

NASA-CR-136470) THE APPLICATION OF  
REMOTE SENSING TECHNOLOGY TO THE SOLUTION  
OF PROBLEMS IN THE MANAGEMENT OF  
RESOURCES IN INDIANA Semiannual Status  
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## INTRODUCTION

The purpose of this investigation is a departure from that of previous investigations sponsored by the office of University Affairs and conducted by the Laboratory for Applications of Remote Sensing, Purdue University. In an effort to bridge the gap between the research community and the user agencies, this investigation was designed to take the remote sensing technology and products of that technology to the user agencies and to assist them in the use of this technology.

In order to implement the objectives of the proposal it has been necessary for staff members of the Laboratory for Applications of Remote Sensing to seek out agencies (federal, state, regional and local) which have responsibilities for planning, monitoring, managing and developing natural resources; to determine if remote sensing technology might be of benefit to any of these agencies; and to work cooperatively with interested agencies in the application of remote sensing technology to their needs.

Due to the nature of this investigation it is necessary to rely on previously developed and reported research findings. Most of this body of research has been carefully described in other reports which are not included or referenced in this report. It is, however, important to realize that even though many of the procedures referred to are not new, this effort is directed toward the implementation of these findings into the routine of the user agencies.

The first semi-annual report summarizes the progress which has been made in the following specific projects:

- A. Pilot study for land use inventory of the Great Lakes Watershed
- B. Resource inventory of Marion County (Indianapolis), Indiana.
- C. Resource inventory of 8 central Indiana counties for the Indiana Heartland Coordinating Commission.
- D. Applications within the Indiana Department of Natural Resources.
- E. Applications within the Indiana Department of Commerce.
- F. Applications within the USDA Soil Conservation Service.

## A. GREAT LAKES WATERSHED STUDY

### Background

The Governments of Canada and the United States of America, pursuant to Article IX of the Boundary Waters Treaty of 1909, requested the International Joint Commission (IJC) to conduct a study of pollution of the boundary waters of the Great Lakes system from agricultural, forestry and other land use activities, in the light of the provision of Article IV of the Treaty which provides that the boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health and property on the other side, and in the light also of the Great Lakes Water Quality Agreement signed on April 15, 1972.

In November 1972 the IJC appointed an 18-member Reference Group on Great Lakes Pollution from Land Use Activities. The Reference Group was requested to prepare and to submit for review by the Great Lakes Water Quality Board by January 30, 1973, an outline of the necessary investigations and studies, a schedule for the study, and the estimated cost to complete the study and prepare a report to the IJC. The Reference Group was directed to take into account the request of the Governments for a report as soon as possible.

The Reference Group has adopted the following general procedures.

- Task A. To assess problems, management programs and research and to attempt to set priorities in relation to the best information now available of the effects of land use activities on water quality in boundary waters of the Great Lakes.
- Task B. Inventory of land use and land use practices, with emphasis on certain trends and projections to 1980 and, if possible, to 2020.
- Task C. Intensive studies of a small number of representative watersheds, selected and conducted to permit some extrapolation of data to the entire Great Lakes basin and to relate contamination of water quality, which may be found at river mouths on the Great Lakes, to specific land uses and practices.
- Task D. Diagnosis of degree of impairment of water quality in the Great Lakes, including assessment of concentrations of contaminants of concern in sediments, fish and other aquatic resources.

## Request to LARS.

On May 30, 1973 the Task B Subcommittee and several members of the Reference Group on Great Lakes Pollution from Land Use Activities met at LARS for a briefing on the state-of-the-science in remote sensing technology. During this meeting a lengthy discussion ensued concerning the possibility and feasibility of preparing a current land use inventory of the Great Lakes Watershed by computer-implemented analysis of multispectral scanner data from the Earth Resources Technology Satellite.

As a result of this May 30 meeting at Purdue University, LARS was requested to prepare a land use inventory of an area of several counties in Michigan for which LARS already had ERTS multispectral data. The Reference Group indicated that the results of this pilot study would be given serious study. If the study proved successful, consideration would then be given to the use of these techniques for producing a land use inventory of the entire Great Lakes Watershed.

## Funding of the Pilot Study.

After consultation with members of the Reference Group concerning the funding of the pilot study, it was determined that there were no funds that could be made readily available. Discussions between officials of the Office of University Affairs (NASA) and LARS led to an agreement that a limited amount of PY funding could be used for this study.

