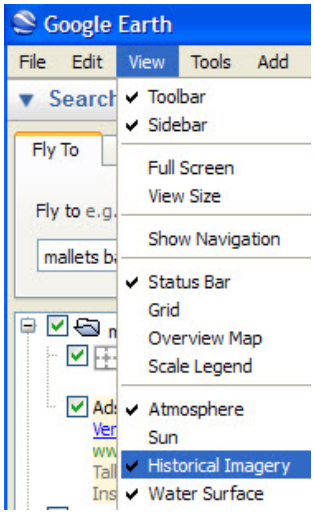
Air Photo Interpretation with Field Verification

Preface to teachers: The purpose of this activity is to apply remote sensing to land use and land cover mapping. Today's activity is targeted towards you as educators as an example from which to develop an activity for your own students. It is recommended that students be assigned to small teams that will be required to photointerpret satellite and/or aerial imagery (bird's eye view) to answer questions that require an understanding of the spatial interaction of landscape features in space and time. This task introduces or requires a basic understanding of the concepts of photointerpretation (see below), hierarchical classification, spatial resolution, orientation (both within the imagery and in the field), map scale, extrapolation and verification. The task is also heavily dependent upon deductive reasoning and consensus building within each team. One approach would be to address these concepts as a classroom exercise followed by a field trip (to field check the photointerpretation call) to allow students to apply their knowledge. This exercise could also be readily modified to address more specific applications, such as landscape change over time, stream geomorphology, planning, etc.

Adapting activity to your area: In today's exercise you will be provided with imagery for a local Burlington site. This activity can be adapted to your local area using imagery provided by SWAC or captured using Google Earth. With SWAC provided imagery and IDRISI and/orENVI software, you can capture image subsets for your local area that include natural color, color infrared (CIR) and black and white panchromatic imagery through time. Google Earth imagery is limited to natural color and panchromatic imagery only. Using the View tab > Historical Imagery on Google Earth, one can select recent or historical imagery with the sliding tool bar. Using screen grab software you can capture a copy of aerial imagery of the area encompassing your specific area of study as a jpeg file.



Following the examples in this activity, you can select specific features in your local imagery and/or compose questions that require a more complex understanding of how features relate to one another in space and time.

To facilitate the acquisition of aerial imagery in your local area, there are several free screen capture software packages available. An evaluation of these freeware packages can be found at http://www.freewarefiles.com/. Search for "screen capture" software. Snapshot and FoxArt are both highly rated. These software packages allow you to capture full screens, active windows, or rectangular areas of whatever is shown on screen.

These materials were prepared by Leslie A. Morrissey (RSENR/UVM)

TODAY'S ACTIVITY

Introduction: Photointerpretation is the process of identifying objects (features) visible in aerial photographs or satellite imagery and determining their meaning or significance. Photointerpretation is dependent both on one's experience and subjective judgment. An experienced photo interpreter evaluates shape, size, pattern, shadow, tone or color, texture, spatial association, and site information to identify what is visible in the imagery. Although some features may be identifiable using a single element, others may require combining evidence from multiple elements or sources of information. Some understanding of the landscape or the features to be identified is essential to accurately and efficiently photointerpret imagery. Always begin by identifying the most obvious features (e.g., water, agricultural fields, and forests) and then move towards the more difficult features or higher hierarchical categories (e.g, row crop vs. pasture lands or deciduous vs. evergreen forests). These guidelines will allow the interpreter to proceed from the known to the unknown with confidence. They also allow the extrapolation of feature identifications throughout an image. For example, if the evidence strongly supports the identification of a single feature as a given land cover type, then that identification can be extrapolated to other features in the image that appear similar. Lastly, it should also be recognized that photointerpretation is subject to error and can be improved upon or verified by identifying features in the field. This is analogous to hypothesis testing in that the accuracy of the photointerpretation can be verified through independent field observations.

In the 1970s, the U.S. Geological Survey began a program to map land use and land cover of the United States using aerial photography (satellite imagery today). The resultant land use and land cover (LULC) classification system (attached) was devised specifically for use with remotely sensed imagery. Its categories are appropriate for information interpreted from aerial photographs or satellite images, and it has a hierarchical structure that lends itself for use with images of differing scales. Level I, for example, is tailored for use with small-scale, i.e. coarse-resolution, imagery. Level II represents more detailed classes that can be interpreted from higher spatial resolution images. Although the USGS system specifies only the level I and II categories, level III categories can be defined by the user to meet the specific requirements of a particular study or a specific region. The USGS LULC classification can be found on the last page of this exercise.

Objectives: The objectives of this activity are to interpret features visible on aerial photographs or satellite imagery and verify those interpretations in the field. Students will need to become familiar with the USGS Land Cover/Land Use classification system and possibly develop appropriate Level III user defined classes. Two aerial photographs and a transparent overlay are provided with **24** features identified on the overlay. Work in teams of 3. Your tasks are:

1. **Orient yourself within the image, i.e. identify North and the approximate map scale.**
2. **Make a preliminary photo-identification of the features on the overlay.**
3. **Use the image to orient yourself in the field and identify key landscape features.**
4. **Check your photo-identification of the selected features by visiting each feature in the field.**
5. **Answer the questions that follow regarding features on the imagery.**

Two sets of aerial photography are provided. These photos vary by spatial resolution (detail) and date of acquisition as follows: CIR air photo (acquired in the 1980's) and natural color (**NC**) acquired in April, 2004.

