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LAND USE DETERMINATION

BY REMOTE SENSOR ANALYSIS

by

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ABSTRACT

TITLE:	Land Use Determination by Remote Sensor Analysis
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ABSTRACT: A land use analysis of 18 selected census tracts in the Metropolitan Washington area using aerial photography was undertaken in this study. A comparison of the results was made with comparable land use data from the Metropolitan Washington Council of Governments' Parcel File, and the results reported. Summary conclusions and recommendations for the use of photo-derived data in land use studies by COG are made in this document.

LAND USE DETERMINATION BY REMOTE

SENSOR ANALYSIS

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INTRODUCTION

This study represents an element of research within the broad framework of the USGS-sponsored 1970 Census Cities Project as a geographic application of the NASA Earth Resources Program.

Its purpose is to describe the results of a land-use analysis study which examined and evaluated land useage patterns in selected portions of the Washington metropolitan area using aerial photography and compared them with data available in the Metropolitan Washington Council of Governments' land use parcel file.

The work provides expanded photo-derived data on land use in this metropolitan area. It complements the urban studies work conducted in-house by the Geographic Applications Program, U.S. Geological Survey and the USGS-sponsored research by the Institute of Urban and Regional Research, University of Iowa, which together are developing sizeable blocks of photo-derived data on this region.

The Washington metropolitan area is experiencing almost unparalleled growth. The needs for providing reliable, detailed, uniform, and complete data to regional and local planners on a timely basis and in such forms for ready analysis to support rational community growth decisions are more pressing than ever. Decisions relative to the optimum utilization of land, for example, are made daily at local jurisdictional levels. The long-term beneficial or adverse effects of many

of these decisions are often not immediately apparent. In some
cases, even the short range results have had serious conse-
quences. Current data must necessarily provide the basis
for sound planning judgements. The increased use of computer
technology for local and regional applications for record
keeping, tax and other service billing routines, as well as
for planning studies, all place great premiums upon reliable
and current data.

The use of data derived from aerial photography by local
jurisdictions and regional planning organizations, except for
map-updating and general survey purposes, is of relatively
recent origin. Some of the problems attending its less than
wide use at present have been due to the difficulties of data
extraction, lack of understanding of photo data potential,
the form of these data as compared with other data sources,
and, to some extent, the costs involved for periodic survey.
Particular benefits in this connection are anticipated from
NASA's ERTS (Earth Resources Technology Satellite) and follow-
on satellite-derived imagery of Metropolitan Washington.
Periodic coverage is expected to provide much needed data on
changes in growth, drainage, vegetation, open spaces, and
other related aspects of regional concern. As a consequence,
work needs to be done to smooth the interface between use of
conventional data systems and those data derived from remote

sensing systems if the fullest benefits are to be achieved

from their coordinated use.   This report attempts to contribute

toward establishing this interface.

1. THE DATA

Land use analysis of 53 selected census tracts within the Metropolitan Washington Council of Governments Region using large (1:13,000) and small (1:50,000) scale imagery has been undertaken by the Geographic Applications Program (GAP), USGS and by University of Iowa teams. The criteria for selection of these tracts were developed by the GAP, USGS staff and considered population density, land use, employment areas, size, location, and other factors. The tracts selected represent a variety of "livelihood" areas (residential, suburbanizing, and non-urban areas) in the Washington metropolitan area.

An early suggestion was made to this Project by GAP, USGS, to consider undertaking a land use analysis of census tracts on the Northern Virginia side of the metropolitan area. The data, as developed, would round out the scope of overall analysis in the area and help finish work started previously by the GAP team. This suggestion has proved to be sound because of the variety and usefulness of data obtained; the insights and familiarization gained by the COG team with land patterns of the Virginia suburbs; and because the inventorying of land use in the tracts analyzed has provided the detailed basis for a follow-up land use change detection study.

Eighteen census tracts in Fairfax and Arlington Counties

and the cities of Alexandria and Falls Church were selected
for analysis (see Figures 1 and 2). Factors entering into
the selection of the tracts were as follows: (1) Previous
GAP sampling of 53 "livelihood" areas (residential, suburbanizing,
and non-urban areas) in the Washington metropolitan area, (2)
location and the nature of the tracts, (3) need for comparability
of 1960 and 1970 census tract outlines as basis for COG parcel
file data extraction and for subsequent land use change
detection studies, (4) availability of aerial photography
(1968 coverage) covering these tracts, and, to some extent,
(5) likelihood of change or stability in the tracts selected.

The land use data for each census tract was obtained
in print-out form from the Council of Governments' parcel
file. These data were derived from local real estate assessment
records of the 1968 period and improved by subsequent COG
re-analysis. Designation of land useage is by a 2-digit code
utilizing the COG General Land Use Categories.[1] In this code,
the first digit describes the principal functional use category
and the second digit, a second order of subordination. For
example, "0" is Residential, "01" is Single-family, "02" is
Multi-family, "03" is Rooming Houses and so forth. Industrial
is "1", Educational is "2", and other first order functional
categories are shown in Table 1.

_____

1.
    See Appendix: Metropolitan Washington Council of Governments
General Land Use Categories.

CENSUS TRACTS SELECTED
FOR ANALYSIS
(1960, 1970 Outlines).

Fig. 1.
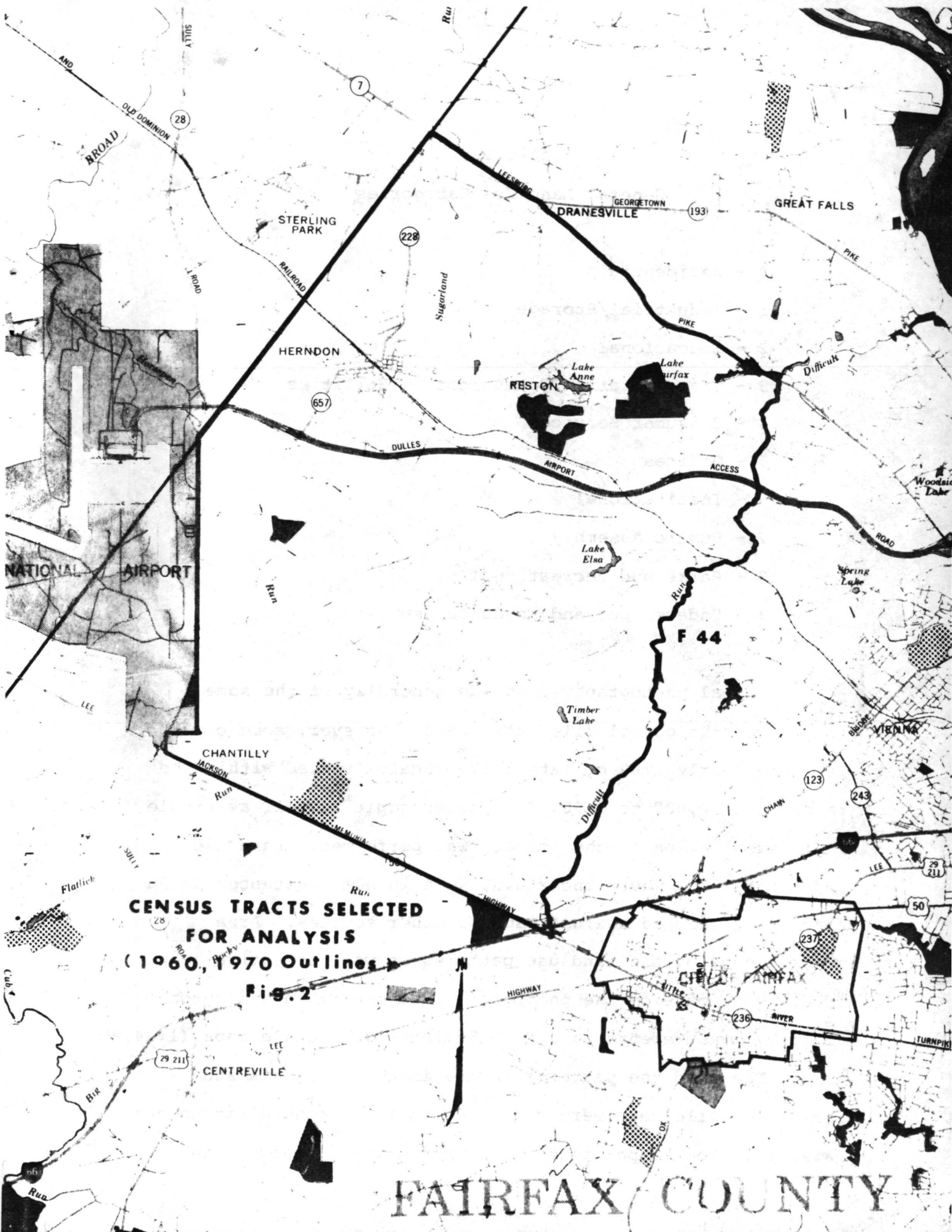
CENSUS TRACTS SELECTED
FOR ANALYSIS
(1960, 1970 Outlines)
Fig. 2

Table 1

General Land Use Categories

0 - Residential

1 - Industrial/Storage

2 - Educational

3 - Transportation/Communication/Utilities

4 - Consumer Services

5 - Offices

6 - Institutional

7 - Public Assembly

8 - Parks and Recreational

9 - Undeveloped and Resource Use

Aerial photography used was generally of the same
vintage as the parcel file data; 1968. However, some coverage
was dated early 1969 or late 1967. Scales varied within the
range of 1:13,000 to 1:50,000. Stereoscopic as well as single
frame examination of the imagery was performed. Land use
interpretations, where uncertain, were in some instances field
checked or checked against maps or other sources. Area
measurements of the land use patterns as well as entire
tracts were made on the photography and confirmed and recon-
ciled by measurements on USGS 7.5-minute quadrangle maps (1:24,000).

The land use patterns in the imagery analysis and
the parcel file data were described to the second digit useage
category. For comparisons and reporting, the useage data

and their areas (expressed in acres) obtained from the parcel
file and imagery analysis were summed within each census
tract to the more general, first digit, land use category.
These data are discussed in detail in the following section.

For ready orientation and geographic reference, the
tracts analyzed in this study are shown in Figures 1 and 2.

2. THE ANALYSIS

Tables 2 through 6 contain the summation of data
by census tract developed during this analysis. The table
format, developed by the University of Iowa team in a previous
study, has been used essentially without modification for
convenient data comparisons. The columns for each indicated
census tract contain the areas (in acres) of land use by
categories (as expressed by the digits along the top row).
Areas of land useage from the COG parcel file are given in
the first line of data; corresponding areas of land useage
as identified in the remote sensing analysis in the second.
The numerical comparisons are given in lines 3 and 4. The
percentage differences are expressed in terms of the remote
sensing area data as the base for comparison.