Title: Land Use Classification of Six Counties in Southwest Michigan by Computer Analysis of ERTS Multispectral Scanner Data.

Objective: To prepare a current land use inventory of a pilot area in the Great Lakes Watershed.

1. To produce by computer-implemented analysis of ERTS multispectral scanner data a land use map of each county delineating the following major land use categories:
  - a. urban
  - b. agriculture
  - c. forest
  - d. water
  
2. To classify and list in tabular form the following land use categories for each county:
  - a. urban (low density)
  - b. urban (medium density)
  - c. urban (high density)

- d. transportation
- e. extractive
- f. row crops
- g. close grown crops
- h. pasture and meadows
- i. orchards and vineyards
- j. forest and woodlands
- k. water
- l. wetlands
- m. barren lands

### Pilot Area

The counties selected for this analysis include Ottawa, Kent, Ionia, Allegan, Barry, and Eaton (Figure 1). The major urban area in these counties is the city of Grand Rapids located in south central Kent County. Several other small to medium-sized cities occur in Ottawa and Allegan Counties primarily along the Lake Michigan shore. Eaton County borders on the city of Lansing. However, little of the actual urban area extends over the county line.

### Data Source

Multispectral scanner data from the ERTS-1 pass on 25 August 1972 were analyzed. The six-county area selected for this study was relatively clear with only a few scattered cumulus clouds near Lakes Michigan in Ottawa and Allegan Counties. The data were found to have some minor noise in band 4 and a significant six-line recurring noise signal in band six. This data problem in band six was considered bad enough to delete that band from the analysis.

### Analysis Procedures

The analysis was undertaken on short notice and had the additional constraints of less than three weeks working time to complete the analysis. Since the data were nearly a year old and no photographs or other ground observations were immediately available for use in defining training sets, the analysis was approached primarily from the point of view of using spectrally separable classes as defined by the clustering algorithm. Due to the relatively large area involved, it was decided to use Kent County as the primary training site. Kent includes the largest urban development, and a representative of the Soil Conservation Service (SCS) from Grand Rapids was available for consultation on ground cover and crop conditions in the vicinity of Grand Rapids. This information proved to be very useful. However, the major problem to locate accurately certain known cover types which could be used for training

