NASA APPLICATIONS PROJECT IN MIAMI COUNTY, INDIANA

Progress Report - Grant NAGW-1472

June 1990

Prepared by

Chris J. Johannsen
R. Norberto Fernández
D. Fabián Lozano-García

with the assistance of

Miami County cooperators, Purdue University investigators and graduate students

Laboratory for Applications of Remote Sensing

Purdue University

West Lafayette, Indiana, 47907

LARS Contract Report 012391

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Executive Summary

for

APPLYING REMOTE SENSING AND GIS TECHNIQUES IN SOLVING RURAL COUNTY INFORMATION NEEDS

Laboratory for Applications of Remote Sensing

Purdue University

June 1990 NASA Review, Annapolis, Maryland

This project was designed to acquaint county government officials and their clientele with remote sensing and geographic information systems (GIS) products that contain information about land conditions and land use. The specific project objectives are:

1) to investigate the feasibility of using remotely sensed data to identify and quantify specific land cover categories and conditions for purposes of tax assessment, cropland area measurements and land use evaluation;

2) to evaluate the use of remotely sensed data to assess soil resources and conditions which affect productivity;

3) to investigate the use of satellite remote sensing data as an aid in assessing soil management practices;

4) to evaluate the market potential of products derived from the above projects.

We will have completed two years of effort on our project by July 1, 1990. During this time we have achieved the following:

1) We have selected 28 square miles (28 sections) for our study area in Miami County, Indiana. This includes 14 sections as development sites and 14 as evaluation sites.

2) Communication with the county officials has been a key aspect for the success of this project. We hold meetings on a regular basis with the Miami County Cooperators. In addition, an annual workshop is held, the first in April 1989 and a second planned for late Fall 90-early Spring 91. Approximately 50 persons attend these workshops.

3) We have defined an area of 4 square miles to develop the geographic information system. For that area we have digitized detailed soil maps, land ownership maps, roads,

surface drainage, ditches and contour line maps. All information is registered to a common geodetic framework.

4) We have sampled soils in different slope positions to study the relationship between soil spectral data, selected soil parameters, and potential soil erosion conditions. Laboratory analyses included: organic carbon, iron oxides, manganese, particle size, and soil color using spectral data. Statistical analyses were performed in order to select the best spectral regions to detect soil erosion.

5) We developed a "ground-truth form" for gathering information on soil management during the 1986-88 period for selected areas within the county. Cooperators were identified in those areas in order to obtain historic information on land management practices and crop rotations.

6) We have obtained landowner/cooperator records from the County Surveyor, Soil Conservation Service and the Agricultural Stabilization and Conservation Service to complement the ground truth information.

7) Because of the large amount of data included in the ownership records and the soil maps, we have developed large spatial databases for these two variables. These databases can be used to generate reports, or in combination with the cartographic databases within the GIS environment. This information will be used for future modeling. We have used high-level data models in designing these databases.

8) The State office of the Soil Conservation Service has provided us with computerized soils information for Miami county. We have used these data to load our soil database.

9) We have performed digital classifications of four different Landsat TM scenes over the entire county for land cover/land use. Selected sites were analyzed using SPOT data for two different dates. All these information will be used for temporal analysis in order to accurately identify different land cover types for specific uses. The classifications are evaluated using ground truth information (as described in 5 and 6) plus aerial photographs provided by the ASCS.

10) During our work in database design we have determined that the commercial cooperator was making serious errors with the land appraisal work for the County. Since then we have been assisting the Miami County officials in alternatives to overcome those problems.

PLAN FOR YEAR THREE

-Complete the analysis for TM and SPOT data

-Temporal analysis to improve discrimination of land cover categories

-Select new site for soil erosion-soil spectral properties studies

-Continue with soil management research, and models for erosion/sedimentation

-Selection of a new commercial firm to complete the tax assessment

-Major analysis effort with ASCS during the Fall of this year

-Cooperative work with SCS to determine eroded areas using satellite data

-Production of several maps to show potential applications of remote sensing and GIS in rural planning (with County Surveyor and County Extensionist)

MATERIALS

1. Satellite Data:

   1a. Landsat-5 TM:

March 23, 1987	April 26, 1988
July 29, 1987	June 13, 1988
	August 16, 1988

   1b. SPOT:

March 17, 1987	November 6, 1987

2. Ground-truth:
   2a. Farmers' information
   2b. Aerial photographs

3. Geographic Information System:
   3a. Maps: Land property: 1:4800
   Soils: 1:20000
   Roads, Drainage, Topography: 1:24000

   3b. Databases:
   -Land ownership (existing),
   -Soils (Soil Conservation Service)

4. Soil Erosion:
   4a. Soil samples for selected areas
   4b. Satellite data
   4c. Farmers' information (selected)

5. Soil Management:
   5a. Farmers' information (collaborators)
   5b. Satellite Data

STATE OF INDIANA
MIAMI County

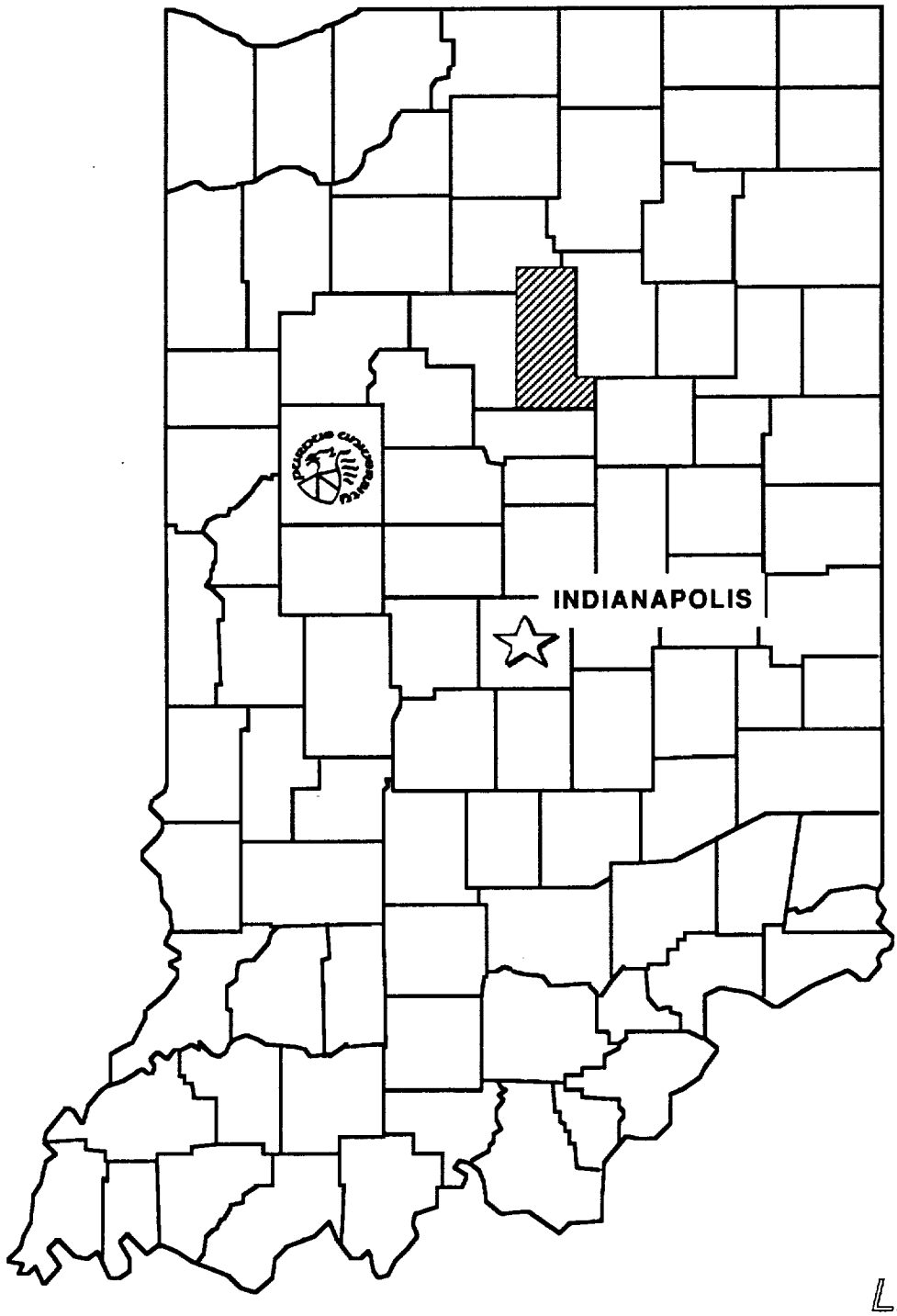
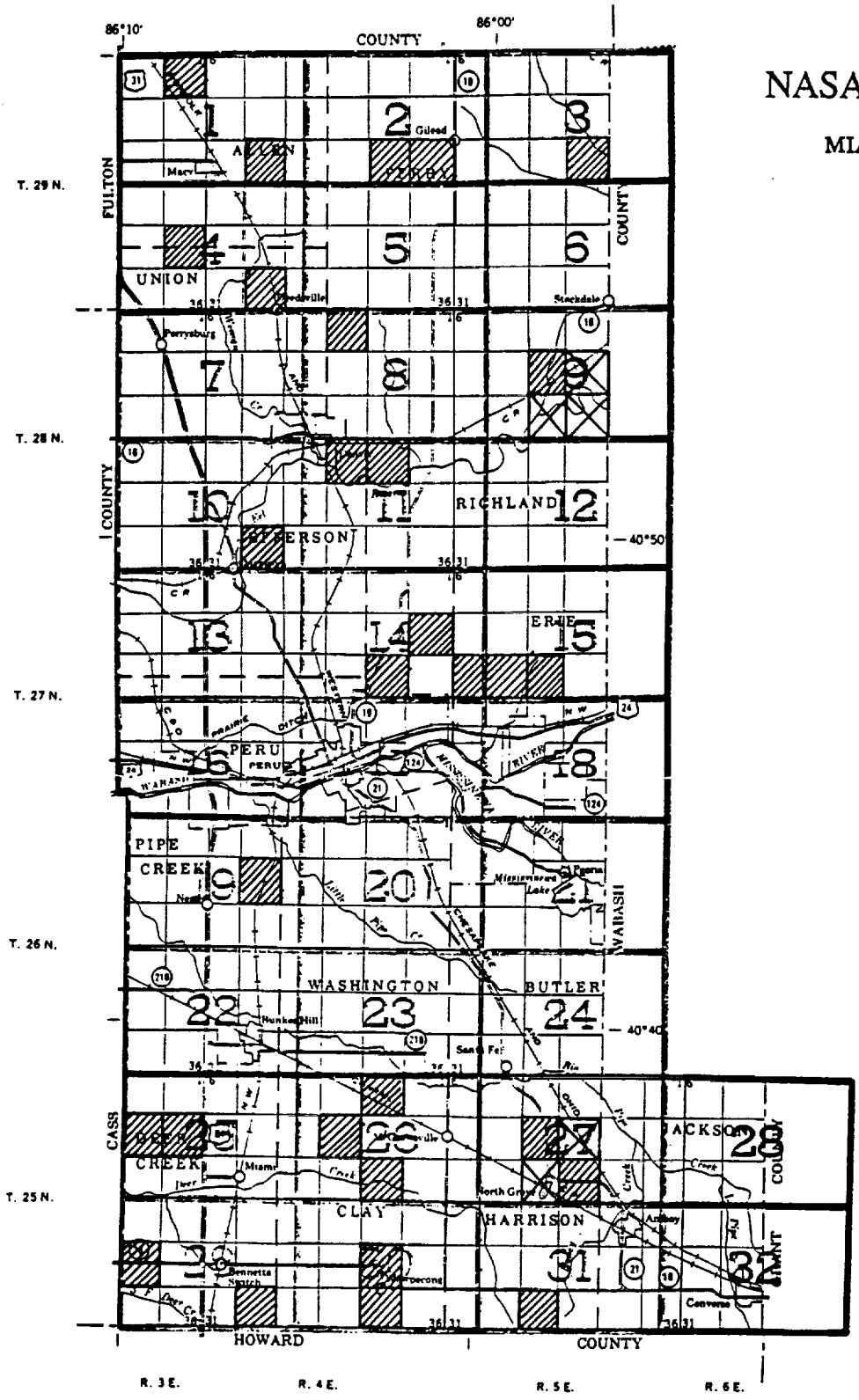


