ILLINOIS NATURAL AREAS INVENTORY UPDATE

SURVEY MANUAL

ILLINOIS NATURAL AREAS INVENTORY UPDATE SURVEY MANUAL

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I conceived of the *Survey Manual* and wrote the first four editions. I should not be cited as author of subsequent revisions or editions.

— John White
June 29, 2009

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CHAPTER 1

BASIC PRINCIPLES, CONCEPTS, AND TERMS

1.1. Basic Principles

The Illinois Natural Areas Inventory Update is a thorough, systematic survey of the state to find, describe, evaluate, classify, and map significant natural areas. The following aspects of the inventory are emphasized:

Clear selection standards, consistently applied

A systematic and thorough inventory process

Careful and permanent documentation

Clear selection standards, consistently applied

Nature is complex and variable, and it is often difficult to determine the significance of a potential natural area. The Natural Areas Inventory Update strives to ensure that (a) every site that meets the project's selection standards is identified, and (b) a marginally significant site is not nominated as a natural area unless it actually meets the qualifications. These goals call for the uniform application of clear selection standards.

A systematic and thorough inventory process

The Natural Areas Inventory Update draws from a broad base of information sources to identify and characterize candidate natural areas, including historical records, local inventory projects, current scientific literature, and knowledgeable individuals. Maps

and aerial photographs are systematically examined to ensure that the entire state is uniformly scrutinized. Aerial reconnaissance and on-site surveys provide detailed, current information about areas of interest.

Careful and permanent documentation

The Illinois Natural Areas Inventory Update emphasizes thorough documentation and permanent records of its methods and results. These records will let people know how the inventory was conducted, which areas were evaluated, and what decisions were made about them. Natural resource inventories commonly produce records that are incomplete, illegible, intelligible only to the recorder, and eventually lost. The INAI Update was conceived with the intent that such problems with documentation would not occur.

1.2. Definition of a Natural Area

The Natural Areas Evaluation Committee of the Illinois Department of Natural Resources determines which areas qualify for listing in the Illinois Natural Areas Inventory. A Natural Area is a site that contains one or more Significant Features and meets the qualification standards that are set by the committee. The boundaries of a Natural Area are delineated to encompass enough land to allow the Significant Features to be protected and managed, and to encompass the diversity of Natural Communities that are directly associated with the Significant Features.

1.3. Natural Area Categories and Significant Features

The Illinois Natural Areas Inventory is based on *Natural Area Categories* and *Significant Features*. The Department of Natural Resources recognizes five Natural Area Categories, each of which is defined by a distinct set of Significant Features. The presence of a Significant Feature is the *reason why* a site is recognized as a Natural Area. Every Natural Area must have at least one Significant Feature (*e.g.* a high quality forest). Natural Area Categories and Significant Features are further addressed in Chapter 2.

1.4. Survey Features and Survey Sites

In addition to Natural Area Categories and Significant Features, the Inventory is based on *Survey Features* and *Survey Sites*. A Survey Feature is any ecological feature or other aspect of the landscape that needs to be examined during the process of screening potential natural areas. A Survey Site is a place where a Survey Feature occurs. In other words, the presence of a Survey Feature is the *reason why* the Natural Areas Inventory investigates a site. Survey Features and Survey Sites are further discussed in Chapter 2.

1.5. Survey Stages

The survey to identify Natural Areas is a step-by-step process: a Survey Site is selected and then examined closer and closer to determine whether it qualifies for nomination as a Natural Area. At each stage of this procedure, the standards for selecting and evaluating a candidate area are kept liberal enough to help ensure that a significant area is not rejected before it is passed on to the next step in the screening process. Survey Stages are discussed in Chapter 3.

1.6. Survey Regions

A *Survey Region* is a formally defined, specific geographic area that is systematically surveyed for Potential Natural Areas. The most common Survey Region is a county or a group of counties. A Survey Region may also be recognized on an ad hoc basis; for instance, a narrow corridor along a river that extends across several counties may be defined as a Survey Region in order to conduct an aerial survey for seeps or hill prairies that extend along the river valley.

CHAPTER 2

INVENTORY FEATURES AND TYPES OF SITES

2.1. Natural Area Categories and Significant Features

The Illinois Natural Areas Inventory is based on *Natural Area Categories* and *Significant Features*. The Department of Natural Resources recognizes five Natural Area Categories, each of which is defined by a set of Significant Features (see Table 1 on page 8). The Natural Areas Evaluation Committee of the Illinois Department of Natural Resources maintains a set of Standards and Guidelines with criteria for recognizing Significant Features in each of the Natural Area Categories. The presence of a Significant Feature is the reason for recognizing a site as a Natural Area. Every Natural Area must have at least one Significant Feature.

The seven Natural Area Categories that were originally recognized by the Illinois Natural Areas Inventory have been redefined by the Illinois Department of Natural resources, and they have been reduced to five categories, so there currently is no Category V or Category VII.

Table 1. Natural Area Categories and Significant Features.

Cat.	Significant Feature
I	High quality Natural Community
II	Specific suitable habitat occupied by Endangered or Threatened species
III	State-dedicated nature preserve
IV	Outstanding geological feature
VI	Significant concentration of flora or fauna

2.2. Survey Features and Survey Sites

During the early stages of the Inventory Process, * it is often not possible to state exactly what Significant Feature may occur in a Potential Natural Area. Consequently a flexible, ad hoc classification of Survey Features and Survey Sites is employed. A *Survey Feature* is any biological element, ecological phenomenon, or landscape feature that needs to be examined during the process of selecting, evaluating, and classifying Survey Sites. A place where a Survey Feature is documented as occurring is a *Survey Site*.

A *Survey Feature* must be one of three kinds:

(1) something being sought by the Illinois Natural Areas Inventory Update (*e.g.* a high quality, relatively undisturbed Natural Community), or

(2) something that needs to be examined in order to evaluate the natural significance of an area, or

(3) something else that needs to be examined or documented in order to carry out the search for natural areas.

* The *Inventory Process* is the entire set of activities that are undertaken to identify a Potential Natural Area and determine whether it qualifies as a Natural Area (see page 17).

A *Survey Site* is an area that has two characteristics:

(1) A Survey Site includes, or is thought to include, an example of one or more Survey Features.

(2) A Survey Site is an area that has been documented with a Survey Site Record.

In other words, a Survey Site is:

(a) a known natural area or a potentially significant area, or

(b) some other kind of area that needs to be examined during the course of the inventory; and

(c) it is documented by the Natural Areas Inventory Update.

Following are examples of three Survey Sites. Each example represents a different one of the three kinds of Survey Features that are numbered and defined on page 8. The Survey Features or their characteristics are italicized in the following three examples:

(1) A part of a pasture that has relatively high potential for a *prairie* remnant because it is a *grassland* on a *steep*, *exposed*, *gravelly slope* in an *isolated*, relatively *inaccessible* corner of a tract — which is a combination of topo-edaphic, land use, and ecological features that has relatively high potential for supporting prairie vegetation. This example is a Potential Natural Area.

(2) An area that exhibits evidence of *draining* and *logging*. These are Land Use and Disturbance Features.

(3) An *average forest stand*, one of a series of such stands that are selected for description and documentation in order to provide ground-truth for photo interpretation and aerial surveillance. This example is a Ground-truthing Site.

Not every example of a Survey Feature is a Survey Site. An example of a Survey Feature must be recorded on a Survey Site Record before it becomes a Survey Site. Most occurrences of Survey Features do not merit treating as Survey Sites because they are of no particular interest to the Natural Areas Inventory.

Not every Survey Site is a Potential Natural Area. Sometimes a Survey Site is identified and documented to provide information that is useful for conducting the inventory of a Survey Region — even though this site has no significant potential for qualifying as a Natural Area. Such an area is a Ground-truthing Site, as discussed on page 12.

Relationship between Survey Features and Survey Sites

Most Survey Sites consist of a single Survey Feature. In such cases, the boundaries of the Survey Site usually correspond with the boundaries of the Survey Feature, and the Survey Site does not encompass any additional land beyond the Survey Feature.

A Survey Site may have more than one Survey Feature. Survey Features can overlap, occupying all or part of the same geographic area. Likewise Survey Sites can overlap. Consider, for instance, a woodlot that is both a high quality forest and the habitat for an endangered plant. In this instance, the woods could be delineated as a single Survey Site with two overlapping Survey Features. However, if the exact location of the rare plant is known, it might be preferable (perhaps more expedient) to delineate two Survey Sites: one for the forest, and one for the plant. In this case, the areas of the two Survey Sites would overlap. [*]

2.3. Types of Sites

In the context of the Illinois Natural Areas Inventory Update, a *site* is a specific, limited geographic area that (a) is identified, analyzed, and documented by the Illinois Natural Areas Inventory Update or (b) is listed by the Illinois Natural Areas Inventory. [†] There are two general types of sites: *Survey Sites* and *Natural Areas*.

Survey Sites are of eight specific types. Here they are grouped and listed in the approximate order in which they have a role in the Inventory Process:

Potential Natural Area
Lead
Ground-truthing Site

Nonqualifying Site
Final Candidate Site

Best-of-Kind Site
Nominated Illinois Natural Area
Nominated Local Natural Area

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[*] The Illinois Natural Areas Inventory Update is currently focusing its search efforts on Category I Significant Features (high quality communities). However, Category II Significant Features (Endangered and Threatened species) will be identified during the course of inventorying for Category I Significant Features. In addition, the presence of a rare species is often an indicator of a high quality, rare, or unusual Natural Community.

[†] As a rule, terms that are specially defined for the Illinois Natural Areas Inventory Update are capitalized in the *Survey Manual* and other documentation for the project. However, the term *site* is not capitalized because it is such a broadly defined, generic term.

The eight types of sites are arranged into three groups. Sites within a group are at the same position in the work flow of the Inventory Process, and no type of site takes priority over any other type of site in its group. For instance, a Potential Natural Area, a Lead, and a Ground-truthing Site can be identified at the same time during the Screening Phase.

In addition to Survey Sites, the project deals with two other kinds of sites, termed *Natural Areas*:

Illinois Natural Area
Local Natural Area

On the following pages, each of the Survey Site types is defined and discussed in the above-listed order.

Survey Site

A *Survey Site* is an area where one or more Survey Features are documented either as occurring or probably occurring. For a more detailed definition and further discussion of the term *Survey Site*, please refer back to page 9.

Potential Natural Area

SHORT DEFINITION: A *Potential Natural Area* is a site that is being surveyed to determine whether it qualifies as an Illinois Natural Area.

LONG DEFINITION: A *Potential Natural Area* (PNA) is a site that is being surveyed to determine its potential for qualifying as an Illinois Natural Area. When the Survey Process is completed, * a Potential Natural Area is designated as either a Final Candidate Site or a Nonqualifying Site.

Lead

A *Lead* is a potential natural area for which the exact location is unknown.

From time to time, a site will be reported to the INAI Update that appears to be a significant natural area, but the exact location of the site is not known. This is most likely to happen when a site is identified during the Existing Information Stage — that is, while reviewing literature or talking with someone. Often it requires only a little more investigation to find out exactly where the site is located. In the meantime, the

* The *Survey Process* consists of the entire series of actions that are carried out to (a) search for, describe, evaluate, classify, and map Survey Sites, and (b) select sites that qualify for nomination as Natural Areas.

Survey Process is set in action by designating the site as a Lead and recording information about it on a Survey Site Record.

Ground-truthing Site

SHORT DEFINITION: A *Ground-truthing Site* is an area that is examined to help carry out the Survey Process but that is not considered to be a Potential Natural Area.

LONG DEFINITION: A *Ground-truthing Site* (GTS) is an area that is selected and documented to help carry out the Survey Process, but that is not known to have any significant potential for qualifying as an Illinois Natural Area. An area is designated as a Ground-truthing Site if:

(a) it is selected and documented with a Survey Site Record in order to provide information that is useful to the Survey Process, but

(b) it is not considered to be a Potential Natural Area.

A Ground-truthing Site may be designated to provide descriptive information that aids photo interpretation. For instance a grass waterway dominated by weedy reed canary grass may be treated as a Ground-truthing Site to document how reed canary grass can be distinguished from prairie vegetation. Another example: if a Surveyor views several representative woodlots from the road to become familiar with the woods in a Survey Region, then each of these woodlots is designated as a Ground-truthing Site so that it can be briefly described on a Survey Site Record.

Nonqualifying Site

SHORT DEFINITION: A *Nonqualifying Site* is an area that has been evaluated and determined not to qualify for nomination as a Natural Area according to the criteria that were applied to it during the Survey Process.

LONG DEFINITION: A *Nonqualifying Site* (NQS) is a former Potential Natural Area that does not qualify as a Final Candidate Site according to the evaluation criteria that were applied to it during the Survey Process. "Nonqualifying" is a neutral term in the sense that a Nonqualifying Site is not necessarily permanently "rejected" or "eliminated" from all further consideration. In some instances, a Potential Natural Area may be determined to be a Nonqualifying Site according to a certain set of criteria — yet the same place may later be reexamined and found to be a Final Candidate Site for some other reason (*i.e.* a different Survey Feature). A Surveyor must not be too quick to exclude a site from all future investigation. In many instances, the Surveyor can conclude only that a site does not meet the evaluation standards that are currently being applied to it.

Final Candidate Site

SHORT DEFINITION: A *Final Candidate Site* is an area that, at the end of the Survey Process, appears to qualify for nomination as a Natural Area.

LONG DEFINITION: A *Final Candidate Site* (FCS) is a Survey Site that appears to meet the criteria for designation as either an Illinois Natural Area or a Local Natural Area. A Final Candidate Site is subject to one or more of three analysis and nomination processes during the Nomination Phase:

(1) If a Final Candidate Site appears to meet the standard criteria for designation as an Illinois Natural Area, then it becomes a *Nominated Illinois Natural Area* and it is brought to the Natural Areas Evaluation Committee for its review and acceptance, modification, or rejection.

(2) If a Final Candidate Site does not appear to meet the standard criteria for designation as an Illinois Natural Area but it appears to qualify as an Illinois Natural Area under the "Best-of-Kind" criteria, then it becomes a *Nominated Illinois Natural Area* and it is brought to the NAEC for its review and acceptance, modification, or rejection.

(3) If a Final Candidate Site does not appear to meet any of the criteria for designation as an Illinois Natural Area but it appears to qualify as a Local Natural Area, then it becomes a *Nominated Local Natural Area* and it is brought to the Natural Areas Evaluation Committee for its review and acceptance, modification, or rejection.

Best-of-Kind Site

A *Best-of-Kind Site* (BKS) qualifies as an Illinois Natural Area because it includes one of the best examples of a Community Type within a certain Natural Division and Section, even though this example of the community does not meet the standard criteria for qualifying as a Significant Feature on the basis of its Natural Quality and acreage.

Nominated Illinois Natural Area

A *Nominated Illinois Natural Area* (NINA) is a site that is brought to the Natural Areas Evaluation Committee for its review as potentially a Natural Area of statewide significance (*i.e.* an Illinois Natural Area).

Nominated Local Natural Area

A *Nominated Local Natural Area* (NLNA) is a site that is brought to the Natural Areas Evaluation Committee for its review as potentially a Natural Area of local significance (*i.e.* a Local Natural Area).

Natural Area

Natural Area is a general term that can be applied to an Illinois Natural Area, or to a Local Natural Area, or to both kinds of areas at once.

Illinois Natural Area

An *Illinois Natural Area* (INA) is a site that has been reviewed by the Natural Areas Evaluation Committee and determined to be a Natural Area of statewide significance.

Local Natural Area

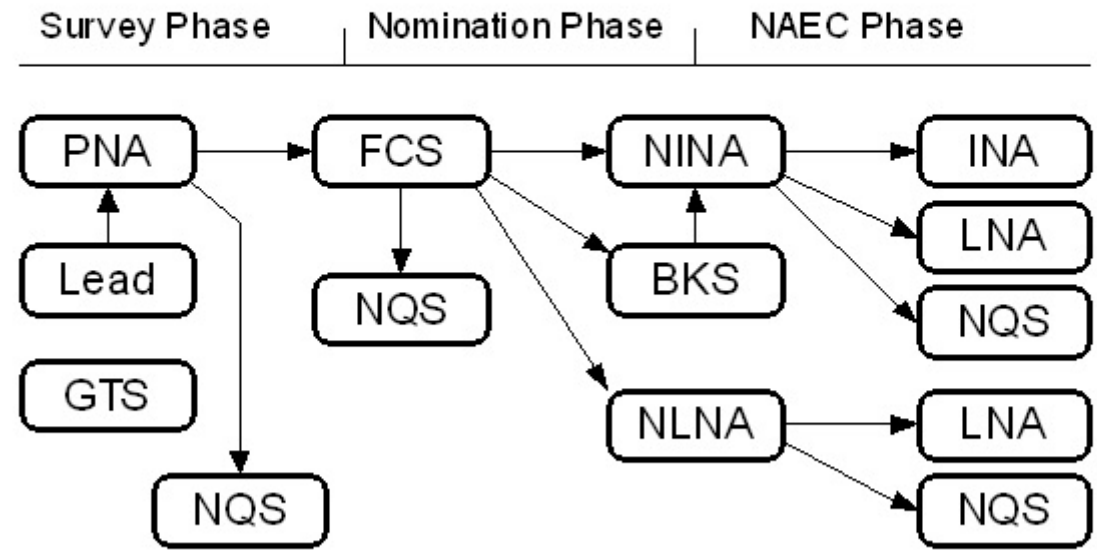
A *Local Natural Area* (LNA) is a site that has been reviewed by the Natural Areas Evaluation Committee and determined to be a Natural Area of local significance.

