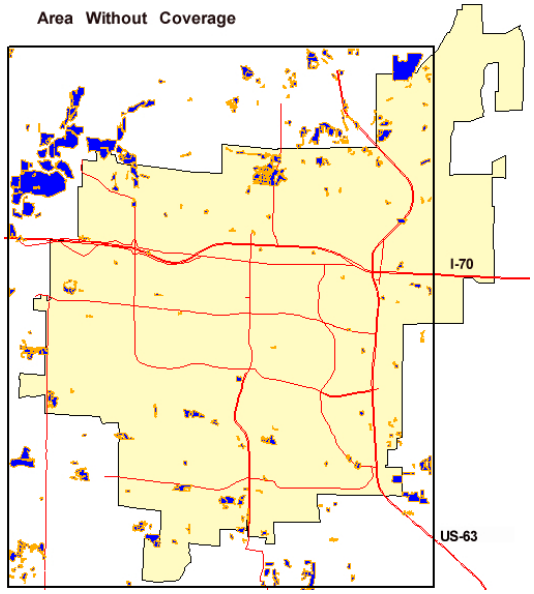

Figure 6. Location of construction in the City of Columbia and surrounding areas on April30, 2000 based on the supervised classification of IKONOS multispectral data (4-m spatial resolution).

ANTICIPATED IMPLEMENTATION PROBLEMS IN URBAN GOVERNMENT

The government agency interested in implementing this approach to be used on a routine basis should have the appropriate image processing hardware and software in place. Once the

training and testing sites for supervised classification have been defined for an appropriate range of soil types in the area, it will be possible to produce land use maps showing active construction areas from any other IKONOS multispectral data sets without technical supervision.

ADDITIONAL WORK

The information contained in IKONOS pan band (0.45 – 0.90 μm) still has to be evaluated in combination with the multispectral bands.

PROJECT PARTICIPANTS

Dr. Aderbal C. Corrêa and Mr. Janggam Adhityawarma of the Center for Environmental Technology (CENTECH), Department of Civil and Environmental Engineering, carried out the project for ICREST.