# PILOT STUDY AREA GREAT LAKES WATERSHED

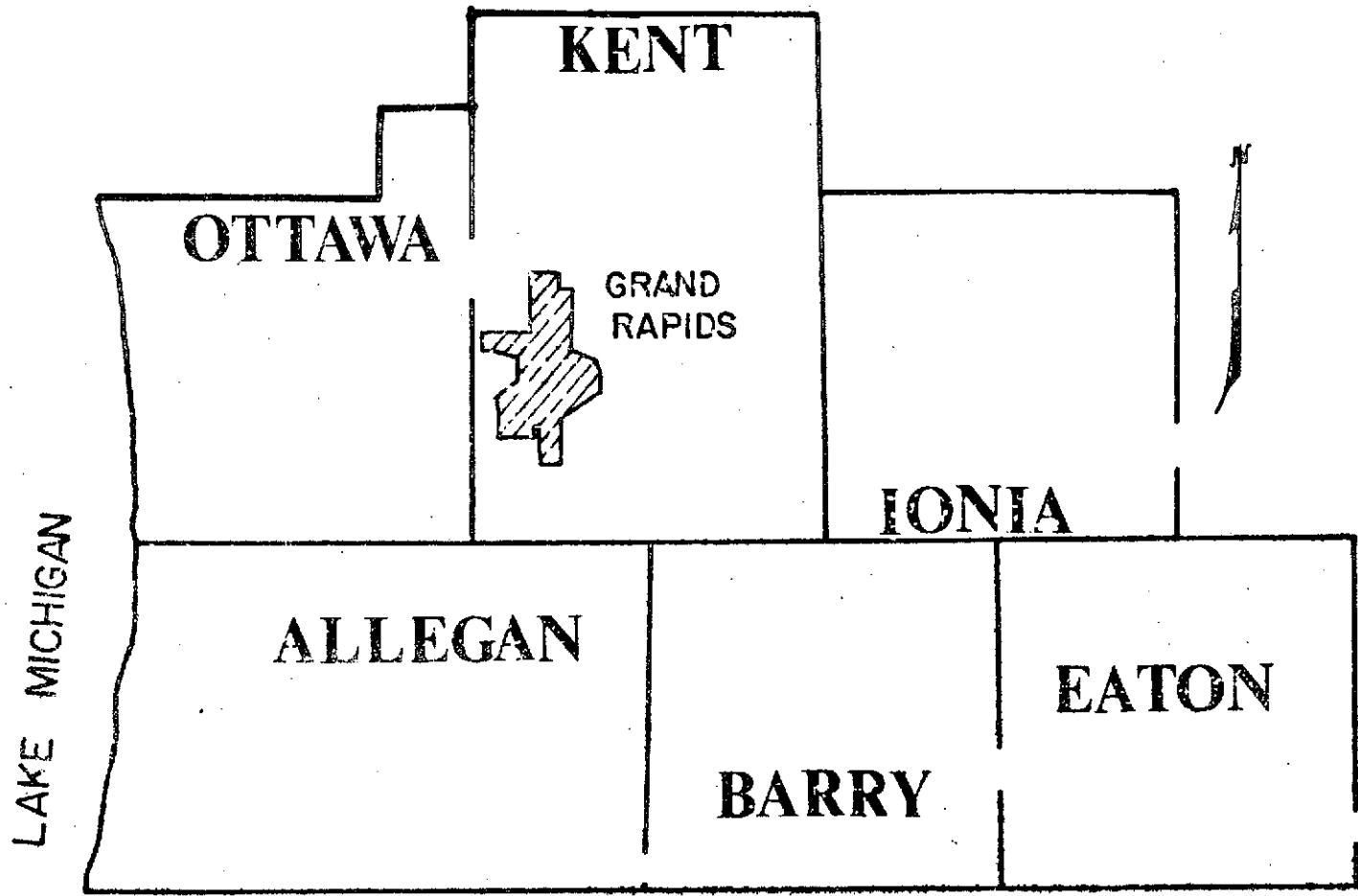


FIGURE 1.

purpose remained. This proved to be very difficult under the time constraints of both the personnel involved and computer time available for such work. Several cover types were identified with the help of the SCS representative and were included in the training sets. On the day following the SCS consultation one of the Purdue analysts flew to Grand Rapids in a light aircraft for the purpose of taking aerial photographs of the area and personally evaluating the cover types in an attempt to pinpoint further some possible areas which could be used as training sets. Numerous photographs were taken from the air. However, the time limitation prevented many of these sites from being located with sufficient accuracy in the data set to be used for training purposes. Those pictures which were obtained will be useful for demonstrating the types of cover found in the area. The aerial reconnaissance flight was hampered by relatively low clouds and some restrictions in visibility. This prevented taking photographs from a sufficient altitude to show large areas or to locate other areas from some existing photography which was carried on board. The aerial survey was carried out primarily in the vicinity of Grand Rapids since this was being used as the primary area for training purposes.

### Classification Results

Several classifications were made of portions of Kent County around Grand Rapids to evaluate and improve the training set with successive iterations in additional input from the SCS and the aerial survey. Five general land-use categories were specified for investigation and attempt at analysis in this study. These are:

#### 1. Urban-commercial-industrial

Several classes of urban density have been designated and are in general mixed together with the transportation and extractive classes. In particular hard surfaces of over 25 percent of the area are in general classified as transportation i.e. interstate and large highways and extractives including gravel pits, bare sand and soil.

#### 2. Agricultural

A class of row crops and pastures was designated on the basis of photo interpretation techniques using the digital image display since no immediate information was available from the past growing season as to the exact location of row crop fields. The accuracy of this class is somewhat questionable. An additional class was requested for orchards and vineyards.

As shown in some of the aerial photographs the orchards in this area are many and extremely variable in their crown closure and general appearance and size. This will tend to require many classes to define orchards and will lead to a high degree of misclassification between orchards, pasture land and open forest areas. Since it was not possible to locate any vineyards with accuracy, this land use category was not included in the training set. One area of truck farming was noted both by the SCS official and in the aerial reconnaissance flight between Grand Rapids and the city of Zeeland, Michigan. The training set was defined with two subclasses, but the actual ground cover in this case is not known. A class of pasture and meadow was also defined. It appears from the classification and also from the aerial photographs that the orchard and pasture class will probably be mixed together because of the high variability in crown closure of orchards which in most cases have grass or green vegetation background.

### 3. Forested Land

The forest area was defined by three separate classes which are shown in the line printer printouts (Figure 2) as the symbol y in all cases and as green in the color photographs. This class is probably one of the best defined and most accurately classified. The general observation from the air and from the photographs is that in most cases the forest at least in central Michigan appears to be quite dense with few areas of open crowns which could be misclassified as orchard.