In the following sections, data comparisons will be
discussed first by census tract and secondly by major land
use category.

Figures 3-7 depict and illustrate land use delineations
on census tracts R-29, R-30, F-6, A-3, A-15, FC-1, and FC-2,

TABLE 2

LAND USE COMPARISONS*

Land Use Categories*
(Area data expressed in acres)

Census Tract	Data Source	0 Residential	1 Industrial	2 Educational	3 Trans./Comm./& Utilities	4 Consumer Services	5 Offices	6 Institutional	7 Public Assembly	8 Recreational	9 Recreational Un-developed	Total Tract Developed Acres
R-2	COG [1]	520.9	0.1	37.3	0.2	13.2	11.2	0.0	9.9	18.9	25.9	639.1
	R.S. [2]	699.4	0.0	34.0	0.0	15.9	4.1	0.0	8.1	17.8	20.7	800.0
	Diff.	-178.5	+0.1	+3.3	+0.2	-2.7	+7.1	0.0	+1.8	+1.1	+5.2	-160.9
	%Diff.	25.5	-	9.7	-	17.2	173.0	0.0	22.2	6.2	25.2	20.1
		168.1	0.0	19.7	0.5	4.7	0.0	0.0	1.9	6.1	4.8	205.8
R-10	"	211.5	0.7	19.3	0.0	7.4	1.1	0.0	2.1	2.5	7.7	252.4
	Diff.	-43.4	-0.7	+0.4	+0.5	-2.7	-1.1	0.0	-0.2	+3.6	-2.9	-46.6
	%Diff.	20.6	100.0	2.1	-	36.5	100.0	0.0	9.5	144.5	37.7	18.5
		218.5	0.0	2.2	4.6	27.4	7.5	0.6	2.7	4.7	15.3	283.5
R-18	"	310.9	0.0	3.8	33.7	26.6	11.6	0.0	1.4	4.8	7.5	400.3
	Diff.	-92.4	0.0	-1.6	-29.1	+0.8	-4.1	+0.6	+1.3	-0.1	+7.8	-116.8
	%Diff.	28.9	0.0	42.1	86.4	3.1	35.4	-	92.8	2.1	105.5	29.1
		118.8	0.0	9.0	0.0	7.3	0.0	0.0	1.9	0.0	5.3	142.3
R-22	"	152.4	0.0	9.6	0.0	6.2	0.0	0.0	1.9	30.7	12.5	213.3
	Diff.	-33.6	0.0	-0.6	0.0	+1.1	0.0	0.0	0.0	-30.7	-7.2	-71.0
	%Diff.	22.0	0.0	0.2	0.0	17.7	0.0	0.0	0.0	100.0	57.6	33.3

*Metropolitan Washington Council of Governments Land Use Categories

1. COG Land Use Parcel File   2. Remote Sensing

TABLE 3

LAND USE COMPARISONS*

Land Use Categories*
(Area data expressed in acres)

Census Tract	Data Source	0 Residential	1 Industrial	2 Educational	3 Trans./Comm./& Utilities	4 Consumer Services	5 Offices	6 Institutional	7 Public Assembly	8 Recreational	9 Un-developed	Total Tract Acres
R-25	COG[1]	106.3	0.0	12.7	3.8	11.8	1.1	0.0	1.3	1.8	20.1	158.9
	R.S.[2]	143.0	0.0	15.9	10.2	21.3	3.7	39.6	1.4	3.0	9.5	247.6
	Diff.	-36.7	0.0	-3.2	-6.4	-9.5	-2.6	-39.6	-0.1	-1.2	+10.6	-88.7
	%Diff.	25.6	0.0	20.1	62.7	46.8	70.3	100.0	7.1	40.0	111.8	35.8
R-29		136.4	49.7	9.8	5.9	26.7	0.9	0.0	2.0	29.9	33.2	288.5
	"	153.1	43.9	10.2	18.9	58.1	0.0	0.0	2.6	24.6	37.0	348.4
		-16.7	+5.8	-0.4	-13.0	-31.4	+0.9	0.0	-0.6	+0.7	-3.8	-59.9
		10.9	13.2	39.2	68.8	54.0	—	0.0	23.1	2.8	10.3	17.2
R-30		130.6	0.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.8
	"	152.6	0.0	8.0	22.3	0.0	0.0	0.0	0.0	10.6	9.5	203.0
		-22.0	0.0	+0.2	-22.3	0.0	0.0	0.0	0.0	-10.6	-9.5	-64.2
		14.4	0.0	2.5	100.0	0.0	0.0	0.0	0.0	100.0	100.0	31.7
R-34		19.8	30.4	0.0	0.2	5.5	35.5	2350.?	0.0	0.0	8.2	2499.1
	"	5.1	107.1	0.0	1190.9	3.4	43.9	811.0	31.1	38.9	511.9	2743.3
		+14.7	-76.7	0.0	-1190.7	+2.1	-8.4	+1539.0	-31.1	-38.9	-503.7	-294.2
		289.0	71.6	0.0	99.9	61.8	19.2	189.5	100.0	100.0	98.5	10.7

*Metropolitan Washington Council of Governments Land Use Categories

1. COG Land Use Parcel File   2. Remote Sensing

TABLE 4

LAND USE COMPARISONS

Land Use Categories*
(Area data expressed in acres)

Census Tract	Data Source	0 Residential	1 Industrial	2 Educational	3 Trans./Comm./& Utilities	4 Consumer Services	5 Offices	6 Institutional	7 Public Assembly	8 Recreational	9 Undeveloped	Total Tract Developed Acres
F-6	COG [1]	1094.0	0.0	41.2	26.8	67.5	0.4	0.0	99.8	565.2	757.1	2652.
	R.S. [2]	1771.4	0.0	63.8	23.6	26.0	0.0	0.0	125.2	101.9	1497.2	3609.
	Diff.	-677.4	0.0	-22.6	+3.2	+41.5	+0.4	0.0	-25.4	+463.3	-740.1	-975.
	%Diff.	38.2	0.0	35.5	13.6	159.8	-	0.0	20.3	456.0	49.5	27.
F-11		842.9	0.0	47.1	20.7	22.2	0.5	0.0	24.6	25.8	452.2	1436.
	"	1023.4	0.0	40.4	15.6	23.8	1.0	161.0	8.3	14.5	456.0	1744.
		-179.1	0.0	+6.7	+5.1	-1.6	-0.5	-161.0	+16.3	+11.3	-3.8	-307.
		17.5	0.0	16.6	32.7	6.7	50.0	100.0	196.5	78.0	0.8	17.
F-17		768.9	0.0	37.3	0.0	65.0	8.1	5.8	8.9	0.0	14.3	908.
	"	734.2	0.0	42.1	0.0	61.1	1.0	1.0	6.7	0.0	81.0	927.
		+34.7	0.0	-4.8	0.0	+3.9	+7.1	+4.8	+2.2	0.0	-66.7	18.
		4.7	0.0	11.4	0.0	6.4	710.0	480.0	32.9	78.0	82.4	2.
F-44		2100.9	463.1	75.7	88.5	70.9	46.2	2504.1	38.5	455.1	23,403.8	29,246.
	"	1982.1	110.1	79.2	707.7	18.3	17.5	14.3	15.9	807.4	27,231.8	30,984.
		+118.8	+353.0	-3.5	-619.2	+52.6	+28.7	+2489.8	+22.6	-362.3	-3828.0	-1737.
		5.9	318.0	4.4	87.3	288.0	163.5	17,400.0	142.2	44.9	14.1	5.

Metropolitan Washington Council
of Governments Land Use Categories

1. COG Land Use Parcel File   2. Remote Sensing

TABLE 5

LAND USE COMPARISONS*

Land Use Categories*

(Area data expressed in acres)

Census Tract	Data Source	0 Residential	1 Industrial	2 Educational	3 Trans./Comm./& Utilities	4 Consumer Services	5 Offices	6 Institutional	7 Public Assembly	8 Recreational	9 Undeveloped	Total Tract Acres
	COG [1]	354.9	6.5	0.0	0.0	2.7	0.0	3.1	0.0	0.0	439.2	1006.3
	R.S. [2]	512.8	8.6	22.9	57.1	9.8	3.4	5.7	7.6	0.0	565.3	1193.2
A-1	Diff.	-157.3	-2.1	-22.9	-57.1	-7.1	-3.4	-2.6	-7.6	0.0	-126.1	-186.9
	%Diff.	30.7	24.4	100.0	100.0	72.5	100.0	45.6	100.0	0.0	22.3	15.7
		283.4	0.0	0.0	0.0	32.3	0.5	0.0	0.0	5.6	191.1	534.7
		342.1	0.0	49.4	50.3	63.1	1.0	0.0	0.3	14.7	179.2	700.1
A-3	"	-58.7	0.0	-49.4	-50.3	-30.8	-0.5	0.0	-0.3	-9.1	+11.9	-165.4
		17.2	0.0	100.0	100.0	48.8	50.0	0.0	100.0	61.9	6.6	23.6
		139.6	68.5	0.0	1.9	26.0	0.0	0.0	0.0	2.3	671.5	964.1
		115.4	162.2	3.8	29.1	38.4	2.8	104.1	0.0	7.5	551.0	1014.2
A-4	"	+24.2	-93.7	-3.8	-27.2	-12.4	-2.8	-104.1	0.0	-5.2	+120.5	-50.1
		20.9	57.7	100.0	93.5	32.3	100.0	100.0	0.0	69.3	21.9	4.9
		174.9	0.0	0.0	0.0	1.2	0.1	0.0	0.0	0.0	53.9	230.1
		246.3	0.0	4.9	2.8	3.4	1.5	15.3	7.3	1.9	22.5	305.9
A-15	"	-71.4	0.0	-4.9	-2.8	-2.2	-1.4	-15.3	-7.3	-1.9	+30.4	-75.8
		28.9	0.0	100.0	100.0	64.6	93.3	100.0	100.0	100.0	135.0	24.8

*Metropolitan Washington Council of Governments Land Use Categories

1. COG Land Use Parcel File   2. Remote Sensing

TABLE 6

LAND USE COMPARISONS

Land Use Categories*
(Area data expressed in acres)

Census Tract	Data Source	0 Residential	1 Industrial	2 Educational	3 Trans./Comm./& Utilities	4 Consumer Services	5 Offices	6 Institutional	7 Public Assembly	8 Recreational	9 Undeveloped	Total Tract Acres
FC-1	COG [1]	188.3	2.0	3.9	4.8	28.7	10.5	3.0	5.7	2.0	17.8	273..
	R.S. [2]	259.4	0.0	0.0	17.7	44.6	10.5	0.0	12.9	0.0	9.6	354..
	Diff.	-71.1	+2.0	+3.9	-12.9	-15.9	0.0	+3.0	-7.2	+2.0	+8.2	-81..
	%Diff.	27.5	-	-	72.8	35.6	0.0	-	55.8	-	85.5	23..
FC-2		287.5	1.1	5.8	5.3	25.9	13.5	0.0	4.0	5.8	14.1	368.
	"	406.0	0.0	4.7	4.7	30.5	4.7	0.0	4.8	4.8	4.8	462..
	Diff.	-118.5	+1.1	+1.1	+0.6	-4.6	+8.8	0.0	-0.8	+1.0	+9.3	-93.
	%Diff.	29.2	-	23.4	12.8	15.1	187.5	0.0	16.7	20.8	193.5	20.