Figure 1

DEVELOPMENT AND EVALUATION SITES



NASA Applications Project

MIAMI COUNTY, INDIANA

Scale 1:190,080

1 0 1 2 3 4 Miles

Figure 2

SATELLITE DATA ANALYSIS

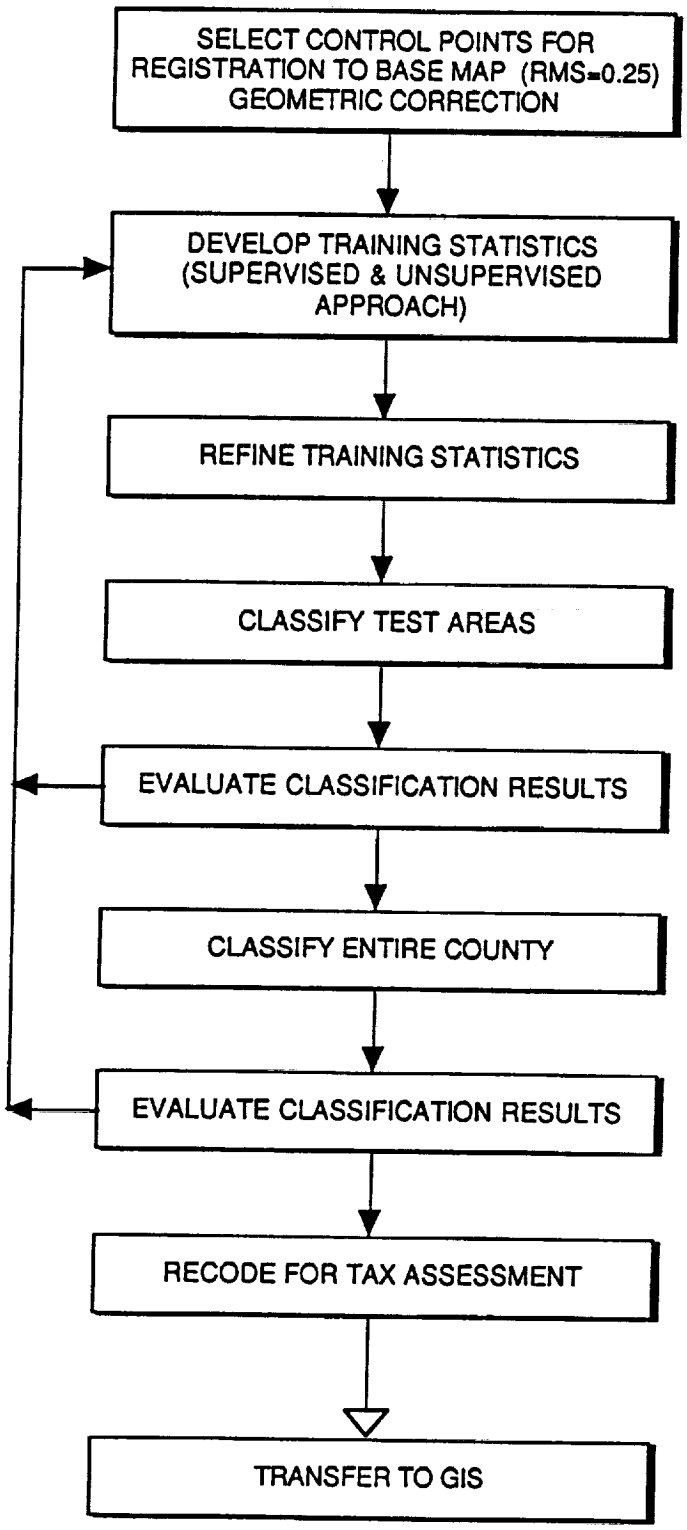
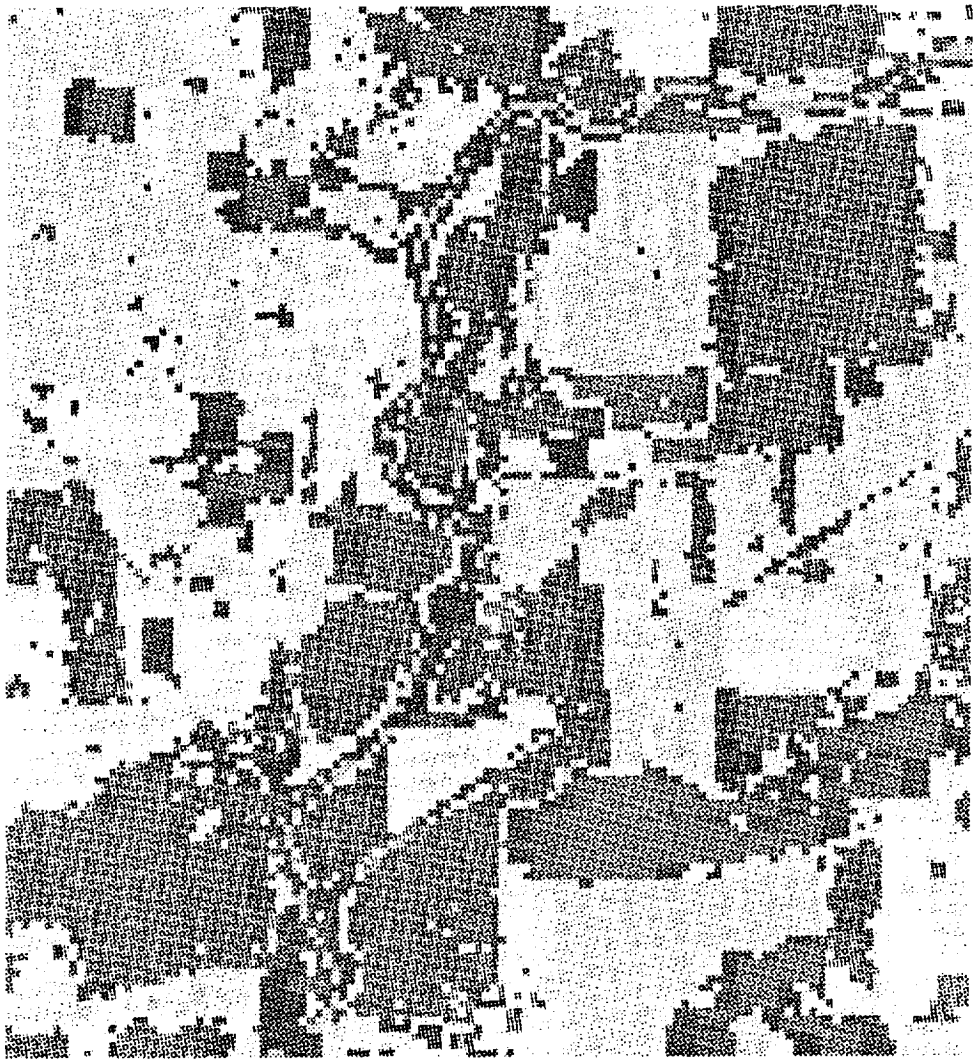


Figure 3

NASA Applications Project
Miami Co.

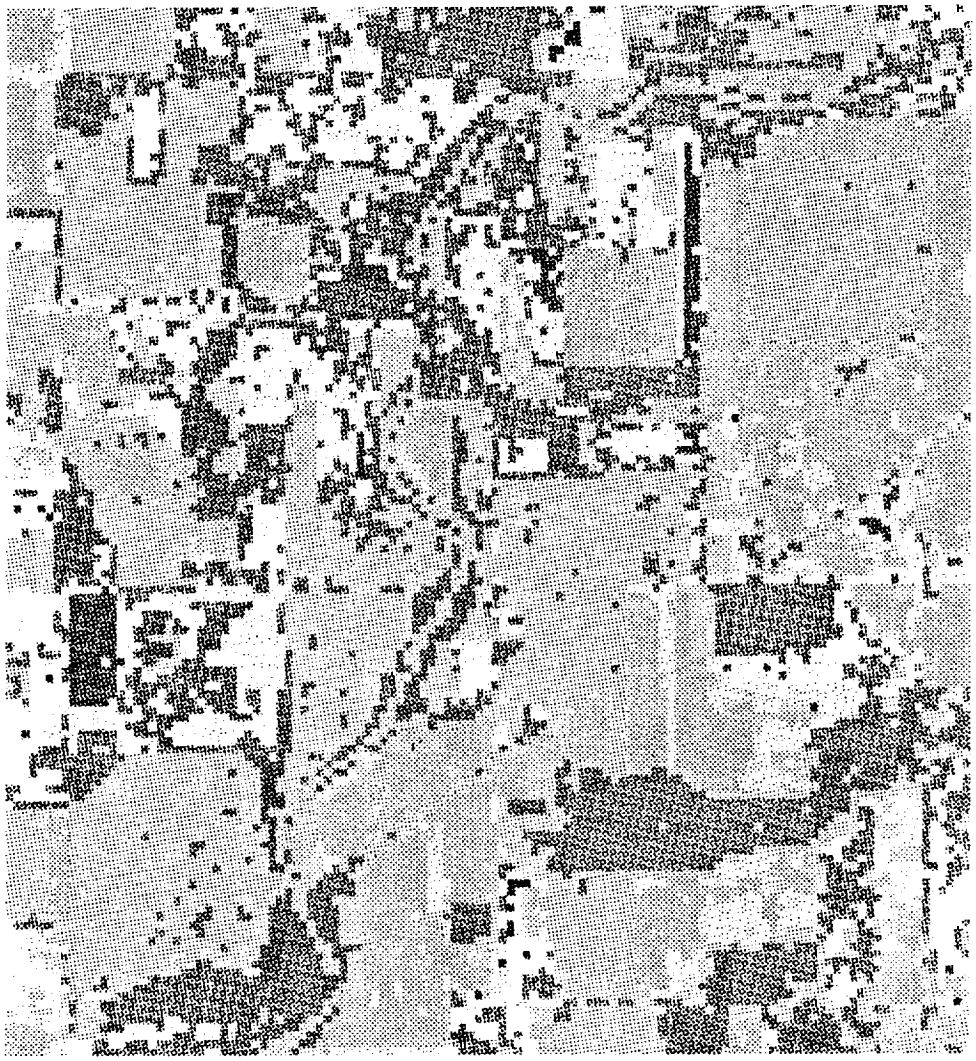


Landsat-TM Classification (April 26, 1988),
Sections 3,4,9,& 10, T28N, R5E

Laboratory for Applications of Remote Sensing

Figure 4

NASA Applications Project
Miami Co.



