

Graphic Documentation

INTRODUCTION

Line drawing, photography, and videography are techniques for graphically documenting cultural landscapes. Line drawings, such as measured plans, sections, and elevations, and black and white photographs are the types of graphics used in a Cultural Landscape Report (CLR) to accurately record the appearance of a landscape at a particular time. Other graphics, such as diagrams, sketches, perspectives, maps and charts—reproduced from contemporary or historic materials—may also be used in a CLR. Additional forms of graphic documentation, such as color slides and video, are also valuable tools for recording the landscape and may be used to supplement other documentation.

Throughout a CLR, different formats and various scales of graphics are used to supplement narrative descriptions and documentation of the landscape. In the site history, period plans are used to illustrate landscape change through every relevant historic period. (See Figure 1.) These graphics are created by analyzing historic materials or reproduced from existing historical documents. In the existing conditions, an existing conditions plan is generated based on site research and investigations. This drawing, in addition to photographs, provides a contemporary record of a landscape's appearance and the condition of landscape characteristics and associated features. In the analysis and evaluation, elevations, plans, and schematic diagrams are used to show the relationship between historical research and the findings of existing conditions investigations. In the treatment section, a diagram, schematic, or detailed treatment plan illustrates a proposed treatment as it relates to a whole site, character areas, or management zones.

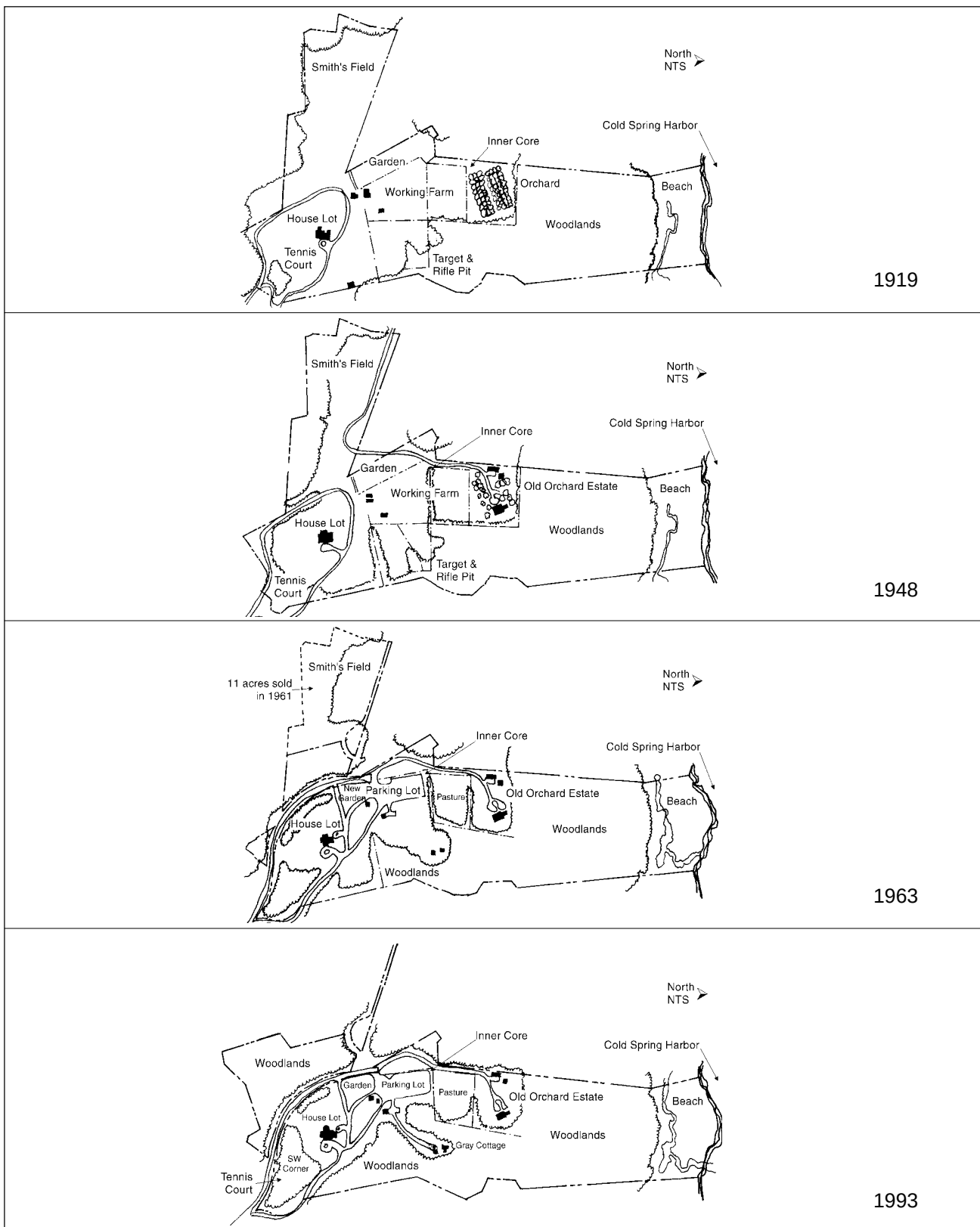


Figure 1. Diagrams are useful for quickly conveying certain types of information. These serial diagrams convey changes in spatial organization from 1919 through 1993. Sagamore Hill National Historic Site. (NPS, 1993)

LINE DRAWING DOCUMENTATION

Line drawings, particularly measured plan drawings, are a primary graphic technique used to accurately record the appearance of a landscape at a particular time. Line drawings may be hand-drawn or computer-generated, and in all cases must be accurate, clear, consistent in style, reproducible, and durable.

Accuracy

The purpose of line drawings is to objectively record in a durable medium the appearance of a landscape, and the landscape characteristics and associated features. It is important that line drawings accurately depict cultural landscapes because each graphic will become a historical record and a primary source of information. Accuracy is not, however, absolute; some inaccuracy results from graphically representing three-dimensional spaces. Although line drawings should be as accurate as possible, their accuracy is influenced by the following:

- management objectives for the CLR
- level of investigation required by the project agreement
- proposed treatment of the landscape
- accuracy of available site data, field surveys, and other sources used to prepare the line drawings

Depending on management objectives, park and technical staff should define the acceptable degree of accuracy in line drawings in the project agreement for a CLR.

Clarity

The clarity of a graphic refers to its legibility; that is, how easy it is to see the information presented in the graphic. All plans representing an entire landscape should have the same scale and use the same base map or base plan layer for clarity. (See Figure 2.) For example, a period plan and an existing conditions plan drawing should be generated from the same base plan and at the same scale to allow direct comparison. If a plan represents only an area of a landscape (such as landscape character areas or management zones), it should be clearly referenced to a base map of the entire landscape to indicate its specific location. A diagram key may appear on the drawing to indicate the location of the area represented by the larger plan.

Plans belonging to a series should have the same sheet size, title block, orientation, and scale. To determine the sheet size for a plan, consider the following:

- management objectives for the CLR
- the size and character of the landscape
- the final page size of the plan reproduced in the formatted CLR

For documentation and analysis purposes, a landscape may need to be represented at multiple scales. The following table suggests scales for various uses.