1/ 6.4 acr unassigne

2/ 5.7 acr unassigne

*Metropolitan Washington Council
of Governments Land Use Categories

1. COG Land Use Parcel File   2. Remote Sensing

as determined in this analysis. Varying scales of photography
and requirements for mosaicking and reproduction precluded
similar illustrations for all tracts analyzed.

ANALYSIS BY CENSUS TRACTS

Arlington County

Tract R-2. This is a fairly settled community. Data from
the COG parcel file and remote sensing sources are in close
agreement. No major land classification problems were noted.
The total tract area as measured on the photos and map is
about 20 percent in excess of that reported in the COG parcel
file. This represents a reasonable figure to attribute
to areas occupied by streets and roads (not otherwise categorized
in the Transportation category column - 3). The percentage
is roughly equal to the corresponding difference within the
Residential - 0 category. The comparative data for Consumer
Services - 4 and Offices - 5 are at some variance. This would
be expected from the nature of such similar functional building
types.

Tract R-10. Both sets of data are in fairly close agreement,
closer than expected. Streets and roads would be expected to
contribute somewhat more acreage to the tract than is apparent.
In the residential category the difference seems to be normal.
In all categories, reported land use is essentially as observed
in the photography. About 7 acres more of Offices - 5 useage
are reported in the parcel file records than in the photo-
derived data.

Tract R-18. The Transportation - 3 category has considerably more acreage visible in the photography than is listed in the parcel file data. Here, specifically, the rights-of-way occupied by Fort Myer Drive and Washington Boulevard contribute considerable amounts of visible land useage to this category. Additional amounts of transportation land useage reported in the remote sensing column are from commercial parking lots adjacent to shopping centers. The parcel file area data suggests that perhaps these lots are included with the Consumer Services - 4 (commercial activities, etc.).

Tract R-22. Except for a large park area of approximately 3 acres along Four Mile Run (which the parcel file data does not record) and a difference of 11 acres in open space (essentially along the same flood plain), both sets of data are in fairly close agreement. Educational - 2, Consumer Services - 4, and Public Assembly - 7, are within 1 percent of each other.

Tract R-25. Of the nine categories of land useage described within this tract, the principal differences between the data sets are in the Public Assembly - 7, Transportaion - 3, Consumer Services - 4 and Undeveloped Land - 9. In the first case, 40 acres, which are part of Defense Department installations south of Fort Myer and west of the Pentagon, are not carried in the parcel file data. These are carried in the remote sensing data as Military Installations (category 68). In the Transportation category - 3, most of the difference in the two data sets is due to the land used as highway rights-of-way along Washington Boulevard and the large interchange

at Columbia Pike and the Washington Boulevard, as well as
to additional parking areas in the tract. About 10 acres
of additional commercial land useage under Consumer Services -
4 are reported in the photo-derived data than are shown
in the parcel file records. About ten acres more of open
space are recorded in the photo-derived data than listed
in the parcel file set.

Tract R-29. See Figure 3. Both data sets, in nearly all
land use categories, are in fair agreement with each other.
Two categories, Transportation -3 and Consumers Services - 4,
both contain more acreage in the remote sensing data than
in the parcel file. The differences are 13 and 35 acres re-
spectively. This is a relatively small census tract in the
Shirlington area so that these differences represent
about 4 and 10 percent respectively of the total measured
tract area.

Tract R-30. See Figure 3. Recreational - 8, Undeveloped - 9,
and Transportation - 3 categories represent the three
principal items of difference between the two data sources.
The differences are respectively: about 11, 10 and 22 acres
for which there are no corresponding data in the parcel file.
The transportation land use data from the remote sensing
source is almost entirely attributable to Interstate Route 95
passing along the edge of this tract. Playground and open
space account for the differences in the other two categories.

LAND USE PATTERNS
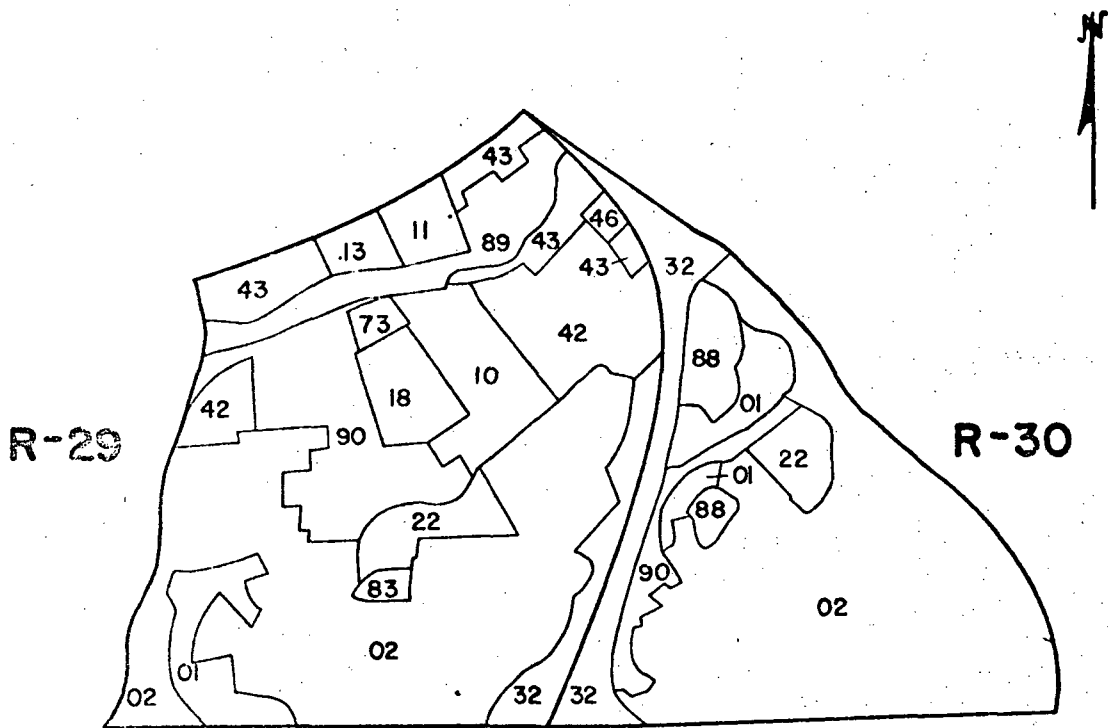
CENSUS TRACTS
R-29 and R-30

Figure 3

Tract 34. This is the largest census tract in Arlington
County - about 2700 acres and the second largest among
those selected for analysis in this study. The tract embraces
National Airport, the Pentagon, Arlington National Cemetery,
Fort Myer, the surrounding road and highway systems, part
of the large railroad yard system along the west side of
the Potomac River, and the surrounding commercial, industrial,
and open spaces in that area. Except for the three categories,
Residential - 0, Consumer Services - 4, and Offices - 5,
for which the results from the two data sources are in
fairly close agreement, none of the data for the balance of
the categories compare well. The total tract area figures from
both sources are, however, reasonably close, about 11 percent
of each other. The Institutional category - 6 represents
the greatest difference between the two data sets - about
1500 acres. Both the parcel file and the remote sensing
data report the Federal military installations in this tract
as being in the Military Category - 68. However, in addition,
the area embraced by National Airport seems also to have
been included in the military category within the parcel
file as there is no indication that it has been included
within the Transportation - 3 category. The photo analysis
does not delineate the military installations and categorize
them entirely as such. Within areas of Fort Myer and Arling-
ton National Cemetery, for example, additional visible

functional uses are identified and reported, such as unused
areas and national monuments (Amphitheater, the Iwo Jima Monument,
open space, etc.). These designations diminish the total
area of military land useage in the remote sensing data,
and, of course increases the relative variation between the
two data sources. Similarly, the large Pentagon parking
areas and its heating and sewage plants have been classified
in the remote sensing data within the appropriate Transportation
and Utilities - 3 category. Within this tract the Institu-
tional - 6 category has apparently been used in parcel file
source data to lump all Federally owned lands regardless
of specific functional use. The Transportation category - 3
also contains significant differences of land use acreage
(about 1200) between the two data sources. The parcel file
reports less than one acre of such useage. The photo-derived
data within this category contain the acreage of National
Airport (about 727), highway and road rights-of-way (about 300)
and the balance of about 160 acres devoted to large parking
areas around the Pentagon and National Airport. Other principal
differences in the data sets include: 31 and 39 acres respec-
tively in the Public Assembly - 7 and Recreational - 8 cate-
gories for which no acreage is recorded in the parcel file.
In the Undeveloped category - 9, about 510 acres are observed
as open spaces in the remote sensing data while about 9 are
recorded in parcel file records. A large wildlife sanctuary
consisting of about 150 acres is observed in the photo data
and is so reported.