Landsat-TM Classification (July 29, 1987),
Sections 3,4,9,& 10, T28N, R5E

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Figure 5

NASA Applications Project
Miami Co.

SPOT Classification (March 17, 1987),
Sections 3,4,9,& 10, T28N, R5E

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Figure 6

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Miami Co.

Landsat-TM data (April 26, 1988),
TM-4=Red, TM-5=Green, TM3=Blue

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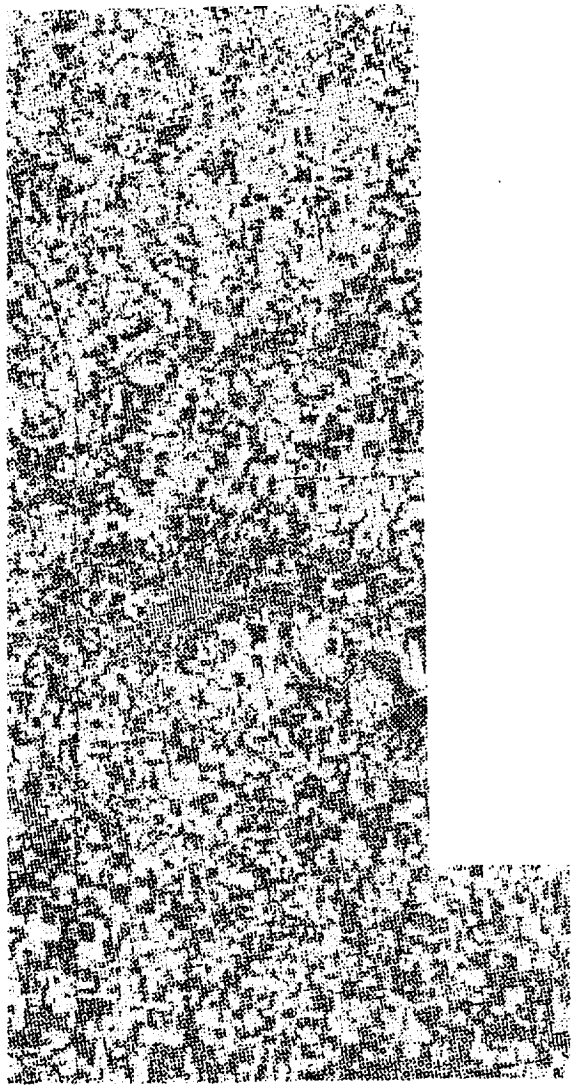
Figure 7

NASA Applications Project
Miami Co.



Landsat-TM data (April 26, 1988),
Classification

Laboratory for Applications of Remote Sensing

Figure 8

NASA Applications Project
Miami Co.

Landsat-TM Classification (July 29, 1987), Sections 3,4,9,& 10, T28N, R5E

	No. of Points	Percent Correct	Corn	Soybean	Pasture	Forest	River	Other
Corn 1	117	95.7	112	0	0	5	0	0
Corn 2	202	100.0	202	0	0	0	0	0
Soybean 1	138	95.6	0	132	0	0	0	6
Soybean 2	65	100.0	0	65	0	0	0	0
Pasture 1	123	56.1	0	0	69	0	0	54
Pasture 2	57	91.2	0	0	52	0	0	5
Forest 1	32	87.5	4	0	0	28	0	0
River	36	94.4	0	0	0	2	34	0

Laboratory for Applications of Remote Sensing

Figure 9

TRADITIONAL APPROACH

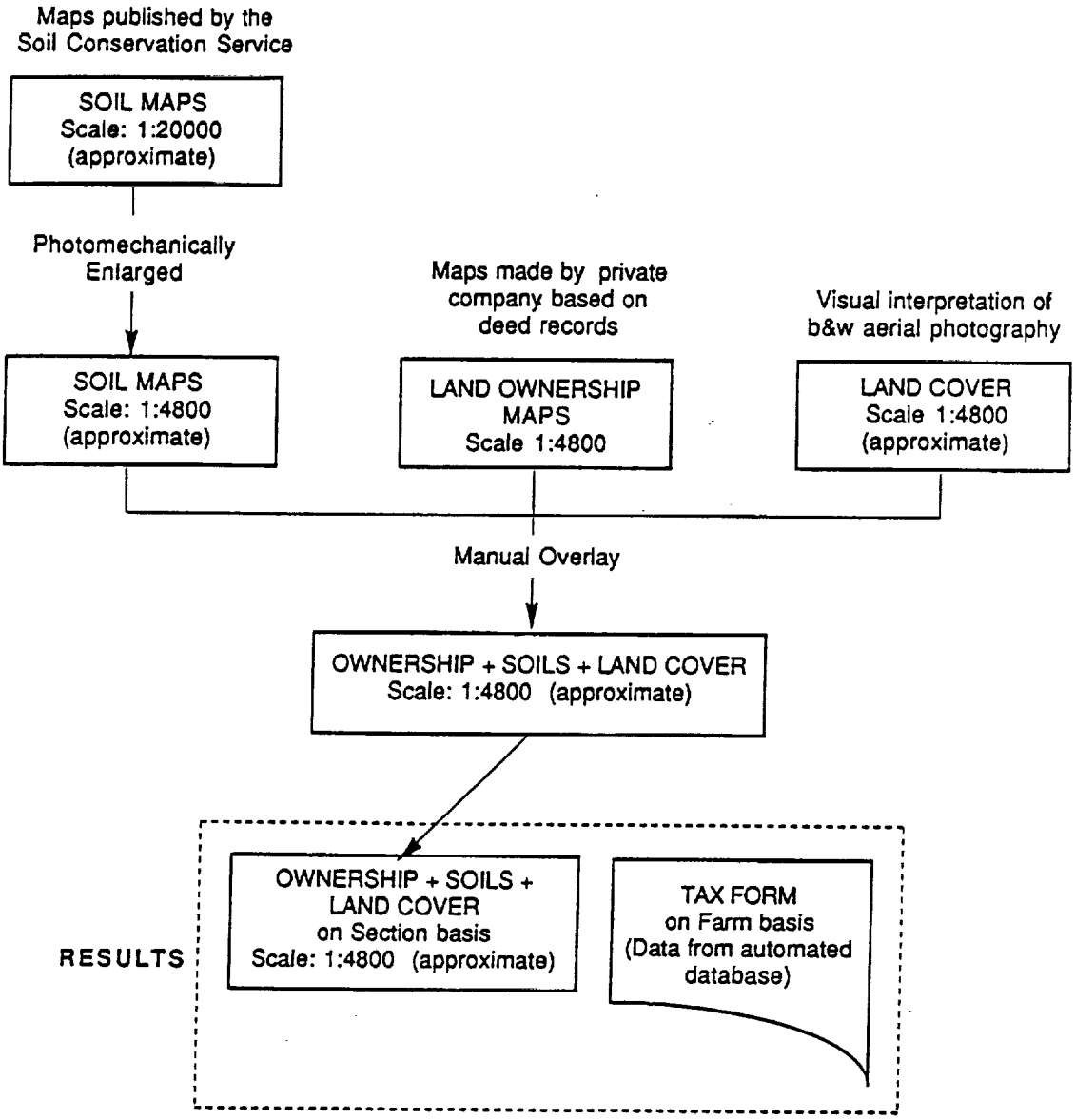
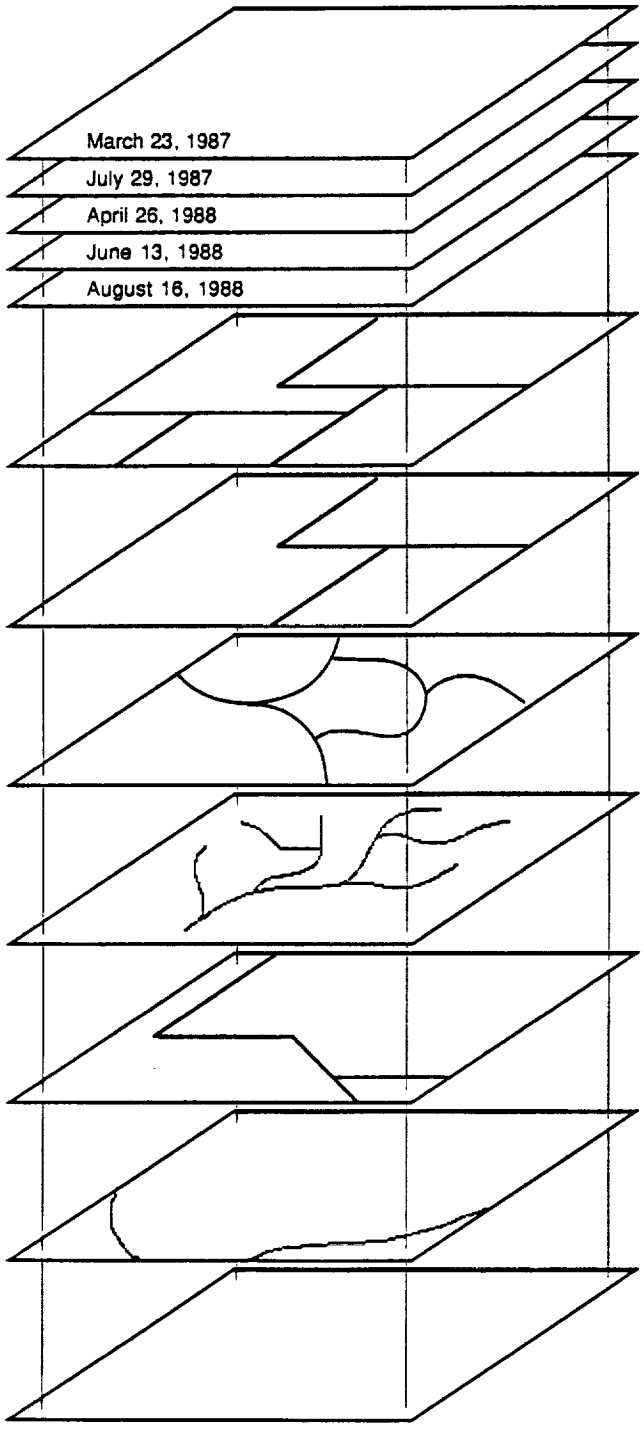