### 4. Recreational Land

No attempt was made to define park land or cottages due to the inability to separate this type of land use with ERTS data.

### 5. No Major Usage

This class includes water (both river and lake), wetlands, and barren land. Separate classes were defined for lakes, rivers, and wetlands and appear to be quite accurately classified. Barren land is in general being classified in the extractive or transportation class if it shows complete lack of vegetative cover.

For this pilot study there was insufficient time to make geometric corrections of the data. County areas and boundaries have been approximated. Classification results by county are presented in tables 1 and 2.

### Evaluation of Classification Results

No means exist under the time constraints for this classification to establish any test procedures for evaluation of the





accuracy of the classification. A subjective evaluation can be made by reference to maps and existing photographs as to the general accuracy of large features such as lakes, highways, and major urban areas. These features appear to be reasonably accurately classified. A variable amount of misclassification probably is occurring with the sub-groups of the agricultural classes. In particular orchards, pastures and row crops are probably being intermixed within the classification. The urban class as a whole appears to be quite accurately classified as do the forest and water/wetlands classes. Several gradations of density within the urban areas of Grand Rapids are being shown. However, the amount of actual hard surface area within these areas is not well known to the analyst and therefore cannot be evaluated accurately. Much of the obviously high percentage of hard surface such as shopping center parking lots, airport ramps, downtown areas are being intermixed with the highway or transportation classes.

Report Prepared and Submitted By

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Table 1

## MAJOR LAND USE CATEGORIES IN SIX MICHIGAN COUNTIES

County	No. of Sample	Percentage of Samples Classified into				
		Urban	Agriculture	Forest	Water	Clouds and Shadow
Ottawa	326214	18.7	66.8	10.7	1.5	2.3
Kent	539168	13.4	54.1	28.8	3.0	0.7
Ionia	337230	8.3	55.3	33.6	2.3	0.5
Allegan	521301	15.9	67.4	13.2	1.4	2.1
Barry	348578	5.5	54.0	35.8	3.7	1.0
Eaton	368226	7.5	51.7	38.9	1.3	0.5

Table 2

## LAND USE CLASSIFICATION OF SIX MICHIGAN COUNTIES USING ERTS MULTISPECTRAL SCANNER DATA

Percentage of Samples Classified Into

County	No. of Samples	Trans- portation	Urban	Agri- culture	Truck- farm	Orchard	Pasture	Forest	Water	Bare Soil & Gravel	Cloud & Shadow
Ottawa	326214	3.0	15.0	23.2	5.4	22.3	15.9	10.7	1.5	0.7	2.3
Kent	539168	3.0	9.6	16.9	3.1	12.0	22.1	28.8	3.0	0.8	0.7
Ionia	337230	3.4	4.7	20.7	1.4	11.2	22.0	33.6	2.3	0.2	0.5
Allegan	521301	2.1	13.2	25.5	4.7	24.6	12.7	13.2	1.4	0.6	2.1
Barry	348578	1.8	3.5	17.1	2.6	12.4	22.0	35.8	3.7	0.1	1.0
Eaton	368226	3.1	4.2	19.9	0.7	10.1	21.0	38.9	1.3	0.3	0.5

## B. RESOURCE INVENTORY OF MARION COUNTY

### Background

Several meetings have been held with officials of Marion County Unified Government. Meeting dates, topics of discussion and personnel attending are listed at the end of this section.

The conclusions reached as a result of these meetings are limited to cooperation with the Department of Metropolitan Development, Division of Planning and Zoning. This group seems to be the logical one to use, analyze and evaluate remote sensing technology as applied to land use planning.

The Indianapolis Department of Metropolitan Development is one of the most sophisticated planning agencies in the United States. It is highly organized with a large staff of planners and design specialists. The Department has access to two computers. An example of the type of work that they are capable of undertaking is the inventory of every parcel of land in the county. To date they have inventoried four of the nine townships. The inventory contains such information as parcel address, ownership, type of improvements, value of improvements, assessed valuation and other pertinent data of this nature. All this information is machine stored.

### Planned Activities

Because of the high degree of development of this department, the ordinary land use inventory would be of little value. The temporal overlay of ERTS images and analysis of change from one date to another is information that this planning organization would use. It was agreed that the Laboratory for Applications of Remote Sensing would implement a change detection program on Pike township, Marion County. This program will be run for evaluation and use by the Department during the next six months period.