Each numbered site on the overlay transparency should be labeled according to the USGS classification system. For level III sites you will need to add your own defined **class number and label** (e.g., 111; single family residence). **Each team will hand in one clean and neatly hand printed lab form at the end of the exercise.**

What each team will need: USGS Land Cover/Land Use classification system, one transparent overlay, a set of aerial photographs, a clipboard, and the activity assignment. The air photos and transparent overlay will be reused each year, so please use care with these materials.

Time required: 2-3 hours total. The students could initially photointerpret features in the classroom (45 minutes) and then go outside to verify the features in field (1 - 2 hours).

Before you begin:

- VERIFY THAT THE PHOTO PROTECTIVE ENVELOPES ARE TIGHTLY SEALED TO PREVENT WATER OR SOIL FROM ENTERING, AND DO NOT REMOVE PHOTOS FROM THEIR PROTECTIVE COVER.
- DO NOT MARK ON THE PHOTOS OR PROTECTIVE JACKETS.
- DO NOT CROSS THE MAIN ROADS; use your photointerpretation skills to address those features that lie outside your area of access. *Check similar features within your study area.*

TASK 1 – PHOTOINTERPRETATION

a) Make a preliminary photo interpretation call for all 24 features identified on the clear overlay using the color infrared (**CIR) aerial photograph** acquired in the 1980s. The overlay is marked so that it can be visually registered to the CIR air photo provided. Record the USGS category Level I to Level III (*students will need to define Level III categories)* on the attached Table 1. Note: sites 23 and 24 do not appear on the CIR imagery but are visible on the natural color imagery.
b) Check out these same features on the natural color (**NC**) imagery acquired in 2004 and indicate if the same features that were visible on the 1980 exist on the 2004 imagery. *Always use a pencil for fieldwork.*
c) Visit these sites in the field both to hone your photo interpretation skills and verify your photointerpretation call.

SO THAT ALL GROUPS DO NOT VISIT THE SAME FIELD SITES AT THE SAME TIME, LOOK AT THE NUMBER ON YOUR CLIPBOARD AND START ON THAT NUMBER FOR YOUR FIRST FIELD SITE VISIT. THAT IS, IF YOUR CLIPBOARD IS #4, START WITH SITE #4 IN THE FIELD.

The adventure begins...

Table 1: LULC classes based on photointerpretation of the 1980 CIR photo* & field checking

Feature number	USGS Level I	USGS Level II	User Defined Level III	Verify Field Call	Exist on 2004 image?
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23*					*no*
24*					*no*

TASK 2 - ELEMENTS OF PHOTOINTERPRETATION

A. Answer the following questions based on photointerpretation of the CIR photo.

1. Why do features 17, 18, and 19 differ in appearance?

2. How can one differentiate residential from public or commercial buildings using only aerial photography?

3. What materials were used to construct features 3 and 21?

4. What's the difference between sites 9 and 10?

5. Why are features 16 and 17 distinguishable?

6. What time of year do you think this CIR photo was acquired? Why?

7. What time of day (morning, noon, afternoon) was the photo taken and why?

8. What is feature 5 and why is it so red in color?

9. Feature 4 is a continuation of what other feature (by number) identified on your overlay? What is it?

Note, the acquisition date of the CIR photography you will use is unknown, but is presumed to be from the 1980's. Many changes in land use/land cover are thus expected to have occurred since the photography was acquired; some features on the photography may since have been removed, while others may have been added. Compare the CIR to the 2004 natural color imagery to identify changes over time.

10. Identify 4 new features/recent changes in land use/land cover between the CIR photo acquired in the 1980's and the 2004 natural color imagery?

USGS Land Use/Land Cover Classification System for Use with Remotely Sensed Data (Anderson and others, 1976)