Figure 10



Landsat-5 TM
SPOT

Land Cover

Land Ownership

Soils

Drainage Network

Road Network

Watersheds

Reference
Framework

Figure 11

GIS APPROACH

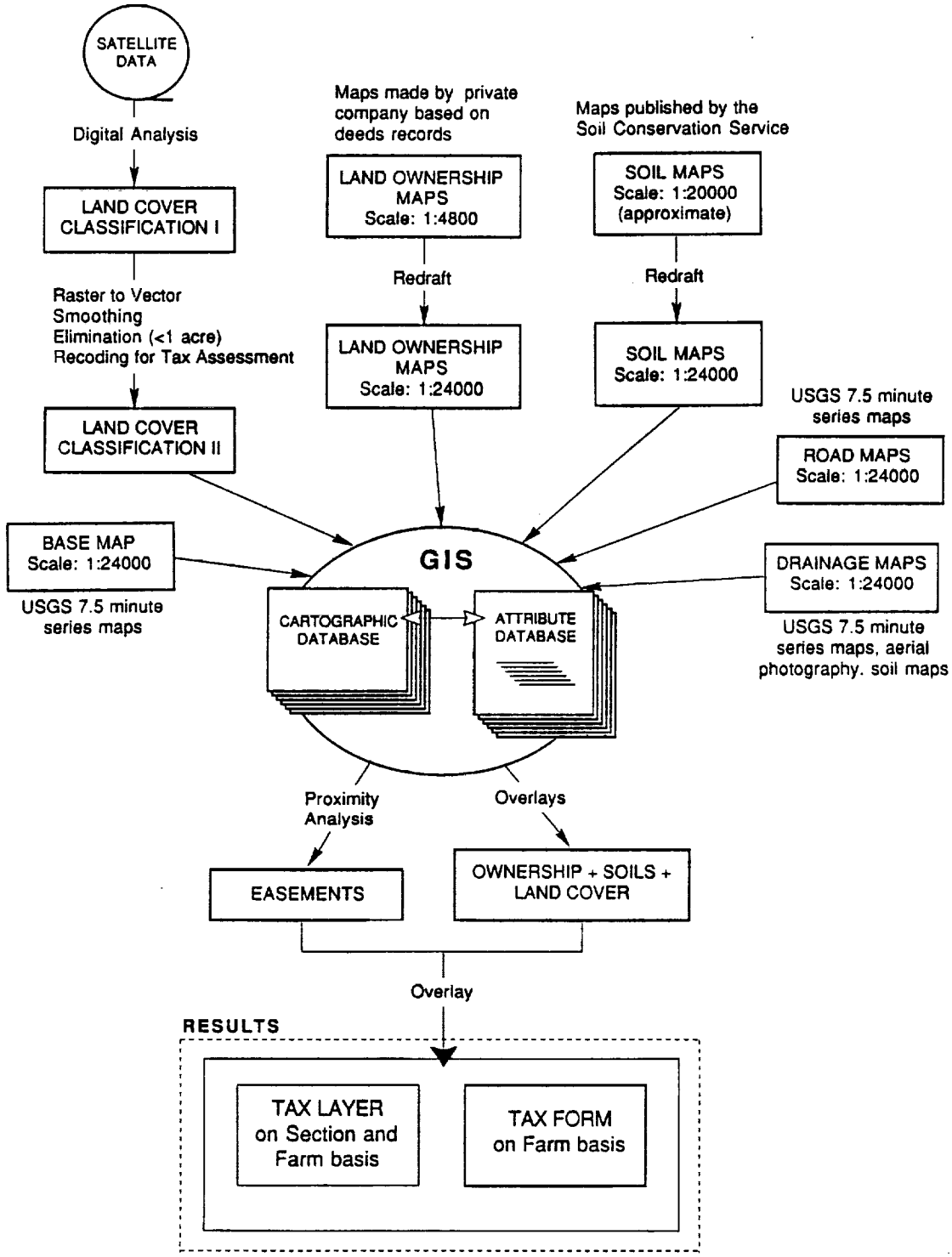
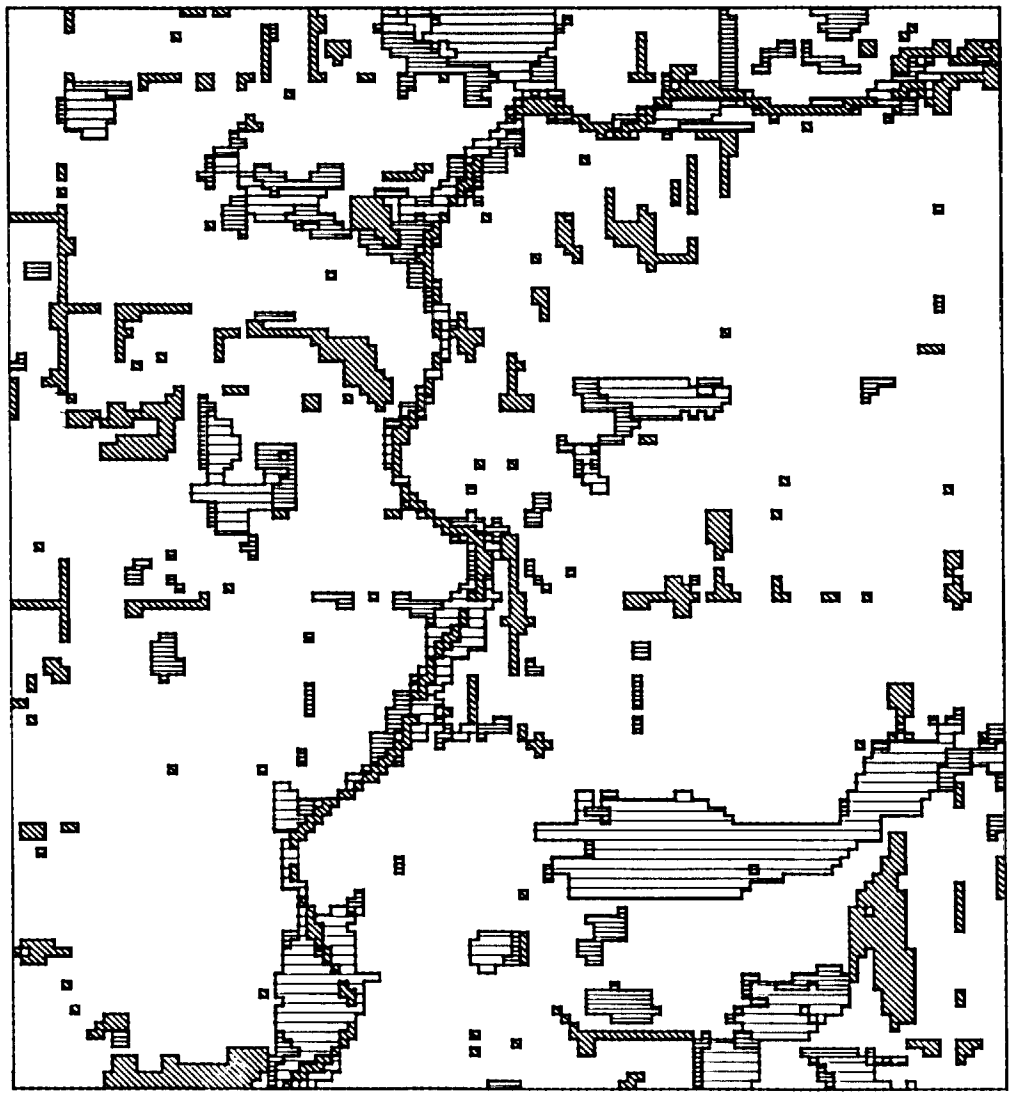