Pike township is in the northwest corner of Marion County. Urban development in the past has been limited to a few industrial areas and scattered residences. It is 44 square miles in area and in the past has been primarily an agricultural area. Recently a great deal of apartment complex construction has taken place in the past 4 years. There has also been an increase in the amount of industrial-commercial construction and land speculation. The Department of Metropolitan Development needs a periodic inventory of this area to indicate the stage of development of these projects. This information will be used to assess the ecological impact of this construction in the township.

MEETINGS

September 15, 1973 - fourteen representatives from Department of Metropolitan Development, Department of Transportation and Department of Public Works, Indianapolis, were present for an educational presentation on remote sensing. A computer classification and two gray scale printouts of Marion County were given to the Department of Metropolitan Development. They expressed an interest in securing a remote terminal for use by the Department.

October 9, 1973 - Donald Spaid, Deputy Director, Division of Planning and Zoning, Department of Metropolitan Development, Indianapolis, Indiana.

An Integrated Grant Application for the Unified Planning Program (1974) was worked out with Mr. Spaid. This application contained two parts: (1) the cost of training personnel within the Department in the multispectral data analysis using LARSYS software system; (2) a request for funding a LARS remote terminal.

The application was submitted October 15, 1973, by the Department. As of the date of this report, this funding has not been confirmed.

November 28, 1973 - Donald Spaid, Deputy Director, Bernard Wilcox, Principal Planner Data Development, Division of Planning and Zoning, Indianapolis, Indiana, toured the Laboratory for Applications of Remote Sensing, Purdue University. At this meeting Pike township was chosen for a change detection study.

LARS Staff Members Involved In Meetings

M. F. Baumgardner  
D. A. Landgrebe  
R. H. Gilbert

C. RESOURCE INVENTORY OF EIGHT CENTRAL INDIANA COUNTIESBackground

The Indiana Heartland Coordinating Commission is a recently organized regional planning unit for Indianapolis and the seven surrounding counties.

The commission is composed of 3 voting members from each county and municipalities within the region. These counties include, Boone, Hamilton, Hendricks, Johnson, Shelby, Hancock, Morgan and Marion. (Figure 3). This area is the Indiana planning and Development Region 8 and the Indianapolis Standard Metropolitan Statistical Area (SMSA).