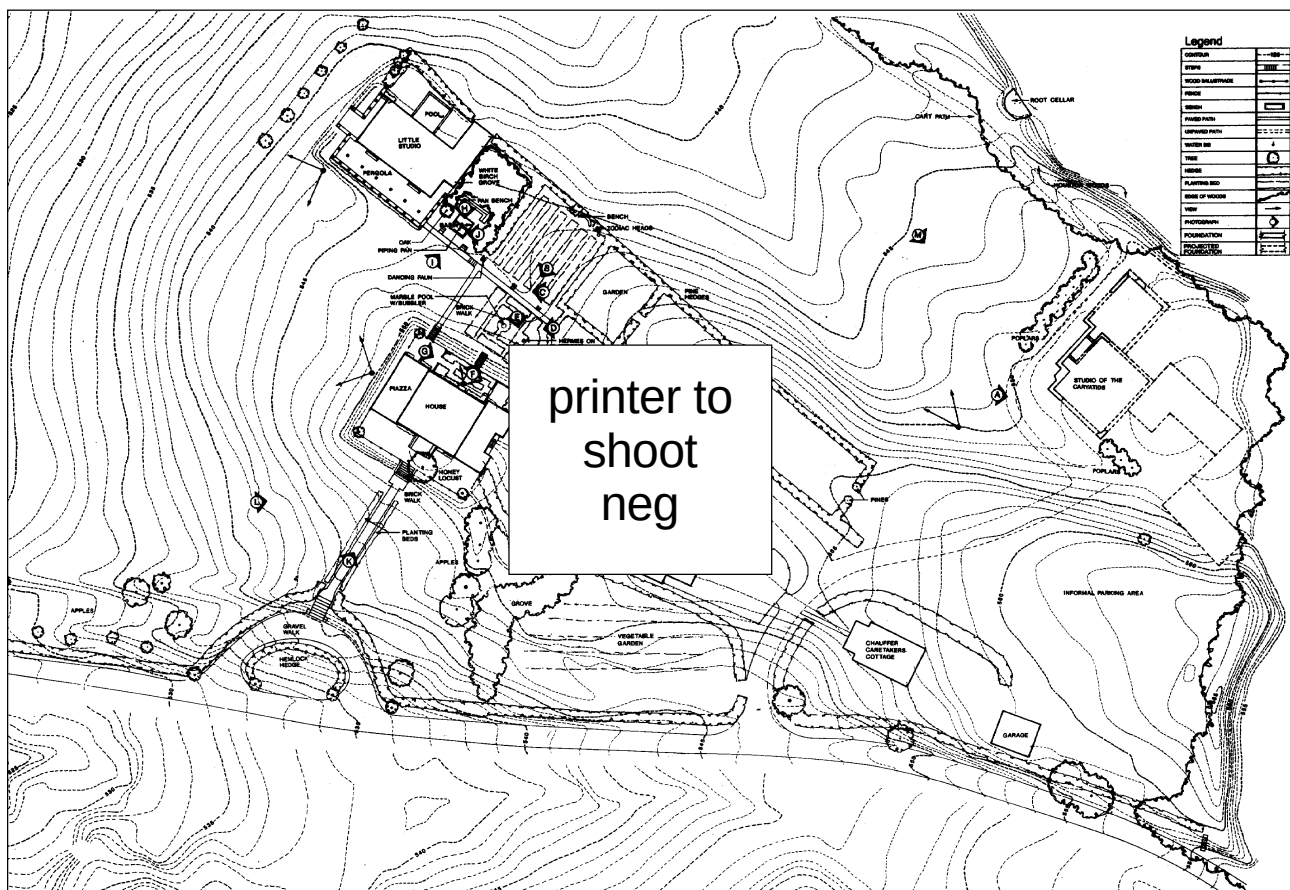


Figure 2. This 1926 period plan is one of a set of five. The plan has clarity and consistency with the other plans so direct comparisons can be made. Saint-Gaudens National Historic Site. (NPS, 1993)

SCALES	USE
1" = 200'	Landscape plans depicting an entire landscape
1" = 400', 1" = 500', or 1" = 1,000'	Large landscapes
A series of 1" = 200' plans with match-lines show connectivity between plans	If a landscape is too large to be represented on one sheet using a 1" = 200' scale
1" = 100' and 1" = 50'	Small landscapes
1" = 20'	Tree and shrub identification and small landscapes (about two acres).
1" = 10' or 1/4" = 1'	Planting plans and construction drawings

Current National Park Service (NPS) policy regarding the use of metric or English scales is given by *Preparation of Design and Construction Drawings, NPS-10*. It requires only that metric and English scale conversions are indicated on a cover sheet to a set of drawings. Either metric or English scales can be used for individual drawings, but only one scale convention should be used throughout a CLR.

Contours should appear on all plans. A contour interval that clearly depicts the landscape topography and serves the CLR's management objectives should be used. The desired contour interval may vary in different areas of the landscape, depending

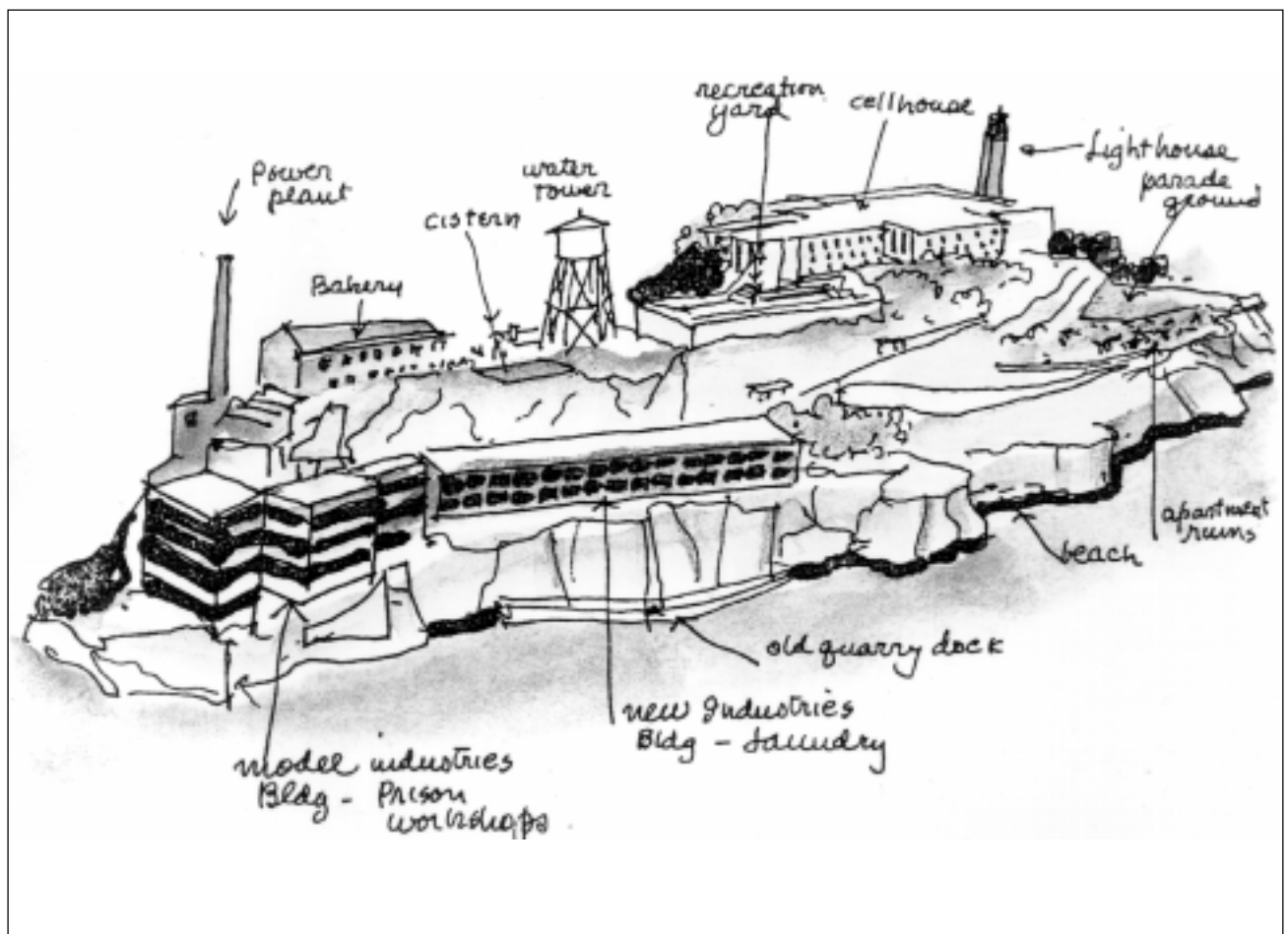


Figure 3. Loose sketches are useful for quickly recording field observations or conceptual ideas. This perspective sketch of Alcatraz Island conveys a concept plan for the future use of this historic site. Golden Gate National Recreation Area. (Sketch by Lawrence Halprin, NPS, 1988)

on the range of topographic relief, the complexity of landscape characteristics and associated features, or specific management objectives in different areas. The contour interval used on line drawings may be increased or decreased in particular areas of the landscape as long as the change makes the plan more readable or enhances the information. (See *Landscape Lines 9: Surveys*.) For information on contracting computer-generated topographic plans from aerial photographs, see the section titled “Photogrammetry,” later in this document.

Consistency

Numerous references exist for landscape architectural graphic standards, many of which are identified in the reference section of this text. Preferably, one graphic standard should be used throughout a CLR, but it may be necessary to use more than one standard where omissions exist. For example, *Preparation of Design and Construction Drawings, NPS-10* does not have a symbol for a property line. For consistency and clarity, all symbols should be identified in a legend on each drawing. The legend should show the symbol and define its meaning.