Figure 12

LAND

LAND COVER

LANDSAT TM-July 29,1987



TILLABLE LAND

NON-TILLABLE LAND

WOODLAND

OTHER

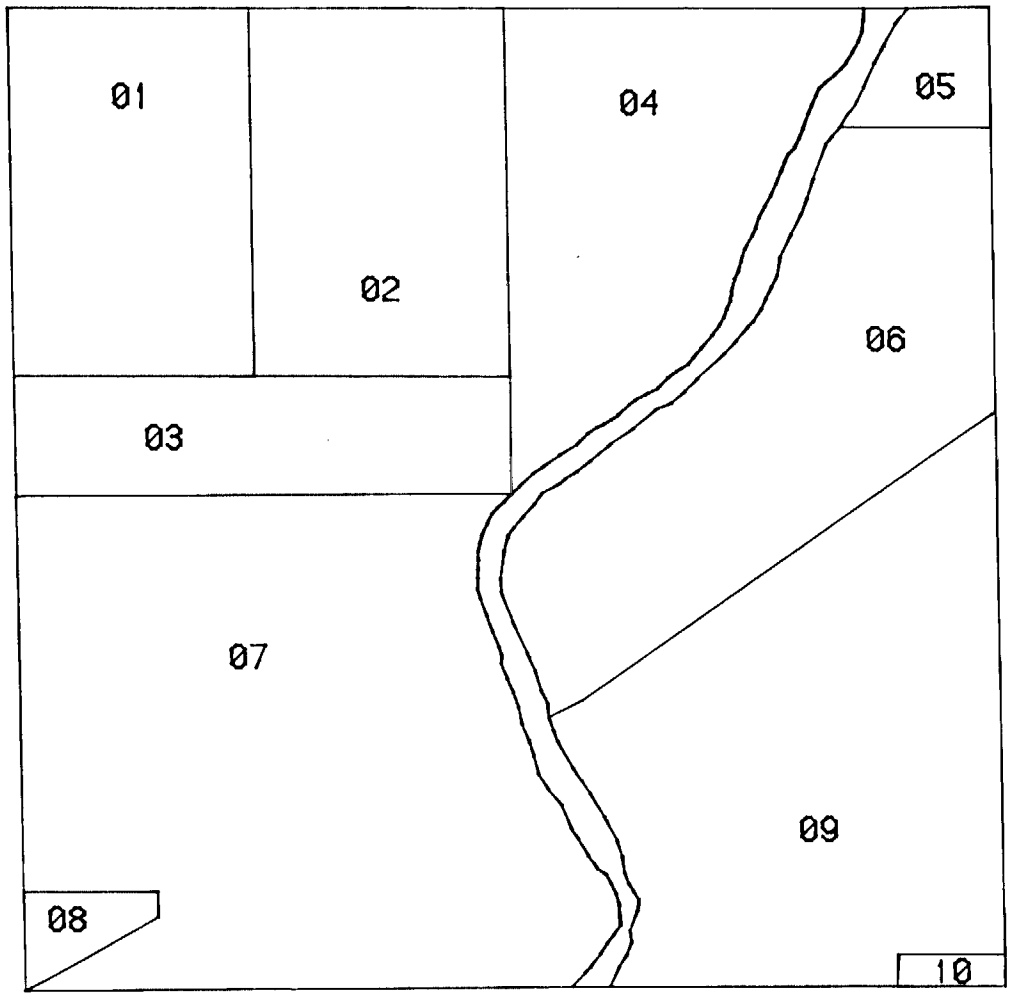
RIVER

Sections 4,3,9,10; T28N,R5E
Miami Co., Indiana
NASA Applications Project

Scale: 1:27500

LARS/Purdue University

Figure 13



LAND OWNERSHIP

Section 9,T28N,R5E
Miami Co.,Indiana

NASA Applications Project

N

SCALE 1:12500

LARS/Purdue University

Figure 14

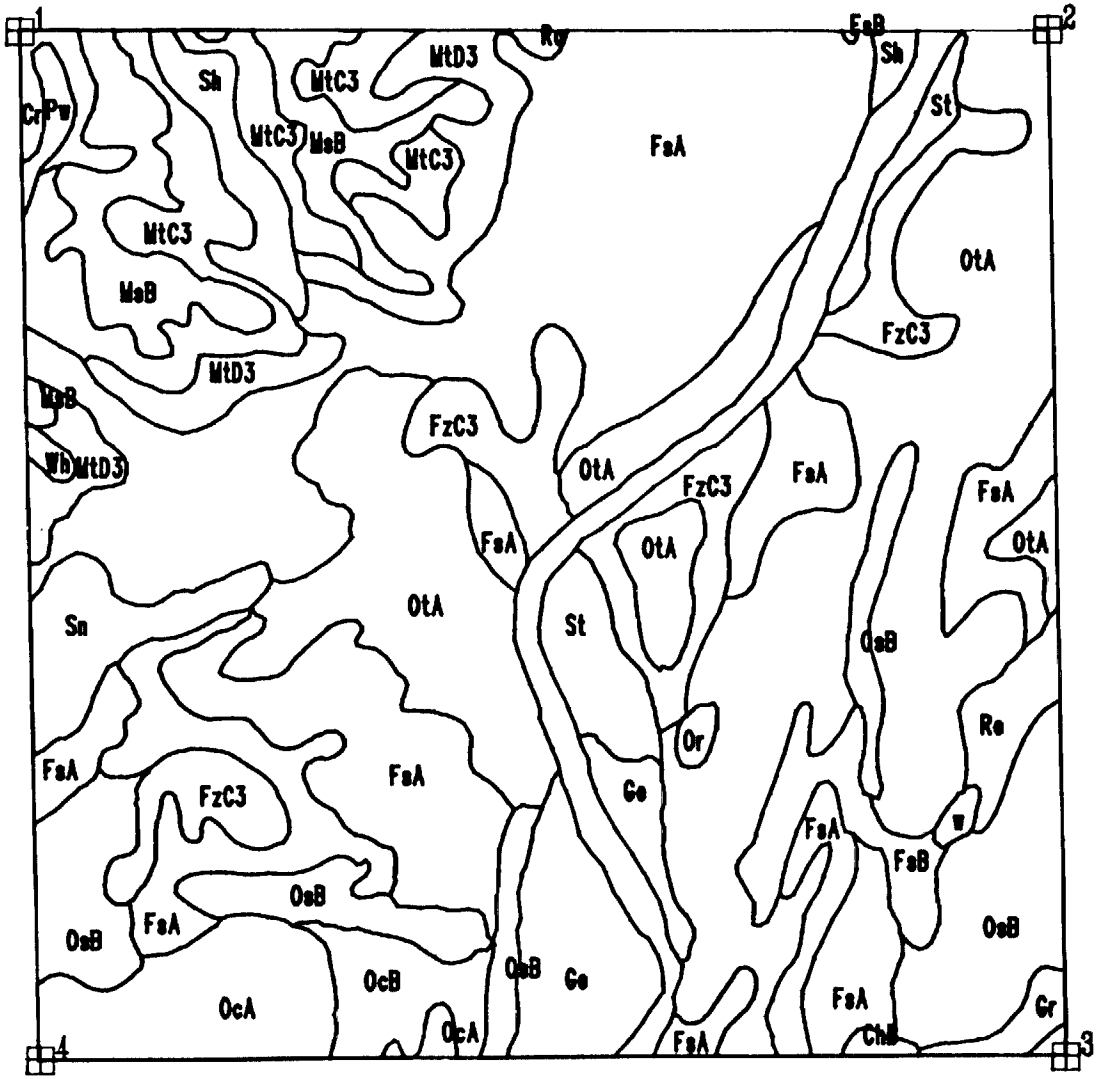


Figure 15

SOILS MAP

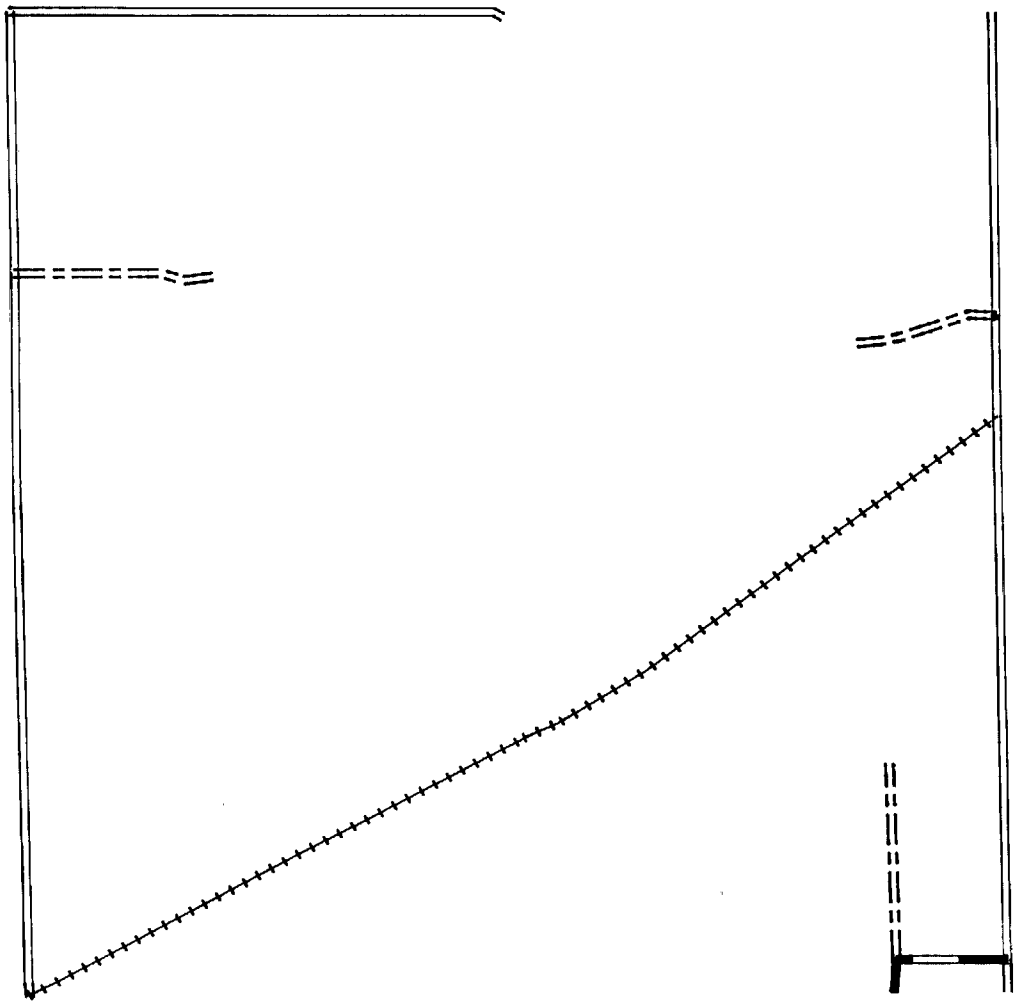
Section 9,T28N,R5E

Miami Co., Indiana

NASA Applications Project

LARS/Purdue University

TRANSPORTATION



Medium Duty

Light Duty

Unimproved Dirt

Railroad

Section 9,T28N,R5E

N

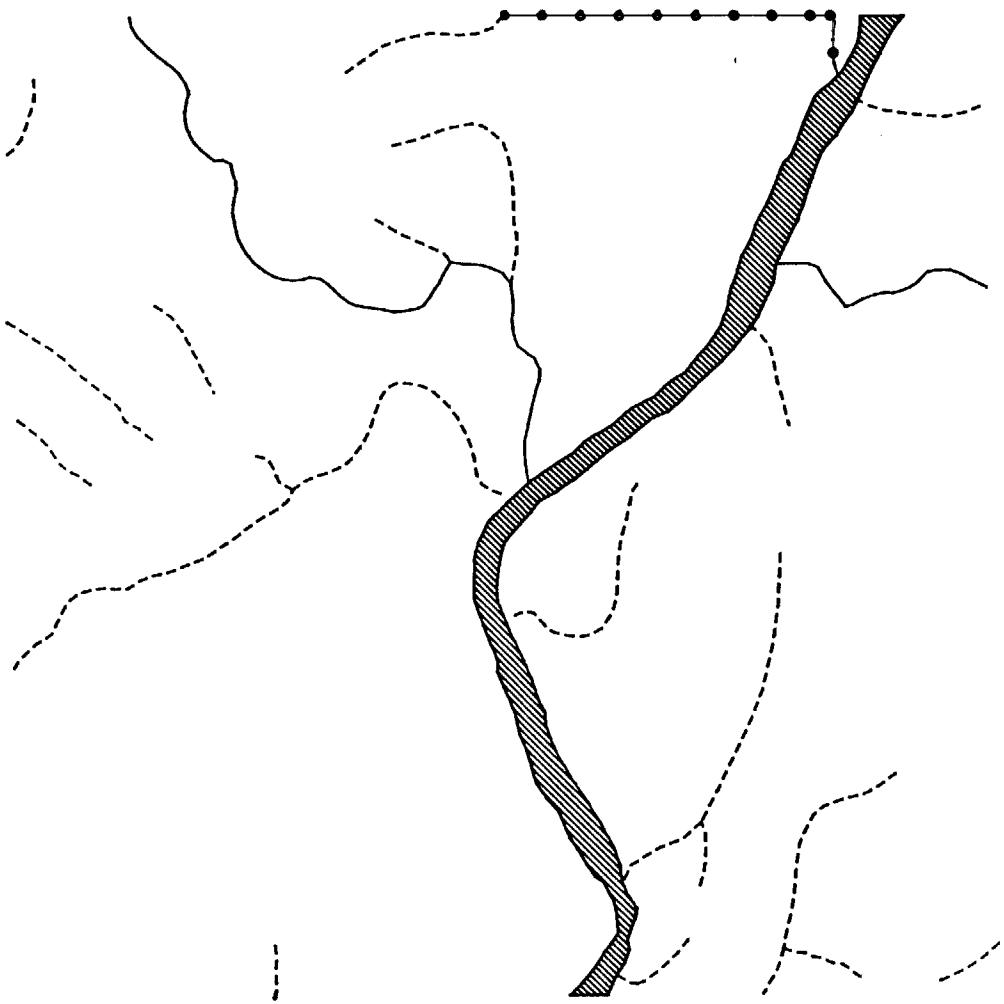
SCALE 1:12500

LARS/Purdue University

NASA Applications Project, Miami Co.,IN

Figure 16

SURFACE HYDROLOGY



Perennial 1

Perennial 2

Intermitent

Drainage end

Canal/Ditch