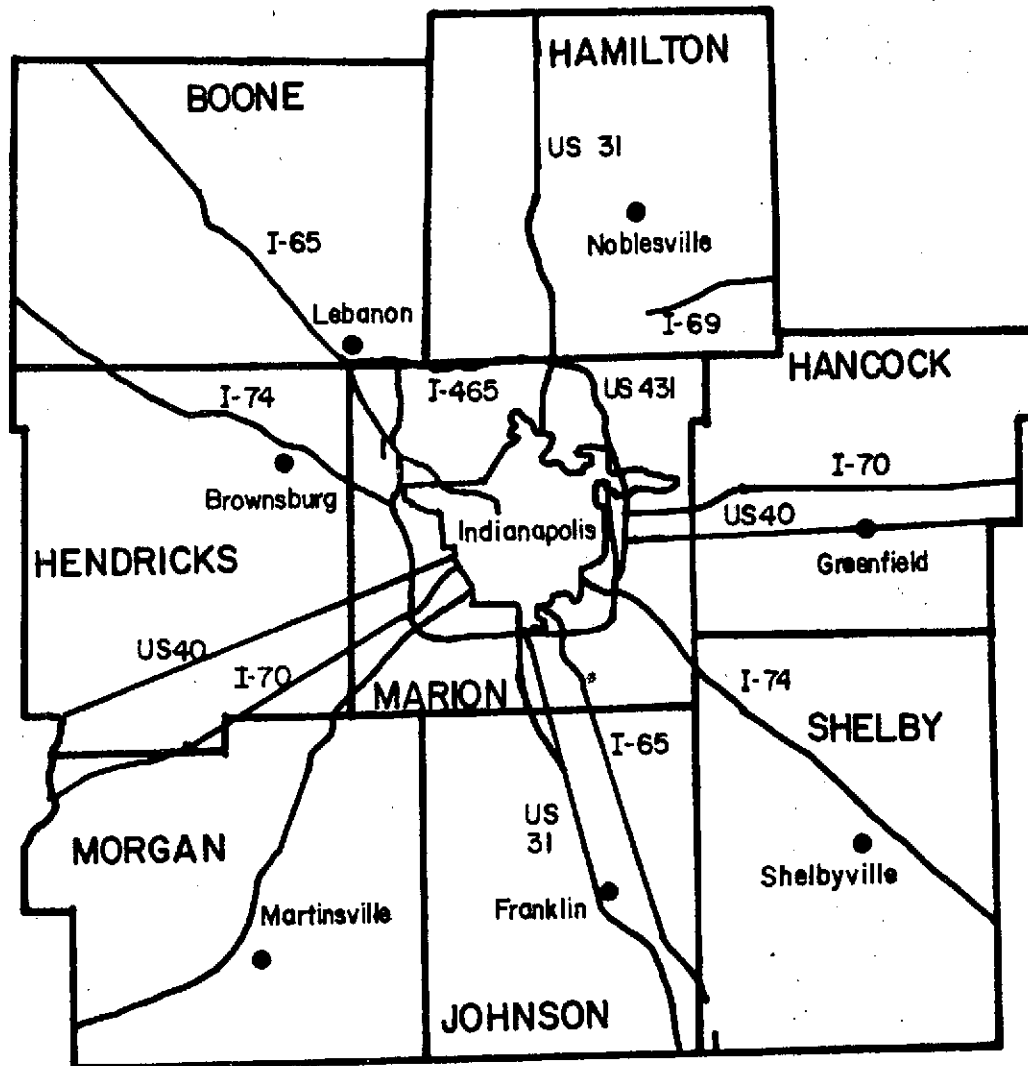


Figure 3. The Indiana Planning and Development Region 8 is composed entirely of a Standard Metropolitan Statistical Area (SMSA) as established by the Indiana Department of Natural Resources. The Region is characterized as an area of high income and immigration with Marion County as the clear center. The region constitutes 20.55% of the State's population or 1,110,000.

Several meetings have been held between staff members of LARS and Mr. Neil Horstman, Executive Director of the Indiana Heartland Coordinating Commission (IHCC). Meeting dates, topics of discussion and personnel attending are listed at the end of this section.

January 1, 1974 the I.H.C.C. will become operational with a staff of 5 people. In addition to the executive director, Mr. Horstman, there will be an assistant director/principal planner, a regional planner and two clerical personnel.

November 7, 1973 the I.H.C.C. adopted "Goals for the Indiana Heartland Coordinating Commission and the Heartland Region". This document ranked eight activities in order of importance that the I.H.C.C. would concentrate on in order to reach its stated goals. Priority I is Regional Growth and Development; Priority II is Human Resources; and Priority III is Environmental Quality. The primary concerns of Priority III are: open space and recreation planning-management; preservation of prime agricultural land; and solid waste planning and disposal. It is felt that remote sensing technology could be applied to this activity.

#### Planned Activities

Through verbal agreement with Mr. Horstman it was decided that LARS would provide a Natural Features Map of the Heartland Region. This map would define the following categories for each county in the region.

1. Water
2. Forest
3. Agriculture (row crops)

This map would be used by the commission as a basis for sound planning decision of regional significance in central Indiana.

#### MEETINGS

November 15, 1973 Met with Mr. Neil Horstman, Executive Director, Indiana Heartland Coordinating Commission (I.H.C.C.) in Indianapolis, Indiana. Mr. Horstman explained the "Overall Program Design" and the recently adopted "Goals for the I.H.C.C. and the Heartland Region".

November 28, 1973 Mr. Horstman toured the LARS facility at Purdue. At this meeting it was decided that a Natural Features Map of the region would be provided to the I.H.C.C. by LARS.

LARS Staff Members Involved In Meetings

M. F. Baumgardner  
D. A. Landgrebe  
R. H. Gilbert

D. APPLICATIONS WITHIN THE INDIANA DEPARTMENT OF NATURAL RESOURCES1. Division of WaterBackground

The Indiana Department of Natural Resources (IDNR) is the state organization with primary responsibility for the development, monitoring and regulation of the States natural resources. The Department is divided into two bureaus: The Bureau of Land, Forestry and Wildlife and the Bureau of Water and Minerals. Within each Bureau are several Divisions. Each Division has primary responsibility for one particular phase of the natural resources within the state.

Several meetings have been held with individuals and groups within the IDNR. Meeting dates, topics of discussion and personnel attending are listed at the end of this section.

The Division of Water and the Division of Reclamation have expressed interest in using remote sensing technology. The Division of Forestry would also be a potential user, however, there has been no contact with this division yet. It is planned that contacts will be made in the near future.