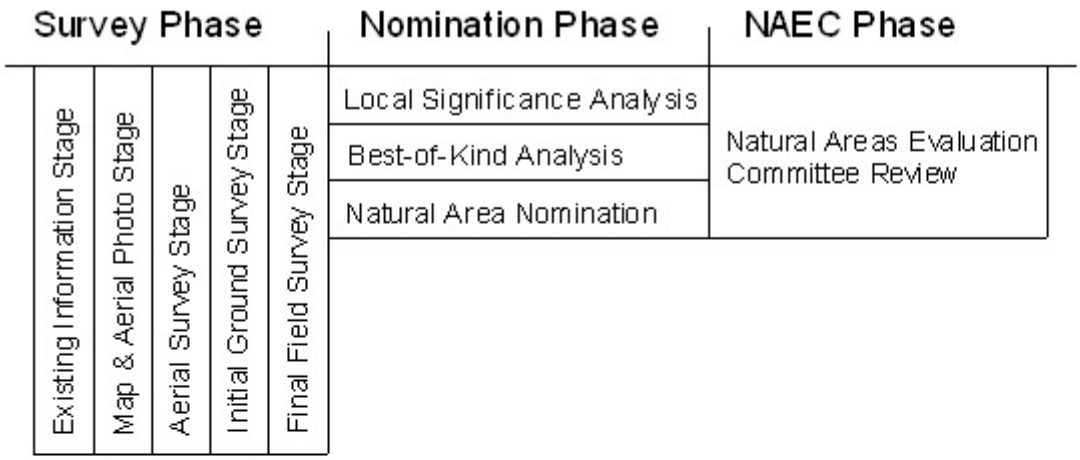
2.4. Relationships among Inventory Phases and Types of Sites

Figure 1 on page 15 shows the various types of sites in relation to each other and in relation to the three phases of the Natural Areas Inventory. The text that follows this flowchart examines those relationships. The three phases of the Inventory Process (that is, the Survey Phase, the Nomination Phase, and the NAEC Phase) are defined and discussed in the next chapter.

Figure 1.

ILLINOIS NATURAL AREAS INVENTORY UPDATE
INVENTORY PHASES and TYPES OF SITES



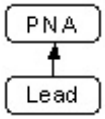


KEY TO ABBREVIATIONS

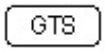
BKS	Best-of-Kind Site	NINA	Nominated Illinois Natural Area
FCS	Final Candidate Site	NLNA	Nominated Local Natural Area
GTS	Ground-truthing Site	NQS	Nonqualifying Site
INA	Illinois Natural Area	PNA	Potential Natural Area
Lead	Lead		
LNA	Local Natural Area		

NAEC Natural Areas Evaluation Committee

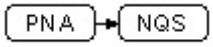
Interpretation of Figure 1, "Inventory Phases and Types of Sites" (page 15):



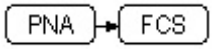
Most of the Survey Sites identified during the Survey Phase are Potential Natural Areas. A few of these sites start out as Leads.



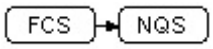
Some sites identified during the Survey Phase are Ground-truthing Sites and are never considered to be Potential Natural Areas.



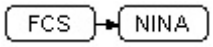
Most Potential Natural Areas are determined to be Nonqualifying Sites during the Survey Phase.



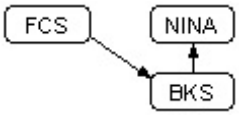
A Potential Natural Area that makes it through the Survey Phase to the Nomination Phase is a Final Candidate Site.



On rare occasions, a Final Candidate Site may be determined to be a Nonqualifying Site during the Nomination Phase.

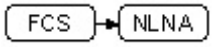


Most Final Candidate Sites will be designated as Nominated Illinois Natural Areas.



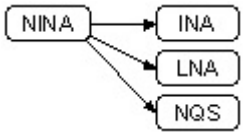
Some Final Candidate Sites will be identified as Best-of-Kind Sites and then will be designated as Nominated Illinois Natural Areas.

In the Inventory Process, there ultimately is no real distinction between a Best-of-Kind Site and any other Nominated Illinois Natural Area. That is, there is no "Nominated Best-of-Kind Illinois Natural Area": they all are treated simply as Nominated Illinois Natural Areas.

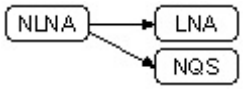


Some Final Candidate Sites will be designated as Nominated Local Natural Areas instead of Nominated Illinois Natural Areas.

Nominated Illinois Natural Areas and Nominated Local Natural Areas go to the Natural Areas Evaluation Committee in the NAEC Phase.



Most Nominated Illinois Natural Areas will be accepted as Illinois Natural Areas. But the NAEC may decide that some of these nominated sites will be designated as Local Natural Areas or even Nonqualifying Sites.



Most Nominated Local Natural Areas will be accepted as Local Natural Areas. But the NAEC may decide that some of these nominated sites will be designated as Nonqualifying Sites.

Some Nominated Local Natural Areas might even be designated as Illinois Natural Areas, but this outcome is not shown on the flowchart because it is a remote possibility. If the NAEC determines that an NLNA should be an INA instead of an LNA, the site probably should go back to the Nomination Phase to be reevaluated and re-nominated.

CHAPTER 3

INVENTORY PROCESS AND INVENTORY PHASES

3.1. Inventory Process and Inventory Phases

The *Inventory Process* is the entire set of activities that are undertaken to identify a Potential Natural Area and determine whether it qualifies as a Natural Area. This work is carried out in a series of major steps, or *phases*. The activities that are completed during these phases are termed *processes*. That is, *phases* define *when* various tasks are done, and *processes* specify *what* tasks are done.

The five *Inventory Phases* are:

Survey Phase
    Screening Phase
    Final Field Survey Phase
Nomination Phase
Natural Areas Evaluation Committee Phase

3.2. Survey Phase

The *Survey Phase* consists of the Natural Areas Inventory's five Survey Stages:

(1) Existing Information Stage
(2) Map & Aerial Photo Stage
(3) Aerial Survey Stage
(4) Initial Ground Survey Stage
(5) Final Field Survey Stage

These five stages are described beginning on page 20.

The *Survey Process* consists of the entire series of actions that are carried out to (a) search for, describe, evaluate, classify, and map Survey Sites, and to (b) select sites that qualify for nomination as Natural Areas.

The Survey Phase is subdivided into two smaller phases: *

The *Screening Phase* embraces the first four Survey Stages (enumerated above).

The *Final Field Survey Phase* consists of the fifth and last Survey Stage.

Screening Phase

In the *Screening Phase*, Regional Ecologists systematically examine the state to select and investigate Potential Natural Areas. The four-stage Screening Phase begins at a coarse or remote level with the Existing Information Stage and the Map & Aerial Photo Stage. These first two stages usually do not provide detailed and up-to-date information about a site. During the last two stages (Aerial Survey and Initial Ground Survey), the Screening Phase affords a closer, current look at a site.

The *Screening Process* consists of selecting a Potential Natural Area and then examining it closer and closer to learn more and more about it until the Surveyor reaches one of two conclusions: (1) the area is a Nonqualifying Site and it should not be investigated any further, or (2) the area is a Final Candidate Site and it should not be investigated further during the Screening Phase unless more fieldwork is needed to prepare for the Final Field Survey.

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* The Screening Phase and the Final Field Survey Phase are both part of the Survey Phase, but they are distinguished from each other because they each employ distinctly different procedures and record formats. The Screening Phase treats *Survey Features*, and the Final Field Survey Phase treats *Significant Features*. Even though the Screening Phase and the Final Field Survey Phase are distinct from each other, they are combined as the Survey Phase because it is often useful to refer to all of these activities as a single unit of work.

Final Field Survey Phase

The *Final Field Survey* is the link between the Screening Phase and the Nomination Phase. The Final Field Survey gathers information to (a) determine whether a site should be nominated as a Natural Area and to (b) prepare documentation for the nomination process.

3.3. Nomination Phase

The *Nomination Phase* follows the Final Field Survey. It includes three processes:

Best-of-Kind Analysis
Local Significance Analysis
Natural Area Nomination

Best-of-Kind Analysis

In the *Best-of-Kind Analysis*, members of the Survey Staff (primarily the Regional Ecologists and Field Survey Director) accomplish the following tasks:

(1) Review the Survey Sites that have been identified in a Natural Division and Section.

(2) Determine which Natural Communities in a Natural Division and Section are not adequately represented by Illinois Natural Areas and Nominated Illinois Natural Areas.

(3) Select Best-of-Kind Sites from the pool of Survey Sites to fill the gaps or deficiencies in representation that were identified in step 2.

Local Significance Analysis

In the *Local Significance Analysis*, the Survey Staff does the following:

(1) Apply the Inventory's "local significance" criteria to the Survey Sites that have been identified in a Natural Division and Section, county, or other selected Survey Region.

(2) Select Final Candidate Sites that meet the Inventory's criteria for local significance, and designate them as Nominated Local Natural Areas.

Natural Area Nomination

For the *Natural Area Nomination* process, the Inventory staff prepares site nomination packages for Nominated Illinois Natural Areas and for Nominated Local Natural Areas. Nominated Illinois Natural Areas include Best-of-Kind Sites as well as Final Candidate Sites that qualify for nomination without going through the Best-of-Kind Analysis.

3.4. Natural Areas Evaluation Committee Phase

The *NAEC Phase* is the last step in the Inventory Process, when the Natural Areas Evaluation Committee considers the Natural Area nominations and accepts, modifies, or rejects them.

3.5. Survey Stages

A *Survey Stage* is one of the five investigative steps that a Survey Site may undergo during the Survey Phase:

(1) Existing Information Stage
(2) Map & Aerial Photo Stage
(3) Aerial Survey Stage
(4) Initial Ground Survey Stage
(5) Final Field Survey Stage

During each successive stage of the survey, a site is examined more and more closely. When a Potential Natural Area is determined to be a Nonqualifying Site according to the criteria that are being applied, it is removed from further consideration.

A new Survey Site may be discovered at any stage (— possibly even while conducting the Final Field Survey of another site). But most of the Potential Natural Areas are identified during the first two stages, and most of the Nonqualifying Sites are determined during the third and fourth stages (see Figure 2).

Existing Information Stage

The *Existing Information Stage* includes activities that are carried out to identify Survey Sites and to gather information about them without conducting any new, original investigations. The Existing Information Stage consists primarily of reading or talking with knowledgeable individuals.

Compiling and reviewing sources of existing information is the subject of Chapter 4.

Figure 2. Survey Sites in relation to Survey Stages.

	Most examples are identified during this stage.
	Fewer examples are identified during this stage.
	Fewest examples are identified during this stage.
—	No example (or almost none) is identified during this stage.

Survey Stage ▸ / Survey Site ▾	Existing Information	Map & Aerial Photo	Aerial Survey	Initial Ground Survey	Final Field Survey
Potential Natural Area				—	—
Lead		—	—	—	—
Ground-truthing Site					—
Nonqualifying Site					
Final Candidate Site					

Map & Aerial Photo Stage

In the *Map & Aerial Photo Stage*, the Surveyor scrutinizes topographic maps, soil maps, aerial photography, and other geographic information resources to accomplish the following: (a) systematically screen a Survey Region, (b) identify Survey Sites, (c) learn more about these sites, and (d) determine that the remainder of the landscape probably has no significant potential for natural areas (based on the criteria that are being applied). Careful and systematic study of maps and aerial photos helps ensure that a Survey Region is thoroughly screened. Most Potential Natural Areas are identified during this stage of the inventory.

Procedures for map and aerial photo examination are further discussed in Chapter 5.

Aerial Survey Stage

Low-level aerial reconnaissance is a quick and efficient way to have a closer and more recent look at a Potential Natural Area than is possible by examining aerial photographs. During the *Aerial Survey Stage*, many of the previously identified Potential Natural Areas are determined to be Nonqualifying Sites. The Aerial Survey also makes it possible to find some kinds of Potential Natural Areas that cannot be detected well (if at all) by examining maps and aerial photos.

Aerial survey techniques are detailed in Chapter 6.

Initial Ground Survey Stage

The *Initial Ground Survey* (IGS) is a quick visit to a Ground-truthing Site or to a Potential Natural Area to learn more about it. If the site is a Potential Natural Area, the main purpose of the IGS is to decide whether the site should receive a Final Field Survey (FFS). Normally the IGS is brief; at a minimum, enough observations are made in order to decide whether the area is a Final Candidate Site and therefore needs an FFS. If the site does qualify for an FFS, then more information may be gathered during the IGS: *i.e.* to start compiling species lists, to partially map the boundaries of communities, and to estimate the amount of work needed to complete the FFS.

The Initial Ground Survey is further discussed in Chapter 7.

Final Field Survey Stage

The *Final Field Survey* involves detailed, on-site description, evaluation, classification, and mapping of a Survey Site that appears to qualify for nomination as a Natural Area. During the Final Field Survey, information is gathered to (a) document a site as a significant natural area and (b) begin to lay the foundation for protecting and managing the site. A Final Candidate Site is sometimes determined to be a Nonqualifying Site on the basis of information that is gathered about it during the Final Field Survey.

See Chapter 7 for more about the Final Field Survey Stage.

3.6. Sequence and Timing of Survey Stages

The five Survey Stages are usually completed in a certain sequence, but the inventory is not a strict 1–2–3–4–5 process. At the outset of the project, readily available information is gathered and reviewed (stage 1). Then aerial photo interpretation is carried out (stage 2) before conducting aerial surveys (stage 3). However, Initial Ground Surveys (stage 4) must be done from the very beginning of the project in order to provide the on-the-ground knowledge (or ground-truth) that is necessary for effective photo interpretation and aerial reconnaissance.

Sometimes a Survey Stage is skipped, or repeated, or done out of the usual sequence in order to accommodate special situations. For example, in some circumstances, it may be more efficient to identify seepage areas in a stream valley by flying instead of trying to pick them out ahead of time on aerial photography. Or, if the available information shows that a site should definitely be considered a Final Candidate Site, then the Surveyor may skip from stage 1 directly to the Final Field Survey (stage 5).

Many procedures can be done only at a specific time of year. For instance, summer is the only time to establish sampling plots for herbaceous vegetation. Different kinds of aerial surveys are best carried out in the fall, or winter, or spring — depending on

the characteristics of the Survey Features and the purpose of the survey. See the discussion under the heading of *Seasonal considerations* for various Survey Features in the *Survey Standards and Guidelines* (White 2009).

CHAPTER 4

EXISTING INFORMATION STAGE

Existing information consists of facts about a Survey Region, its natural areas, and its other resources that can be gained by reading and by talking with people. This kind of information is available without doing any original research such as examining aerial photos.

4.1. Purposes of Compiling and Reviewing Existing Information

This stage of the Survey Process serves a number of purposes:

Enlist the interest and support of local experts.

Develop a general knowledge of the Survey Region.

Learn which Natural Communities occur in the region (some Natural Communities may be inadvertently overlooked unless they are specifically targeted).

Gather information about previously identified natural areas.

Identify new Survey Sites.

Acquire additional sources of information.

Many natural areas would be overlooked if the Natural Areas Inventory Update did not make good use of the wealth of information that is available from written sources and knowledgeable individuals. This is more true now during the Update because there is currently far more local knowledge about natural areas than was available during the original Inventory in the 1970s. Not all natural areas can be recognized solely by studying maps and aerial photos. Information gained during the Existing Information Stage can serve as ground-truth to support the Map & Aerial Photo Stage.

4.2. Sources of Existing Information

This information can be obtained through four major avenues:

Studying background materials

Contacting people and organizations

Assimilating electronic databases

Reviewing literature

Each of these sources is discussed under the next four headings.