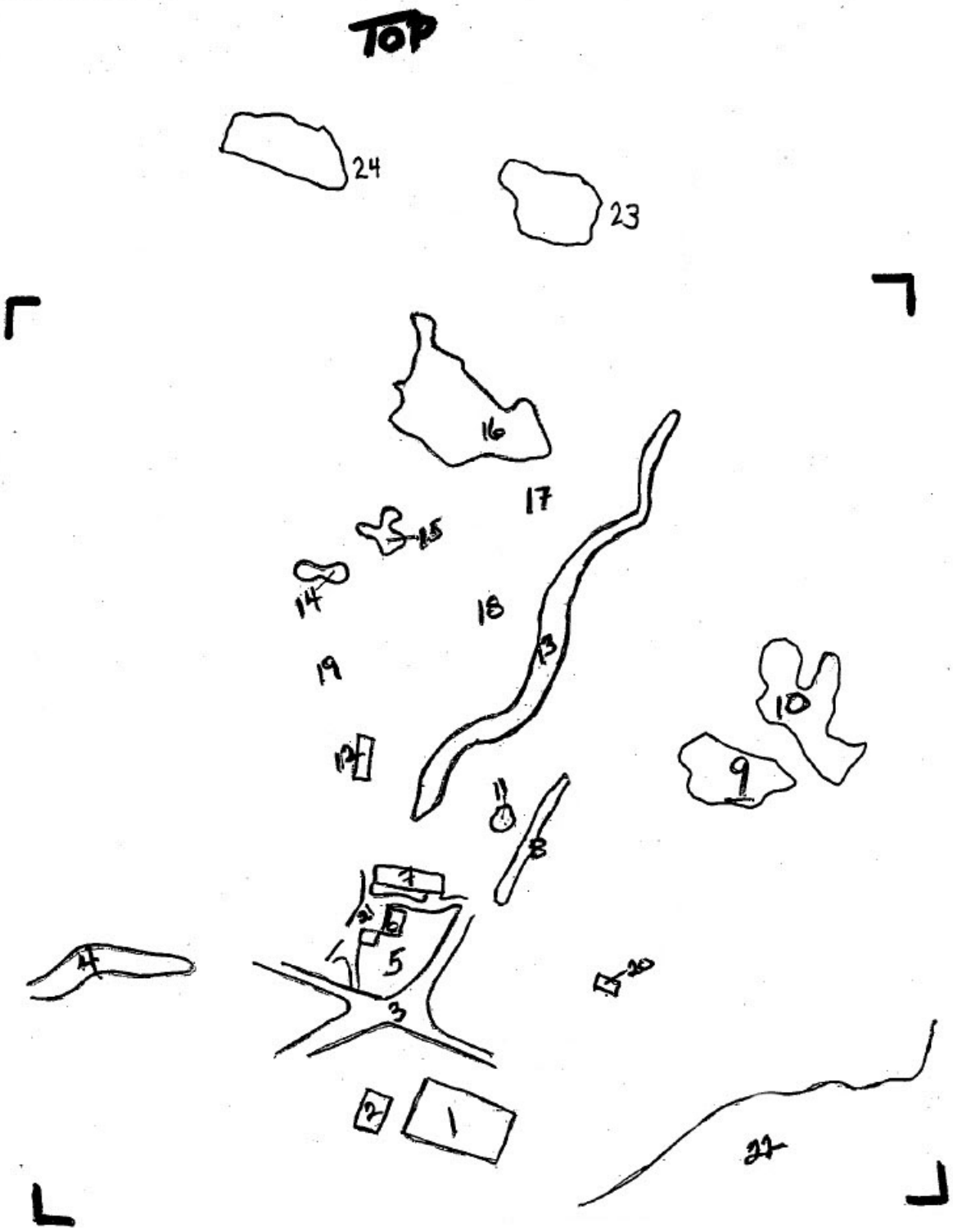
User defined

LEVEL I	LEVEL II	LEVEL III
		EXAMPLES…
1 Urban and Built-up Land	11 Residential	*e.g. 111 Single family*
	12 Commercial and Service	*e.g. 121 Retail store*
	13 Industrial	
	14 Transportation, Communication, Utilities	*e.g. 141 Road, 142 driveway*
	15 Industrial and Commercial Complexes	*e.g. 151 Shopping mall*
	16 Mixed Urban or Built-up Land	e*.g. 161Church*
	17 Other Urban or Built-up Land	*e.g. 171 Lawn*
2 Agriculture	21 Cropland and pasture	*e.g. 211 Corn or 212 Bare field*
	22 Orchards, vineyards, nurseries	*e.g. 221 Apple*
	23 Confined feeding operations	*e.g. 231 Dairy farm*
	24 Other agricultural land	*e.g. 241 Bare fields*
3 Rangeland	31 Herbaceous rangeland	*e.g. 311 Grassland*
	32 Shrub brush rangeland	
	33 Mixed rangeland	
4 Forest Land	41 Deciduous forest	*e.g. 411 Maple dominant*
	42 Evergreen/conifer forest	*e.g. 421 Spruce dominant*
	43 Mixed forest	*e.g. 431 Birch dominant*
5 Water	51 Streams	
	52 Lakes	
	53 Reservoirs	
	54 Bays and estuaries	
6 Wetland	61 Forested wetland	
	62 nonforested wetland	
7 Barren Land	71 Dry salt flats	
	72 Beaches	
	73 Sandy areas other than beaches	
	74 Bare exposed rock	
	75 Strip mines, quarries, gravel pits	
	76 Transitional areas	
	77 Mixed barren land	
8 Tundra	*81 Shrub and brush tundra*	
	82 Herbaceous tundra	
	83 Bare ground	
	84 Mixed tundra	
9 Perennial Snow and Ice	*91 Perennial snowfields*	
	92 Glaciers	

These categories are probably not applicable for today's activity…

CIR air photo from the 1980's (source unknown)

Natural color imagery acquired in April 2004 CCMPO DOQ


TOP
24
23
16
17
15
14
18
19
13
10
9
12
11
8
7
6
5
4
3
20
2
1
22