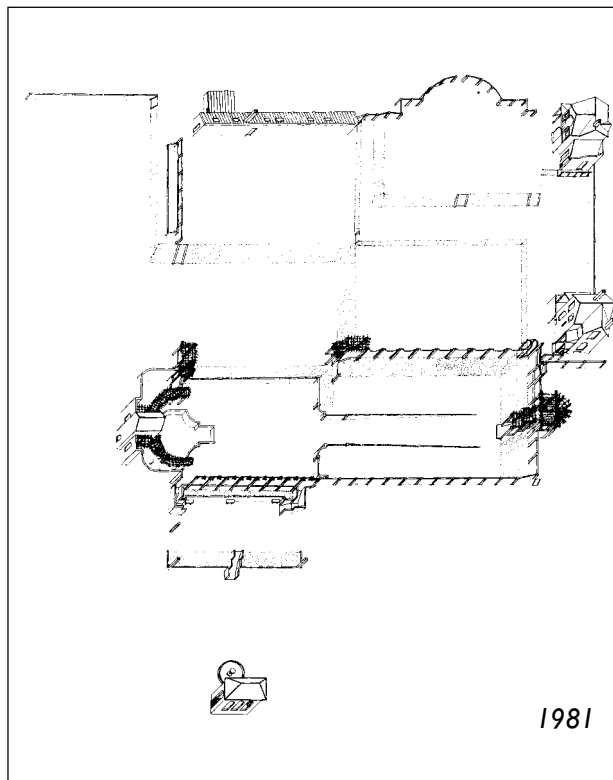
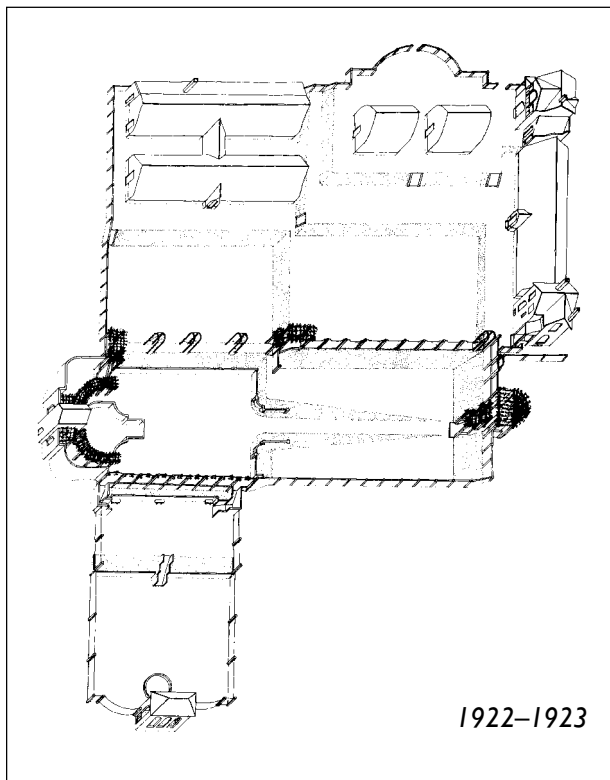
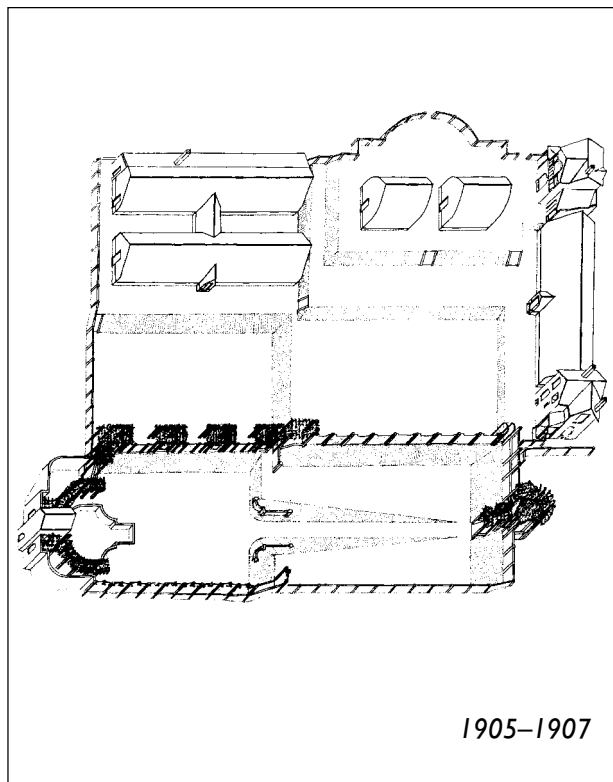
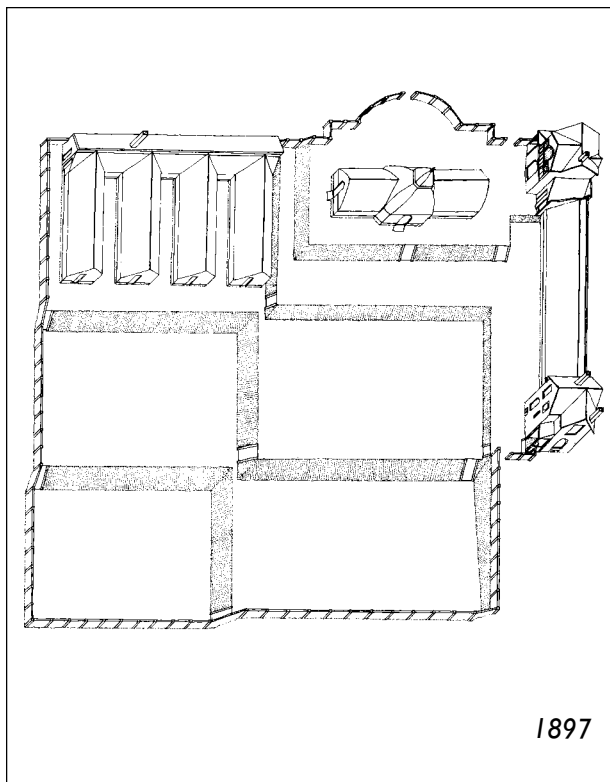


Figure 4. These serial axonometric perspective drawings were useful in documenting the evolution of the formal gardens from 1897 through 1981. Vanderbilt Mansion National Historic Site. (NPS, 1981)

The following list of standards and guidelines is arranged in descending order of comprehension and refinement:

- The American Institute of Architects' Architectural Graphic Standards and Guidelines
- Historic American Building Survey and Historic American Engineering Record Standards and Guidelines
- NPS Design and Construction Documents Guideline
- National Register Documentation Guidelines
- United States Geological Survey, Topographic Map Symbols

For computer aided design (CAD) drawings it may be necessary to use graphic standards established by an NPS Region or Support office. Regardless of the level of refinement, acceptable degree of accuracy, or graphic conventions used for line drawings, the style of each CLR drawing should be consistent. The following list gives the information required to appear on each plan. Examples are given in parenthesis.

- project title ("Cultural Landscape Report: Lower Town, Harper's Ferry National Historic Park")
- project location ("Harper's Ferry National Historical Park, West Virginia")
- drawing title ("Period Plan: 1815-1865")
- NPS drawing number: numbers are used and controlled by designated offices, and consist of the park code plus a number assigned by a NPS

Region or Support office (see *Drawing and Map Numbers Guideline*, NPS 29, revised edition)

- graphic bar scale and statement of scale
- north arrow oriented towards the top of the sheet
- date of drawing
- illustrator's name and title
- legend of symbols
- sources of information (metadata) used to prepare drawing ("Based on CLI field survey, 3/4/96, not a measured drawing")

Computer-generated drawings should include all the above information. If multiple layers are used (such as topography, boundaries, and structures), they should be individually classified within the drawings. Standards for graphic file formats may exist within an NPS Region or Support office, and these should be used when naming and saving computer-generated graphics files.

Geographic Information Systems (GIS) may be an alternative computer technology to computer graphic programs (such as CAD). For many years the quality of cartographic output available through GIS software could not equal that achieved with manual methods or computer graphic programs. But this is no longer the case. Numerous mapping tools are now available in most GIS packages, including desktop systems, which offer the added benefit of being easy enough to learn and use for novice GIS users. (See *Landscape Lines 10: Geographic Information Systems*.)

Reproducibility

The preferred media for hand-generated drawings is waterproof black ink on 3mm or 4mm polyester film, such as mylar. Double-sided, rather than single-sided film, with texture on both sides of the sheet, may be useful for particular visual effects, such as shading on the back side. Pin-bar registered multiple sheets of film may be used to separate layers of information. Film sheets can be obtained in the following precut sizes: 18" x 24", 24" x 36", and 34" x 44".

When deciding what film sheet size to use, consider both the final image size of the reduced original in the CLR and the preferred scale of the plan. An early decision (preferably during the project agreement phase) should be made about whether 8½" x 11", or 11" x 17" pages of reduced drawings will be placed within the body of the CLR or whether full-sized drawings will be folded into a pocket at the back. The page size of graphic images depends on the scale or complexity of site information to be conveyed. Greater landscape scale and greater complexity of information (such as close contour intervals and dense or diverse plantings) limits the extent to which an image can be reduced and still be legible. Full-size, folded drawings have the disadvantage of being bulky at the back of the document and the possibility of being lost, but have the advantage of being useful for easy access and reference alongside the CLR text.

The printing cost of a CLR with a back pocket for folded plans tends to be more expensive than a CLR with reduced plans integrated within the body of the document. Pages that are 11" x 17" can be

folded to create a pull-out page with a larger image size than the 8½" x 11" page.

A graphic bar scale is required on any plan or section drawing so that the scale of the plan can be understood regardless of the percent reduction. The following guidelines apply to legibility of text for reduced plans.