Background Materials

Background materials comprise resources such as unpublished files, World Wide Web documents, technical publications, and "gray literature" such as government documents that were produced in-house and were not widely distributed. Important sets of background materials include the following:

Illinois Natural Areas Inventory files, including old Potential Natural Area Forms
Illinois Department of Natural Resources element occurrence records
Critical Trends Assessment Program (CTAP) reports
County soil survey reports
Local natural resource inventories by government agencies (*e.g.* geology, wildlife, fisheries, and forest preserves)
Web sites of conservation organizations, government agencies, and scholars
County plat books (ownership maps)

People and Organizations

Natural resource agencies, conservation organizations, their employees, and other people are helpful sources of information about the location and characteristics of natural areas. These individuals and groups can provide resource materials, referrals to other sources of information, and introductions to landowners and government workers. Following are examples of the kinds of people and organizations that need to be contacted.

Natural resource managers:

Illinois Department of Natural Resources district and regional personnel (*e.g.* District Heritage Biologists, foresters, wildlife biologists)
Illinois Nature Preserves Commission (Natural Areas Preservation Specialists)
Public land managers (*e.g.* park staff, Forest Preserve District staff)
Farm Service Agency (County Executive Directors)
Natural Resources Conservation Service (District Conservationists)

Educational and research institutions:

Illinois Natural History Survey staff
College and university faculty
High school science teachers
County Agricultural Extension Service agents

Other organizations and individuals:

Private conservation groups (*e.g.* Illinois Audubon Society chapters and affiliates)
Nature clubs (*e.g.* Chicago Herpetological Society, Illinois Native Plant Society)
Professional and avocational naturalists
Key landowners
Rural real estate agents, in some instances

Electronic Databases

In addition to the statewide Natural Areas Inventory and Natural Heritage Database that are maintained by the Illinois Department of Natural Resources, a few county-based agencies now have their own inventories of natural areas.

Scientific institutions have a number of electronic databases that can be of use to the Natural Areas Inventory. These include community-based information from the Critical Trends Assessment Program, plant and animal collection data from the Illinois

Natural History Survey, and information about plant specimens that has been computerized at various herbaria.

Literature

This category of information includes scientific publications as well as periodicals produced by natural history organizations. Reviewing this literature will reveal information such as vegetation studies, potentially significant sites, and methodological innovations.

Some publications have a broad scope. The following serials are among the most productive of these sources: *Transactions of the Illinois State Academy of Science*, *Illinois Natural History Survey Bulletin*, *American Midland Naturalist*, *Ecological Restoration*, *Natural Areas Journal*, and North American Prairie Conference proceedings.

There are also many local and special-interest publications — such as the *Bulletin of the Chicago Herpetological Society*, *Illinois Steward*, and *Erigenia* (published by the Illinois Native Plant Society).

Information about past ecological conditions can be gleaned from thousands of sources, including *Collections of the Illinois State Historical Library*, *Journal of the Illinois State Historical Society*, county and local history books, and early scientific periodicals. Historical accounts about the ecology of nine regions of the state have been published in a series of volumes for the Critical Trends Assessment Program.

4.3. Procedures for Compiling and Reviewing Existing Information

Studying background materials

The Field Survey Director will provide you with some background material and will help set you on the course of compiling further information. You will need to set up a filing system, organized by county and topic, to store these materials.

Much of the background information should be read at the outset of the project. This material will help make you conversant in the Survey Region's natural features and previous studies. Local naturalists and researchers are likely to be more cooperative in sharing information if you have done some homework and are already somewhat familiar with their work before you ask for help.

Contacting people and organizations

Contacts with people and organizations need to begin early in the Inventory Process. To benefit the most from local experts, you need their information when you start working in a particular county. Most people will appreciate knowing what the INAI is doing in their local area, and contacting them early will help ensure good working relationships.

Follow these steps before meeting with knowledgeable people and groups:

(1) Gather or prepare information about the Illinois Natural Areas Inventory, which will help introduce the project. (Much of this material is already prepared.)

(2) Develop a working list of individuals and organizations to contact in your region.

(3) Make appointments with these people and groups to introduce yourself, explain the project, and ask for their help.

At the outset of your meeting, be sure to explain the Natural Areas Inventory's purpose and criteria. This will help focus the discussion on what you want to learn.

Farm Service Agency.—The FSA (formerly called the Agricultural Stabilization and Conservation Service) is part of the U.S. Department of Agriculture. It has offices in almost every county, usually in the county seat. The FSA's aerial photography is one of the principal resources for identifying Potential Natural Areas. The FSA staff may also be able to provide information about landowners and farm operators, so it is critical to establish good relationships at each FSA office.

Natural Resources Conservation Service.—The local office of the Natural Resources Conservation Service (or NRCS, formerly called the Soil Conservation Service) is usually housed in the same building as the Farm Service Agency. The District Conservationist and other NRCS staffers can be very helpful. They know the rural landscape and farmers well, they are well respected, and they are strong advocates for conservation.

Landowners and tenants.—The first contact with a landowner or tenant usually is to ask permission to visit a property — but it may be the beginning of a series of steps that lead to the protection of a natural area. Owners and tenants often have a keen interest in their natural areas, and they can provide information about the site's natural features and history of land use that nobody else knows.

Assimilating electronic databases

Procedures for assimilating information from electronic databases need to be developed when access to the databases is obtained.

Reviewing literature

To avoid duplication of effort, the relevant scientific and historical literature should be systematically reviewed at a central location (each Regional Ecologist should not have to independently page through the same journals to identify Survey Sites). The results of the systematic review of literature will be distributed to the Regional Ecologists.

4.4. Publicity Efforts

In addition to personal contacts with specific individuals and groups, the Natural Areas Inventory will carry out more general publicity efforts. These activities may take the form of news releases, interviews with journalists, articles in newsletters, and presentations at meetings.

General publicity efforts can be time-consuming, and they often produce false leads to Potential Natural Areas, but they occasionally pay off significantly in terms of identifying sites. Publicity has further benefits by increasing public awareness and support for protecting natural areas.

CHAPTER 5

MAP & AERIAL PHOTO STAGE

In the Map & Aerial Photo Stage, the Surveyor studies topographic maps, soil maps, aerial photography, and other geographic information resources. Most of the Potential Natural Areas are identified during this stage of the inventory.

5.1. Purposes of Examining Maps and Aerial Photography

The map and aerial photo examination stage has a twofold purpose:

Systematically screen a Survey Region to identify Survey Sites.

Describe, evaluate, classify, and map Survey Sites.

The following tasks are accomplished in this stage:

Eliminate obviously disturbed land from further consideration as a potential Category I natural area.

Detect disturbances in wildlands, and select areas that show no evidence of significant disturbance.

Identify topo-edaphic extremes and other situations that are likely to have significant natural features.

Map-and-photo interpretation is a key step in the Illinois Natural Areas Inventory Update's procedures. If a potential Category I natural area is overlooked during this stage, it is not likely to be identified later. Specific techniques for interpreting maps and aerial photos to identify Survey Features and Survey Sites are detailed in the *Survey Standards and Guidelines*.

5.2. Sources of Maps and Aerial Photos

The primary maps used by the Natural Areas Inventory are 1:24,000-scale, 7.5-minute topographic quadrangles, which are made by the U.S. Geological Survey. Soil maps that accompany county soil survey reports are also standard tools for the INAI. Other maps are useful in certain situations — for instance, geologic maps, U.S. Public Land Survey plats, and wetland maps.

Soil surveys are available in digital format for several counties. ArcView software makes it possible to quickly find and display individual soil mapping units or selected groups of soils in these counties. For instance all of the organic soils can be identified in an effort to find seepage areas.

Aerial photography is available from many sources. The U.S. Geological Survey, the U.S. Department of Agriculture's Farm Service Agency, [ENDNOTE 1] and other Federal agencies have traditionally produced photos in the form of paper prints. Now these agencies are producing and distributing more and more aerial imagery in digital form. The Illinois Department of Transportation and Illinois Department of Natural Resources also acquire aerial photography, often in conjunction with federal programs. County governments and other local agencies produce a wide variety of large and medium-scale maps and aerial photos of their areas.

Selected sets of maps and aerial photographs will be supplied to you in digital format. You will need to find out what other useful maps and aerial imagery are available for each county in your Survey Region. In addition to local USDA offices, the following agencies may have maps and photos of interest: county zoning departments, tax assessors, historical societies, and forest preserve or conservation districts. [NDNOTE 2E]

The principal sets of maps and aerial photos used by the Natural Areas Inventory are described on the following pages.

5.3. Topographic Maps

The U.S. Geological Survey (USGS) has produced several series of topographic maps of the state. The most detailed and popular maps are the 7.5-minute series. Each of

these maps spans 7.5 minutes of latitude and longitude (an area about 9 miles from south to north and 7 miles from east to west). The scale of 7.5-minute maps is 1:24,000 (or 1 inch equals 2,000 feet).

A series of 15-minute topographic maps has been published by the USGS at a smaller scale (1:62,500, or 1 inch equals nearly 1 mile). A 15-minute map sheet is smaller than a 7.5-minute map, but it covers four times as much land area. The 15-minute map series is not as detailed and accurate as the 7.5-minute series, and they have not been published for decades.

There is a 1:100,000-scale topographic map series. Each of these maps covers 30 minutes of latitude and 60 minutes of longitude, which covers an area about as big as two or three average-sized counties. The USGS also produces a 1:250,000-scale map of the entire state.

USGS topographic maps are commonly called quadrangles. Many of the recently published quadrangles are *provisional* editions, which have not been as thoroughly field checked and do not look as polished as the standard maps.

Each of these map series serves a purpose for the Inventory. The 7.5-minute maps are used to find and map natural areas. The 15-minute maps are useful for their historical information (for example, a 15-minute map may show the former extent of a marsh that has been artificially impounded and expanded). The 30-by-60-minute maps are useful for navigation and planning purposes. The 1:250-000 scale statewide map has been used by various agencies as a base for publishing several "wall maps" that depict land cover and other resources for the entire state.

5.4. Soil Survey Reports and Maps

Soil survey reports are available for most counties in Illinois. For some counties, no report is currently in print, but unbound maps or other unpublished materials may be available. The reports provide descriptions and maps of the county's soils, along with information about the use and management of each soil series. Modern reports are available for some counties; these use the present-day soil classification system, and the soils are mapped on aerial photos. Older reports are less sophisticated and their maps are simpler (not drawn on aerial photos) — yet even these reports are valuable storehouses of information.

The soil surveys have been prepared by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) in cooperation with the Illinois Agricultural Experiment Station. Reports may be available free of charge from the county NRCS office or the local office of the Cooperative Extension Service (which is usually housed with the NRCS). In counties for which there is no modern soil survey report, the NRCS may be able to provide a pre-publication draft or other maps and information

specific to the county. The District Conservationist or another staff member at the county NRCS office may be able to tell you about small patches of anomalous soils, such as peaty areas that do not appear on the county soil survey maps.

Soil reports can also be obtained from the University of Illinois: Agronomy Department, University of Illinois, 1102 South Goodwin Avenue, Urbana, Illinois 61801; 217/333-3650.

Natural features such as soils and vegetation do not lend themselves to easy classification because they tend to vary continuously across the landscape and they do not have distinct boundaries. As a result, any attempt to classify and map most natural features requires arbitrary decisions. The resultant map is a generalization and should be treated as such: tests of soil maps commonly reveal errors in the range of 10 to 40 percent when the maps are compared with actual conditions in the field.

5.5. Aerial Photographs

Aerial photography comes in many forms:

Paper prints, transparencies, or digital files
Contact prints * or enlargements
Color or black-and-white photographs
Infrared film or conventional panchromatic film
Growing-season ("leaf-on") or dormant-season ("leaf off") photography

Several different years and types of photography must be consulted in order to take full advantage of the available resources. Although almost any kind of aerial photography can prove worthwhile to examine, the following sets are the primary resources for identifying and mapping Survey Sites:

Digital orthophoto quarter-quads (DOQQs) from the Illinois Department of Natural Resources (IDNR)
Digital color infrared and natural color photography from the Farm Service Agency (FSA)
Black-and-white panchromatic prints from the Farm Service Agency

Each of these sets of photos has its own advantages and its own limitations. The IDNR's DOQQS are handy to use, but they are not the highest resolution or the overall best film type. The FSA's digital photos are quite recent because a new set is obtained each year. Although new color or color infrared photography has big advantages for identifying natural areas, the FSA's series of old black-and-white photos also offer unique advantages, and they remain a mainstay for the Natural Areas Inventory.

* A contact print is the same size as the film negative.

Photos and photo-like images are also available from orbiting satellites, but they are not well suited for the kind of methods spelled out in the *Survey Standards and Guidelines*, and they probably will be of limited or no use to the project.

The four most common types of aerial photography are discussed under the following headings: *black-and-white panchromatic*, *natural color*, *color infrared*, and *black-and-white infrared* photographs.

Black-and-white panchromatic photographs

These are standard, old-fashioned photos. With black-and-white (b&w) panchromatic (or "pan") film, colors are recorded as shades of gray (from black to white). This kind of film is preferred for some photo-interpretation purposes because the film is sensitive to nearly the same light spectrum as the human eye. The film does not record infrared radiation (which is invisible to humans), so these aerial photos depict the landscape in much the same way as one would see it with the naked eye (but without colors). The film is not very sensitive to different shades of green, however, so vegetation generally appears as medium gray, with comparatively little contrast between different plant communities.

The amount of reflected light, rather than the actual color of the object, is the strongest determinant of the gray tone on b&w pan film. For example, the roof of a house with only one color of shingles may appear on an aerial photo in two or more shades of gray, depending on how the sun reflects from roof surfaces that slope in different directions. Large amounts of reflected light produce light tones. A smooth, relatively reflective surface such as a paved road (sometimes even a blacktop highway) produces a lighter tone on black-and-white aerial photography. A rough-textured surface such as tall vegetation produces darker grays and mottled tones. Low, even-surfaced vegetation (such as a mowed meadow or a closely cropped pasture) appears lighter gray and is more nearly uniform in tone and texture than tall vegetation.

Black-and-white aerial photography is common because it has a long history of use by government agencies and private aerial survey companies.

Advantages of black-and-white panchromatic photos:

+ Low cost and wide availability.
+ Available from years as far back as the 1930s.
+ As a general rule, black-and-white prints have relatively high resolution, compared with other kinds of prints.

Disadvantages of black-and-white panchromatic photos:

- Relatively low contrast and poor discrimination between different vegetation types.

- The prints lack many advantages of other kinds of photography.

Natural color photographs

Color photos convey more information than black-and-white photos because the human eye can distinguish far more colors than shades of gray. Despite this advantage, conventional color film (as opposed to color infrared film) has not been in wide use for aerial photography until recently. Color film requires exacting exposure and careful processing, so color aerial photos are often of disappointing quality.

Until recently, the Farm Service Agency annually acquired color aerial photos of farmland in the form of conventional 35-millimeter slides. These transparencies have proven useful for some purposes (such as looking for purple loosestrife infestations when they are in flower). But for the most part, the slides have been of little use for identifying natural areas because they are difficult to view and often of poor quality. The slides are entirely adequate for the USDA's purpose (to identify the kind of crop being grown in each field), but they are often too blurry to be of much help for inventorying natural areas.

Advantages of natural color photos:

+ Color conveys more information than gray tones. *
+ Natural color (as opposed to false-color infrared) photos are familiar and therefore may be relatively easy to interpret.
+ At low altitudes, color is superior to black-and-white photos for identifying plant species, types of soil, and rock exposures.

Disadvantages of natural color photos:

- Colors are often inaccurate, which can be misleading.
- Color prints and FSA slides often have poor resolution and low contrast.
- High-altitude color photos tend to appear bluish, hazy, or washed out.

Color infrared photographs

Color infrared film (also known as "CIR" or "false-color infrared" film) is sensitive to both visible light and near-infrared reflected radiation. The type of infrared film normally used in aerial photography is sensitive to *near-infrared* radiation, which is not the same as *thermal infrared* radiation, or radiant heat.

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* With color photography, one speaks in terms of *colors*; the corresponding shades of gray on black-and-white photos are *tones*.

CIR photos are called "false-color" because the colors on the image do not correspond to true colors in nature. The most immediately obvious difference is that near-infrared radiation (which is normally invisible to the human eye) is recorded as red by the film. Because most living green vegetation is highly reflective of near-infrared radiation, most green plants appear red on color infrared film. The way in which color infrared film records reflected light is rather unpredictable: a non-living green surface such as a rooftop usually appears bluish.

The unnatural rendering of colors by false-color infrared photography may initially be confusing, but CIR is the overall best imagery for natural area surveys because it combines the advantages of both color photography and infrared sensing. To take advantage of CIR photos, one must learn how to read the false colors. *

Water absorbs infrared radiation and reflects little of it back to the camera — so lakes, streams, and bare, wet soil appear very dark and distinct on CIR photos. This is a big advantage for detecting and mapping wetlands and bodies of water.