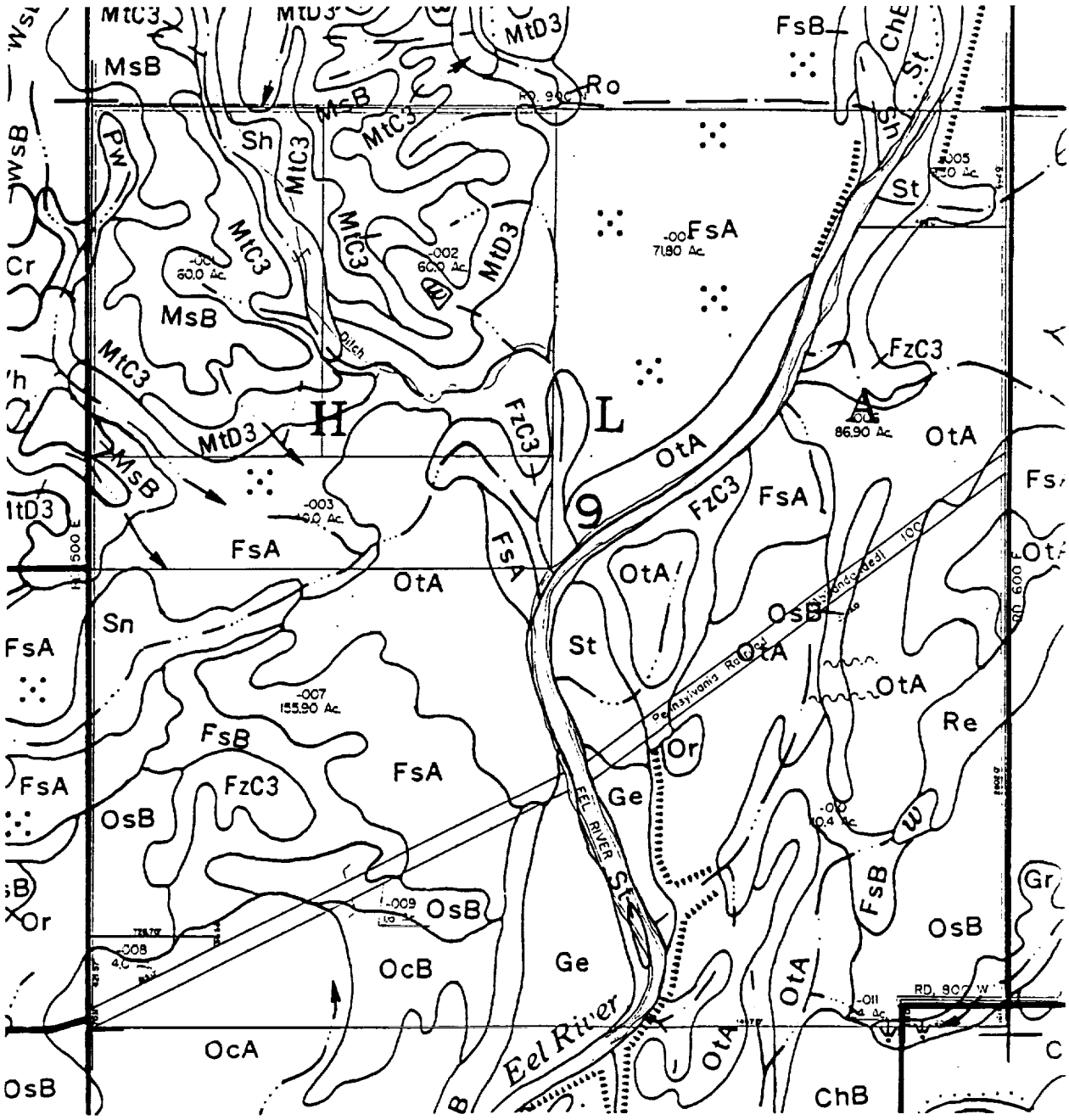
Section 9,T28N,R5E

N

SCALE 1:12500

LARS/Purdue University

Figure 17



ORIGINAL PAGE IS
OF POOR QUALITY

Figure 18

SOIL PRODUCTIVITY FACTORS

SPF > 1.10

SPF < 0.60

Water

Sections 4,3,9,10; T28N,R5E
Miami Co., Indiana

NASA Applications Project

Scale: 1:24000

LARS/Purdue University

Figure 19

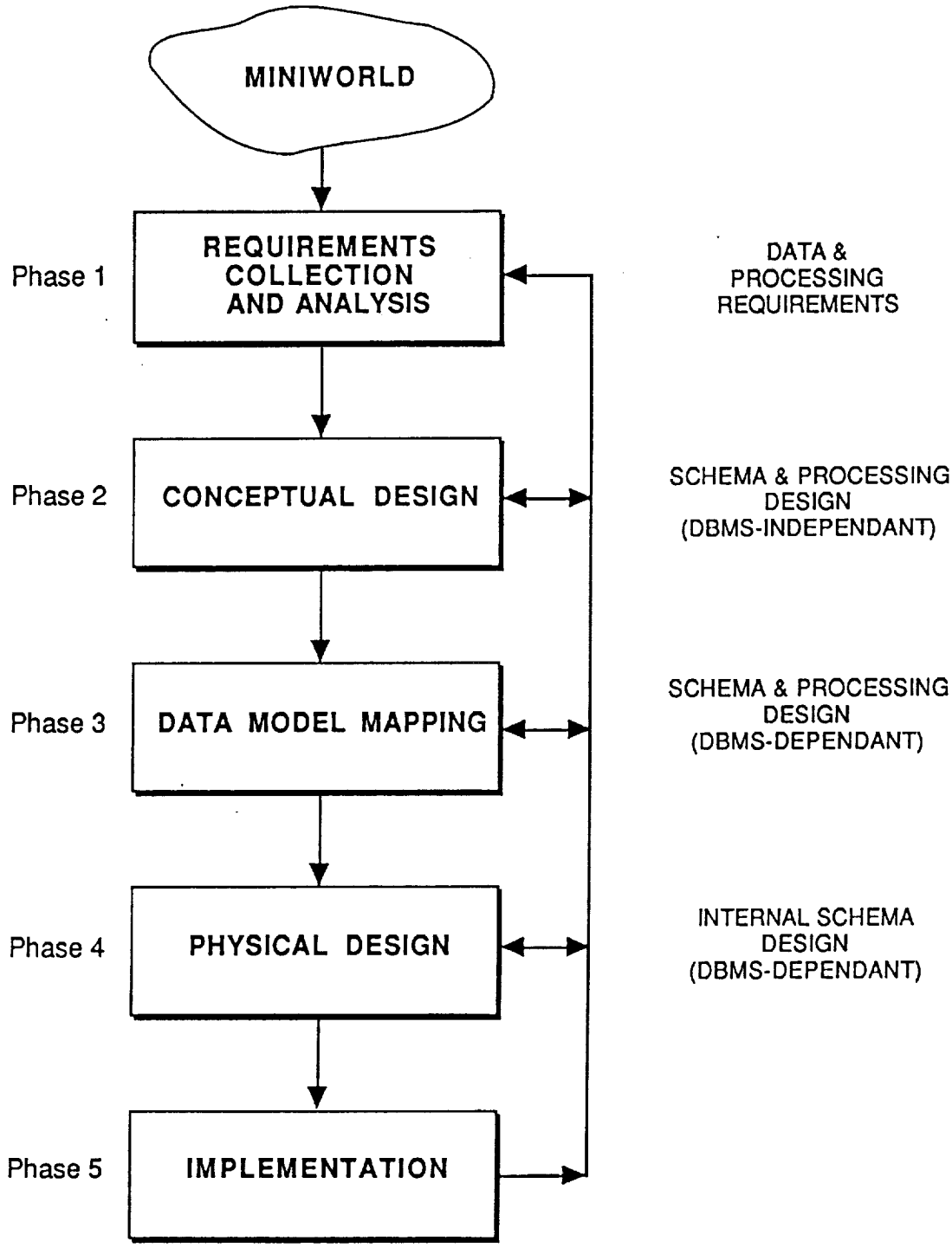

MINIWORLD
Phase 1
REQUIREMENTS COLLECTION AND ANALYSIS
DATA & PROCESSING REQUIREMENTS
Phase 2
CONCEPTUAL DESIGN
SCHEMA & PROCESSING DESIGN (DBMS-INDEPENDANT)
Phase 3
DATA MODEL MAPPING
SCHEMA & PROCESSING DESIGN (DBMS-DEPENDANT)
Phase 4
PHYSICAL DESIGN
INTERNAL SCHEMA DESIGN (DBMS-DEPENDANT)
Phase 5
IMPLEMENTATION

Figure 20

THE ENTITY-RELATIONSHIP MODEL

Entity: is an object in the real world, with an independent existance.

Relationship: set of associations between entities.

Attributes: characteristics that describe entities or relationships.