One of the responsibilities of the Division of Water is the design criteria and evaluation for all ponds and lakes constructed within the state that meet certain minimum specification as perscribed by law. Not all structures built in Indiana that meet these minimum specifications have been inspected by the Division of Water. At the present time there is one person in the Division that has responsibility for enforcement of this law throughout the entire state.

Planned Activities

Although the Division of Water is not yet fully cognizant of all the aspects of remote sensing especially those techniques available from LARS, it is planned that a map of surface water be made from ERTS-1 data. This map would cover several counties and could be evaluated by the Division. An effort will be made to invite a small group of professional people from the Division of Water to the LARS facility for information and educational purposes.



MEETINGS

November 14, 1973 - Robert Jackson, Director, Division of Water, John Simpson, Assistant Director, Division of Water and William Stein, Geologist, Division of Water, I.D.N.R.

A general discussion of remote sensing and its application with the Division of Water was held at this meeting. It was generally agreed that the Division could use remote sensing technology.

December 4, 1973 - Joseph Cloud, Director, Indiana Department of Natural Resources.

Mr. Cloud gave his verbal agreement for the cooperation between IDNR and LARS. He suggested William Andrews, Deputy Director, Bureau of Water and Minerals act as the contact person for the Department.

LARS Staff Members Involved In Meetings

R. H. Gilbert

2. Division of ReclamationBackground

The Division of Reclamation has only been in existence for a few months at this time. It is a small division consisting of a Director, Assistant Director, agronomist and three foresters. It is principally concerned with the reclamation of Strip-mined areas and mine waste deposits in the state.

For several months research has been conducted at LARS to delineate strip mined areas in the state. This study is in conjunction with a study by the Bureau of Sport Fisheries and Wildlife, Department of Interior, to determine the feasibility of reclaiming strip mine pit areas for fisheries applications. These studies utilized high altitude aerial photography and aircraft scanner data.

Planned Activities

Efforts will be made to produce a map within the pilot area of strip mines using ERTS data. This map will be used by the Division of Reclamation to evaluate the accuracy of this type of inventory and aid them in the reclamation of some of these areas.

MEETINGS

November 15, 1973 - Richard McNabb, Director, Division of Reclamation, IDNR.

A general discussion in Mr. McNabb's office led to his expressing interest in remote sensing. He stated an interest in LARS providing a useful inventory for the Division of Reclamation.

Further meetings in the future will explore the type of information that LARS can furnish. Acid spoil areas are of great concern to this state agency. With the present technology and data available at LARS, this information could easily be provided. Further information on this area will be included in the next status report.

LARS Staff Members Involved In Meetings

R. H. Gilbert

3. Indiana Geological Survey

On November 28, 1973 Dr. John B. Patten, State Geologist and five other persons from the Geological Survey visited LARS and received a briefing on research being conducted that related to geology. The PY program was explained to them. Although nothing definitive was outlined during this meeting, there was interest expressed that further meetings might prove to be beneficial for this group. The Geological Survey has a remote sensing group within its organization. LARS could work effectively through this group. Further information on this area will be included in the next status report.

MEETINGS

November 28, 1973  
 John B. Patten, State Geologist  
 Richard Powell  
 Ned Bleuer  
 Michael Moore  
 Maurice Briggs  
 Charles Weir

LARS Staff Members Involved In Meetings

D. W. Levandowski	R. H. Gilbert
M. F. Baumgardner	W. T. Lehman
D. A. Landgrebe	T. R. West
L. A. Bartolucci	

## E. APPLICATIONS WITHIN THE INDIANA DEPARTMENT OF COMMERCE

### Background

The Indiana Department of Commerce is the state agency that has statutory authority for land use planning. The Planning and Research Group (formerly the Division of Planning) is very interested in remote sensing applications for land use inventories. From January to June, 1973 an employee of the Group was stationed at LARS about half time. Mr. R. Miller was trained as an analyst using LARSYS during this period. Recently the Department has again become very interested in remote sensing as a method of acquiring an inventory of the land use in the state.

The Department of Commerce has formally given written support for the ERTS-B proposal as submitted by LARS. They need inventories and evaluations in areas other than those covered by that proposal. These inventories and evaluations are needed by them in the near future, prior to the acquisition of the ERTS-B data.

### Planned Activities

Further discussion and investigation of potential uses of remote sensing will be necessary before a specific project can be instituted. These discussions are planned for early 1974. Further information will be included in the next status report.