Advantages of color infrared photos:

+ Comparatively sharp contrast and good resolution.
+ Relatively good discrimination between vegetation types.
+ Good distinction of evergreen conifers from other trees.
+ Sharp delineation of water bodies.
+ Superior delineation of wet ground.
+ Sharp contrast between natural features and artificial disturbance features (such as buildings, pavement, and bare earth).
+ Superior penetration of atmospheric haze (which is important in high-altitude photography).

Disadvantages of color infrared photos:

- Generally not as readily available as panchromatic photos (until recently).
- Usually photographed from a high altitude, and therefore small-scale. A magnifying lens is needed to read them unless they have been photographically or digitally enlarged.
- False-color rendition can be confusing unless adequate time is spent in training.
- Shadows are often so dark that features in shadowed areas are completely obscured.

* The photo interpreter is advised to forget the adage "red is green" on the drive home after a long day of scrutinizing CIR photos.

Black-and-white infrared photographs

Black-and-white infrared photography has the advantages of infrared film without the advantages afforded by color. Black-and-white infrared photos are less expensive than color infrared photos. This type of photography was not common in Illinois until the National Aerial Photography Program (NAPP) was instituted in the 1980s. Forestry management projects often use this film because it is very good for distinguishing hardwoods from evergreen conifers; however, compared with panchromatic black-and-white photography, there may be less variation in tones among deciduous trees.

Old aerial photography

The first flights to obtain systematic, broad-scale aerial photographic coverage of Illinois were made by the U.S. Department of Agriculture during the 1930s. Since then the USDA has photographed each county on a schedule that called for flights about every seven to ten years. These series of old USDA photos — along with other early photography — are irreplaceable records of past land use and land cover.

Old aerial photography can aid in the determination of the boundaries of a natural area or a significant feature by showing past disturbances that are not visible on new photos. An old photo may also be the basis for rejecting a Potential Natural Area if the photo shows that the area was once severely disturbed. For example, by checking an early photo, one might learn that a marsh was a cultivated field a half-century ago. See Appendix 1, "Historical Aerial Photography." Tips for examining old photos are discussed in several places in the *Survey Standards and Guidelines* under the heading of *Map and aerial photo interpretation guidelines: Time.*

Old aerial photos are especially useful in areas with potential for dry, open, early successional communities because these communities were generally more open, more extensive, and more distinct in the past (see the *Savanna* Survey Standards and Guidelines).

Some of the older USDA photography has a distinctly higher quality than much of the newer photography. These old photos often have higher resolution and better contrast than more recent photos. However, early photography is sometimes quite distorted because the airplane was tilted and the camera was not pointing straight down at the ground. This distortion is usually not a problem unless precise mapping is required, and the distortion can be reduced to an acceptable level by orthorectifying with GIS software.

Season of photography

Summer or late spring photography, taken after trees have leafed out, is necessary for finding and evaluating some kinds of Natural Communities. But woods and

shrubby areas are most distinct and easiest to identify and map with "leaf-on" photography. Without leaves on the trees, a forested stand has the confusing appearance of a multitude of sticks and shadows. With leaves on the trees, it is often possible to see individual trees and to spot small canopy gaps in the forest canopy that may indicate selective logging, or may indicate open woodland vegetation.

Although summer photography has its advantages, a leafy tree canopy commonly obscures minor habitat features such as bedrock outcrops, small stream channels, seeps, and vernal pools — so it is necessary to obtain winter (dormant-season or leaf-off) photos in order to detect these features well. Ideally this second set of photography should be infrared film, which is particularly good for detecting such features.

5.6. Scale

The *scale* states that a unit of distance on a map or aerial photo depicts a certain actual distance on the ground. One unit of distance on a 1:24,000-scale topographic map covers 24,000 units of distance on the ground; in other words, 1 inch on the map covers 24,000 inches (or 2,000 feet) in the real world. Please note, though, that a computer can easily change the scale at which a digital map or photo is displayed. One must be careful to recognize that the scale of a map or photo on a computer screen is likely to be different than the "nominal" scale (that is, the scale at which the image was originally produced and is generally intended for use).

The terms *large scale* and *small scale* are often confused because their definitions may seem counterintuitive. A large-scale map covers a small area, not a large area. One way to keep the terminology straight is to remember that things are *larger* on a *large-scale* map.

A 1:24,000-scale map is larger scale than a 1:100,000-scale map. Confusion can arise if two different units of measurement are used in reference to the scale. For example, a common scale for photo enlargements is 1:4,800, which is "1 inch equals 4,800 inches" or "1 inch equals 400 feet." These photos are commonly called "one to four hundred scale" or "400 scale," but they are correctly called "one to forty-eight hundred scale."

Endnotes

1. **Farm Service Agency:**

The main office of the U.S. Department of Agriculture that acquires and uses aerial photography is the Farm Service Agency. This branch of the USDA has undergone many reorganizations and name changes over the years; these names or their acronyms can often be found stamped on the back of their photographic prints. During the 1930s, the USDA had an Agricultural Adjustment Administration (AAA) as well as a Farm Security Administration (FSA). In 1953 the Commodity Stabilization Service (CSS) came into being and assumed the responsibilities of the former AAA and FSA. Between 1961 and 1994 this agency was called the Agricultural Stabilization and Conservation Service (ASCS). In 1994 various USDA offices and functions were changed, and the agency was named the Consolidated Farm Service Agency for a brief while. It has been called the Farm Service Agency (FSA) ever since.

The Farm Service Agency administers the U.S. Department of Agriculture's programs related to farm loans, crop insurance, conservation incentives, and price supports. As the FSA's Web site <www.fsa.usda.gov/pas/> states, "Every day FSA helps promote America's high-quality, affordable, varied, and abundant food supply and sound stewardship of the land."

2. **Sources of maps and aerial photography:**

The following Web sites display sets of maps and aerial photos, some of which are available at no cost:

> Illinois Natural Resources Geospatial Data Clearinghouse:
> www.isgs.uiuc.edu/nsdihome
>
> TopoZone: www.topozone.com
>
> TerraServer.com: www.terraserver.com
>
> TerraServer–USA: www.terraserver-usa.com
>
> TerraFly: www.terrafly.com
>
> Google Maps: http://maps.google.com
>
> Google Earth: http://earth.google.com

Each of these Web sites has an array of products and services, and they all have advantages and disadvantages.

CHAPTER 6

AERIAL SURVEY STAGE

6.1. Why Fly?

The Aerial Survey Stage usually is a step in the INAI screening process between the map and aerial photo examination stage and ground surveys. An aerial survey is a quick and efficient way to have a closer and more recent look at Potential Natural Areas than is possible by examining aerial photography. Flying also makes it possible to find some sites that cannot be seen well (if at all) on aerial photos.

Purposes of aerial surveillance

Aerial reconnaissance may be conducted for the following reasons:

(1) To screen sites identified during earlier Survey Stages:

   (a) To determine that some Survey Sites are nonqualifying, therefore removing them from further consideration.

   (b) To decide which sites merit further screening.

(2) To find and evaluate new Survey Sites, including:

   (a) Sites with features that were not detectable by earlier Survey Stages.

   (b) Sites with features that can be screened most efficiently by air without exhaustive preparation with maps and aerial photos.

(3) To learn more about Survey Sites (*i.e.* to map communities, identify disturbances, and refine site boundaries).

Advantages and limitations of aerial surveys

See Hutchison (1981) for a good discussion of the advantages and disadvantages of aerial surveys. He noted that aerial surveillance is effective, fast, easy, economical, and current.

Flying provides a quick overview of an area, revealing things that might not be evident even after many hours of on-the-ground inspection. Fieldwork for the original Illinois Natural Areas Inventory in 1975–78 would have required seven to ten times as much time and seven to ten times as much money to complete if the work had been attempted without aerial surveys. It would have been impossible for the original Inventory to accomplish some tasks and to find many of the natural areas without using aircraft. [*]

An aerial survey can be fast and efficient, but flying has its drawbacks. A good pilot may be hard to find. Not everyone is adept at navigating and reconnoitering from a light plane. Flights are often cancelled because of bad weather, and they may be cut

[*] In the 1970s, almost all of the available aerial photography consisted of black-and-white panchromatic prints. Most of those photos were at least a decade old. Now a wide variety of very recent, high quality aerial photos are readily available. These new photos are so useful that there will be less need for aerial surveillance during the Update than during the original project.

short because of airsickness. A poorly planned and ineffective flight is a poor investment of time and money.

When an aerial survey is warranted

An aerial survey is most effective when conducted by skilled observers under one or more of the following conditions:

> The Survey Region has undergone very recent disturbance or development (*i.e.* since the date of the aerial photography that was examined during the Map & Aerial Photo Stage).
>
> It is not possible to interpret the available photography with a high degree of confidence and accuracy (*e.g.* the photos have low resolution).
>
> At least some of the features are more effectively surveyed by aerial reconnaissance instead of map and photo interpretation or on-site inspection.
>
> Access to the property on the ground is difficult or impossible.

If none of the above conditions is met, then an aerial survey will reveal little new information. Aerial reconnaissance should be done only when it is likely to (a) find new Survey Sites, (b) identify a significant number of Nonqualifying Sites, or (c) acquire needed information most efficiently. An aerial survey is not worthwhile if it merely verifies decisions made from reading aerial photos and if it provides little new information.

6.2. Aircraft, Flight Services, and Pilots

Choosing the right aircraft and pilot is critical. Safety comes first. Cost is a major consideration. The wrong aircraft or pilot will result in a partially wasted flight — and there might not be an opportunity to redo the survey later.

Aircraft

Both airplanes and helicopters are suitable for inventories. Single-engine light planes are usually adequate and are much less expensive than helicopters.

The ideal airplane for most work is slow enough and maneuverable enough to make close turns around sites, yet has enough reserve power to fly fast between sites and to quickly recover from a stall.

The aircraft must provide good visibility of the ground. A low-wing plane has such an obstructed view of the ground that it cannot be used effectively. An airplane that

has retractable landing gear and has no wing struts is ideal because wheels and struts get in the way of observations, especially photography. Planes with fairings (skirts or "fenders") covering the wheels should be avoided if possible because they interfere with the surveyor's line of sight.

The most widely available airplane with these characteristics is the Cessna 172, or Skyhawk. This is a single-engine, four-seat, high-wing airplane. A Cessna 172 will cruise at 120 miles per hour, can easily be throttled back to 80 to 90 mph, and flies safely as low as 500 feet.

Smaller conventional airplanes generally are not satisfactory. The Cessna 150 series (*e.g.* Cessna 152) seats only the pilot and one passenger. The cabin is so cramped that it is difficult to handle maps and forms without interfering with the pilot. Although this craft has been used for natural area surveys, it is not recommended. Some people warn against using such a small aircraft for low-level circling of sites at slow speeds (approaching stall speed) because the plane may not have the altitude or the power to pull out of a stall.

Larger airplanes (*e.g.* the Cessna 180 and 210 series) are faster, more powerful, less maneuverable, and more expensive. They are not good choices even if they are available at no cost..

Helicopters are very maneuverable and can fly low and slow. Compared with an airplane, more time can be spent over a site instead of looping back to make another pass. A helicopter can fly very low and hover or land in the proper circumstances, which is a big advantage for work such as identifying plants. A small helicopter is not as maneuverable as commonly assumed, though: the pilot has difficulty holding it in one place for long.

A small helicopter is likely to cost at least four times as much per hour as a light plane. Even if a helicopter is made available at little or no cost, one should consider its limitations. Small, affordable helicopters are cramped, making it difficult to handle maps and equipment. Engine noise and vibration are usually so high that a headset must be worn to muffle the sound and to talk to others in the cabin. The vibration may make it difficult to take sharp photos and to take legible notes. A helicopter usually cruises slower than an airplane between sites. A helicopter makes it easy to linger over sites more than absolutely necessary, further driving up the cost. Despite these drawbacks, a helicopter might be the aircraft of choice when cost is not an overriding consideration.

Flight services

One of the best ways to find a pilot is by word-of-mouth. If you cannot get a personal recommendation, look in the telephone directory's yellow pages under *aircraft charter, rental & leasing service*, *airports*, and similar listings.

Some private pilots will volunteer their services for conservation projects. They may donate their time but ask to be reimbursed for the cost of the aircraft rental or fuel. Especially when making arrangements to fly with a private pilot instead of a commercial service, safety must be the foremost consideration. Do not be shy about discussing safety issues and the pilot's experience (number of flight hours, familiarity with low-level reconnaissance). A pilot should welcome a frank discussion about safety.

A government agency may be able to provide flight time on its airplane or helicopter at little or no cost. However, it may prove difficult to schedule these flights because the agency will give priority to its own needs. Consequently flights may be cancelled, or made available on short notice, or offered at a less-than-ideal time. An agency's airplane may be a Cessna 180 series or larger, which is too big and fast to be satisfactory for natural area surveys.

Other possibilities are worth exploring. The Air National Guard has occasionally provided soldiers and equipment to local public service projects as part of their routine training activities. The Civil Air Patrol is composed of retired pilots who need to fly in order to keep their licenses current; these pilots may volunteer their time. Project Lighthawk is a private charitable organization that provides flights for conservation purposes, but it does not normally operate in Illinois.

Coordinate with the Survey Director when looking for a flight service. Although it may pay to shop around for a volunteer pilot or low-cost commercial service, a discounted price is not worthwhile if the service is unsafe, or in an unsuitable aircraft, or offered at the wrong time. It may be better to pay full price.

Pilots

Pilots tend to be an independent lot. They vary in their abilities, and not all of them like low-altitude reconnaissance. Low, slow circling is a lot of work, and it is more dangerous than cross-country flying. A pilot should have plenty of experience and skill, and should enjoy the work. The manner in which an aircraft is flown can make all the difference in the success of a natural area survey flight. A cooperative pilot who knows the local countryside and enjoys "connect-the-dot" flying from one site to another will make the flight smoother. As Max Hutchison (1981) observed, "The way an airplane is flown can make a lot of difference in the success of a flight and especially in the expense of the trip."

The bottom line: Find a good pilot and keep going back to the same person whenever practical.

Arranging for a flight

Contact a flight center or individual pilot, and hire an aircraft and a pilot by the hour. Be prepared to discuss the following: the purpose of the flight, kind of aircraft, location, date, and approximate duration of the flight. Estimate the length of the flight as accurately as possible.

If a flight service's representative initially has difficulty understanding what kind of flight is needed, say "photography." Flight services are accustomed to taking real estate agents and others up to take pictures. If you explain that part of your work will involve photographing woodlots and other areas, the pilot will begin to get the picture of what you need to do. Some pilots will be personally familiar with this kind of survey work because they have provided similar services, such as flying for a wildlife biologist who is conducting a census of deer.

Set up a tentative or flexible schedule, with a "rain date" if possible. Flight services and pilots are accustomed to cancellations and delays because of weather, and they should be willing to accept conditional arrangements.

Make arrangements for paying the bill.

6.3. Preparing for an Aerial Survey

Aerial survey strategy

An aerial survey builds on previous stages of the inventory (*i.e.* reviewing available information, and examining maps and aerial photos), and it sets the stage for ground surveys. With the overall Inventory Process in mind, lay out a plan for the flight: its location, purpose, participants, methods, and duration.

Ground-truthing

On-the-ground familiarity with the Survey Region is imperative. You must know the local area — and ideally you should have personally chosen the Survey Sites. You should visit the region to be flown, check specific sites before the flight, and take notes that will be used as "ground-truth" during the Aerial Survey Stage. These notes should include information such as plant species, tree sizes, and disturbance features. This information needs to be recorded as Survey Sites (*i.e.* written on Survey Site Records and drawn on topographic maps) so that it can be used for reference while in the air.

Flight map

Prepare a flight plan on a single map that has a small enough scale to cover the entire flight route. Normally this is a 1:100,000-scale USGS map with the boundaries and names of the 1:24,000-scale quadrangles marked on it. This small-scale map serves as both a route map and an index to show the 7.5-minute topographic map for each Survey Site.

Plan to examine perhaps 20 to 40 sites in a single flight. With a pencil, draw each of the Survey Sites on the flight map, and number them. The site boundaries do not need to be precise.

Draw a flight line that connects the sites in the order in which they will be surveyed. Plan the flight sequence so that the first part of the flight goes over Survey Sites that you have ground-truthed. This arrangement will help you relate what you see from the air to what you know on the ground.

As a general rule, the shortest course should be laid out, but other factors must be considered:

(1) To minimize shuffling of topographic maps, the flight line should stay on one map as long as possible if this arrangement does not appreciably lengthen the flight.

(2) The sun should be kept behind the observers as much as possible. If many sites are strongly backlit, then glaring sunlight will greatly reduce the survey's overall effectiveness.

(3) It may be advisable to insert some longer stretches between Survey Sites into the flight plan in order to provide short rest breaks. Surveying can be hectic where sites are closely clustered.

In addition to checking Survey Sites that have already been identified, the flight may involve searching for new sites (such as seeps or bedrock outcrops along a stream valley) that have not been detected on aerial photography. If this is the plan, draw the flight line to show where these new sites will be sought.