Fairfax County

Tract F-6. See Figure 4. The total tract areas from the
two data sources differ by about 950 acres. About 320 acres
of these are water areas within the tract (portions of Dogue
and Little Hunting Creeks). It is not possible at this
point to explain the balance of the difference in the total
areas. In the Residential category - 0, there are about
677 acres more in the photo-derived data than in that from
the parcel file. This is in excess of what has been the
observed difference between the sets. About 40 acres used
for a mobile home park are observed in the photography and
are not included in the parcel file data. On the other hand,
while not affecting the difference between the two residential
area figures, there are about 17 acres of multi-family
housing reported in the parcel file data while the photo-
derived analysis reports none. About 40 more acres of
Consumer Services - 4; are reported in the parcel file than
in the remote sensing data. With respect to the Educational
category - 7, there is a difference of about 22 acres. This
is high on the remote sensing side. The difference is
probably attributable to outline delineation differences
because all the school areas within this tract have been
accounted for in both data sets. Comparisons between the
Recreational - 8, Public Assembly - 7, and Undeveloped - 9
categories are interesting. Much of the difference between
the two data sources is due to the classification of Mount
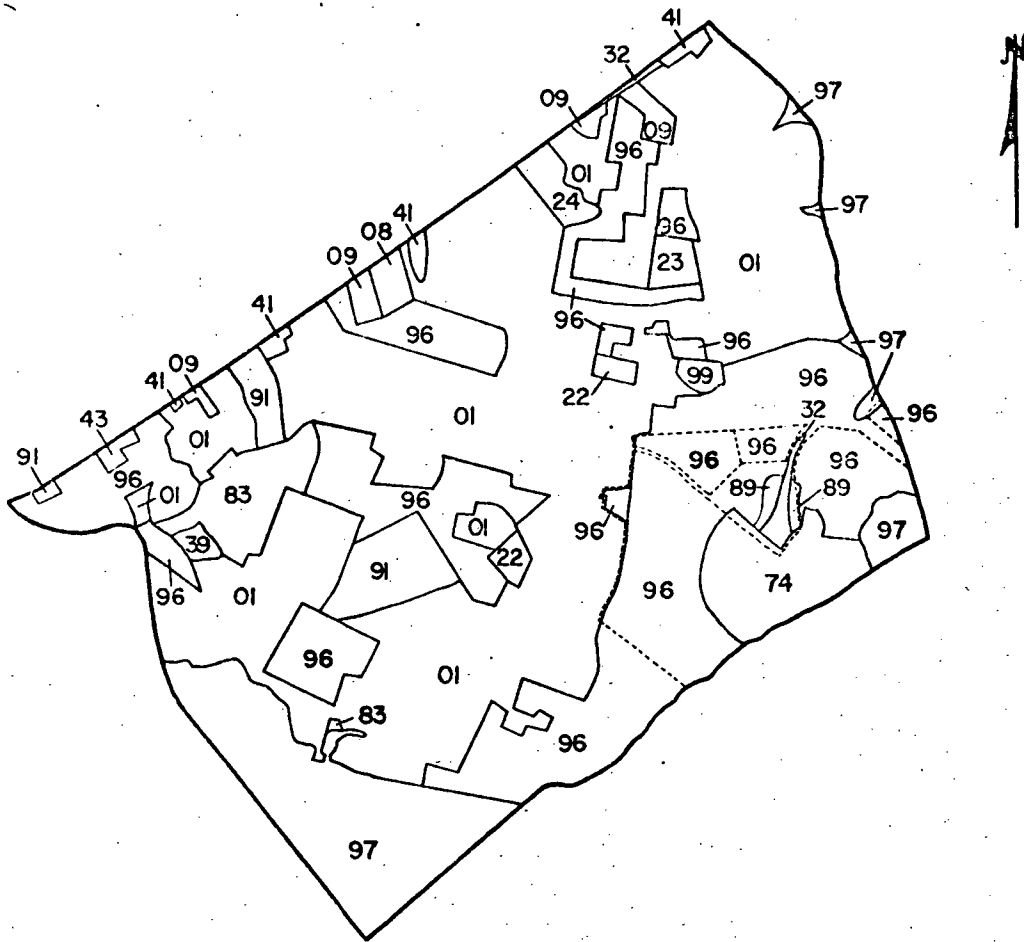
LAND USE PATTERNS

CENSUS TRACT
F-6

Figure 4

------ MOUNT VERNON
PROPERTY LINE

Vernon. The parcel file classified the tract as Recreational -
8, while the photo-derived data categorized it as an Historic
Site (74) under Public Assembly - 7. The outlined area
of Mount Vernon is delineated on the sketch by the dotted
line; it consists of about 500 acres (488 acres in parcel
file records). The outline of the site delineated by remote
sensing analysis describes what appears to be the public
visitation areas of the tract (125 acres) as well as those
areas categorized as open and undeveloped land and road and
highway rights-of-way. The principal differences between
the data sets in this reppect are due to those useage areas
described by visible outlines and those described by owner-
ship outlines.

Tract F-11. The data from the two data sources are in
fairly close agreement. Residential acreage is higher in
the photo-derived data by a figure (17%) well within the usual
range. The major difference noted is in the Institutional
category - 6, in which a large cemetery comprising some 160
acres is reported from the imagery, but is not reported in
the parcel file. More acreage is occupied by churches
and parks as reported in the parcel file data than in that
from the photography; about 16 and 11 acres respectively.
There is most likely more church-owned property listed in
the parcel file than is visible and reportable from the
imagery.

Tract F-17. The total areas as well as the useage delineations from the two data sources do not appear to differ too much for this tract, except in two instances. The Residential category - 0 seems to contain a considerable difference. There is less residential area in both the single and multi-family residential categories in the photo-derived data than reported in the parcel file data records. This is unusual. There are four sizeable enclaves of multi-family residential occupancy in this tract. The bulk of the tract except for a commercial fringe is almost (80 percent) entirely single-family residential in character - much of it built around Lake Barcroft. Yet parcel file records indicate an excess of multi-family occupancy than is visible in the imagery - about 50-50 distribution of single - and multi-family useage patterns. Educational - 2 and other categories are reasonably close. The Undeveloped category - 9 represents another large point of difference (about 67 acres) between the data sets. However, about 33 acres of this is the water area of Lake Barcroft.

Tract F-44. This census tract is the largest of those sampled in this analysis - with an area of approximately 30,000 acres. The tract is bounded by Dulles International Airport, the Loudoun - Fairfax County line, Virginia State Route 7 (Leesburg Pike), U.S. Highway 50, and Difficult Run. It contains much open area, considerable farm land, recreational facilities, and has a growing residential character. Reston falls within the tract. As with the other large tract, R-34 in Arlington County, many land useage activities were observed, as were considerable differences in land use designations between the two data sources. Its analysis presented the most problems. The photography was flown at different altitudes with different focal lengths and orientations. Mosaicking the photos was difficult. About 12 photographic prints covered the tract. Some of which were provided by USGS, the balance were purchased. The total area measurements of the tract were preformed on the photography with appropriate scale conversions. For control, (as with all other census tracts) comparable measurements were made on 6 USGS 1:24,000 scale 7.5-minute quadrangle maps. The total tract area as measured on the photo prints was 30,984 acres. The area as measured on the USGS maps was 30,350 acres. This difference of about 600 parts in 30,000 or 1 part in 50 was considered to be acceptable; the photo-derived data, therefore, were used without adjustments. The tract area from the parcel file records is approximately 29,250 acres. This degree of agreement is unusual, perhaps too close (6 percent). The usual differences in the two data

sets attributable to roads and highways (and other increments of land frequently not included in parcel data), has generally been higher. With the exception of the Educational Category - 2, in which there is good agreement between the two data sets (3.5 acres in about 80 acres all total), the other categories of land useage, as reported in the parcel file and remote sensing sources, differ substantially. Remote sensing data reports less (by about 120 acres) of Residential - 0 land useage than does the parcel file. However, single-family dwelling acreage was high by 25 acres in the remote sensing data, but multi-family acreage was about 145 acres lower than the parcel file records. The latter difference seems most unusual in such a rural/suburban area. It suggests doubling up by multi-family occupancy in otherwise single-family-type dwellings. The number of multi-family structures within this census tract is largely concentrated in the Reston area, and most of these have been accounted for in the analysis. The largest differences in the two data sets are shown in the Undeveloped - 9 and the Institutional - 6 categories. In the former, the photo-derived data was high by about 3800 acres; (though the agricultural acreage in both data sets was very close). In the latter, the parcel file data was high by about 2500 acres. Inquiry into the parcel file records reveals a parcel of about 2500 acres in Fairfax County east of and adjacent to the Dulles International Airport which has been categorized as Institutional - "Government Services", (Category 60) and is land probably

dedicated to future service use for the Airport. At present it is visibly being used as farm land, residential, or is open land - and is so described and categorized in the photo-derived data. Another large difference between the data sources (about 620 acres) is noted in the Transportation category - 3. The tract is disected by several large rights-of-way: The Dulles Access Highway, the abandoned Old Dominion Railroad line, and several power and pipeline routes. Only 89 acres of this useage category are reported in the parcel file. In both the Industrial - 1 and the Recreational - 8 categories there are differences of about 350 and 360 acres respectively, with the parcel file being high in the first case, and the photo-derived data being high in the second. It would appear that more land was dedicated for industrial use than was actually in such use at the time of photography. With respect to Recreational - 8 useage, the bulk of the difference is attributable to two large areas not being included in the parcel file data. One of which is the County-owned park, Lake Fairfax, and the other, the privately owned International Town and Country Club. Consumer Services - 4, Offices - 5 and Public Assembly - 7 (churches, etc.) account for the balance of the differences between the data sources; about 53, 29 and 23 acres respectively.

Alexandria

Tract A-1. The total area from parcel file records for
this tract is about a thousand acres. Of this, about 200
acres are not accounted for in terms of specific land useage
categorizations. The rest of the data from the two sources
may be compared as follows, keeping in mind that the areas
of categorized land useage from the parcel file data will be
somewhat less (in unknown amounts) than actual. Within
the Residential category - 0, there are about 75 acres more
of single-and multi-family residential useage in the remote
sensing data than in the parcel file sources. In both cases,
this would represent an average of 29 per cent difference,
which is not unusual for this category. About 23 acres of
Educational - 2 category are observed in the imagery, while
none is reported in the parcel file data; fifty-seven acres
of Transportation - 3 land useage are observed in the photography -
mostly Interstate Route 95 right-of-way. None of this is
reported in the parcel file data. The other principal
difference in the two data sources is in the Undeveloped
category - 9; about 126 acres. Other smaller area differences
include churches, a cemetery, shopping centers and industrial
warehouse areas amounting to about 25 acres not all described
in the parcel file data.