THE EXTENDED ER DIAGRAM

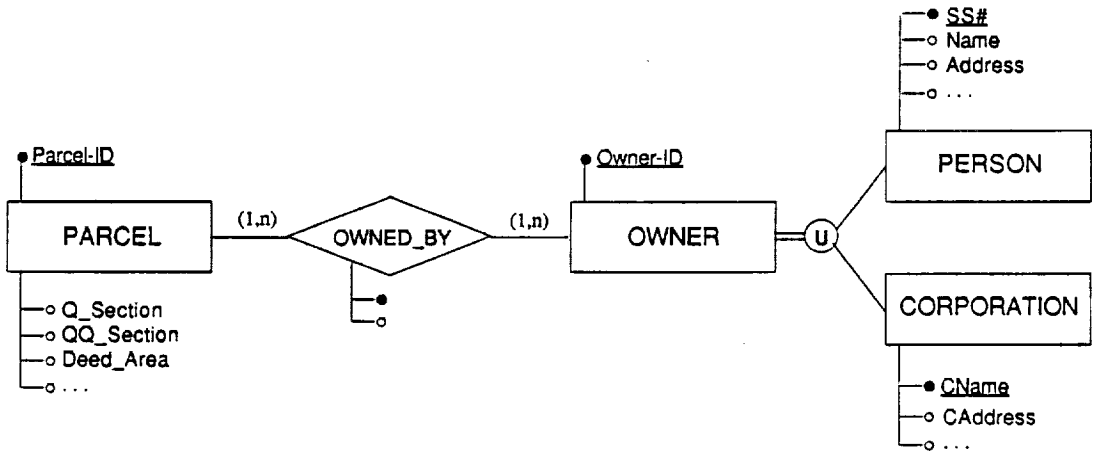


Figure 21

LAND OWNERSHIP DATABASE - EER DIAGRAM

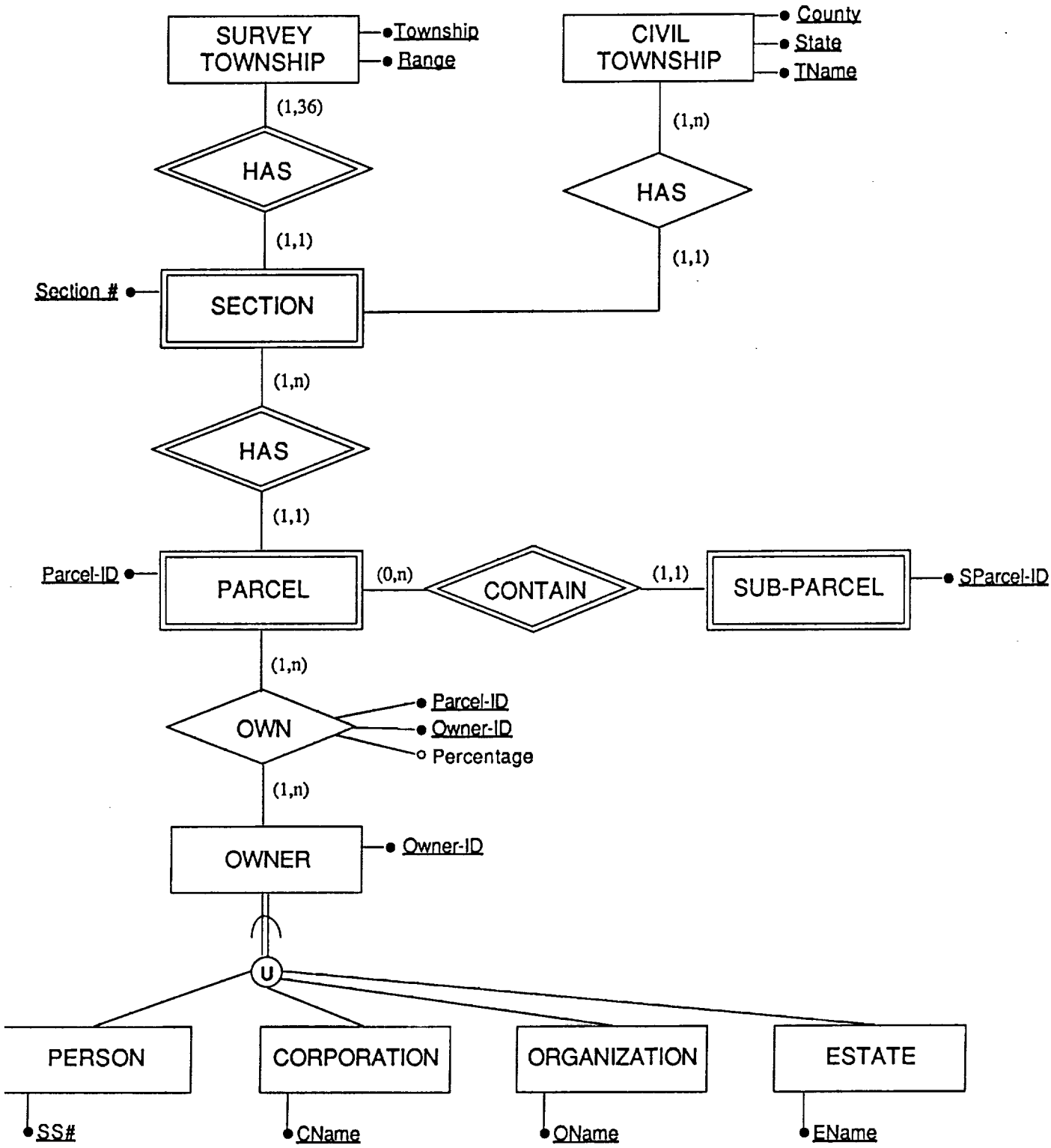


Figure 22

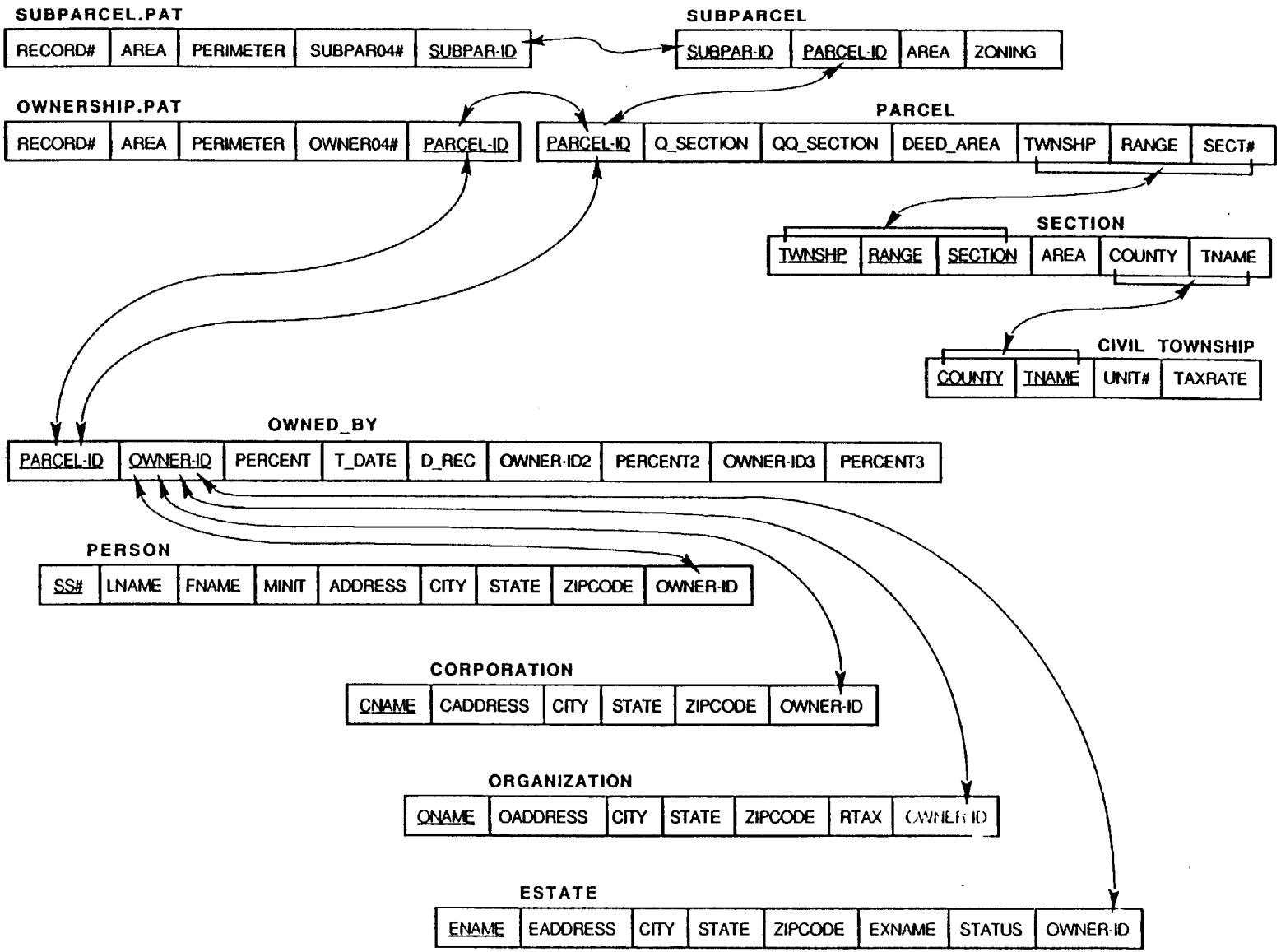

SUBPARCEL.PAT
RECORD#
AREA
PERIMETER
SUBPAR04#
SUBPAR-ID
SUBPARCEL
SUBPAR-ID
PARCEL-ID
AREA
ZONING
OWNERSHIP.PAT
RECORD#
AREA
PERIMETER
OWNER04#
PARCEL-ID
PARCEL
PARCEL-ID
Q_SECTION
QQ_SECTION
DEED_AREA
TWNSHP
RANGE
SECT#
SECTION
TWNSHP
RANGE
SECTION
AREA
COUNTY
TNAME
CIVIL TOWNSHIP
COUNTY
TNAME
UNIT#
TAXRATE
OWNED_BY
PARCEL-ID
OWNER-ID
PERCENT
T_DATE
D_REC
OWNER-ID2
PERCENT2
OWNER-ID3
PERCENT3
PERSON
SS#
LNAME
FNAME
MINIT
ADDRESS
CITY
STATE
ZIPCODE
OWNER-ID
CORPORATION
CNAME
CADDRESS
CITY
STATE
ZIPCODE
OWNER-ID
ORGANIZATION
ONAME
OADDRESS
CITY
STATE
ZIPCODE
RTAX
OWNER-ID
ESTATE
ENAME
EADDRESS
CITY
STATE
ZIPCODE
EXNAME
STATUS
OWNER-ID