- For a 34" x 44" original plan to be reduced to an 8½" x 11" page, the minimum font size on the original plan should be no less than 18 point (3/16" high).
- For an 18" x 24" or 24" x 36" original plan to be reduced to a 8½" x 11" page, the minimum font size on the original plan should be no less than 14 point (1/8" high).
- The minimum font size on any reduced plan (8½" x 11" or 11" x 17") should be no less than 9 point.

Computer drawing programs allow for excellent line quality at almost any scale on many types of paper (limited by the capability of the printer). The preferred paper for computer-generated, line drawing originals is acid-free bond paper. The legibility of the text needs to be considered when reducing computer-generated drawings. Consideration should be given to preparing two sets of computer-generated drawings: one for full-scale and one for reduced-scale production.

Durability

Waterproof, black ink on polyester film is the most durable media for hand-generated drawings. Other media, such as graphite pencil or ink

pen on vellum, reproduce well, but are less durable. All graphic images used in a CLR—whether line drawings, diagrams, or charts—should be equally durable. The use of sticky-back or adhesive lettering is not recommended on hand-generated drawings; these media tend to bubble up or flake off over time. (Where sticky-backs are used, photomyllars of the originals should be created to insure durability of text in archival conditions.) Drawing text is most durable as ink on film, hand lettered, or traced with a Leroy template.

In processing a camera-ready copy of a CLR, the United States Government Printing Office (GPO) or printer may photograph each page of the document to create proofs from which the document will be printed. Ideally, all line

drawings that are part of a CLR should be supplied to the printer as photometallic transfers or PMTs (a photographic reduction process). PMTs are highly durable and are produced on 8½" x 11" or 11" x 17" size paper. Copies of full-size line drawings can be supplied to the printer as original artwork with special instructions, such as location, position, and percent reduction.

Full-size drawings larger than 11" x 17", which are to be folded into a pocket at the back of the document, are directly photocopied onto acid-free bond paper by the printer. Blueprints, which are created through the diazo process, are not recommended for full-size drawings because they become unstable with prolonged light exposure.

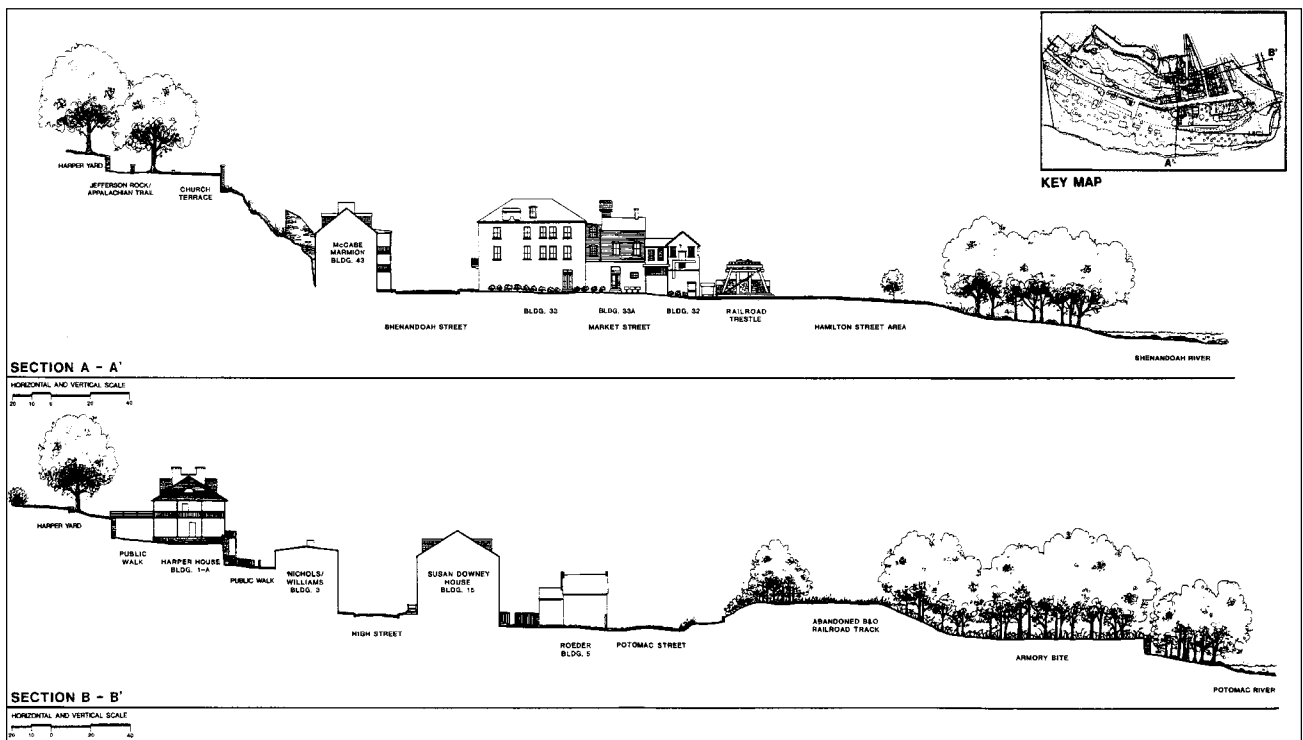


Figure 5. These section drawings show the existing topography, vegetation, circulation, and character of buildings and structures in Lower Town. Harpers Ferry National Historical Park. (NPS, 1991)

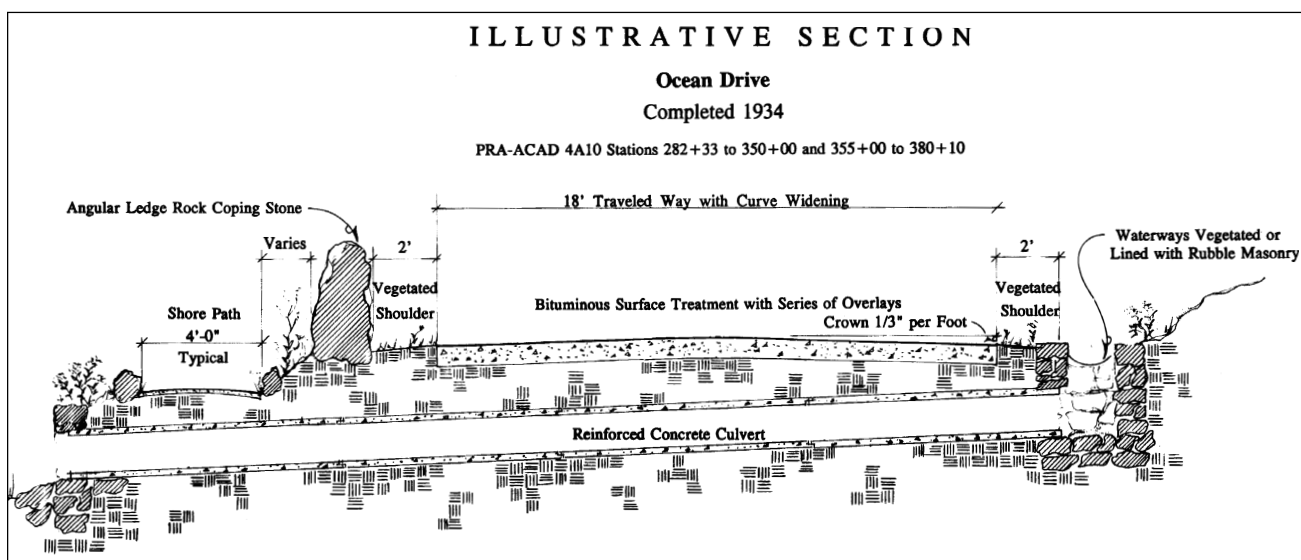


Figure 6. This illustrative section drawing of the historic roadbed at Ocean Drive illustrates a typical construction detail of the road in 1934. Arcadia National Park. (NPS, 1993)

Computer-generated drawings can be archived as electronic files on disks, compact disks (CDs) and tapes. Since the durability of these storage media has yet to be established, some archivists believe acid-free paper is still the most durable medium for storing information. Other archivists believe electronic files on disks, CDs, and tapes are durable for 100 years, under climate-controlled conditions.

Upon completing a CLR project, original line drawings, other graphic materials, including electronic files, and film negatives and positives, should be submitted to the park for inclusion in park archives. (See *Landscape Lines 14: Preparing, Cataloging, Printing, and Distribution*.)

REFERENCES

Annotated Graphic Documentation References

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Balachowski, Joseph D. December 1993. *Handbook for Recording Structures with Measured Drawings*. Washington, DC.: USDI NPS, Cultural Resources, Historic American Buildings Survey and Historic American Engineering Record, Draft. Pages 58-63 offer procedural guidance on landscape documentation with sections on research, measuring and drawing.

Burns, John A. 1989. Historic American Buildings Survey and Historic American Engineering Record. *Recording Historic Structures*. Washington, DC.: The American Institute of Architects Press. Pages 206-219 include a case study of Meridian Hill Park in Washington, DC., to illustrate a section on "Recording Historic Landscapes."