Tract A-3. See Figure 5. In this tract there are about 22
acres of the total land useage (535 acres) not assigned to
specific use categories in the parcel file records. The
parcel file data lists no schools, while the photo-derived
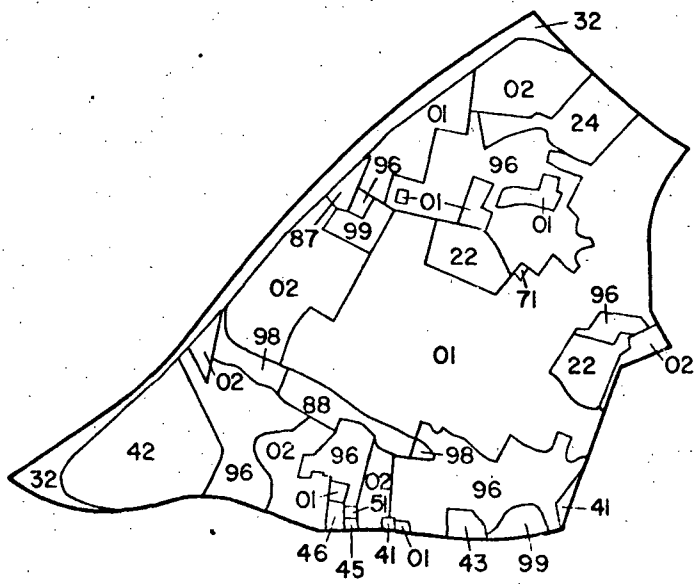
LAND USE PATTERNS

CENSUS TRACT
A-3

Figure 5

data reports about 50 acres of educational useage (3 schools);
one of which is Hammond High School). About 50 acres of
Interstate Route 95 right-of-way are reported in the imagery
source data, in the parcel file; none. The photo and parcel
file records differ substantially on the large Landmark
Shopping Center - 52 and 32 acres respectively. An additional
10 acres of commercial useage are reported int the imagery
data. About 12 acres more of undeveloped land are reported
in the parcel file records than are reported in the photo-
derived data.

Tract A-4. This tract consists of a large variety of activities;
manufacturing, warehousing, sand and gravel pits, railroad
and highway rights-of-way, undeveloped areas, and clusters
of residential useage. As with census tracts A-1 and A-3,
there are 54 unassigned (uncategorized) acres in the parcel
file data for this tract (tract total of 764.1 acres). There-
fore, the following comparisons between useage categories in
the two data sources are a little less valid. The total
tract area figures for both data sets are closer than usual -
about 5 percent difference. In addition, the residential
useage area is less in the photo-derived data than that from
the parcel file. There are other substantial differences
between the two data sources. No Institutional-- 6 useage
is reported in the parcel file data, yet the U.S. Army's
Cameron Station is situated within this tract. About 104
acres were so reported in the photo-derived data. It is
possible that this acreage could have been listed under

another category in the parcel file. The only one sufficiently large in area to accomodate this acreage would be the Undeveloped - 9 category. About 94 more acres of Industrial - 1 land useage and about 30 acres more of Transportation - 3 useage are reported in the imagery data than in the parcel file data. In the latter case, only 1.9 acres of railroad right-of-way are reported in the parcel file data. Small amounts of Educational - 2, and Office - 5 useage are reported in the photo-derived data; none are reported in the parcel file data. The largest difference - about 120 acres - is noted between the two data sets in the Undeveloped - 9 category.

Tract A-15. See Figure 6. This tract is in a well developed and mature residential area, consisting primarily of single-family residences. The total tract areas from both data sets compare rather well. The Residential - 0 data also compares well. There are several differences however. The photo-derived data reports a cemetery, a school, several churches and a small park (about 30 acres in all) for which there are no comparable data in the parcel file. The difference between the parcel file and the photo-derived acreages for the Undeveloped category - 9 is about 30 acres (the larger amount being in the parcel file data.
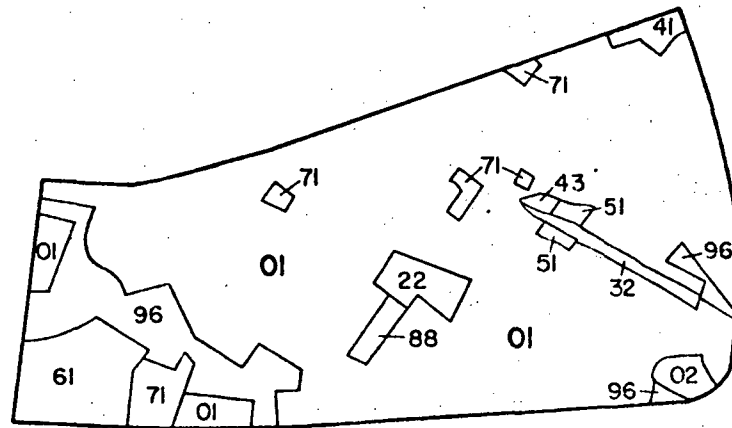
LAND USE PATTERNS

CENSUS TRACT
A-15

Figure 6

LAND USE PATTERNS

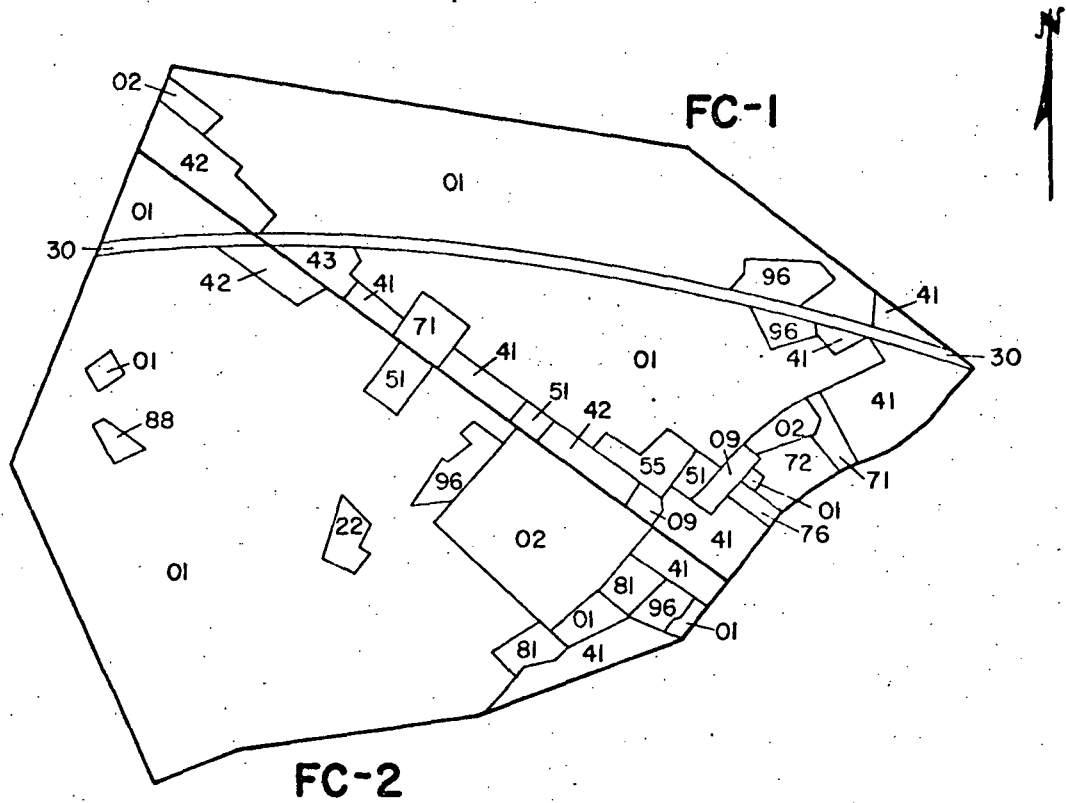## CENSUS TRACTS
FC-1 and FC-2

Figure 7

FC-1. See Figure 7. Within this tract, the Residential - 0 acreage
from both data sources seem to compare well, though somewhat more
transient housing (hotels, motels, and tourist accomodations) - 09,
is reported in the imagery-derived data than from the parcel file
sources. No photo-derived acreage is reported in the Industrial/Storage
- 1, Educational -2, Institutional -6, and Undeveloped and Resource
Use - 9 Categories. Small areas for these categories are reported in
the parcel file data. Three categories: Offices - 5, Transportation - 3,
and Public Assembly -7 present the greatest differences in the two
sources of data. In the second of these, the right-of-way of the
abandoned Old Dominion Railroad contributes to the bulk of the
difference.

FC-2. See Figure 7. The residential acreages from both data sources
are in good agreement. No useage data for Industrial - 1 and Public
Assembly - 7 are reported in the photo-derived data. For the Transporta-
tion category - 3, areas from both data sources are in close agreement,
though different types of useage are being described. In the photo-
derived data, the abandoned railroad right-of-way contributes to the
bulk of the acreage, while for the parcel file data, auto parking lots
represent the useage. For the remaining categories, differences in the
two data sets are slight, except for Offices - 5 and Undeveloped and
Resource Use - 9. In these two categories, parcel file areas were
higher, being almost double the areas from the photo measurements.

ANALYSIS BY LAND USE CATEGORIES

The following section describes the analysis in terms of the principal categories of land use. Figures 8 to 18 are graphs on which are plotted the comparable land use acreage data for all tracts. from remote sensing and parcel file sources as shown in Tables 2 to 6. Figure 8 plots the total tract acreages from both sources; Figures 9 to 18 plot the acreage data for each land use category. In a few instances, points falling off scale or because of clustering were omitted.

Residential - 0. In all but four of the tracts analyzed, there was a fairly consistent relationship between the acreage data from both data sources. The photo-derived data were consistently higher (with the exceptions noted) by a range of 11-33 percent, with an average of about 22 percent. This is a reasonable figure to expect and would account for land occupied by streets and roads not otherwise categorized under the Transportation - 3 category. The four exceptions consist of the data from tracts F-44, R-34, A-4, and F-17. In these tracts, the parcel file data recorded more residential useage than was observed in the photography. In three of these tracts, F-44, R-34 and A-4, the differences between the total tract areas from parcel file data and photography were the least of all tracts analyzed (5-11 percent). The first two of these tracts are the largest sampled. They are very

heterogeneous in character but quite different from each other -
the one rural, the other very built up. Classification differences
and area delineations probably account for these anomalies -
farm lands, open areas, and residential useage in the former
case, and increments of residential useage not picked up
in the imagery in the latter. With respect to tract F-17, an
excess of multi-family land use in the parcel file data is
suspected for the difference.

Industrial and Storage - 1.

The major differences in these data occurred within the same
three tracts as noted in the foregoing paragraph; F-44, R-34,
and A-4. In the first tract, the remote sensing data were
low by about 350 acres, in the second two tracts, it was high
by 77 and 94 acres respectively. In the first case, industrial
land dedicated for such useage but not so utilized, at least
at the time of photography, possibly accounts for much of
this difference. This would include some undeveloped (as of
1968) "industrial park" areas in Reston. In the second two
instances, parcel file data seemed a little lean in categorized
industrial areas. The lower part of tract R-34 contains its
industrial areas. During 1968, much of this area was in a
change of status from industrial to high-rise office and
residential complexes (part of Crystal City). The photo-
derived data is probably high here.