Aerial survey equipment and supplies

A generic list of things to take on the flight is in Table 2. You will need to prepare your own custom list, with specifics about camera equipment and so forth.

Items should be kept to a minimum and must be well organized. It is difficult to keep track of everything in the cramped cabin of a small aircraft. An item that is dropped

Table 2. Aerial survey equipment checklist.

Forms, maps, and writing materials	**Still photography**
Flight map	Digital still camera
Topographic maps	Digital storage device
Survey Site Records	Spare battery for camera
Aerial Survey Source Record	
Pencils (several)	**Videography**
Clipboard	
Notepaper	Video camera
Expandable file folders to hold papers and maps	Video recording media
	Spare batteries for video camera
Audio recording	**Other supplies**
Voice recorder	Watch
Audio recording medium (tape, memory card, etc.)	Snack and drink
	Motion sickness medicine
Spare batteries for voice recorder	Air sickness sacks
	Headsets or microphones
	Binoculars
	Satchel for holding equipment

beneath a seat may be practically impossible to retrieve while in the air.

Pilots usually keep airsickness bags ("sick-sacks" or "barf bags") in the aircraft, but bring your own to be sure. Commercial airsickness bags are made of coated paper, and they have a fold-down seal. As an alternative, a sturdy, conventional plastic bag that can be knotted shut or closed with a twist-tie is preferable to a zip-lock bag. Vomit that dribbles into the closure track of a zip-lock bag may prevent it from sealing cleanly.

Conferring with the pilot

Review the flight plan with the pilot. Find out whether any "restricted," "prohibited," or other "special use" airspace is on the route. These areas are indicated on 1:500,000-scale aeronautical charts (known as "sectionals") carried by pilots. Permission to enter a special airspace can usually be obtained by the pilot radioing ahead to the appropriate control tower.

Clearly explain how you want the pilot to fly. Tell the pilot the desired altitude and speed, and describe how to circle a site. You have a right to good service, but the flight may be unsatisfactory unless you state your needs and expectations. Otherwise

the pilot may assume what you want, or may decide to fly in a manner that is easier for the pilot but less than satisfactory for you.

It is possible to slow down the airplane by extending the wing flaps. This requires that the pilot increase the engine speed, and it is somewhat more work to keep the plane flying. The pilot may not want to do this, or at least may not volunteer to fly this way. Discuss using the wing flaps ahead of time, before getting into the air.

Figure out where to stop to rest or refuel. You may be asked to pay for fuel or for a landing fee if it is necessary to stop at another airport.

Find out how the pilot will determine the flight time — either by the aircraft's Hobbs meter or tachometer. * To circle as slowly as needed for many surveys, the wing flaps can be extended while running the engine at a higher speed. Under these conditions, a tach timer may give a fairer measure of the expense of running the plane.

Once in the aircraft and ready to start, take note of the time, mention it to the pilot, and write it down. (Do the same at the end of the flight. This helps avoid mistakes, disagreement, or misunderstanding that might later arise about how long a flight lasted.)

Final flight preparations

Make sure everything on the flight checklist is at hand and in working order.

Review the flight plan with the other participants, and agree on procedures and responsibilities.

Assemble the Survey Site Records and topographic maps that will be used during the flight. Put the forms and maps in the order in which they will be used (or, if the flight line will cross repeatedly from one map back to another map, it may be less confusing to keep the maps in alphabetical order).

Visit a restroom one last time. Avoid drinks that stimulate urination. Depending on the individual, this may include caffeinated, sweet, or sour drinks.

If desired, take motion sickness medicine before the flight. You may want to take more medicine while in the air if the flight is so long that the first dose begins to wear off.

Take care of these final preparations before the scheduled flight time, so that you do not keep the pilot waiting.

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* A Hobbs meter is a conventional clock that begins running when the engine is started. A tachometer (or "tach") varies with the speed of the engine: when the engine is idling, a tach timer runs slower than a regular clock. Both devices measure tenths of an hour.

Check on the weather one last time. Do not fly if conditions are marginal or may turn stormy.

6.4. Conducting an Aerial Survey

Flight crew and seating arrangement

The maximum crew in the cabin of a four-seat airplane can be specified as follows: pilot, navigator, recorder, and assistant.

Pilot.—The pilot is in charge of all matters pertaining to the operation and safety of the aircraft. The pilot customarily sits in the front left seat, but the plane can also be flown from the right seat.

Navigator.—The navigator is responsible for directing the pilot along the flight course. This crew member sits in the copilot's seat (usually the front right). The navigator performs the following duties: uses a regional map with the sites and a flight line marked on it, directs the pilot where to fly, points out each area as it is approached, and directs the pilot how to fly around or over it. If necessary the navigator also indicates the sites to the recorder.

The navigator's duties usually extend to matters such as keeping track of time and ensuring that rest breaks are taken. Pilots sometimes neglect to note the flight time accurately, so the navigator needs to mention the time to the pilot and write it down at the start and end of the flight.

Recorder.—The recorder takes notes, usually has the primary responsibility for making observations, and normally has the final authority for evaluations and decisions about Survey Sites. This person records observations with on paper, with an audio recorder, and with a camera. The recorder sits behind the navigator.

Assistant.—The assistant holds the maps and other materials, hands them to the navigator and recorder as asked, and takes materials back to keep them in order when they are not being used. The assistant usually sits in the left rear seat, which is the poorest position for seeing the Survey Sites because it requires craning over the shoulder of the recorder to look out the right window. The plane is often tilted so that the ground cannot be seen well from the left window. [*]

[*] The rear seats are not as stable and comfortable as the front seats because the ride is rougher in the back. The rear seats go up and down and sway more because they are closer to the aircraft's tail. Consequently people in the back seat are generally more prone to airsickness.

The assistant is in a good position to watch and learn the skills of the navigator and recorder. Another duty is to help watch for radio towers and for other aircraft in congested areas.

The pilot customarily sits in the left seat but can sit on the right. This right-hand position is an advantage when the sun is in the west and the flight course is best arranged so that the plane heads generally southward. If the navigator and recorder switch to the left side of the plane in this situation, they can avoid having the sun in their eyes more of the time.

Although a full crew can consist of four persons including the pilot, a three-person crew usually is plenty. Or, a single skilled surveyor and a pilot will suffice under many circumstances — but it is usually preferable to have two or three surveyors to share and organize the workload. More eyes and minds usually result in better descriptions and evaluations of sites because surveyors can consult with each other. If one person of a full crew needs to rest, then the others can continue working so that the flight does not need to be cut short.

Outline of aerial surveillance activities

Following is a description of roles for a crew of four in a light plane.

Once the Survey Region is reached, the navigator uses the flight map to identify the next site to be surveyed, then directs the pilot toward it. The navigator must watch the maps and ground continually to know where the plane is at all times. Some pilots will want to glance at the flight map to see where to go next, but most prefer to be given directions with verbal compass directions and distances accompanied by hand gestures. For example, the next site might be described as "about two miles ahead at 10 o'clock," or (in a region that is regularly gridded with section-line roads) "one mile west and three miles north." A compass on the instrument panel shows the direction in which the aircraft is headed.

As the plane approaches a Survey Site, the navigator spots it in the distance and begins to discern its boundaries by studying the topographic map or flight map. The navigator points out the site, describes its boundaries if necessary, and tells the pilot how to fly around it. For instance, the navigator might say, "We want to look at this long swampy area next — everything that's under water. Fly so that we're looking down at the edge of the water, then turn right at the bridge. On the way back in this direction, keep us over the powerline."

If the navigator has been using a 7.5-minute topographic map to find the site, the navigator hands it back to the recorder and points out the site to the recorder. The recorder refers to the Survey Site Record, calls out the site's number, and tells the other observers what the Survey Features are.

As a general rule, the plane circles to the right (clockwise), banked so that the surveyors on the right side can look down at the ground almost directly below. If the site is small (less than a quarter mile across), then it normally can be seen well enough by flying just outside its perimeter. One to three loops around the area are usually enough.

If the area is quite small, the pilot will need to pass by it rather than closely circling it. If an area is big, the surveyors may have to take several passes across the middle of it. A very extensive site must be crossed in a series of parallel flight lines if the entire area needs to be studied.

All three observers study the site, focusing on its Survey Features. They consult with each other and reach agreement on its description and evaluation. Then the recorder records the information.

If still photography or video recording is done, the plane may need to make one or more additional passes to accomplish this task.

The plane then heads for the next site. The navigator may be able to find it by reading the flight map alone, but will ask for a 7.5-minute topographic map if needed.

Aerial navigation

To keep track of the aircraft's position, the navigator must continually look back and forth between the flight map and the ground, relying on specific landmarks as well as broader geographic patterns such as road networks and drainageways.

The navigator needs to keep turning the map to orient it properly. To make it possible to quickly relate the map to features on the ground, the north edge of the map should be held roughly northward — even though the map must be read sideways or upside down most of the time.

The survey should proceed according to the prepared flight plan. You should resist the temptation to take sites out of sequence. If you abandon the planned route, then maps and forms are apt to get out of order — and it is far too easy to accidentally skip a site. If you do, however, depart from the planned sequence of sites, amend the flight map to show the route that was actually flown.

When flying from one site to another more than a mile away, the pilot should be asked to fly faster to save time — unless a lull in activity is desired.

Length of the flight

Aerial survey work is wearying. A typical flight usually involves up to two hours (perhaps three hours at most) of actual survey work in addition to time spent flying from the airport to the Survey Region and back. Approximately two hours is as long as most people feel well enough to remain alert, make accurate assessments, and take good notes. If an observer or recorder is feeling weary or airsick, the quality of the work suffers greatly.

Individuals vary in their endurance. Experienced surveyors generally can last hours longer than novices, but anyone can have a bad day in the air. If someone is feeling airsick, take a break from the flight — perhaps leaving the sick person on the ground to wait out the rest of the survey. Or, it may be necessary to quit for the day.

6.5. Making and Recording Aerial Observations

What can be accomplished from the air

An aerial survey can be used to screen previously identified Potential Natural Areas and to find new ones. When examining a site from the air, the following may be accomplished:

(1) Detect and map features that are not apparent on aerial photography.

(2) Find changes since the area was photographed

(3) Refine the site's boundaries.

(4) Decide whether the site needs to be visited on the ground.

The last item in the above list usually is the primary purpose of a flight. Because a light aircraft is a poor platform for making and recording detailed observations, emphasis must be placed on making a simple yes/no decision about whether each site qualifies for further investigation. The reason for the decision also needs to be recorded.

Judgments about a site usually are based on the question, "Is the Survey Feature present?" If the feature is not evident from the air, then the aerial photography may have been misinterpreted — but it often means that the site has changed since the photo was taken. Disturbances that are usually easy to recognize during a flight include: off-road vehicle damage, ditching, trash dumping, timber cutting, farming, soil erosion, heavy invasion of exotic vegetation, land clearing, and recently burned areas.

In addition to accomplishing the above five objectives, an aerial survey helps improve photo-interpretation skills. Flying expands on ground-truthing by providing "air-truthing." A quick, real-time overview from an aircraft increases the surveyor's ability to interpret aerial photography.

Recording observations

Observations can be recorded on paper (forms and maps) and with a camera or audio recording device.

Paper records.—Writing on paper should be kept to a minimum. Trying to write in a bumping and swaying plane can be nauseating. It is difficult to write legibly in an aircraft.

As an alternative to writing on forms, you can take notes on a sheet of tablet paper. These handwritten notes will need to be transcribed into a computerized format.

It may be desirable to revise site boundaries and to locate features by drawing on a topographic map, but you should not write notes on maps. Notes jotted on a map are likely to be a source of mystery and confusion in the future.

Voice recording.—The most expedient way to take notes is to speak into a audio recorder. You can record observations while looking at the site, without having to look down at a piece of paper. An aircraft is noisy, so you must be loud and clear when speaking into a recorder.

Using a voice recorder introduces significant risk that information will be lost. Check often to make sure that the batteries are working. If the recorder has a *pause* button, put a piece of tape over it to disarm it. Likewise tape the *on/off* switch so that the machine cannot be turned off inadvertently. In the noisy, rushed, confusing environment of an aerial survey, it is too easy to make a mistake that will result in unwittingly failing to record observations on a voice recorder.

As a precaution, take a minimum of back-up notes on paper. If possible, this duty may be assigned to someone other than the crew member who is handling the voice recorder.

Still photography.—Decide before the flight where the photographer will sit. There should be a clear view (no wing strut or other obstruction), and enough room to maneuver the camera. Make sure that the window pane is clean and free of scratches. Hold the camera steady. Be aware that the window may distort the view, and look carefully to be sure that you are not picking up a reflection when you shoot through a closed window. (It is usually possible to open a side window temporarily while taking a picture, though this is a windy procedure!)

It may be necessary to make an extra pass at a site in order to photograph it. Off-hand snapshots are apt to be disappointing. On some flights, photography may be the primary activity (for instance, when flying along a river valley to find and photograph seepage areas).

Videography.—A video camera is a good alternative to a still camera and voice recorder. A video camera records a continuous image of a site instead of a series of still photos, which allows you to record the site from all angles. The video camera records sound, so you can record a running narrative description while photographing it. A drawback is that a video image is not as sharp as a still photo.

A microphone mounted on the front of a video camera will pick up so much engine and propeller noise that the voice of the camera operator will almost certainly be inaudible much of the time if this microphone is used. An auxiliary mike must be plugged into the camera and placed directly in front of the operator's mouth. Be aware that the sounds of other people talking in the cabin will be picked up by the recording device.

It is often necessary to make extra passes around a site to videotape it. Allow sufficient time for video recording, or else the results will be unsatisfactory.

Alternative and special techniques

Adjusting for variations in elevation.—Most aerial observations are done from an elevation of approximately 500 feet above the ground, which is the lower legal limit for flying in rural areas. Flying higher is sometimes preferable because it provides a broader perspective, and the ground does not seem to rush by so fast — but take care to adjust for the different altitude!: a tree looks half as big when viewed from 1,000 feet instead of 500 feet. When flying over hilly terrain along river valleys and in the Driftless Area, your elevation above the ground will vary significantly if the airplane keeps an uniform altitude above sea level.

Flying in a grid.—Aerial reconnaissance usually involves flying at a low altitude from site to site. But sometimes it may be useful to fly higher and systematically follow section lines in a straight-line pattern. This method is useful for spotting small prairies and wetlands in farmland (see Reese 1988 — but careful preparation for the flight by examining aerial photos should normally make this sort of grid-like aerial searching unnecessary. Aerial photo interpretation is more comfortable and less expensive than an aerial survey. You should do as much of the screening work as possible at a desk, studying photos — instead of riding in an aircraft.

Examining big areas.—A large Survey Site (over 1 or 2 square miles) is often difficult to assess from the air, but patches of differing quality will be evident in any large area. To deal with large, diverse sites, note which parts look best from the air. Then visit these parts on the ground; if they are not exceptional, then it may not be worth investigating the rest of the site.

Connecting with the ground.—Aerial observers often find that they "space out" and feel disconnected even while trying to concentrate on the work at hand. To combat this feeling, it helps to look for movement on the ground: cars on the road, deer running, people walking (a surprisingly rare sight), waves on water, and rippling, windblown

grass and grain crops. Seeing things in motion can help bring a sense of reality to the scene.

The *Aerial survey* sections of the *Survey Standards and Guidelines* spell out special methods for screening specific Survey Features.

6.6. Post-flight Activities

Thank the pilot. If you liked the pilot's service, be sure to express genuine appreciation.

Complete an Aerial Survey Record after the flight. This is a record of the date, location, participants, methods, and so forth. Record observations about the flight, such as the weather, difficulties during the survey, unusual seasonal observations, and the character of the pilot. New ideas about aerial survey procedures should be forwarded to the Survey Coordinator so that they can be incorporated into the *Survey Manual* and *Survey Standards and Guidelines*.

Transcribe the handwritten and electronic notes into Survey Site Records immediately after the flight — while the observations are still fresh in mind.

Process, label, and file photographs soon after the flight.

Visit some of the sites that you surveyed from the air, and compare what is on the ground with what you saw from the air. This ground-truthing will help build your aerial interpretation skills.

6.7. When to Fly

Time of the year

Each season has its own advantages for aerial surveys, but the dormant season, from late October to April, has the most advantages overall. During this time of year, the interior of forests is not obscured by a leafy canopy. Native prairie grasses are brightly colored and highly conspicuous. Cold, clear days allow the smoothest flights with the best visibility.

The low angle of the sun in midwinter has advantages as well as drawbacks. The crowns of trees are highlighted, so it is easier to determine the size and age of trees; but long, dark shadows obscure the understory and forest floor. Especially in the afternoon, the sun's rays tend to be reddish, and the distinctive colors of prairie grasses are enhanced — but non-native grasses also acquire a confusing reddish cast. During the short days of winter, the observer has more problems with glare from the low angle

of the sun, unless the sky is overcast (but then the light may be too dim for making effective observations).