McClelland, Linda F. 1991. *National Register Bulletin 16A: How to Complete the National Register Registration Form*. Washington, DC.: USDI NPS, Interagency Resources Division. Pages 60-67 offer preliminary guidance on graphic documentation: geographical and sketch maps and photographs.

National Park Service. 1980. *Drawing and Map Numbers Guideline, NPS-29*, no.1. Denver: USDI NPS, Technical Information Center. This is the guideline for assigning NPS numbers to drawings and maps. Revised edition in progress that incorporates changes due to restructuring. For further information call TIC 303-969-2130.

National Park Service. 1991. *CAD System Manual*. 3rd ed. Washington, DC: USDI NPS, National Capital Region, Design Services Division. This is an example of a regional CAD Manual, which establishes standards for consistent and compatible files within a NPS region. The standards apply to internal graphic documents as well as those created by contractors.

National Park Service. 1995. *Preparation of Design and Construction Drawings, NPS-10*, no. 3. Revised ed. Denver: USDI NPS, Graphic Systems

Division, Denver Service Center. The emphasis is on architectural construction drawings, small-scale construction projects, with landscape documentation at the low level of resolution of mapping.

Ramsey, Charles G. 1994. *The American Institute of Architects,' Architectural Graphic Standards*. 9th ed. Edited by John Ray Hoke, Jr. New Jersey: John Wiley and Sons. Pages 749-778 make specific reference to Historic Preservation, and include the section titled, "Preservation of Historic Landscapes." Other sections relevant to landscape architecture are: Sitework, Concrete, Masonry, Metal, Wood and Plastics, and the section on Universal Design in General Planning.

Supplementary Architectural Drawing References

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Cullinane, John J., AIA. 1993. *Understanding Architectural Drawings: A Guide for Non-Architects*. Washington, DC: Preservation Press.

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Reid, Grant W., ASLA. 1987. *Landscape Graphics*. New Jersey: Whitney Library of Design.

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Wiggins, Glenn E. 1989. *A Manual of Construction Documentation*. New Jersey: Whitney Library of Design.

PHOTOGRAPHIC DOCUMENTATION AND ANALYSIS

Contemporary and historical photographs and slides are used in preparing a CLR. Photographs are graphic documents used to:

- document a landscape at a particular time
- analyze and evaluate the chronological development of a landscape

The technical considerations for using photography for the above purposes are described in the following text.

Photographic Documentation

Photography is a rapid technique for graphically documenting a cultural landscape. Black and white photographs are used to illustrate the appearance of a cultural landscape over time, to update the graphic documentation of a landscape, and to record treatment activities in the landscape.

Because photographs can capture fine textures and realistic contexts, photographs have an advantage over line drawings of conveying an experiential understanding of a landscape. However, photographs also have the potential to portray a landscape with greater subjectivity than line drawings. This subjectivity may be exploited to convey experiential qualities (such as those conferred by diurnal, seasonal, or climatic changes), to describe the articulation and quality of space (such as complexity, density, or vacancy) and to emphasize the current state of condition (from well maintained to derelict). Without a clear understanding of the primary intent of a photo-

graph, the subjectivity inherent in the process of making the photograph may lead to inaccurate, misleading, or unrepresentational photographs.

The Purpose

The art and science of photography involves many variables, including cameras, lenses, filters, lighting, film, camera position, and the creativity of the photographer. For cultural landscape research, the purpose of photography is to objectively record, in a durable medium, the physical and visual qualities of a landscape. Photography should not try to evoke emotional reaction through special effects; this may lead to misinterpretation.

The value of photographic documentation depends largely on how well informed the photographer is about the subject and purpose of the project. Additionally, photographic documentation is made more meaningful if the photographer keeps an accurate record of subject, location, and vantage points. Photographs used in a CLR should have captions and both should be included in the park archives.

Durability

Black and white photography (small, medium, or large format) is the most durable medium for photographic documentation in a CLR. Color film is less stable photochemically over time. Due to the visual limitation of black and white images, color slides are often taken to supplement the data provided by black and white photographs (Kodachrome is the most stable color film). Black and white infrared, and

color infrared films are very useful for analysis and evaluation because these films reveal information beyond the surficial appearance of landscape characteristics.

Color image processing has been advanced through photo-CD technology to allow color slides to be digitally incorporated into desktop publishing. Although not definite, color photographic images may be more durable as digital files on photo-CDs or disks than as color film negatives or positives. The color hard copy (paper printout) produced by color printers is currently not as durable as archival quality black and white photographs.

Archival quality photographic negatives are those that have undergone an extended washing process to completely remove processing chemicals. The addition of Selenium toner to the rinse solution allows complete removal of processing chemicals. Archival quality prints are also printed on fibrous contact paper rather than resin-coated paper. Giving negatives and prints archival quality increases developing and printing costs by about 25 percent. (See "Archiving Photographs" later in this section for more information on storage.)

Forms of Photography

Landscape photography may be broadly divided into two categories: aerial and field (terrestrial). For both aerial and field photography, the orientation of the camera can be perpendicular or oblique.

Perpendicular orientation achieves orthographic elevation in field photography and plan shots in aerial photography. Perpendicular field photography is used to record structures, objects, and landscapes with axial arrangements of spaces or formal geometry (for example, bilateral or radial symmetry). (See Figure 7.)

Oblique orientation achieves perspective shots in both aerial and field photography. Oblique field photography and perpendicular aerial photography are most commonly used in the graphic documentation of cultural landscapes. (See Figures 8, 9, and 10.)

Small, Medium and Large Format Cameras

Oblique and perpendicular field photography can be performed using small, medium, or large format cameras. Generally speaking, small format cameras use 35mm wide film, medium format cameras use 220-size (6cm x 7cm) or 120-size (6cm x 6cm, or 2¼" x 2¼") film, and large format cameras use 4" x 5," 5" x 7," and 8" x 10" size negatives. The cost of these various sizes of film is directly proportional to a unit price of film. A single 5" x 7" exposure of film within a large format camera is approximately equivalent in price to a 36 exposure roll of 35mm film.

Small format, 35mm cameras are the least expensive and most portable cameras to operate. They are particularly useful in capturing multiple black and white photographs and color slides of cultural landscapes for reference material. Once enlarged, 35mm negatives can become grainy, and as a consequence may have inadequate clarity for use in a publication.



Figure 7. A perpendicular field photograph of a curb and retaining wall. Blue Ridge Parkway. (NPS, n.d.)



Figure 8. An oblique field photograph. Frederick Law Olmsted National Historic Site. (NPS, 1995)

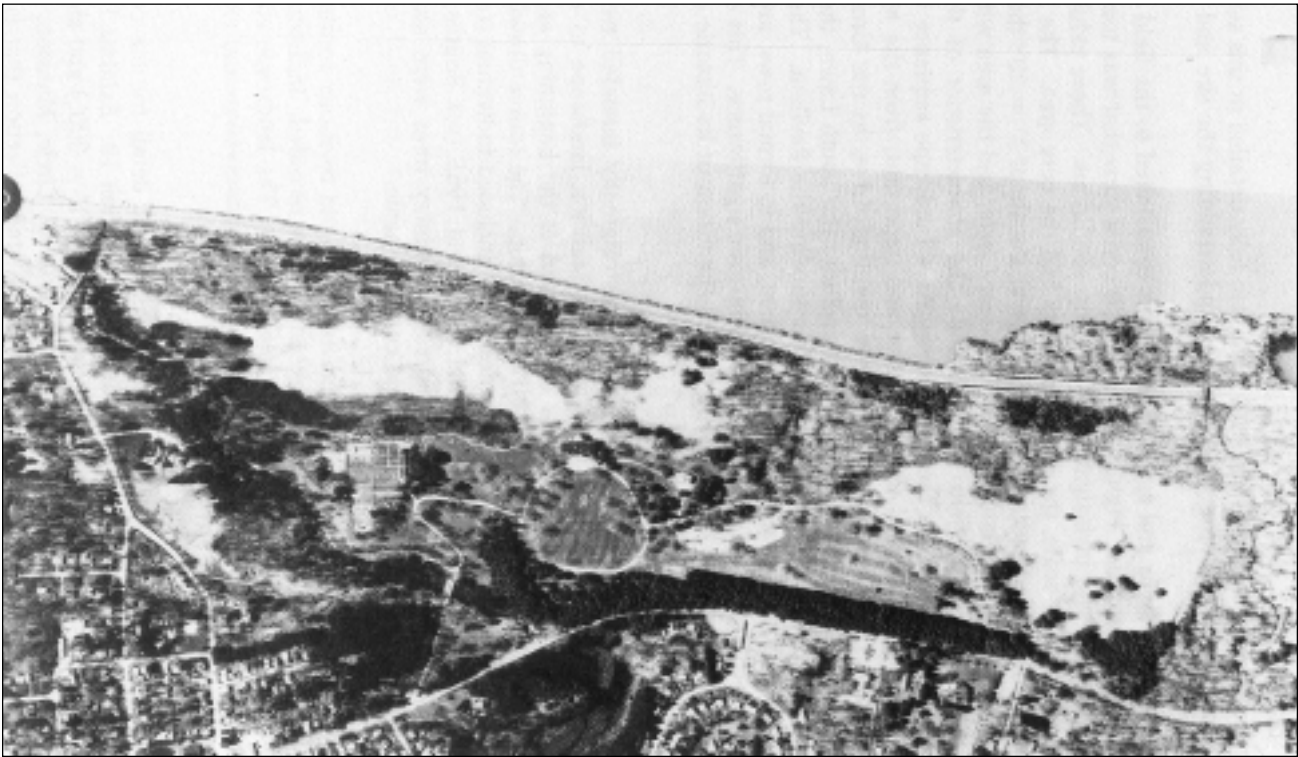


Figure 9. A perpendicular aerial photograph. Vanderbilt Mansion National Historic Site. (Photograph courtesy of Dutchess County Offices, 1990)