Educational - 2.

In nearly all cases and with the exception of one jurisdiction,
the data from both sources were generally in good agreement.
One tract in Fairfax County (F-6) indicated a difference of
about 23 acres between the two data sources. The same number
of schools seem to be indicated, so the difference must be
due to parcel delineation on the photography. Of interest is
the observation that in the four tracts in Alexandria which
were analyzed, the parcel file shows no land useage classified
as educational. It is possible that some of this acreage
is included in the parcel file's uncategorized acres for
these tracts.

Transportation/Communication/Utilities - 3.

In all cases, the photo-derived data were higher than that
provided by the parcel file. The principal reason is due to
the utilization of this category by the photo analysis for
the delineation of highway, pipeline and powerline rights-
of-way as well as large parking areas. These areas in
general are not contained in the parcel file records. This
contributes to much of the difference in the total area
figures between the parcel file records and the photo-derived
data. One large categorization anomaly in the parcel file
records was the classification of Washington National Airport
under the Military Installations category - 68 (presumably,
all Federal lands in that tract, R-34, were lumped under the
Military category).

Consumer Services - 4.

Among the 15 tracts with acreage in this category, the
photo-derived data in 9 tracts, accounted for about 110 acres
more than parcel file records; while in the other 6 the
parcel file data accounted for about 102 acres more than
that from remote sensing sources. Algebraically, the two
would seem to cancel out. However, the error is appreciable
and much of it is due to the relative difficulty of photo-
analysis to clearly distinguish the commercial type buildings
and facilities. Shopping centers and certain service-type
areas with large vehicle parking lots were more readily
identifiable than were smaller shops and stores.

Offices - 5.

The parcel file and the photo-derived data were relatively
close in this category. There does not seem to be a pattern
of one data source or the other being consistently low or high.
In most instances, where office buildings were recorded in
the parcel file records, data from the photography recorded
like useage. However, there are, inherent in this land use
category, possibilities for photo interpretation errors, unless
ground checked. Frequently office spaces, commercial useage
(and sometimes residential) useages are combined in the same
parcel of land. In these cases of multi-use parcels, the imagery-
derived analysis, by itself, is somewhat constrained from

definite and too positive reporting. However, knowledge

of the area, as was the case in several of these tracts,

contributed to improved confidence levels in the photo

analysis. However, for such newer areas as Crystal City,

for example, consisting of large high-rise office building

units, such reporting constraints can be minimized.

Institutional - 6.

For this category, the comparisons between the two data

sources revealed some of the largest differences encountered

during the analysis. The differences were areal in extent,

due to classification (or no classification in some parcel

file records), and to jurisdictional useage designations.

In one large tract (R-34) in Arlington, for example, the

large Federally-owned lands comprising Fort Myer, Arlington

National Cemetery, the adjacent memorial monuments, the

Pentagon complex, and the National Airport (with approximately

720 acres of transportation land use) are classified as In-

stitutional in the parcel file records. The visible functional

useages were described as such in the photo analysis. In

Alexandria, about 104 acres of land occupied by Cameron Station

do not seem to have been categorized. About 160 acres of

cemetery land use in Fairfax County (F-11) were also not

carried in the parcel file records. In another instance in

tract F-44, in Fairfax County, about 2500 acres of multi-

purpose agricultural, residential, and open land just east

of Dulles International Airport is described in the parcel
file as Institutional - 60 (Government Services in local records).
This is a piece of land which presumably has been dedicated
for future use in support of the adjacent airport facility.
It, however, does not have identifiable outlines on the imagery,
and in the imagery analysis, is utilized for farming,
residential, or is open land. The greatest differences in
this category in comparison with imagery-derived use patterns,
have been noted as a result of "block" classification of
Federal lands without useage delineations; non-listing of
Federal or other parcels (cemeteries, etc.); or identifying
parcels by ownership or dedication rather than by useage.

Public Assembly - 7.

As with other categories, as noted, there seem to be juris-
dictional differences in recording data which are reflected
in the parcel file records. Churches fall within this category,
and do not seem to be recorded in the parcel file data for the
four sampled tracts within Alexandria. Other principal
data differences between the two data sources seem to be
largely definitional. One has been touched upon previously:
namely the lumping of the Federal lands within tract R-34
(Arlington) into the Military Installations category - 68
in the parcel file data. Thus, all the large monumental
structures and grounds within the Fort Myer and Arlington

National Cemetery complex are not carried within this category in the parcel file. The photo-derived area data for this category is, therefore, more descriptive. Similarly, the categorization of the Mount Vernon Estate seems to have been classified in the parcel file data within the Parks and Recreation category - 8. In the remote sensing analysis, this site was classified under Historical Sites - category 74. It would seem that there is equal merit in its being classified either way. The analysis of this tract posed some additional interesting questions. The open and wooded areas around Mount Vernon are relatively homogeneous to the limits of the bordering residential communities. However, the property outline of the estate is, as one would expect, materially different than that which is identifiable on the imagery. This ever-present limitation in imagery analysis is illustrated in Figure - 4, in which delineation of the Mount Vernon Estate property outlines and the photo-derived land use outlines are shown.

Parks and Recreational - 8.

In general, the land use acreage in this category is high in the photo-derived data. Considerable amounts (about 460) of this type of acreage are not listed in the parcel file data. Within the eight tracts analyzed in Arlington County, the comparative data on five were in good agreement (three were almost identical in extent); for the other

three, no data were provided in the parcel file records.
The data on the Alexandria tracts were uniformly high for
the photo-derived sources, although the total acreages
involved were not excessive (16 acres). The data on the
four Fairfax County tracts were the least compatible. In
these, lack of corresponding data from parcel file records
accounts for the major difference.

Undeveloped and Resources Use - 9.

The data comparisons for this category by tracts and by
jurisdictions do not seem to have any pattern. This might be
expected because of the nature of the many variables (including
time of data collection) involved in the classification of
land. This would be particularly true for delineations of
land parcels in open country devoted to agriculture, woodlands,
resources exploitation, unused land, etc. Perhaps this
category is one for which general comparisons are less mean-
ingful than for the other categories discussed in the foregoing,
because the bases for classification are so different. The
large tract, R-34, contained, in the photo-derived data, about
500 acres of open space (including a large wildlife sanctuary)
not otherwise categorized. The parcel file records report only
8 acres of open land in that tract. Within the four
tracts analyzed within Fairfax County, the remote sensing
data recorded a total of about 5000 acres in excess of the
parcel file records, of which about 2500 acres were classified
by the latter as Institutional, while the bulk of the acreage

was observed in the imagery to be largely undeveloped or
agricultural. For the four tracts analyzed within Alexandria,
there is no apparent pattern. For three tracts, the parcel
file data were high by about 160 acres, while for the fourth
tract, the photo-derived area was high by about 120 acres.
Water areas are assigned to this category in the remote sensing
data, thus inflating the data for these areas above the levels
provided by the parcel file, which rarely, if at all, reported
water areas. In agricultural areas, farm ponds and reservoirs
are reported as such in the imagery analysis, but are probably
included in parcel file data along with the total farm acreage.
Also, parks and recreational areas unless reliably identified
as such from other supplemental information would ordinarily
be classified in the photo-derived analyses as undeveloped
or open land.

PLOT OF TOTAL LAND USE
FOR ALL CENSUS TRACTS

FIGURE 8

30,984.3
29,246.8

TOTAL TRACT ACREAGE - REMOTE SENSING DATA

500   1000   1500   2000   2500   3000   3500

TOTAL TRACT ACREAGE
PARCEL FILE DATA

1000   2000

PLOT OF RESIDENTIAL – 0 LAND USE
FOR ALL CENSUS TRACTS

FIGURE 9

TOTAL TRACT ACREAGE – REMOTE SENSING DATA

TOTAL TRACT ACREAGE
PARCEL FILE DATA

PLOT OF INDUSTRIAL - 1 LAND USE
FOR ALL CENSUS TRACTS

FIGURE 10

TOTAL TRACT ACREAGE - REMOTE SENSING DATA

TOTAL TRACT ACREAGE
PARCEL FILE DATA

PLOT OF EDUCATIONAL - 2 LAND USE
FOR ALL CENSUS TRACTS

FIGURE 11
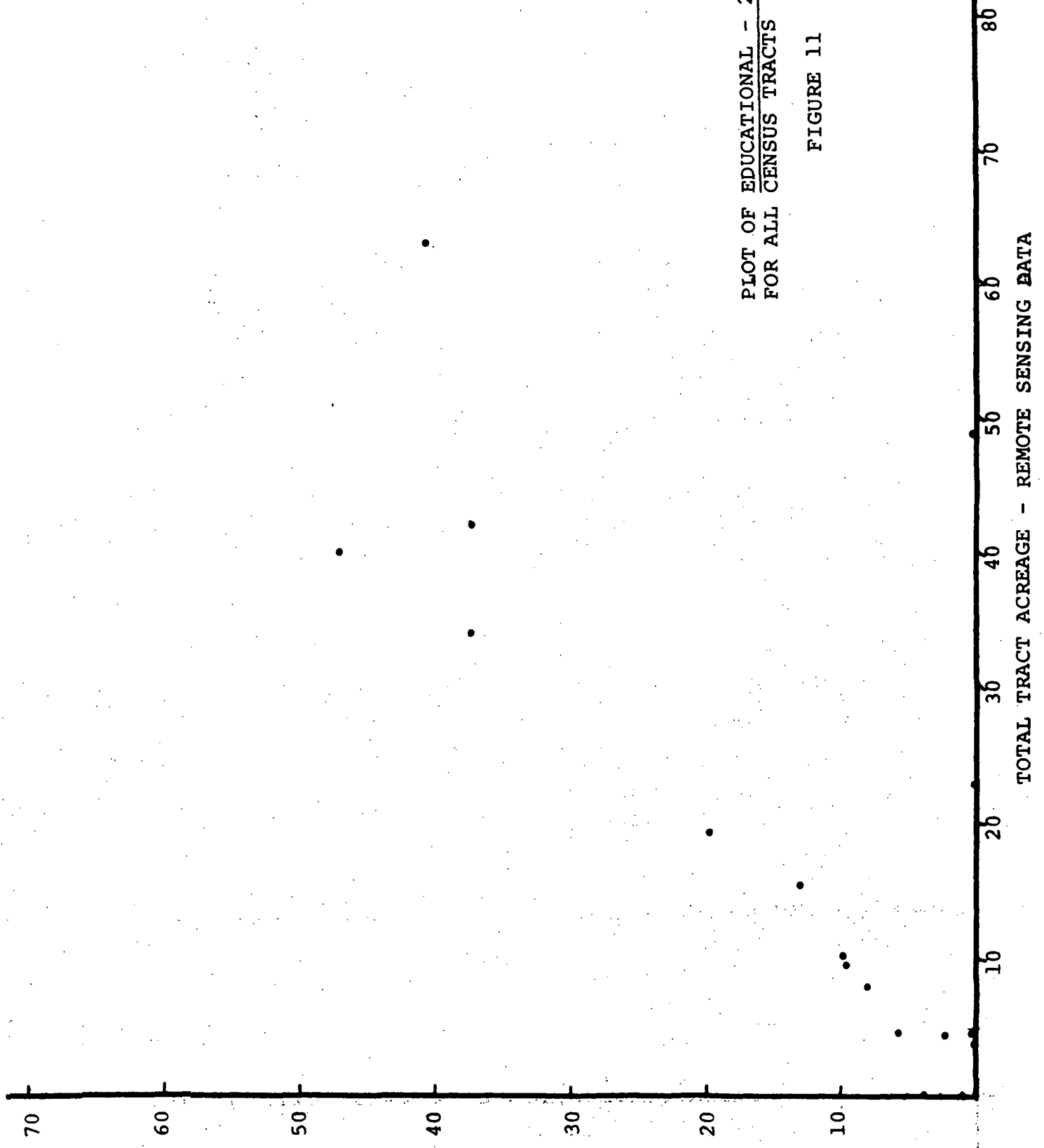
TOTAL TRACT ACREAGE - REMOTE SENSING DATA