### MEETINGS

November 30, 1974 - Planning and Research Group, Indiana Department of Commerce. Theodore Pantazis, Director and Russell Miller, Planner.

This meeting served to brief Mr. Pantazis on activities at LARS and seek his Group's support for the ERTS-B proposal. At this meeting, he expressed a need for remote sensing information in the immediate future.

### LARS Staff Members Involved In Meetings

D. A. Landgrebe  
J. B. Peterson  
R. H. Gilbert

F. APPLICATION WITH THE SOIL CONSERVATION SERVICE, USDA

Background

The Soil Conservation Service, U. S. Department of Agriculture provides technical assistance to each of the 91 Indiana Soil and Water Conservation Districts. This assistance is in the form of personnel who provide inventories of soil resources, and conservation plans for the lands of people within the District. This intimate relationship between the Service, the District and the people provides a vehicle to apply the technology of remote sensing to specific conservation problems. It also makes available to remote sensing specialists a convenient and broad based evaluation group.

Planned Activities

The woodland conservationist of the Soil Conservation Service in Indiana, has requested an analysis of woodland trends and projected increase or decrease of woodland resources in three counties. The analysis of these three counties would be a preliminary effort to measure the effectiveness of such analysis procedures. The ultimate goal of this activity would be to define the direction of efforts for woodland conservation in Indiana.

MEETINGS

September 14, 1973 - USDA, Soil Conservation Service State Office, Indianapolis, Indiana.

Cletus Gillman, State Conservationist  
Robert Bollman, Assistant State Conservationist  
Leon Kimberlin, State Research Conservationist

This meeting was for information purposes. A computer print out of a geometrically straightened classification of Marion County (Indianapolis) was shown.

September 27, 1973 - The same information that was used for the September 14 meeting was shown and explained to Raymond Sinclair, State Soil Scientist.

November 28, 1973 - Messrs. Gillman, Bollman, Kimberlin, and Sinclair toured the LARS facility and were briefed on the activities at LARS. This was primarily an educational meeting. However, it was agreed that the Soil Conservation Service in Indiana would support the LARS ERTS-B proposal. There was also expressed a continuing interest in the application of remote sensing to the soil conservation effort in Indiana. Further meetings in the near future will explore potential uses of remote sensing technology. These meetings will be reported on in the next status report.

LARS Members Involved In Meetings

D. A. Landgrebe  
M. F. Baumgardner  
J. B. Peterson  
R. H. Gilbert

PERSONNEL

At the end of November 1973, Richard Gilbert was appointed to the position of project manager of this project at the Laboratory for Applications of Remote Sensing. Mr. Gilbert has been a full time employee at LARS since July 1973. Prior to that time he was a soil scientist with the U. S. Department of Agriculture, Soil Conservation Service. This transfer was made possible through the use of the Intergovernmental Personnel Act.

This Act authorizes the transfer of Federal Government employees to state and local governmental agencies. The usual term of transfer is two years. During this period the employee is for all practical purposes an employee of the local unit, in this instance LARS. Mr. Gilbert is under the direct supervision of LARS personnel. At the end of this two year period, he will return to the Soil Conservation Service.

Mr. Gilbert is well qualified for this work as his previous position brought him in contact with many state and local agency personnel throughout the state of Indiana. It is felt that a project manager is needed to devote full attention to the effort of problem solving using remote sensing technology. Mr. Gilbert's efforts to date have been instrumental in moving this project through the initial stages.

STATUS REPORT SUMMARY AND CONCLUSIONS

The six areas reported on this document represent a first effort to interface with the user community in Indiana. Without exception each agency is enthusiastic about the potential value of this technology to aid in seeking solutions to specific problems that they must solve.

All phases of remote sensing appear to be applicable to the areas of endeavor of each of the different agencies. Eventually certain techniques will probably be better adapted to solving specific problems than others.

The emphasis of this program during the next six months will be to provide maps, inventories and evaluations for each agency using appropriate remote sensing techniques. Problems solving with remote sensing technology will be the main thrust for this period.

SEMI-ANNUAL STATUS REPORT

Reporting Period June 1, 1973 - November 30, 1973

Grant No. NGL 15-005-186

Title of Investigation

The Application of Remote Sensing Technology  
to the Solution of Problems in the Management  
of Resources in Indiana.

Principal Investigator:

D. A. Landgrebe  
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West Lafayette, Indiana 47906

Submitted to:

The Office of University Affairs  
Code PY  
National Aeronautics and Space Administration  
Washington, D. C. 20546