Figure 10. An oblique aerial photograph. Perry's Victory and International Peace Memorial. (NPS, c. 1925)



Figure 11. Large format photograph showing Sherrick Farm. Note the high resolution of detail in the photograph. Antietam National Battlefield. (Jack Boucher, HABS, NPS, 1992)

Medium format cameras have greater portability and are less expensive to use than large format cameras. They also provide a large negative (6cm x 7cm) that can be proportionately enlarged from a contact print directly to a 8" x 10" image without cropping.

Large format cameras record images in much greater detail and their photographs are well suited for publication because they can be enlarged without clarity degradation. (See Figures 11 and 12.) Large format cameras also allow for parallax adjustment because the lens can be tilted to correct for perspective. On the down side, large format cameras are bulky and heavy to transport and require considerable expertise to operate. In most cases, contracting

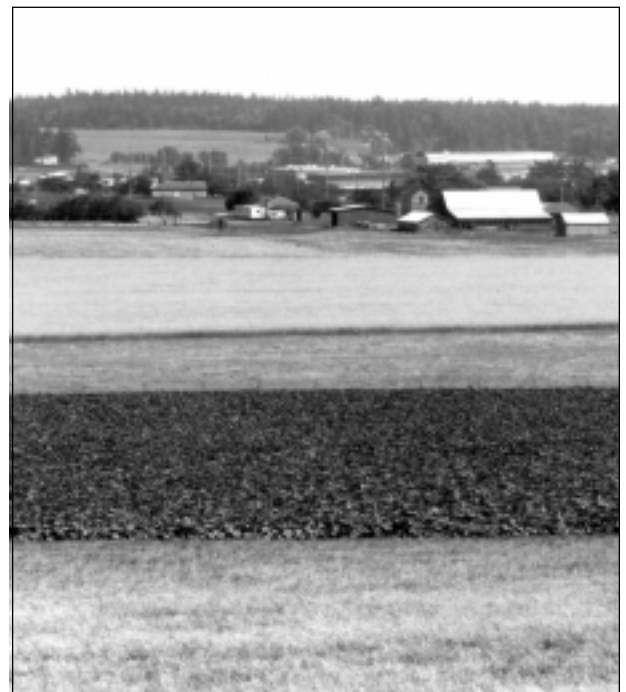


Figure 12. Small format photograph of Ebey's Landing National Historical Reserve. Note the lower resolution of detail in the photograph. (NPS, 1983)

the services of a professional photographer is recommended for large format photographic documentation.

Digital Cameras

Digital cameras are a recent photographic technology. A digital camera can produce color and black and white digital images. One advantage to using a digital camera is that the photographs can be more easily integrated into desktop publishing. The images are screened (composed of dots, like a newsprint photograph) and can be transferred via cable from the camera to a computer. There is no need to scan the photographic image before moving it to the computer. Using image processing software, the photographic images can be manipulated and inserted into a document.

Digital cameras are compact and convenient to use, but they have the following disadvantages, which should be considered when preparing to use a digital camera for field survey:

- The photographic quality produced by a digital camera may be lower than a 35mm camera and the images may not be clear enough to convey details well.
- Some digital cameras may not accept as many lenses or filters as a 35mm camera.
- There is a limit to the number of photographs that can be stored in a digital camera before they must be downloaded to a computer. Typically, digital cameras can store 36 photographs at a lower level of resolution (that is, fewer dots per inch) or 18 photographs at a higher level of resolution (more dots per inch).

Digital images must be archived as electronic files on computer disks, photo-CDs, or tapes. The durability of these media is undetermined.

Lenses, Filters, and Tripods

The standard lens on a 35mm camera is 50mm. The focal length (the magnification) of a 50mm lens is approximately the same as the human eye and is suitable for graphic documentation of cultural landscapes. In addition to the standard 50mm lens, wide-angle lenses, telephoto and zoom lenses, and filters can be used for specific purposes.

Wide-angle Lenses

A wide-angle lens with a 24mm-35mm focal length is less magnifying than a 50mm lens and provides the photographer a broader view of the landscape from a given vantage point. Wide-angle lenses are particularly useful when space is limited and the photographer must position the camera close to the subject of the photograph. However, wide-angle lenses cause distortion, and the wider the angle the greater the distortion (straight lines tend to curve, and parallel lines converge). Perspective-correcting lenses (PC lenses), also called architectural lenses, can be used to remedy the parallax distortion of wide-angle lenses. PC lenses are moderate wide-angle lenses (28mm or 35mm) that shift side to side or up and down. Some perspective correcting lenses also tilt, like a large format camera. PC lenses are available for small and medium format cameras and should be used with a tripod for best results.

Telephoto and Zoom Lenses

A moderate to long telephoto or zoom lens is useful for photographic documentation of landscapes when access near the subject is restricted or limited by physical obstacles. Telephoto lenses with a focal length between 100mm-400mm are more magnifying than a 50mm lens. Telephoto lenses have minimal distortion, yet their depth of field is small (that is, telephoto lenses tend to flatten the resultant image). Telephoto lenses also reduce light interception through the lens. To compensate for the lower light level, the f/stop may need to be manually adjusted (some cameras automatically make this adjustment). Zoom lenses are a common feature on 35mm cameras, and have focal length that can be adjusted from 20-60mm through 200-500mm. (The most common are 35-70mm and 70-200mm.) The versatility of zoom lenses makes them convenient for field photography.

Filters

High quality filters improve black and white photographic documentation by enhancing details that may otherwise be undiscernible. One of the most useful filters for black and white photography is a medium yellow. This filter eliminates the presence of blue in natural light and enhances contrasting values of grey tones, black and white. Orange and deep yellow filters enhance contrast and differentiate textures even more. Green filters emphasize foliage, while a red filter dramatically enhances the contrast between dark and light areas. A polarizing filter reduces or eliminates refraction of light in situations of considerable glare, which may be

encountered in photographing water features on a sunny day, or shooting through the windows of a car or light aircraft. A polarizing filter increases contrast and can darken blue skies in black and white photography.

Filters are mounted over the camera lens, reducing light interception through the lens. Better quality filters cause less light reduction, but all filters require exposure compensation. Cameras with built-in light meters automatically make aperture adjustments for a filter. Cameras with hand-held light meters must be manually adjusted to compensate for light reduction. The “filter factor” (light reduction factor of a filter) is usually engraved on the metal filter ring. A filter factor of 2X (such as that of a medium yellow filter) means the f/stop must be increased by two stops, from f/8 to f/4 (that is, the aperture size and shutter speed are increased).

Tripods

A tripod stabilizes the camera, allowing a sharper image to be captured. It also enables the photographer to create a variety of stable camera orientations and carefully plan the composition before taking the shot. Tripods are useful in the following situations:

- When photographing with a telephoto lens of focal length greater than 135mm. The tripod will reduce camera shake and produce a clearer photograph.
- To correct for image distortion from a tilting camera plane taking a perpendicular shot. A trapezoid is one result of a perpendicular shot of a structure taken with an upwardly tilting

camera (perspective correcting lenses, as formerly mentioned, make a similar adjustment).

- When photographing historic maps, photos, and other historic documents. The camera lens needs to be positioned parallel to the plane of the document to avoid image distortion. A light standard can also be used to position a camera lens in parallel alignment to a historic document (a magnifying lens should be used when photographing historic documents).

A tripod is essential to the technique of repeat field photography, where an earlier or historic photograph is re-shot from the same vantage point. (See "Repeat Photography" later in this section for further information on this analytical technique.)

Further Considerations

Field photography should be timed with respect to the altitude (elevation above the horizon) and azimuth (cardinal position) of the sun to avoid deep, obscuring shadows. A light meter is essential for accurate exposures. Large format cameras require the use of a hand-held light meter. If the scale of the subject in the photograph is important, a scale-stick painted with alternating black and white foot increments may be positioned within the frame. A more refined method for scaling the subject of a photograph is to use a scaled grid situated in front of the camera lens. This is particularly useful for planar features (without using photogrammetry). Regardless of how much the image size of the photograph is subsequently enlarged or reduced, the scale of the subject can be calculated from the imposed

grid. (See *A Guide to Cultural Landscape Reports: Appendices*, "Appendix C: National Register Bulletins.")