For more detailed discussions about the proper timing of flights, see *Seasonal considerations* in the *Survey Standards and Guidelines*.

Time of the day

As a general rule, lighting is best at midday: beginning three or four hours after sunrise, and ending three or four hours before sunset. Early morning is often hazy. When the sun is near the horizon, backlighting and glare are problems — especially for photography.

The late afternoon sun is best for viewing glades and related communities on southwest-facing slopes. Long shadows early or late in the day accentuate the topography, which is useful for pinpointing the location of features such as small glades, seeps, and hill prairies. But long, deep shadows can obscure and distort the appearance of features.

Weather

Ideal conditions for surveying are free of clouds and haze. Skies are clearest immediately after the passage of a cold front (when air pressure is on the rise).

Calm days are best, but some wind is all right if it is not too variable. Hot, sunny days are rough during midday because of thermal updrafts. The pilot can predict how rough a flight is likely to be.

Do not take risks with stormy weather.

6.8. Technical Details

Special considerations while learning

Aerial survey techniques are learned skills. Proficiency comes with training and practice. Screening Potential Natural Areas from the air can be a high-stress job. It is easy to become flustered and frustrated, so it is important not to try to do too much at once.

The best way to learn surveying techniques is to fly with a well-practiced surveyor. Until you have gained enough experience to be confident of the accuracy of your evaluations, you should be careful not to reject too many sites while screening them.

Ground-truthing

The value of *ground-truthing* — that is, becoming familiar with sites on the ground before flying — cannot be overemphasized. You should visit and examine several Survey Sites before a flight in order to learn their characteristics (*i.e.* vegetation types, disturbances, and Survey Features). These ground-truthing sites should be studied early in the flight, with the advantage of knowing what they look like on the ground. Soon after the flight, you should follow up with more ground-truthing by visiting several sites that were viewed during the aerial survey — while their appearance from the air is still fresh in mind.

Aerial surveillance is usually conducted between 500 and 1,000 feet above the ground. Things look different from such a long distance: colors are often muted, but vegetation patterns may be more distinct. Even when you are not preparing for a specific flight, it is useful to practice seeing how things look at a distance. While traveling down a road, look ahead and study how trees and other features appear when they are about 500 to 1,000 feet away (gauging this distance is easy along Interstate highways because the right shoulder is marked with posts that are spaced one-tenth mile, or about 500 feet, apart). Of course, this exercise is limited because the vertical perspective afforded by an aircraft is quite different from the view obtainable from a road.

Photography

A common error for beginners is to point the camera at too shallow an angle to the ground. The perspective usually needs to be close to vertical to ensure that features are clearly visible.

You should take care to include some identifiable landmark in each picture frame to help locate the scene.

Aircraft instruments and equipment

The navigator should be familiar with several of the aircraft's instruments, including the radio and some of the controls in case of an emergency. Learn to read the aircraft's compass, altimeter, air speed indicator, and Dobbs meter.

Air speed is measured in knots, or nautical miles per hour. A nautical mile is 6,076 feet, or 1.15 miles.

Most aircraft come equipped with headsets, which muffle the sound of the engine and propeller, making it easier to talk with other crew members.

Some airplanes have an AC electrical outlet, which might come in handy to power a video camera or other equipment.

Aerial navigation

The abilities of the most practiced navigator are tested by continual circling at a low altitude, particularly when attention is repeatedly diverted to talk to the crew. The following pointers have proven helpful for navigating:

> The Survey Sites themselves often make good landmarks because they are anomalies (*e.g.* evergreens in a matrix of deciduous forest, or a stand of tall trees among younger forest).
>
> Radio towers and airports are good landmarks, and they are shown on the pilot's navigation maps ("sectional charts") as well as on topographic maps. Some navigators prefer to highlight such conspicuous landmarks on the flight map before the flight.
>
> Even the smallest cemeteries are good landmarks. They are likely to be shown on topographic maps, and they are easy to spot from the air because of their conspicuous gravestones, evergreens, and elevated position.
>
> A jog in a road or an oddly angled intersection is often quite distinctive, especially in regions where the road pattern is mostly rectilinear.
>
> To find your position along a stream, match its meanders to your map or look for a bridge.
>
> Any linear feature such as a pipeline or powerline right-of-way that cuts straight across the terrain is a good landmark, particularly if it is on the flight map. Even if this utility corridor is not on the map, you can stay oriented while circling by continually referring back to such a long, conspicuous feature as a reference baseline.
>
> Keep in mind that maps are always out-of-date. Pilots often rely on railroads as landmarks, but this practice can get you lost in a hurry when a railroad is not found where it was expected from the map. Many railroads have been abandoned recently, and long stretches have been obliterated by farming.

Here are some suggestions for the lost navigator:

> Don't fret.
>
> Ask the pilot where you are.
>
> Direct the pilot to fly higher for a broader perspective.
>
> Go to the nearest town and look for a name on the water tower.

Fly in a straight line while studying the map. Circling makes it difficult to keep your bearings.

Sometimes it is quickest to fly several miles to an obvious landmark and start again from there.

A highway makes a good baseline for finding your location. Go to the highway and then fly along it until you can relate some feature along the highway (such as a major intersection or a bridge) to what is shown on your map.

Airsickness

Conditions inherent in aerial reconnaissance tend to promote motion sickness. Even a veteran surveyor can be made miserable by low-level flying in circles while continually concentrating on a spot on the ground and then shifting focus to papers on one's lap. On all but the coldest, calmest days, matters are aggravated by the bump-and-sway of the aircraft, often combined with a hot and stuffy cabin.

The first symptoms of airsickness to catch one's attention often include gastric disturbances: upset stomach, burping, loss of appetite, and a nauseated feeling. Bodily symptoms include a sense of hotness, cold sweating, pale skin, dizziness, drowsiness, headache, and fatigue. Mental debility includes depression, apathy, difficulty concentrating, and mental confusion. If there is no relief from airsickness, it can progress to repeated vomiting and diarrhea. Even if the distress does not progress to the point of vomiting, a person may feel completely incapacitated.

To combat airsickness, reading and writing during a flight should be kept to a minimum. This maxim is hard to apply because studying maps and recording notes are two of the main activities of an aerial survey.

Other important steps are to avoid turbulent days, take a motion sickness drug (if desired), rest periodically, and maintain an easy-going attitude.

If the principal observers are feeling sick, then work must stop. Quality and reliability of judgements and notes plummet when surveyors are nauseated.

The following measures before a flight may help combat the onset and severity of airsickness:

Wear loose, light clothes that can be removed to help keep cool.

Avoid dehydration.

Don't fly on an empty stomach or a full stomach. Eat a light meal, perhaps an hour or two before flying. Non-spicy, non-greasy food is advised unless you know what you can handle. [*]

Take a prescription motion sickness drug or nonprescription drug (such as Dramamine). [†]

Try other remedies, such as eating ginger and applying acupressure to a wrist. [‡]

Abstain from alcohol and tobacco.

If you're worried about becoming sick, try to relieve the stress by talking to others about your concern, but try not to dwell on it.

Be wary of windy days. The pilot can forecast how turbulent the air will be.

On warm, sunny days, fly in the morning before thermal uplifts make for a bumpy ride.

Plan the flight to have periodic idle segments, with nothing to survey.

Plan to stop at an airstrip and rest. Beginners should land after an hour or two, until learning how long they can comfortably continue.

Direct the pilot to bank and turn gently. Even a single steep bank and sharp turn — done "for the thrill of it" — can initiate airsickness.

The following tips will help reduce the likelihood of motion sickness during the flight:

Relax. Don't rush. Enjoy the ride and the scenery. Don't feel pressured or worry about the job.

Be cautious about continually shifting your focus from the ground to the inside of the craft.

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[*] One Web site about motion sickness recommends avoiding meals that are "high in salt, protein, or dairy products." Another Web site disagrees: "go for something that has some protein and fat in it."

[†] These drugs are likely to cause drowsiness or other mental impairment.

[‡] Ginger is available in many forms: dried root, tablet, lozenge, candy, tea, or ginger ale.

Use a voice recorder or video camera to record most observations, rather than writing.

Frequently sit back and look straight ahead or gaze steadily at the horizon.

Avoid looking backward or turning around suddenly.

Use binoculars very sparingly if at all — unless you know that you can look through them without becoming sick. Binoculars greatly magnify the craft's bump-and-sway.

Be aware that looking through the viewfinder of a video camera can induce airsickness.

Some people find it helpful to chew gum.

Avoid unpleasant odors.

Be sensitive to others who seem to be getting sick, and encourage them to rest.

If you are feeling queasy in the air, do the following:

Speak up and tell the rest of the crew that you are not feeling well.

Have an airsickness bag open and held in hand. Nausea can come in an instant. Do not be too proud to open a sick sack and hold it at ready. Everyone will appreciate your precaution.

Open an air vent (usually near the ceiling) and direct a fresh breeze into your face. Hold your wrists in the cool jet of air.

Turn over your duties to someone else and rest while the survey continues.

If circling is the problem, stop the survey and cruise in a straight line for several minutes.

Ask the pilot to fly higher in search of smoother air (though this altitude may prove to be too high to examine the sites adequately).

Try closing your eyes, but open them if dizziness increases.

Take calm, deep, slow breaths.

Yawn.

Try sipping a drink (water, Gatorade, etc.) or eating something bland (crackers, for instance).

If you are sitting in a rear seat, land and move to the front. Rear seats rock and sway significantly more than front seats.

Quit flying before you vomit. Nothing induces nausea faster than a fellow passenger vomiting.

The Internet has plenty of information about motion sickness and how to prevent it. Google "motion sickness" for Web sites. In addition to standard medicines, some people swear by preventive measures such as eating ginger or wearing a wrist strap that presses on an acupressure point. Learn what works best for you, and share this knowledge with other INAI staffers. The Survey Coordinator can provide URLs to selected Web sites as well as other information about preventing airsickness.

CHAPTER 7

FIELD SURVEY STAGES

The Inventory staff conducts visits to Survey Sites in two stages: the Initial Ground Survey and the Final Field Survey.

7.1. Initial Ground Survey Stage

The Initial Ground Survey is a quick visit to a Ground-truthing Site or to a Potential Natural Area.

Purposes of the Initial Ground Survey

The Initial Ground Survey is a quick look at a Survey Site. This stage has the following purposes:

(1) Provide ground-truthing information in support of the Map & Aerial Photo Stage and the Aerial Survey Stage.

(2) Screen Potential Natural Areas and determine whether they should receive a Final Field Survey.

(3) Begin gathering detailed information about sites that will receive a Final Field Survey.

Seasonal considerations

Initial Ground Surveys need to be carried out ahead of the Final Field Surveys in order to determine which areas should receive a Final Field Survey. Initial Ground Surveys must also be carried out in conjunction with the Map & Aerial Photo Stage and Aerial Survey Stage, which are conducted in the fall, winter, and early spring months.

The Final Field Survey of almost all kinds of natural areas must be done in the spring and summer months, when plants are growing and animals are breeding. Although the growing and breeding season also has advantages for Initial Ground Surveys, most of the preliminary surveys are done during the dormant season because there is not enough time to do all of the fieldwork during the spring and summer months. Field surveys must be spread throughout the year.

The dormant season has several advantages for fieldwork:

The weather is not hot during the dormant season.

Marshes, swamps, and other flooded wetlands are easy to survey when they are frozen and the ice is thick enough to walk on safely.

When the ground is frozen, a vehicle is less likely to become stuck in mud.

Biting insects, ticks, chiggers, and spiders are not active.

Poison ivy is much less poisonous. Other irritating plants such as nettles and wild parsnip are harmless.

Mature, intact acorns are available for identifying oak species.

The forest understory is leafless, making it easier to walk and to see through woods. It is easier to spot small rock outcrops, seeps, prairie openings, and disturbance features such as dumps and stumps.

It is possible to do quick roadside surveys because one can see into the edge of woods and through grown-up fencerows.

Corn has been harvested, so it does not block the view across fields.

Farmers are less busy, and they are more likely to have time to deal with a request to look at their land.

Crops are harvested, so farmers are more likely to permit access across fields.

The dormant season also has disadvantages for conducting biological surveys:

It is not possible to prepare a very complete list of the fauna and flora of a site during the dormant season. Many animals become inactive or go elsewhere for the winter. Herbaceous plants have deteriorated significantly or have completely decayed, making it difficult or impossible to adequately assess the flora. Although dominant plants usually can be identified, many species cannot be found or recognized a month or two after they have set seed.

Expert skills are required to identify trees and shrub species when they are leafless.

Land is more likely to be inaccessible during the winter and early spring because of flooding and wet soil.

Field surveys must be curtailed (either suspended or restricted to safe areas) during the firearm deer hunting season.

Some properties are off-limits throughout the hunting seasons for various game animals because the land is reserved for hunters. (Some hunting seasons are during the growing season, too.)

7.2. Final Field Survey Stage

The Final Field Survey involves detailed, on-site description, evaluation, classification, and mapping of a Survey Site that appears to qualify for nomination as a Natural Area.

Purposes of the Final Field Survey

The purposes of the Final Field Survey are to document a site's significance as a natural area, and to collect information that will aid efforts to protect and manage the area. This stage accomplishes the following tasks:

(1) Delineate the natural area's boundaries.

(2) Describe and map the location of Significant Features.

(3) Classify, map, and rate the quality of Natural Communities.

(4) Describe the vegetation and fauna.

(5) Describe the site's ownership, land use, management problems, and threats.

(6) Establish plots and points and gather data to be used for comparing sites and for monitoring sites in the future.

CHAPTER 8

SURVEY SITE RECORD AND THE SCREENING PROCESS

8.1. Survey Site Record

The Natural Areas Inventory Update will identify many more Potential Natural Areas than the original INAI. It is estimated that the Update will need to manage information on approximately ten times more Potential Natural Areas than the original project. It will not be possible to visit all of these sites during the three-year period of the Update. Aside from the sheer number of new sites, more land is off-limits to INAI fieldworkers now than in the 1970s. Consequently the update project will compile preliminary and incomplete information about hundreds of Potential Natural Areas that will not be visited to determine whether they actually qualify as natural areas.

The Survey Site Record is designed to keep track of incomplete information about Potential Natural Areas. It serves to record preliminary evaluations and to set priorities for further inventory work. If a site cannot be fully investigated during the course of the Inventory Update, information about the site will be archived so that the site can be examined more closely as future opportunities and needs arise. For example, a Potential Natural Area might be fully investigated at a later date if it falls within the planning corridor of a projected road construction project.

Preliminary information about Potential Natural Areas will also be saved so that the information can be made available to specialists in the future. For instance, the Regional Ecologists will not attempt to study the biology and water quality of springs, but they will note the location of springs so that they can later be examined by other scientists.

8.2. Designating a Survey Site

The act of creating a Survey Site is called *designating* the site. To designate a Survey Site, one must do the following:

(1) determine the Survey Site type,

(2) determine the Survey Feature,

(3) assign a Site Code,

(4) record the above three items on a Survey Site Record,

(5) delineate the site on a map (either on paper or in a GIS), and (if using a paper Survey Site Record),

(6) record the location.

8.3. Screening Process

The process of screening (selecting and evaluating) a Potential Natural Area usually extends over several months in a series of formally defined Survey Stages. At each of these stages, the Surveyor does the following:

(1) Makes observations and gathers information,

(2) Analyzes the information,

(3) Records the information and analysis,

(4) Makes decisions based on the information and analysis,

(5) Records the decisions,

and

(6) Proceeds to the next stage of screening the Potential Natural Area —

or (more often):

(7) Goes on to another Potential Natural Area and conducts the same Survey Stage.

The Screening Process is designed so that preliminary decisions about a site's significance and its priority for further investigation are recorded while the screening is being carried out. These preliminary decisions help guide the progress of investigating a site.

The INAI Update will identify more Potential Natural Areas (PNAs) than can be fully surveyed during the course of the project. If it is necessary to suspend investigation of a site before it is completed, information and decisions that are recorded in the Screening Status section of the Survey Site Record will be available to guide the survey when work is resumed at some future date. *

8.4. Screening Status

The Screening Status section of the Survey Site Record keeps track of the progress of the survey effort as well as any interim decisions about the Survey Site that were made during the process. The Screening Status section has four subsections or decision points:

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* The survey of a region or of a Potential Natural Area might be resumed when more funding is secured, or for instance when a roadway is being planned through the region, or when a biologist is looking for a set of new research sites.

Next Stage
Screening Prediction
Survey Priority
Screening Conclusion

These four decision points are introduced here in terms of the questions that they address:

(1) **Next Stage:** What Survey Stage should be done next for this site?