Figure 23

SOILS DATABASE - EER DIAGRAM

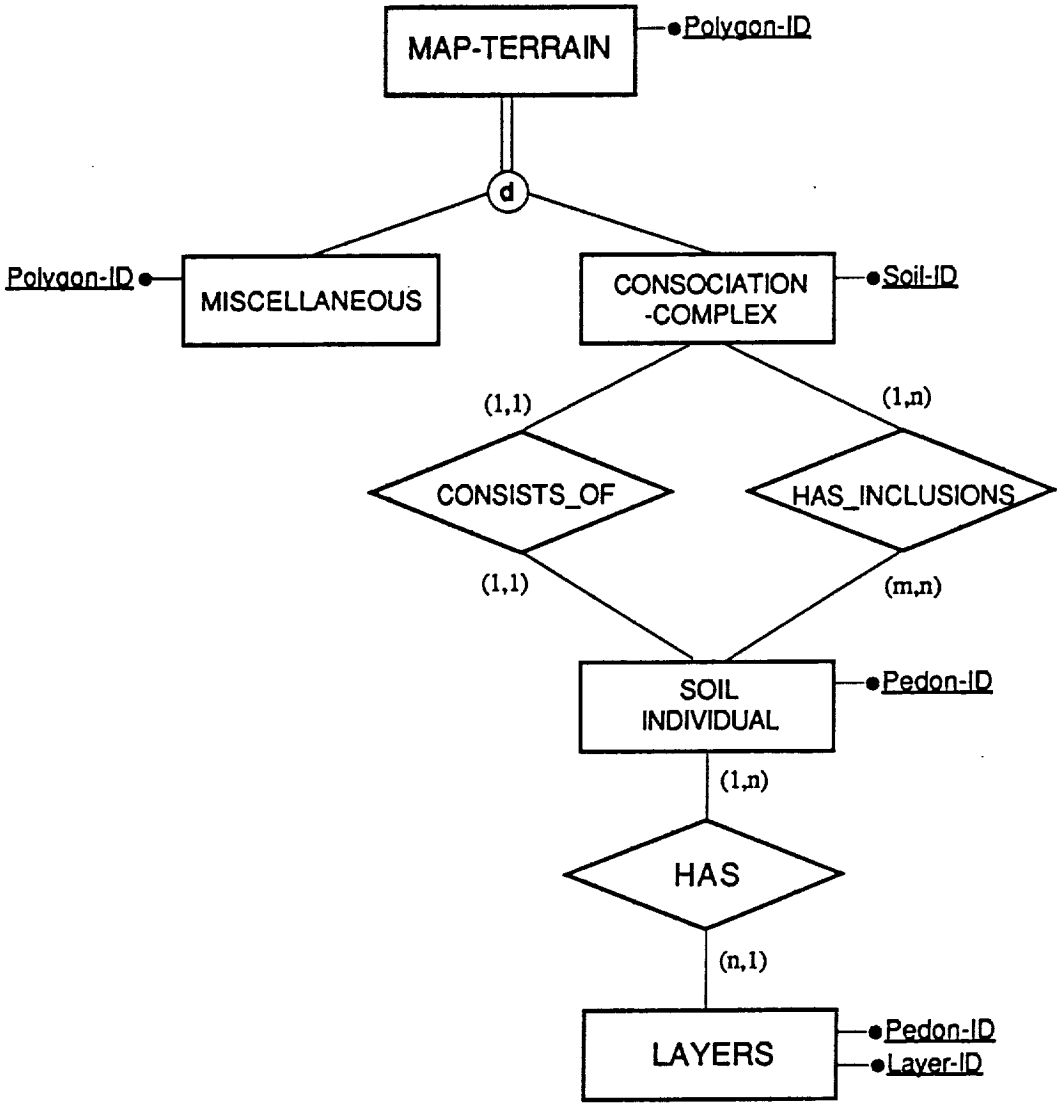


Figure 24

LABORATORY FOR APPLICATIONS OF REMOTE SENSING - PURDUE UNIVERSITY
LAND INFORMATION SYSTEM
MIAMI COUNTY PROJECT

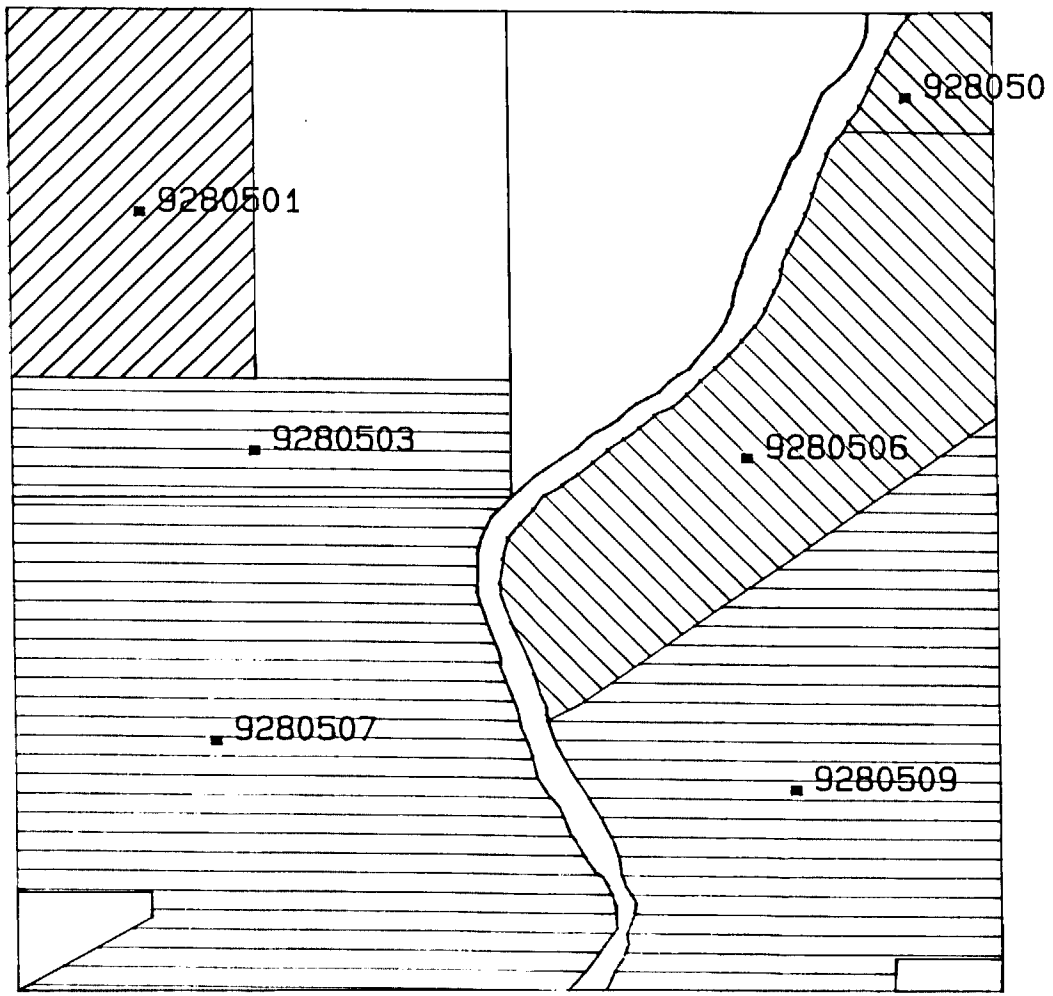
---

1 - DATA INPUT
2 - RECORD UPDATE
3 - DATABASE QUERY
4 - RECORD DELETE
5 - OTHER (FUTURE APPLICATIONS)
0 - EXIT

WHAT IS YOUR CHOICE? (NUMBER):

Figure 25

QUERY OF PARCEL OWNERS



JOHN FARMER

JOHN SMITH

JOHN LARS

Section 9,T28N,R5E

N

SCALE 1:12500

NASA Applications Project, Miami Co., IN

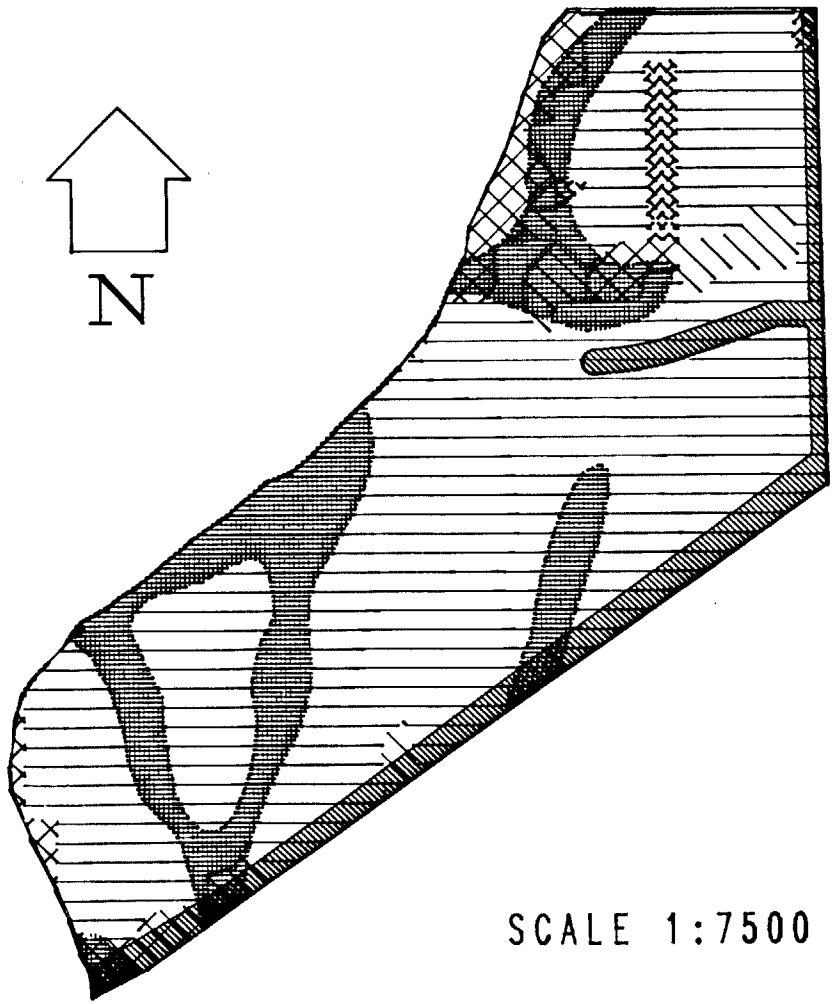
LARS/Purdue University

Figure 26

SOIL PRODUCTIVITY AND LAND COVER

OWNER: John Farmer

LOCATION: Parcel 6,Sect 9,T28N,R5E



SPF > 0.80

SPF 0.70 - 0.80

SPF 0.60 - 0.70

SPF < 0.60

TILLABLE LAND

NON-TILLABLE LAND

WOODLAND

OTHER

NASA Applications Project, Miami Co., IN

LARS/Purdue University

Figure 27

LABORATORY FOR APLICATIONS OF REMOTE SENSING
PURDUE UNIVERSITY
LAND INFORMATION SYSTEM

PARCEL ID: 9280506 COUNTY: MIAMI COUNTY
OWNER ID: SECTION: 9

LAND DATA AND COMPUTATIONS

LAND TYPE	SOIL ID	MEASURED ACREAGE	PROD FACTOR	BASE RATE	ADJUST. RATE	EXTENDED VALUE	INFLUENCE FACTOR	TRUE TAX VALUE
1	FsA	11.35	0.77	495	381	4,324	0.00	4,324
3	FsA	0.04	0.77	495	381	15	0.80	2
1	FzC3	13.43	0.60	495	297	3,988	0.00	3,988
2	FzC3	1.43	0.60	495	297	424	0.60	169
3	FzC3	1.77	0.60	495	297	525	0.80	104
7	FzC3	0.08	0.60	495	297	23	0.00	23
3	Ge	0.47	0.94	495	465	218	0.80	43
1	OsB	2.30	0.64	495	316	726	0.00	726
1	OtA	46.04	0.72	495	356	16390	0.00	16,390
2	OtA	2.12	0.72	495	356	754	0.60	301
3	OtA	0.51	0.72	495	356	181	0.80	36
7	OtA	1.61	0.72	495	356	573	0.00	573
1	St	7.38	0.77	495	381	2,811	0.00	2,811
3	St	3.23	0.77	495	381	1,230	0.80	245
9		1.00		3500		3,500		3,500

MEASURED ACREAGE 91.7 TRUE TAX VALUE 33,235

PARCEL ACREAGE :	86.90	
81 LEGAL DRAIN :	0.00	
82 PUBLIC ROADS:	0.00	
9 HOME SITES :	1.00	
TOTAL ACRES FARMLAND =>		85.90
TRUE TAX VALUE	33,235	
MEASURED ACREAGE:	91.7	
AVERAGE TRUE TAX VALUE/ACREAGE:		362.4
TRUE TAX VALUE OF FARMLAND:		31130.2

Figure 28