Archiving Photographs

Photographs provide a record of a cultural landscape's appearance at a particular moment in time and they become primary sources for future reference and historical research. It is important, therefore, to ensure the longevity of photographs by archiving them properly.

All photographs printed in a CLR should be archived, but not all photographs taken during CLR preparation need to be archived. The expense of archival materials and equipment may preclude all photographs being archived, and it may not be necessary to archive the photographs taken as supplemental records. The decision to render certain film and prints archival quality can be made at the time of film processing. Contact sheets are a useful tool for reviewing all the photographs and selecting which ones to be developed as archival quality.

Special processing techniques are applied to photographs selected for archiving. The negatives and prints are washed for a longer period of time to ensure that the chemicals that develop and fix the image are completely removed so that the image does not continue to develop. Negatives and fiber-based contact prints (as opposed to resin-coated prints) are washed with hyporemove as one of the last steps in dark-room processing. Selenium toner is added to the hyporemove to increase archival stability.

Archival quality negatives and prints should be deposited with the park upon completion of a CLR. Negatives should be stored in archival plastic sleeves and clearly labeled with location name and the date shot. Field records are used to create a descriptive caption list, classified according to the numbers on the negatives. The caption list should be printed on acid-free bond paper and attached to the negative sleeve for storage. Large and medium format negative sleeves are large enough to be captioned directly on the sleeve. The Library of Congress' standards for archiving contact prints require prints to be inserted into photo mount cards, which are labeled and captioned. Each photo mount card is separated from its neighbor by a sheet of acid-free (neutral pH) bond paper. They are then housed in acid-free, lignin-free, high alpha cellulose folders stored horizontally inside map cases or flat file boxes. Vertical storage is not

recommended, as this may lead to curling. The archival storage containers are then kept in a climate-controlled environment.

Aerial Photographs

Aerial photographs are used for graphic documentation and analysis and evaluation of cultural landscapes. (See Figure 13.) Aerial photography makes use of large lens cameras mounted on aircraft or orbiting satellites to shoot images of the earth surface. If aerial photography is used in the analysis and evaluation of a landscape, black and white and color infrared films may be used to elicit more information from the photograph. As a graphic documentation tool, aerial photographs provide objective records of the appearance of a landscape at a specific moment. Aerial photographs are particularly effective in documenting broad landscape patterns, such as land use, spatial organization, settlement, vegetation, and circulation networks.



Figure 13. High-altitude, oblique aerial photograph of Fort Scott in the Presidio, indicating broad patterns of spatial organization, topography, land use, and vegetation. Golden Gate National Recreation Area. (NPS, 1993)

The graphic record of aerial photographs may be important in the documentation of landscapes for which a topographic survey is not available. Graphic information from an aerial photograph may be transferred by hand to a plan drawing of the landscape or captured digitally by using computer aerial photogrammetry to produce a computer-generated plan. Relatively low altitude, aerial photographs can be flown and shot at a scale as detailed as 1 inch = 200 feet, depending upon the scale of the landscape and the type of information to be recorded. Clear skies are essential for shooting effective aerial photographs. Depending on documentation objectives, other factors may be important in scheduling aerial photography services, such as the amount of leaf coverage on vegetation and minimal shadow length. Exact location and timing may be important where an aerial photograph is taken as a repeat photograph; that is, to serve as a matched pair with a historic photograph for direct comparison of landscape characteristics and associated features.

See “Aerial Photography Analysis” later in this text for more information on aerial photography. For more information on computer-generated plans from aerial photographs, see “Computer Aerial Photogrammetry.” For more information on taking a contemporary photograph to match a historic photograph for analysis and evaluation of landscape change, see “Repeat Photography.”

Photogrammetry

Photogrammetry combines perpendicular photography, either field or aerial, with geometry. Photogrammetry makes use of stereophotograph

pairs to create orthographically rectified, measured drawings (perpendicular to the plane of the subject). These drawings may be in the form of elevations (terrestrial) or plans (aerial).

Traditional drawings are created by hand-tracing the “optical model” produced by overlapping paired stereophotographs within a plotting instrument. These stereophotographs are developed from plate glass negatives and printed on resin-coated contact paper. The durability of fibrous contact paper is substituted for measurable accuracy (resin-coated contact paper is not subject to the stretching or distortion possible with fibrous paper). However, plate glass negatives, especially when prepared with extra washing, are the most durable photographic media. Photogrammetry can now be performed by computer technology using digitizing equipment and CAD. Photogrammetric stereophotographs can be archived as digital files on disks, photo-CDs, or tapes. The durability of these storage media is yet to be established.

Computer Aerial Photogrammetry

Perpendicular aerial photographs can be transformed into accurately georeferenced base maps using photogrammetry. A photogrammetric camera lens corrects radial distortion to produce an orthographically rectified photograph. Traditionally, photogrammetry involved tracing an ortho-rectified photograph to obtain a scaled drawing. Current photogrammetric technology consists of digitizing equipment and CAD software that turns photographic images into CAD drawings. (See Figure 14.)

In geographic regions with predominantly deciduous vegetation, the most revealing time of the year to perform aerial photogrammetry is during the dormant season. At this time more of the earth's surface is exposed due to the absence of vegetation canopies and a higher resolution is possible. Generally, the window of opportunity is from early December to early April, with mid-March often being the optimal time for clarity. In March, shadows are smaller and dead leaves are no longer clinging to trees. A quality photogrammetry product is also dependent on clear, sunny weather conditions.

Contracting Computer Aerial Photogrammetry Services

Commercial photogrammetry services can be contracted. The end product is delivered in the form of a digital file on disk or as a hard copy on paper or other media. Preparing a project agreement (scope of work) for contracting aerial photogrammetry services to create a base map may require knowledge of the following:

- Location of base map. The location is preferably given by Universal Transverse Mercator (UTM) coordinates or latitude and longitude

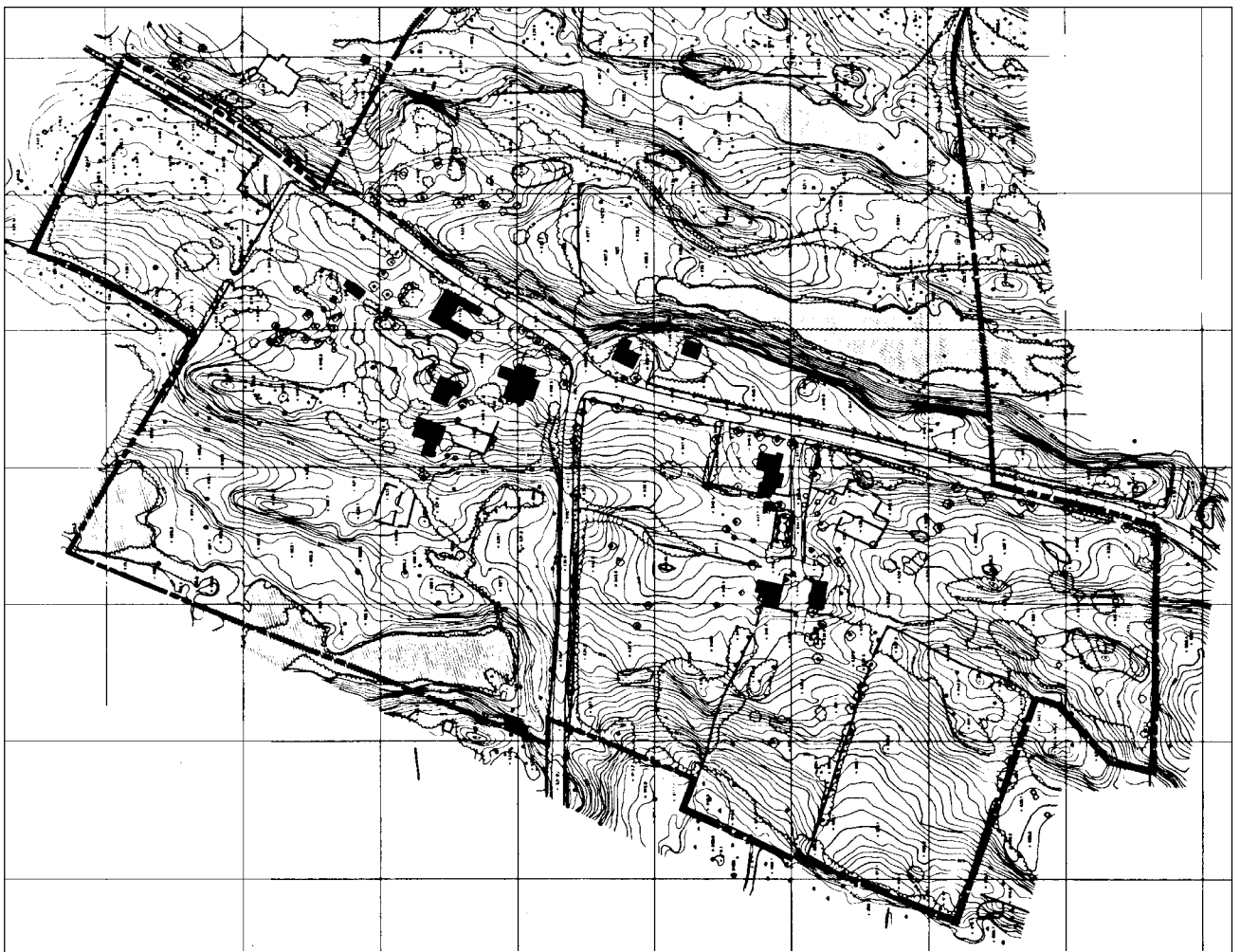


Figure 14. Topographic survey map generated by computer aerial photogrammetry, Weir Farm National Historic Site. (NPS, 1992)

coordinates with a vertical reference point (that is, a control point of known elevation). The requirement for a vertical reference point may not be necessary for aerial photography, but is essential to photogrammetry. Vertical reference points can be white crosses painted on the ground, utility poles, or even traffic arrows on roads of known elevation.