TOTAL TRACT ACREAGE
PARCEL FILE DATA

PLOT OF TRANSPORTATION, COMMUNICATION,
AND UTILITIES - 3 LAND USE FOR ALL
CENSUS TRACTS

FIGURE 12

1190.9
0.2

707.7
88.5

TOTAL TRACT ACREAGE - REMOTE SENSING DATA

TOTAL TRACT ACREAGE
PARCEL FILE DATA

- 48 -

PLOT OF CONSUMER SERVICES - 4
LAND USE FOR ALL CENSUS TRACTS

FIGURE 13

TOTAL TRACT ACREAGE - REMOTE SENSING DATA

TOTAL TRACT ACREAGE
PARCEL FILE DATA

PLOT OF OFFICES - 5 LAND USE
FOR ALL CENSUS TRACTS

FIGURE 14

TOTAL TRACT ACREAGE - REMOTE SENSING DATA
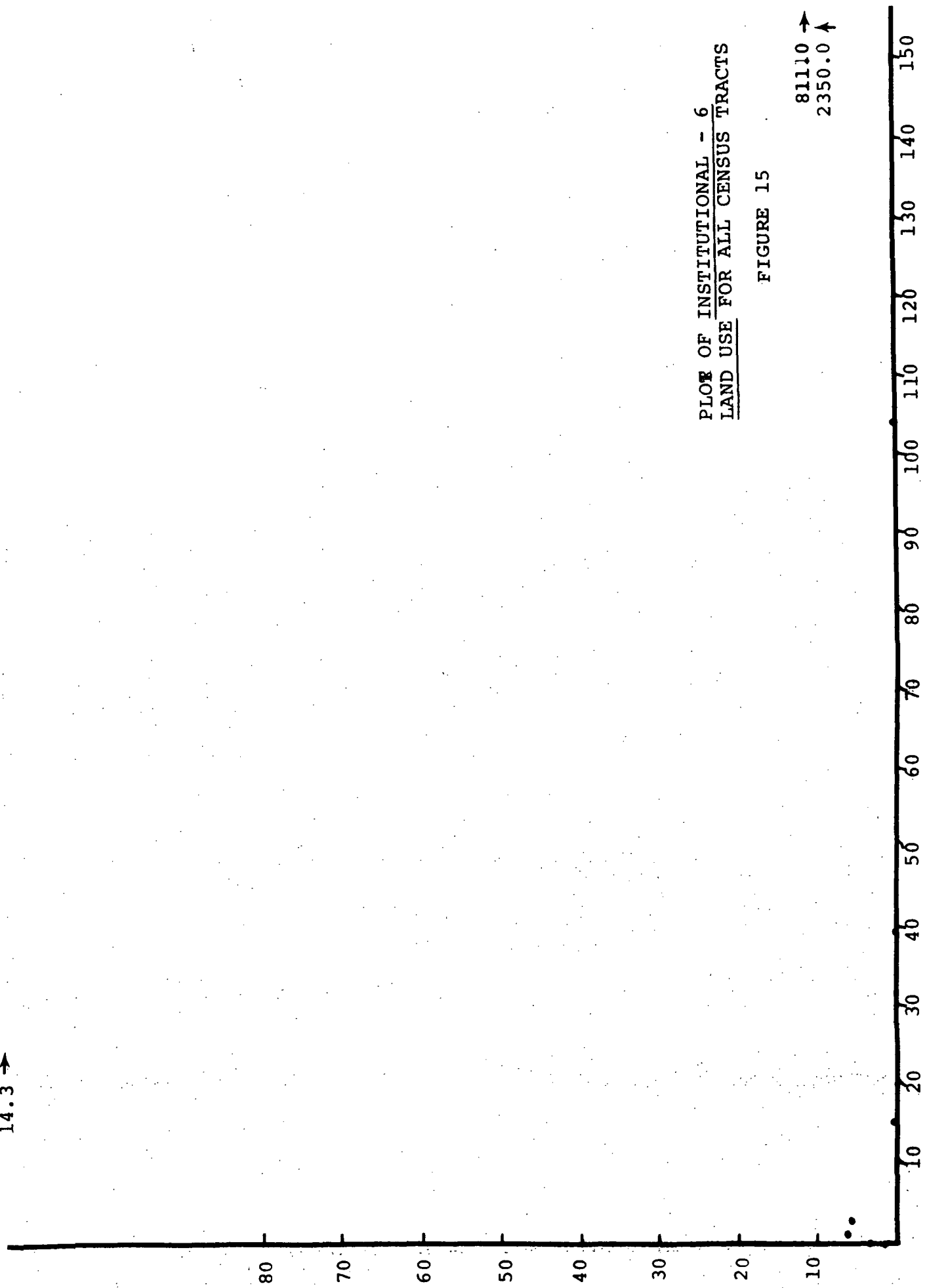
TOTAL TRACT ACREAGE
PARCEL FILE DATA

PLOT OF INSTITUTIONAL - 6
LAND USE FOR ALL CENSUS TRACTS

FIGURE 15

TOTAL TRACT ACREAGE - REMOTE SENSING DATA

PARCEL FILE DATA
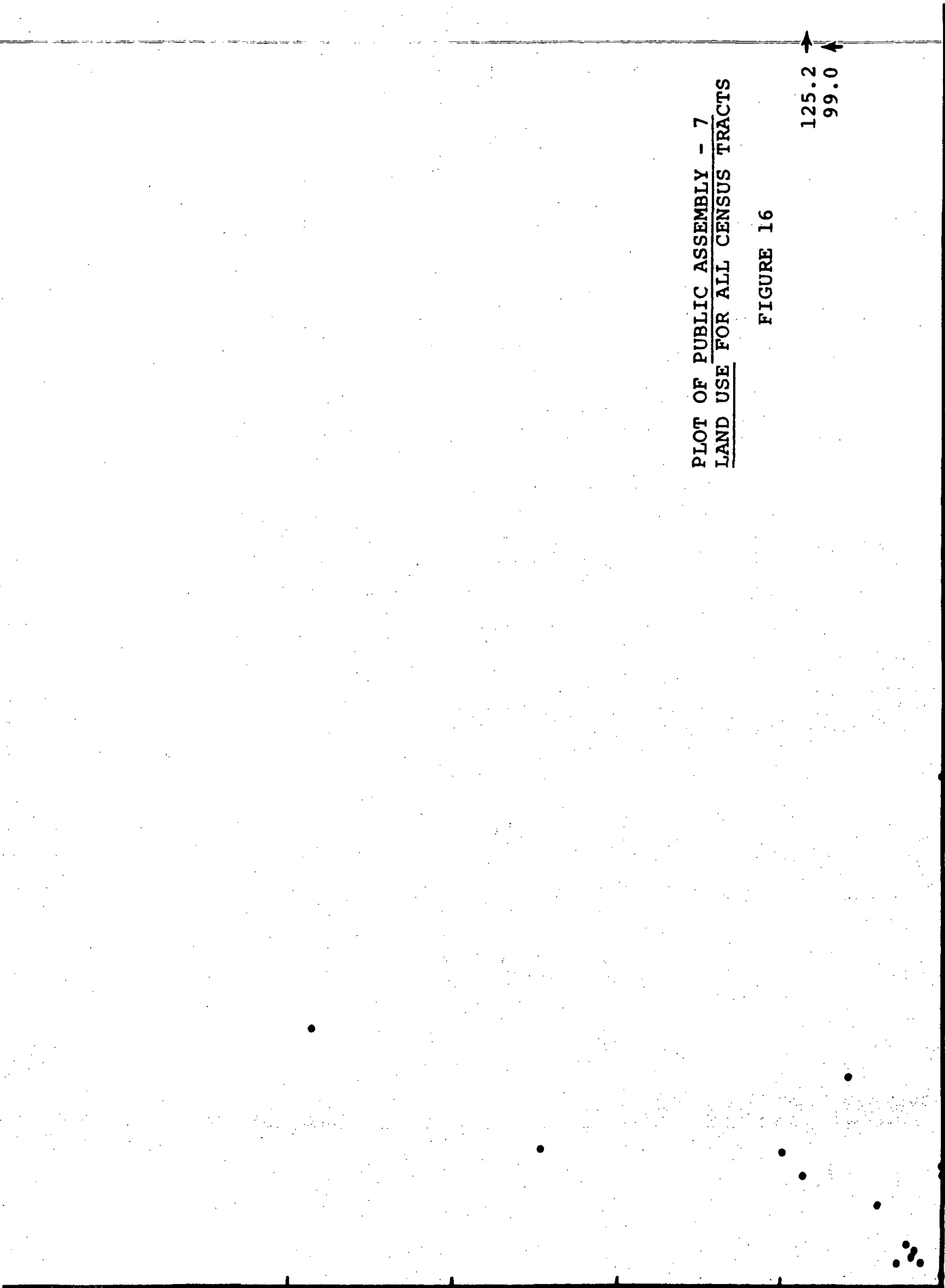TOTAL TRACT ACREAGE

- 51 -

PLOT OF PUBLIC ASSEMBLY - 7
LAND USE FOR ALL CENSUS TRACTS

FIGURE 16

125.2
99.0

TOTAL TRACT ACREAGE — REMOTE SENSING DATA

TOTAL TRACT ACREAGE
PARCEL FILE DATA

- 52 -

PLOT OF RECREATION - 8
LAND USE FOR ALL CENSUS TRACTS

FIGURE 17

807.4 →
445.1 →

101.9 →
565.2 →

TOTAL TRACT ACREAGE - REMOTE SENSING DATA

TOTAL TRACT ACREAGE
PARCEL FILE DATA

- 53 -

file records. The excess was due largely to the areas occupied by streets and roads within residential areas not being included in the residential land parcels, and being included in the photo-derived residential acreage.