(2) **Screening Prediction:** What is the likelihood that this area will turn out to be a Final Candidate Site?

(3) **Survey Priority:** Should this site be one of the next ones to be surveyed, or should its investigation be deferred?

(4) **Screening Conclusion:** Based on the information available at the end of the Screening Phase, how significant does this site appear to be?

Answers to these questions direct the progress of the survey effort for a site. The four decision points are employed only to the extent necessary. The Next Stage subsection of the Survey Site Record is not always filled out or kept up-to-date. The Screening Prediction is recorded primarily to help determine the Survey Priority. The Screening Conclusion is the one decision that ultimately matters.

The four decision points are interrelated but distinct. The first decision point calls for the name of the next Survey Stage that should be completed. The other three sub-sections of the Screening Status section are relative values, summarized as follows:

Table 3. Relative values for the Screening Prediction, Survey Priority, and Screening Conclusion.

Screening Prediction	**Survey Priority**	**Screening Conclusion**
High Potential	High Priority	High Significance
Medium Potential	Medium Priority	Medium Significance
Low Potential	Low Priority	Low Significance
No Potential	No Further Survey	No Significance

Here is the difference between the Screening Conclusion and the Screening Prediction:

> The Screening Conclusion is an estimate of a site's *significance*: *High*, *Medium*, *Low*, or *No* Significance. The Screening Conclusion is reached at the end of the Screening Process, when there is essentially no doubt about the significance of a site. If a site is almost certainly going to qualify as a Natural Area, it has High Significance.
>
> On the other hand, the Screening Prediction is an estimate of the likelihood that a site will later be designated as having High Significance. This estimate is made earlier in the Screening Process, when less is known about the site. The estimate is stated in terms of the site's *potential*: *High*, *Medium*, *Low*, or *No* Potential.

The four parts of the Screening Status section — *i.e.* the Next Stage, Screening Prediction, Survey Priority, and Screening Conclusion — are described on the following pages. An illustration of how all of these parts work together begins on page 80.

8.5. Next Stage

At any time when it is needed or wanted during the Screening Process, the Surveyor can state which Survey Stage should be done next for a Survey Site.

Survey Stages

There are six options for the Next Stage, which are the five formally defined Survey Stages plus a default placeholder ("undetermined"):

> Existing Information Stage
> Map & Aerial Photo Stage
> Aerial Survey Stage
> Initial Ground Survey Stage
> Final Field Survey Stage
> Undetermined stage

When to determine the Next Stage

The Next Stage subsection of the Survey Site Record remains "undetermined" until the Surveyor wants to or needs to specify the next stage of investigation of a site. The Next Stage quickly becomes out-of-date and incorrect if it is not revised every time a Survey Stage is completed, but it is all right to allow the Next Stage to become outdated. It would be busywork to continually prescribe the next step after each Survey Stage is completed, and the Surveyor usually does not need to refer to this item in order to know what needs be done next with a Survey Site.

The Next Stage subsection is completed or updated when it is useful to do so — for instance to indicate which sites in a county need to be flown, or to compile a list of sites to be checked during the next visit to a library where old aerial photos are available.

The Next Stage should be recorded for all Potential Natural Areas in a Survey Region if work in the region is about to be suspended. This precaution helps to ensure that the inventory can be resumed expeditiously at a later date.

8.6. Screening Prediction

At any appropriate time during the Screening Phase, the Surveyor can provide a preliminary estimate of the likelihood that a site will be designated as a Final Candidate Site when it is fully screened. This Screening Prediction is used to help determine the Survey Priority (see page 76).

Although several factors are considered when scheduling future work, the Surveyor often gives priority to sites that show the most potential for qualifying for nomination as a Natural Area. The procedure for selecting Potential Natural Areas is liberal, and most of the candidates that are identified will ultimately turn out to be Nonqualifying Sites. However, among the pool of PNAs, some will show higher potential than others. The Screening Prediction estimates the relative potential of each site.

Definitions of options for the Screening Prediction

The five options are defined as follows:

Table 4. Options for the Screening Prediction.

High Potential	The site is estimated to have a roughly 25% or greater likelihood of being designated as a Final Candidate Site. (25% is a provisional value; it may need to be adjusted.)
Medium Potential	The site is not clearly a High Potential site or a Low Potential site, but it is in-between.
Low Potential	The site is estimated to have an approximately 5% or less likelihood of being designated as a Final Candidate Site.
No Potential	The site is predicted to be a Nonqualifying Site.
Undetermined potential	The site's potential has not been estimated. (This is a default placeholder.)

How to predict a Survey Site's potential

The Screening Prediction is a rough estimate, and there is no prescribed formula or step-by-step method for making this prediction. The estimate is based on four factors:

(a) the characteristics of the site,
(b) the quality of information about the site,
(c) the liberalness of the evaluation process, and
(d) the experienced judgment of the evaluator.

Normally a site's characteristics (*e.g.* its apparent quality) are the primary consideration when estimating its potential, but the quality of the information about the site can also come into play. For instance a site may be rated Low Potential if it was identified on the basis of a report that was considered to be probably unreliable. The last two factors in the above list (*liberalness* and *experienced judgement*) are related: with experience, the Surveyor's judgment should become more accurate (neither unduly liberal nor unduly conservative).

Screening Predictions are interim, ad hoc estimates. Assignment of a prediction should not require much time or any detailed analysis. Three of the options (High Potential, Low Potential, and No Potential) are often obvious choices and are therefore easy to determine; everything else is Medium Potential.

The great majority of Potential Natural Areas will prove to be Nonqualifying Sites when they are fully evaluated. In the end, perhaps only 1 in 20 PNAs will become Final Candidate Sites. Because this proportion is so low, High Potential is defined with generous odds (about 1 chance in 4). If High Potential were defined in more conventional and conservative terms (say, with a 90% or better likelihood of being a Final Candidate Site), very few sites would be rated High Potential. In order for the Screening Prediction to be the most useful tool for planning further survey work, PNAs should be more or less evenly distributed among the *High*, *Medium*, and *Low* options. Consequently the High Potential option is provisionally defined as a roughly 25% or greater likelihood (not a 90% likelihood) that a PNA will prove to be a Final Candidate Site. Among Low Potential sites, only about 1 in 20 areas (at best) is expected to ultimately qualify as a Natural Area.

Relationship between the Screening Prediction and the Screening Conclusion.—The Screening Prediction is an estimate of the probability that a Potential Natural Area will be designated as a Final Candidate Site. The Screening Prediction is not a prediction of the Screening Conclusion (which is discussed on page 78). That is, the Screening Prediction does not address whether a site will end up being of *High*, *Medium*, *Low*, or *No* Significance. Instead the Screening Prediction is a rough estimate (either *High*, *Medium*, *Low*, or *No*) of the likelihood that a PNA will prove to have High Significance. Although most Low Potential sites will ultimately be determined to have Low Significance (or No Significance), there is no direct relationship between the Low

Potential rating of the Screening Prediction and the Low Significance rating of the Screening Conclusion. *

Illustrations of the prediction process

Five examples demonstrate how to predict the potential of a Survey Site:

(1) If a potential prairie is identified on aerial photography and it looks similar to nearby sites that have already been fully screened and determined to have Low Significance or No Significance, the site should be assigned a Low Potential.

(2) On the other hand, if this PNA looks similar to nearby prairies that are known Natural Areas, then it should be rated High Potential. Prairie remnants and seep communities in particular often owe their existence to an unusual combination of physiographic conditions and land use practices. Wherever these factors come together, they tend to do so again and again in a limited region. Consequently natural prairies and seeps are not evenly distributed across the landscape; they are often in loose groups. Even high quality forests are sometimes clustered because the local topography and the land use ethic in a limited region have fostered their survival.

(3) A Survey Site should receive a High Potential rating if it is clear from aerial photography that the area is relatively large and undisturbed.

(4) Old cemeteries in prairie and savanna regions have some potential for significant native vegetation, but the potential is *Low* because the great majority of cemeteries have no native vegetation remnants. In 1976 the Illinois Natural Areas Inventory surveyed 3,923 cemeteries and found that 135 of them had noteworthy native vegetation. On the average, out of every 29 cemeteries, one of them was either a Natural Area of statewide significance or a Notable Area. †

(5) If a trusted expert says that a site is a significant natural area, it should not be assigned High Potential. Instead the Screening Prediction should simply be skipped, and the Screening Conclusion should be designated as High Significance.

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* See page 71 for more discussion of this issue.

† The designation of Notable Area is not being used by the Illinois Natural Areas Inventory Update. A Local Natural Area is roughly equivalent to a Notable Area.

When to determine the Screening Prediction

The Screening Prediction can be made as soon as the Surveyor has gathered enough information to make it. The prediction can be revised at any time as appropriate.

The Surveyor should complete the Screening Prediction for a site before its Survey Priority is determined.

The Screening Prediction should be recorded for all Potential Natural Areas in a Survey Region if inventory work in the region is about to be suspended. This precaution ensures that the Surveyor's latest and best estimate of the potential of every site has been documented.

Uses of the Screening Prediction

The Screening Prediction has three purposes: to help set survey priorities, for Quality Control, and to help refine the survey methods and their application.

Setting survey priorities.—The Screening Prediction is used to help determine the Survey Priority (see page 76). In general High Potential sites are considered High Priority for further investigation. The Screening Prediction is a relative value, and it should be assigned so that PNAs are well spread out among *High*, *Medium*, and *Low* Potential. If almost all of sites are classified as Medium Potential or Low Potential, then the Screening Prediction loses much of its value as a tool for setting priorities for further work. It may sometimes prove necessary to lower the threshold for High Potential sites (*i.e.* from about 1-in-4 to 1-in-10) so that an adequate number of PNAs are designated as High Potential. Otherwise, there might not be a sufficient spread in the rankings, and too few sites will be distinguished as top priority for surveying.

Quality Control.—If a Surveyor consistently overrates or underrates the potential of PNAs (in comparison with other Surveyors), the reason for the discrepancy should be explored. For instance if the Surveyor rates a disproportionate number of sites as High Potential, is this the result of inordinate and unwarranted optimism? Or is the Surveyor truly and simply adept at picking out good sites and passing over ones that would later end up being rejected when they are examined more closely?

Refining the survey methods and their application.—As the inventory progresses, it will be useful to see how well the Screening Predictions match the outcome of the Survey Process. If, for example, the Map & Aerial Photo Stage produces a great number of sites that appear to have High Potential, but hardly any of them prove to be Final Candidate Sites, then the approach to photo interpretation may need to be adjusted.

8.7. Survey Priority

At any appropriate time during the Screening Process, the Surveyor can state the priority for conducting further work on a Survey Site. From time to time, the Survey Priority is used to help summarize what needs to be done next in a Survey Region. The Survey Priority helps keep the project on track, and it helps keep track of how each Survey Site needs to be treated in the future.

Definitions of options for the Survey Priority

The five options are defined as follows:

Table 5. Options for the Survey Priority.	
High Priority	The site should be investigated before lower priority sites if it becomes necessary or desirable to set priorities and follow them when scheduling future work.
Medium Priority	The Survey Priority is not clearly *High* or *Low*, but it is in-between.
Low Priority	Investigation of the site should be deferred if it becomes necessary or desirable to set priorities and follow them when scheduling future work.
No Further Survey	The site does not need any more investigation.
Undetermined priority	The Survey Priority has not been established. (This is a default placeholder.)

How to determine the Survey Priority

The Survey Priority for a site is a simple judgment based on the guidelines in the following table:

Table 6. Guidelines for determining the Survey Priority.	
High Priority: The Survey Site has characteristics that are listed under one or more of the following four considerations:	
Screening Prediction	The site's Screening Prediction is High Potential. SEE NOTE 1 that follows this table.
Value to the Survey Process	The Surveyor needs to learn more about the site in order to do a good job of surveying other sites.

Logistics	In terms of logistics, it makes plenty of sense to survey the site soon. For example: the site is close to other PNAs that will be surveyed soon, and it would be necessary to go far out of the way to visit the site at a later time.
Goodwill	In terms of goodwill for the project, it would be quite worthwhile to survey the site soon. For instance, a landowner is urging the Regional Ecologist to visit the site.
Medium Priority: The priority for further survey work falls between High Priority and Low Priority.	
Low Priority: The Survey Site matches all of the following characteristics:	
Screening Prediction	The site's Screening Prediction is Low Potential (and, perhaps also Medium Potential — depending on the relative proportion of Low Potential and Medium Potential sites). SEE NOTE 2 that follows this table.
Value to the Survey Process	Further investigation of the site would provide little or no information that would improve the Survey Process.
Logistics	In terms of efficiency, there is little or no advantage to surveying the site soon.
Goodwill	Little or no goodwill would be engendered by surveying the site soon.
No Further Survey: No more investigation of the site is required, so there is no need to state a *High*, *Medium*, or *Low* Survey Priority.	
Undetermined priority: The Survey Priority has not been determined. (This is a default placeholder.)	

NOTE 1: A site has High Potential if the Surveyor judges that there is a relatively high likelihood that the site will be designated with High Significance at the conclusion of the Screening Process. There is no prescribed procedure for assigning different levels of importance among a group of sites that have High Potential. In this sense, "All High Potential Survey Sites are considered equal." However, in fact, there is a range in the value of High Potential sites. For instance, a big, diverse site with a rare Community Type is more valuable than a small site with a single, common Community Type. If desired, the Surveyor can fine-tune Survey Priorities on an ad hoc basis by giving higher priority to sites that appear to be more significant. [*]

[*] The Survey Priority is based on of a site's *potential*, not its *significance*. See the discussion of the difference between the Screening Prediction and the Screening Conclusion on page 71. See also *Relationship between the Screening Prediction and the Screening Conclusion* on page 73.

NOTE 2: If the Screening Prediction for a site is Low Potential, then its Survey Priority is *Low*. In addition, some Medium Potential sites may also be included in the *Low* Survey Priority if taking this action will distribute the sites more evenly between Low Priority and Medium Priority. As discussed on page 75 under *Setting survey priorities*, there are advantages to spreading out the sites so that they are not assigned mostly to a single Survey Priority.

NOTE 3: The Survey Priority is often designated in relation to an upcoming Survey Stage. For instance a Survey Site would have a High Priority for the Map & Aerial Photo Stage if old aerial photos need to be reviewed before an upcoming Aerial Survey.

NOTE 4: Additional factors (other than the four considerations listed in the above table of guidelines) may prove to be important for determining the Survey Priority. If other factors are used to decide the Survey Priority, this should be explained in the Notes for the Survey Priority subsection on the Survey Site Record. If additional factors are routinely considered to determine the Survey Priority, then the guidelines will be revised to add these other factors to the standard set of considerations.

When to determine the Survey Priority

The Survey Priority subsection is completed when it is needed for planning purposes. During the first three stages of the Survey Process (Existing Information, Map & Aerial Photo, and Aerial Survey), most or all of the PNAs in a Survey Region (*e.g.* a county) are apt to be surveyed as a group — without setting priorities among sites. The Initial Ground Survey Stage and Final Field Survey Stage are much more time-consuming, so it is more often necessary to set priorities regarding which sites should be visited on the ground.

The Survey Priority should be recorded for all Potential Natural Areas in a Survey Region if work in the region is about to be suspended. This precaution ensures that the Surveyor's latest and best estimate of the priority for every site is documented.

8.8. Screening Conclusion

Whenever enough has been learned about a Potential Natural Area during the Screening Phase, the Surveyor can reach a conclusion about the site's significance. The Screening Conclusion has a substantial bearing on whether a site will receive further investigation.

Definitions of options for the Screening Conclusion

The options are defined as follows:

Table 7. Options for the Screening Conclusion.	
High Significance	The site meets, or appears to meet, the standard criteria for listing as an Illinois Natural Area. SEE NOTE 1 that follows this table.
Medium Significance	The site does not appear to meet the standards for listing as an Illinois Natural Area, but the Category I Survey Feature is at least partly Grade C, or it consists of Grade A or B communities that are too small to qualify as a Significant Feature. SEE NOTE 2 that follows this table.
Low Significance	The Category I Survey Feature is Grade D. SEE NOTE 2 that follows this table.
No Significance	The site does not have the Survey Feature that was the basis for its selection as a Survey Site.
Undetermined significance	The site's significance has not been determined. (This is a default placeholder.)

NOTE 1: The Illinois Natural Areas Inventory Update is focusing on Category I sites, but a Potential Natural Area that has any category of Survey Feature (Category I, Category II, and so forth) may be included in the Survey Process and might be rated with High Significance.

NOTE 2: The options of Medium Significance and Low Significance pertain only to sites with Category I Survey Features. If a site does not have a Category I Survey Feature, it can only be designated as having either High Significance or No Significance. There is no intermediate ranking of Medium Significance or Low Significance for Categories II, III, and so forth.

How to determine a Survey Site's significance

The Screening Conclusion is determined by selecting one of the options that are defined in the preceding table. The conclusion can be based on information that was obtained during any step in the Screening Process. If the conclusion is High Significance, it is likely to have been reached on the basis of information gathered during an Initial Ground Survey. It is usually difficult or impossible to determine that a site is highly significant without setting foot on it.

A conclusion of No Significance is often based on observations made during an Aerial Survey or Initial Ground Survey, but it might also be derived from the Map & Aerial Photo Stage. The fact that a site is not significant is often immediately obvious — even from a distance — if the area is severely disturbed and obviously lacks the Survey Feature that was being sought.

A Screening Conclusion can also be derived from the Existing Information Stage (*e.g.* an interview) if the information is credible and specific enough to reach a conclusion about the site's significance.

When to determine the Screening Conclusion

The Screening Conclusion can be made as soon as the Surveyor has gathered enough information to determine it. The conclusion can be revised at any time as appropriate.

Outcome of the Screening Conclusion

Normally the Screening Process comes to an end for a Survey Site when the Screening Conclusion is reached — but the Regional Ecologist may continue to add or edit information on the Survey Site Record. If the Screening Conclusion is High Significance, the site is carried on to the Final Field Survey Phase. If the Screening Conclusion is Medium Significance, the site may or may not be treated further as a potential Local Natural Area (the procedure for identifying locally significant areas is yet to be worked out). If the Screening Conclusion is Low Significance or No Significance, then the Survey Process is usually finished for the site. [Revise this to add potential BKS.]

8.9. An Illustration of the Survey Process

Figure 3 on page 82 is a hypothetical example of the manner in which a Potential Natural Area is surveyed. The chart shows the four decision points of the Screening Status (*i.e.* Next Stage, Screening Prediction, Survey Priority, and Screening Conclusion) in relationship to the Survey Stage, Survey Site type, Survey Feature, and Significant Feature. Following Figure 3 is a chronology of the activities that are depicted in the figure.

Note that all of the decision points start out as "Undetermined" in Column 1, and they remain undetermined until they are replaced by a specific option. (Each decision point has a standardized set of options from which to choose.)

N/A in a cell means "not applicable."

The short dashed lines indicate steps in the Survey Process where the option for a decision point has expired (or may have expired) but an updated option has not been entered. For instance, the Next Stage in Column 2 is Aerial Survey. After the Aerial

Survey is completed in Column 3, the Next Stage is not updated until the Initial Ground Survey (Column 5), when the Final Field Survey is designated as the Next Stage. It may seem to be a poor practice to allow the Next Stage to expire and not be updated. However, during the early stages of the Survey Process (especially the Aerial Survey Stage and the Map & Aerial Photo Stage), the Surveyor is handling so many PNAs so quickly — it would be an unnecessary and unhelpful expenditure of time and attention to continually update the Next Stage. Documenting the Next Stage is a tool to make sure that the survey progresses efficiently; this documentation should not become an end in itself.

Figure 3. Illustration of the Survey Process for a Hypothetical Survey Site.

Column:	1	2	3	4	5	6
Survey Stage	Existing Information	Map & Aerial Photo	Aerial Survey	Map & Aerial Photo	Initial Ground Survey	Final Field Survey
Survey Site Type	Potential Natural Area →					Final Candidate Site
Survey Feature	Cat. I: Forest →			[The forest was rejected during the Aerial Survey.]		N/A
	[The seeps were not found until the Aerial Survey.]		Cat. I: Seep →		Cat. I: Calcareous seep	N/A
Significant Feature	N/A	N/A	N/A	N/A	N/A	Cat II: Poa wolfii
Next Stage	Undetermined	Aerial Survey	---	---	Final Field Survey	N/A
Screening Prediction	Undetermined	Medium Potential	---	Low Potential	---	N/A
Survey Priority	Undetermined	Undetermined	Undetermined	Undetermined	High Priority	N/A
Screening Conclusion	Undetermined	Undetermined	Undetermined	Undetermined	High Significance	N/A

Chronology of the Survey Process in Figure 3

COLUMN 1: March 1.—A landowner phones Dorothy, the Regional Ecologist, to tell her about a woodlot on her farm. The owner says that the woods has trees "4 foot through," and she gives Dorothy directions to the woods. Dorothy begins a Survey Site Record for a new Potential Natural Area and records the Survey Feature as Category I: Forest. She documents the conversation on an Interview or Files Source Form.

COLUMN 2: March 8–11.—Dorothy conducts the Map & Aerial Photo Stage for the county and examines a series of recent digital aerial photos and old USDA aerial photography of the site. The forest appears to have average trees, and it was obviously heavily pastured in the 1930s to '60s. But based on the owner's description, she gives the site the benefit of a doubt and makes a Screening Prediction of Medium Potential. She slates the site for an Aerial Survey as the Next Stage.

COLUMN 3: April 7.—Dorothy examines the site as part of her aerial survey of the county. She notes that the woods has several large-diameter, broad-crowned white oaks along one edge, but the rest of the stand is mature second growth. The understory is

dense with multiflora rose and autumn olive, indicating that the woods never recovered from past grazing. A grassy patch at the head of a ravine appears to be a seep. Dorothy deletes the Survey Feature called Category I: Forest and adds a new one, Category I: Seep.

COLUMN 4: April 18.—Dorothy reexamines early aerial photography and confirms that all of the woods, including the ravine with the potential seep that she noted from the air, was heavily grazed. By scrutinizing recent dormant-season color infrared photography, Dorothy detects small seepage areas in a total of three ravines. Based on the prolonged history of pasturage and the degraded condition of the surrounding forest, Dorothy decides that the seeps have low potential, and she selects this option for the Screening Prediction.

COLUMN 5: April 21.—Dorothy conducts a quick Initial Ground Survey and spots grass-of-Parnassus in the first seep that she visits. This species indicates calcareous seepage, so she revises the Survey Feature to Category I: Calcareous seep. It is too early in the growing season to evaluate the quality of the seeps, so she looks no farther than the first one and decides to come back later in the year. Based on this initial on-site inspection, Dorothy records the Screening Conclusion as High Significance, she designates the Survey Priority as *High*, and she prescribes the Next Stage as Final Field Survey.

COLUMN 6: June 20.—Dorothy returns to the site with a field assistant to conduct the Final Field Survey. They find that the seeps are all Grade D because they are strongly dominated by reed canary grass and there is hardly any native plant species diversity. But the assistant finds a thriving colony of Wolf's bluegrass, an Endangered Species, surrounding a block of tufa in the middle of one seep. The Survey Site type is changed from Potential Natural Area to Final Candidate Site, with the Significant Feature being Category II: Poa wolfii.

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APPENDIX 1

HISTORICAL AERIAL PHOTOGRAPHY

Introduction

The first flights to obtain systematic, broad-scale aerial photographic coverage of Illinois were made by the U.S. Department of Agriculture during the 1930s. Each county was first photographed from the air in a series of flights between 1936 and 1941. Each photo covers about 10 square miles, and an average county is covered by a few hundred overlapping photos.

These historical aerial photos are irreplaceable records of past land use and land cover. Natural areas are relatively undisturbed relicts of past conditions, so the information preserved by the earliest available aerial photography is fundamental for selecting and evaluating potential natural areas.

Historical aerial photography is useful to the Natural Areas Inventory Update in three main ways:

(1) Detecting some natural areas that are not distinguishable on newer photography.

(2) Rejecting some Potential Natural Areas by determining that they were too heavily disturbed in the past.

(3) Helping to map old disturbance features and delineate the boundaries of a natural area by identifying past disturbances that are not visible on new photos.

In Praise of Old Photos

Aerial photography taken prior to World War II is a window into the past, preserving the appearance of the landscape when it was farmed with horses, including the distinctive pattern of haystacks and corn shocks arrayed across fields.

Compared with recent photography, historical aerial photos are often a clearer and more productive source of information about natural lands and waters. Photos from the 1930s usually have relatively good resolution, and they often have exceptionally good contrast — making it possible to distinguish small but important features such as a cowpath in a prairie or a gap in the forest canopy caused by the death of a single tree. In contrast, modern photos are usually taken from a higher altitude, and their resolution and contrast are often disappointingly poor.

The resolution of modern digital aerial photography does not compare favorably with that of conventional photographic prints. Today's high-resolution digital aerial photos consist of a grid of square pixels that cover areas as little as one-half meter or even six inches wide on the ground. Any thing smaller than a cluster of several of these pixels is usually unidentifiable on such photography. In contrast, the fine grain of conventional aerial photography often allows the photo interpreter to distinguish high-contrast linear features that are as narrow as the dashed center stripe on a highway and sometimes even cables strung between electrical transmission towers.

Many of the natural areas that we value today are the product of a long period of recovery after heavy disturbance (even clearcutting of forest) around the beginning of the last century. The present-day character of a natural area is more strongly influenced by conditions a century ago than by the so-called presettlement conditions of two centuries ago. We have no aerial photos from a century ago; flights conducted during the 1930s provide the earliest comprehensive visual documentation of the landscape.

Using Historical Aerial Photography to Find and Evaluate Natural Areas

Historical aerial photography from the 1930s is an essential tool for accomplishing the following tasks:

(1) Assessing the former character of wooded lands.

(2) Helping to determine the present condition of wooded lands.

(3) Identifying potential prairies.

(4) Learning the history of change in wetlands.

(5) Detecting small, rare, cryptic, and unusual Natural Communities.

(6) Distinguishing long-ago disturbances in wildlands.

Each of these topics is discussed under the next six headings.

Assessing the former character of wooded lands

Historical aerial photography can be used to distinguish the following types of wooded lands:

(1) Areas that had a dense, closed-canopy *forest* in the 1930s.

(2) Formerly open *woodland* areas that had a discontinuous tree canopy (*i.e.* with many openings among the trees) during the 1930s.

(3) Former *savannas* that once consisted of individual trees as well as small copses scattered in grassland.

In addition to distinguishing the above three kinds of wooded land, historical aerial photos reveal how these lands were treated in the distant past. The first four decades of the 20th century was a period of the most pervasive and intense disturbance to wooded areas. By examining aerial photography from the 1930s, it is possible to see forests, woodlands, and savannas when they were maximally used and disturbed. Four major disturbances were at or near their maximum during the 1930s: *clearing*, *logging*, *grazing*, and *burning*.

Clearing.—By the early 1900s, most of Illinois' wooded lands had been converted to crop fields and pastures. For the most part, only the steepest hillsides and the wettest, most flood-prone bottomlands were left in trees. Soil erosion was severe on ground that should never have been farmed. Fields were abandoned as they wore out. Aerial photography from the 1930s shows the extent of clearing of wooded hill country during the era when this practice was at its height — and just when marginal farmland was starting to be taken back out of production during the Dustbowl era and the Great Depression.

Logging.—The greatest overall impact from logging came in the late 1800s when the remaining old-growth forest was harvested. During the 1930s, forest land consisted largely of the first generation of trees that were growing up after the original forest was logged. Timber cutting for lumber and firewood continued to be heavy into the 1930s. Although periodic logging has continued to be an important disturbance since

that time, the forests of the 1920s and '30s were generally as cut-over and immature as they have been during any period in history.

Grazing.—Almost all of the wooded areas in Illinois were pastured by domestic livestock as soon as immigrant farmers occupied the land in the early 1800s. Continual grazing since then helped maintain the open character of woods that had originally been kept open and grassy by frequent fires. Pasturage of woods did not begin to decline until the 1960s, when a great many farmers quit raising livestock or switched to confinement feeding operations.

Burning.—Broad-scale and frequent burning of wooded areas was a common practice until government-sponsored fire prevention campaigns were initiated in the 1930s and '40s. Severe drought during the 1930s made wildlands all the more flammable. Consequently aerial photography from the 1930s shows woods when they were being burned at a frequency and severity that may have been unprecedented. Soon afterward, though, the practice of burning woods was greatly curtailed, and eventually fires were almost completely eliminated from the state's wooded areas.

Burning during the early 1900s — along with logging, grazing by domestic livestock, and partial clearing — put wooded lands in their most damaged condition ever. The history of Illinois' woodlands and forests since the 1930s has been largely a history of recovery from these disturbances. Changes in the vegetation that attended this process of recovery during the past 70 years can be seen by comparing aerial photography from the 1930s with more recent photos, as discussed under the next heading.

Helping to determine the present condition of wooded lands

When historical aerial photos are studied in conjunction with modern photography, the following objectives can be accomplished:

(1) Identify forested stands that (a) appear to have been undisturbed and mature or old growth during the 1930s — and that (b) still appear to be undisturbed on new photography. These areas have high potential to be significant natural areas.

(2) Distinguish areas that were originally forested from areas that (a) were formerly savanna or open woodland — but that (b) have grown up into dense, closed-canopy forest since grazing and burning has ceased. The shift from open woodland to closed forest is one of the biggest ecological transformations of Illinois' wildlands during the past century.

(3) Recognize areas that now appear to be savannas but that were recently created by the removal of most of the trees in a wooded tract.

Identifying potential prairies

By examining a series of aerial photos that were taken over the course of many years, it is sometimes possible to find prairies that would otherwise be overlooked. Tracts of grassland typically exhibit a fine-scale, mottled pattern of small, contrasting patches of vegetation. In a high quality prairie, this pattern can be relatively stable over many years (*i.e.* the patches hardly shift their position or change their shape). If the vegetation pattern in a grassland remains unchanged from decade to decade, this is an indicator of natural prairie. Aerial photographs from the 1930s are the closest to the original natural conditions, so they are invaluable when searching for prairie remnants by comparing vegetation patterns in a series of photos that spans decades.

Long ago when prairies were more common, farmers often mowed them for hay. On aerial photography from the 1930s, it is not unusual to find a freshly mowed meadow that might be a prairie. It is rarely possible to confidently distinguish a native prairie from a non-native haymeadow by examining aerial photography, but if it appears that a haymeadow may have been a natural grassland in the 1930s, then the site should be checked on recent photography to see whether it still exists. A prairie that persisted until the 1930s might survive until the present. In fact, the practice of cutting hay may have helped to preserve the prairie by forestalling woody encroachment and by giving the farmer an economic incentive not to plow it under.

Learning the history of change in wetlands

Historical aerial photography is an irreplaceable source of information about the former existence, extent, and character of wetlands. Old photos often reveal the following sorts of conditions in wetlands:

- An apparently natural wetland is actually the product of an artificial impoundment or an excavation.
- A wetland was once larger but has diminished because of sedimentation, improved surface drainage, or groundwater depletion.
- A wetland that now appears to be natural was once drained and farmed. Old photos may reveal signs of past cultivation or drainage efforts that are now undetectable or too obscure to recognize with certainty.
- A wet area that is now dominated by trees and shrubs was once covered by herbaceous plants.

Aerial photography that was taken during the drought years of the 1930s can often be used to determine the former extent of a wetland that had already been drained and was being farmed at that time. A drained wetland may appear on this photography as the only part of a field where crops are growing well despite the stress of drought.

Detecting small, rare, cryptic, and unusual Natural Communities

Historical aerial photography is ideal for finding rare and unusual Natural Communities that occur as small anomalies and inclusions in wooded areas — such as glades, hill prairies, and fens or other seepage communities. In almost every instance, these small openings in the woods have shrunk because of encroachment by woody plants in the past 50 to 70 years.

Many of these areas are still significant even though they are being overgrown by trees and shrubs. They may be difficult or impossible to distinguish on recent aerial photography, but they usually can be spotted easily on photos from the 1930s.

Old aerial photography is especially useful in searches for rare remnants of barrens and other dry, thinly vegetated Natural Communities because these areas were generally more open, more extensive, and more distinct in the past.

Distinguishing long-ago disturbances in wildlands

By studying historical aerial photos, it is possible to see disturbances that are no longer obvious on new photography — such as abandoned wagon roads, clearings, fencelines, and farmsteads. The presence of these features on old photos can help explain variations in the present-day landscape and vegetation which are the result of disturbances that are no longer directly evident.

Examination of old photos can help confirm evidence of relatively recent logging that is not obvious enough to be conclusively identified on recent photography. If a forest has a denser, more continuous canopy on old photos than on new ones, this indicates that the forest may have been logged (or otherwise disturbed) after the date of the older photography.

An old aerial photo can show the past use of a field that is currently fallow, and it may provide evidence of the approximate year when the field was taken out of production. Or, an old photo may show that a supposed old field is actually a natural opening in the woods. If an opening is of questionable origin and it is not present on older photos, then it probably is an artificial clearing.

A field that has been cleared from a wooded area typically has sharp boundaries, and it often has a roughly rectilinear shape (*i.e.* straight edges and squarish corners). If this field is abandoned, then its boundaries will gradually soften and become curved as trees and shrubs encroach first on the most favorable spots along the borders. Consequently an opening that has a natural-appearing shape on a recent aerial photo may prove to be a former clearing if its original shape is determined by examining photography from the 1930s.