For similar reasons, the large discrepancies in the Transportation/Communication/Utilities category were due to the almost total absence of highway, rail, power and pipeline rights-of-way in the parcel file records.

Within the Industrial, Educational, Institutional, Parks and Recreational, Public Assembly, and Undeveloped and Resource Uses categories, the differences were attributable largely to ommissions of acreage from the parcel file data; to "lump" categorization as with large tracts of different types of Federal lands being classified under a single use category; and to ownership or dedication categorization rather than by current useage.

Imagery interpretation was probably the weakest in the analysis of the Consumer Services, Offices, and the Undeveloped and Resource Uses categories. Certain types of industries were difficult to distinguish from office buildings. Field checking in many of these instances was generally helpful.

Classification anomalies were noted in the analysis. Parcel file source data from public tax and land records were found to omit several types of non-tax bearing properties. Thousands of acres of land useage, including Federal lands, churches, cemeteries, schools, highway and rail rights-of-way

and water areas were so excluded.

For the classification analyst, the coding of the Public Assembly - 7 and Parks and Recreation - 8 categories presented difficulties because of overlaps and inconsistencies. Is Mount Vernon, for example, an Historical Site - 74, or is it a Park - 88? Similar definitional problems were encountered in the Offices - 5 and Institutional - 6 categories. Is the Pentagon, for example, a Military Installation - 68, or is it a Federal Government Office Building - 54? Would the Forrestal Building in L'Enfant Plaza be a Military or Federal Office Building? While these may be isolated instances, they are examples of the classification dilemma sometimes faced by the classification analyst. Too frequently the classification systems are based upon ownership criteria and do not always provide (where there are differences) for use and activity designations. Land use areas need to be accurately categorized and mapped, as this information provides basic inputs to regional and other studies. As large aggregations of the data are made, the differences described in this report would, of course, be reflected in the studies upon which the data were based.

Jurisdictional differences were also noted. Some jurisdictions carried educational properties, public schools, for example, on the records, others did not. Variations were noted in classifying institutional and governmental land holdings.

Lastly, the comparative analysis using both data sources required frequent consultations between the COG Data Systems Office and the remote sensing team. These discussions and their results were totally informative and fruitful and, in many instances resulted in illuminating an area in both photo and parcel file data which required additional research or corrective analysis. This aspect of the analysis represented the most significant and promising element in this study, because it demonstrated the beginning of an analytical correlation between two bodies of data which, standing alone, are subject to sizeable error. For instance, for the twenty-five hundred acres of land in Fairfax County previously noted as classified "Institutional" in the parcel file, there was no visible photographic evidence of such useage. Parcel file data provided the location and, the photo analysis the inference that the land, presently observed to be in every-day use for farming, and residential purposes or else undeveloped, has been dedicated as government land for future use by the Dulles International Airport.

This process of timely correlation of photo-derived data with COG land use and other data files to provide validity checks on information inventories is worth further investigation and application. Specifically, this would require the initiation of procedures for the aggregation of parcel file and remote sensing data into an improved and more reliable data base.

4. RECOMMENDATIONS

1. Examine the Metropolitan Washington Council of Governments'
General Land Use Category codes with a view to provide for:
(a) modification or adjustments to the classification levels
and (b) additional digital fields to accomodate imagery-
derived updating and verification as to current land useage,
activity, multiple use, etc. in addition to ownership
identification.

2. Initiate in-house procedures for verification and validity
checking of land use classification records by correlation
with remote sensor-derived data (field-checked as required)
prior to entry into the Council of Governments' computeriaed
data bases. Such procedures should probably be initially
directed to verification of data in the parcel file and the
development of a new improved data aggregation. With expectancy
of synoptic and repetitive imagery and related data from
ERTS-A (Earth Resources Technology Satellite) becoming
available to COG in 1972, procedures should become operative
by that time.

3. Encourage, possibly through COG computer modelling and
prediction programs and studies, increased uniformity among
the region's jurisdictions in the recording and reporting of
land use data, (including untaxed and public land areas).

4. Examine available remote sensing technology and data read-out equipment for possible utilization in facilitating computerization of land use data analysis, measurement and correlation procedures. This examination should include assessment of the possible effectiveness of utilization of such equipment at all appropriate levels of need (local and/or regional).

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APPENDIX

METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS

GENERAL LAND USE CATEGORIES

0 - Residential

1 - Industrial/Storage

2 - Educational

3 - Transportation/Communication/Utilities

4 - Consumer Services

5 - Offices

6 - Institutional

7 - Public Assembly

8 - Parks and Recreational

9 - Undeveloped and Resource Use

     The COG generalized land use code as proposed by Data Systems has several important new properties:

     1 - It is hierarchial

     2 - Education is now a separate category

     3 - It corresponds closely with URA/BPR and the RMIS Code #1

     Use of the most general level of coding (i.e. ending in 0) is permitted for cases when the information is so general as to not allow more specific coding as well as for cases where the information is so specific that no two digit equivalence has been made. An appropriate error message will normally be generated for each assignment to the one digit level of coding.

     Blanks will be inserted where a conversion can not be made to either a one or two digit level.

CODE #1

COG GENERALIZED LAND USE CODE

0 Residential

  01 Single Family (including detached, semi-detached, triple-attached and row, plus individual mobile homes)

  02 Multi-Family (two or more dwellings in a single building, including apartments and residential hotels)

  03 Rooming and Boarding Houses

  04 Membership Lodgings

  05 Residence Halls and Dormitories

  06 Retirement Homes, Orphanages and Religious Quarters

  07 Seasonal Housing (including summer cottages and farm labor camps)

  08 Mobile Home Parks or Courts

  09 Hotels, Motels and Tourist Accommodations

  00 Residential, NEC

1 Industrial/Storage

  11 Manufacturing and Processing

  12 Research and Testing

  13 Wholesale, Warehousing and Solid Storage

  15 Contract Construction

  16 Vehicle Storage - Truck Parking

  17 Vehicle Storage - Taxi Parking

  18 Vehicle Storage - Bus Parking

  19 Refuse Disposal

  10 Industrial/Storage, NEC

2 Educational

  21 Nursery Schools

  22 Elementary Schools (Grades 1 - 6)

23. Combination of Nursery and Elementary Schools (pre-school through 6)

24 Secondary Schools (Grades 7 - 12)

25 Colleges and Universities

26 Commercial Schools

20 Educational, NEC

3 Transportation/Communication/Utilities

31 Railroad/Rail Rapid Transit Rights of Way (includes terminals)

32 Street and Highway Rights-of-Way

33 Airports

34 Auto Parking

35 Bus/Taxi Terminals

36 Radio/Television and Telephone/Telegraph Communications

37 Electric Utility

38 Gas Utility

39 Water/Sewer Utility

30 Transportation/Communication/Utilities (includes marinas, pipelines, etc.), NEC

4 Consumer Services

41 Stores

42 Shopping Centers

43 Gas Stations, Auto Repair, Automobile Dealers and Auto and Truck Rentals

44 Repair Services (not auto repair)

45 Personal Services

46 Eating and Drinking

47 Medical and Dental Clinics, Centers, and Laboratory Services

40 Consumer Services, NEC

5 Offices

    51 Commercial Offices

    52 Professional and Trade Associations

    53 Institutional Offices

    54 Federal Government Offices

    55 State and Local Government Offices

    56 Foreign Governments and International Organizations
        including embassies, chanceries, etc.

    50 Offices, NEC

6 Institutional Services

    61 Cemeteries

    62 Hospitals

    63 Nursing Homes

    64 Other Health Facilities (except those coded under 47)

    65 Police Stations

    66 Fire and Rescue Stations

    67 Correctional Institutions

    68 Military Installations

    69 Welfare and Charitable Services

    60 Institutional Services, NEC

7 Public Assembly

    71 Churches, Synagogues, and other places of worship

    72 Civic, social and fraternal associations

    73 Libraries

    74 Permanent exhibitions, including museums, art galleries,
        monuments, planeteria, aquariums, and urban historic sites

    75 Sports and miscellaneous assembly including stadiums,
        auditoriums, recreation halls, etc.

    76 Entertainment assembly including theaters

70 Public Assembly, NEC

8 Parks and Recreation

81 Indoor recreation, including recreation centers, indoor
swimming, gymnasiums, ice and roller skating rinks,
bowling, and penny arcades

82 Outdoor Amusements, including fairgrounds, race tracks,
go-cart tracks, miniature golf, golf driving ranges,
and amusement parks

83 Private Outdoor Recreation, including tennis, swimming,
country clubs, and yachting clubs, limited to members
and guests

84 Commercial Outdoor Recreation, including resorts, riding
academies, ski runs, organized camps, and marinas

85 Public Golf Courses

86 Play lots, playgrounds and playfields

87 Outdoor Courts and pools open to the public (tennis,
basketball, swimming, etc.)

88 Parks - Leisure and ornamental

89 Parks - general recreation, including individual camping
and picnicking as well as areas for the enjoyment of
nature, including zoos, botanical gardens, arboretums
and national parks

80 Parks and Recreation, NEC

9 Undeveloped and Resource Uses

91 Agriculture and Related Activities

92 Forestry Activities and Related Services

93 Mining Activities and Related Services

94 Permanent Conservation Areas

95 Other Resource Production and Extraction

96 Undeveloped and Unused Land Area

97 Water Areas

98 Vacant Floor Areas

99 Under Construction

90 Undeveloped and Resource Uses, NEC

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16. Abstracts A land use analysis of 18 selected census tracts in the Metropolitan Washington area using aerial photography was undertaken in this study. A comparison of the results was made with comparable land use data from the Metropolitan Washington Council of Governments' Parcel File, and the results reported. Summary conclusions and recommendations for the use of photo-derived data in land use studies by COG are made in this document.

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