- **Scale of base map.** It may not be necessary to specify the scale of the aerial photograph for the base map, or the flight altitude to the contractor. The contractor should have the expertise to determine the most efficient method to produce a base map of the desired scale.
- **Contour interval.** This is determined according to the scale and extent of topographic relief of a landscape and the potential use of the information (for example, the management objectives of a CLR).
- **Additional information to be mapped.** Additional information required, such as property boundaries, structure footprints, roads, drives and footpaths, hydrologic features, vegetation types, trees over 6-inch caliper, and major shrubs may be indicated.
- **Product format.** The base map-product should be in hard copy form or as a digital file on CAD. If CAD is used, the contractor will need further information about the configuration of layers and layer classification (for example, vegetation, topography, hydrology, boundaries, and structures may be organized as different CAD layers). In either case, the degree of vertical and horizontal accuracy should be specified.

Photographic Analysis and Evaluation

Photographs are used in cultural landscape research to analyze and evaluate a cultural landscape's chronological development and to graphically document its appearance. (See Figure 15.) In analysis and evaluation, photographs are used for comparison, to verify other data, to understand the influences that have shaped a landscape, and to measure the extent to which change has taken place. Other sources of data, such as historic records, maps, and other photographs, are used with contemporary or historic photographs to interpret the history of a landscape.

Both field and aerial photographs are useful in photographic analysis and evaluation. Contemporary aerial and field photographs can be shot from the same vantage point as a dated historic photograph, thereby serving as a matched pair of repeat photographs for direct comparison of changes since a known period.



Figure 15. National Park Service staff person, Troy Siefert, examining an aerial photograph. (NPS, 1993)

Repeat Photography

Repeat photography is the technique of locating the site of a dated, historic photograph, reoccupying the original camera position, and shooting a contemporary photograph of the landscape, landscape characteristics and associated features from the same vantage point. Preferably, the photographer uses the same focal length camera lens and shoots the photo at the same time of day as the original photograph. This provides the best conditions for comparing the contemporary and historic photographs.

The pair of photographs is referred to as a matched pair of repeat photographs. Depending on the objectives of the analysis and evaluation, the time interval between matched photographs may be decades, seasons, or even seconds (as in the case of photographing landscape change during a volcanic eruption). Matched pairs of photographs are more directly comparable when the direction and length of shadows in each photograph is similar, though valid interpretations can be made from photographs that are matched less closely. (See Figures 16 and 17.)

Repeat photographs can be used to interpret the nature, rate, and direction of change in a cultural landscape, to evaluate the cause(s) of perceived change, and to establish new photographic records for future analysis of change.

Sources of Inaccuracy

Old photographs can be misleading and should be used cautiously for analysis and evaluation. Photographs taken before the advent of pan-

chromatic film in the 1930s can be unrealistic in depicting the conditions of the time. Early films were not sensitive to red light and overly sensitive to blue light. As a result, red is not distinguished from black, and the sky in historic photographs may appear white, with the distant landscape appearing faint, or not being represented at all.

Historic photographs taken with artistic motives may also be misleading due to tricks in the use of perspective or depth of field, or the creative use of lighting. Historic photographs may also be unrepresentative of the typical condition of the time, which may have been the photographer's motive in taking the photograph. To counter the effects of inaccuracy due to the personal biases of photographers, it is best to use historic photographs from a variety of sources.

Performing the Technique

Matched pairs of repeat photographs are most directly comparable if they are taken at the same time of year, at the same time of day, are the same size photograph, and encompass the same area. Matched photographs taken with the same focal length of lenses will encompass the same area with the same resolution. If a different focal length lens is used for the contemporary photograph, the photographs may be rendered similar by enlarging or reducing and cropping during the printing process.

To repeat a historic photograph, position the camera lens at the same location as the historic lens and aim the lens at the same subject. (See Figures



Figure 16. A nineteenth century photograph. John Day Fossil Beds National Monument. (NPS, 1893)



Figure 17. A repeat photograph of the landscape shown in Figure 16. John Day Fossil Beds National Monument. (NPS, 1992)



Figure 18. A photograph of the lower meadows of Vanderbilt Mansion National Historic Site. (NPS, c. 1950s)



Figure 19. A repeat photograph of the landscape in shown Figure 18. This later photograph indicates some encroachment of woody growth into the meadow. Vanderbilt Mansion National Historic Site. (NPS, 1991)

18 and 19.) Do not attempt to frame the new photograph to match the outline of the old; this will result in error in the position of the camera lens. The correct position and aim of the camera lens is found by using the parallax apparent in the historic photograph (that is, the apparent distortion due to the effect of perspective). A copy of the historic photograph must be taken into the field. The foreground features that exist in the center of the field of view of the historic photograph can be used to align the camera. Near and distant features in the center of the field of view are aligned through the camera as in the historic photograph. The photographer then moves the camera toward or away from the field of view, so that peripheral features are aligned and parallax is correct with their appearance in the historic photograph. If no foreground features exist or none are close enough to use the parallax method, the historic camera position must be found by comparing the ratios of horizontal and vertical distances in the historic photograph with the image through the camera lens. To make the comparison

more direct, a negative of the historic photograph may be placed beneath the mirror of a 35mm camera so that the historic image can be seen through the viewfinder.

If it is important to reproduce the historic conditions as closely as possible, astronomical tables can be used to estimate the altitude and azimuth of the sun in historic photographs. The altitude and azimuth of the sun affect the character of shadows and highlights in historic photographs. Therefore, when taking repeat photographs of structures, geologic formations, landscape architectural details, and topographic relief, it may be important to match the length and direction of shadows in the historic image. This may be unimportant for historic photographs taken on a cloudy day, or at noon on a sunny day.

It is useful to create a permanent record of the camera station for future repeat photograph analysis. The camera station is directly below

the camera lens and is determined by suspending a plumb bob beneath the camera tripod. Photographers use steel rods driven into the ground, or star-shaped drill holes in rocks to mark camera stations. A record of the camera station should be noted on the archival sleeve of the negatives of repeat photographs, along with captions. This should include the angle and inclination of the camera lens at the camera station.

Aerial Photograph Analysis

Aerial photograph analysis is a well-developed discipline. Experts can be found in the professions of landscape architecture, geography, forestry, anthropology, and archeology. Aerial photography has been used for observation of earth processes and environmental analysis for more than 60 years. It is a technologically advanced form of photography that uses large-lens cameras mounted on either low or high altitude aircraft or orbiting satellites to shoot images of the earth surface.

Aerial photography analysis is a form of remote sensing, examining earth features from a distant platform situated above a target area. Aerial photographs are also valuable research tools for providing a graphic record of the appearance of a cultural landscape during a particular period. In analysis and evaluation, aerial photographs from known, successive periods can be compared and interpreted to verify and expand on the historical record.

An expert in aerial photograph analysis can derive highly refined information on natural resources (such as soils, geology, geomorphology, hydrologic

patterns, climate, and vegetation), as well as cultural resources. (See Figure 20.) Current aerial photographs may be used to create a base map of existing conditions. (See Figures 21 and 22.) If an aerial photograph is used to create a base map, a lower altitude photograph (that is, larger scale, such as 1 inch = 200 feet) is usually flown. If aerial photographs are used to analyze changing physical conditions over time, higher altitude, archival photographs obtained from the United States Geological Survey Earth Resource Observation Systems (EROS) Data Center may be useful.

Computer aided technologies that build on traditional aerial photography include computer aerial photogrammetry and geographic information systems (GIS). Computer aerial photogrammetry represents the most current technology in deriving base maps from aerial photographs. (Refer to “Computer Aerial Photogrammetry” earlier in this text for more information). As a form of spatial data, aerial photographs are now implicitly related to the development of geographic information systems. GIS takes aerial photograph analysis to a new level of resolution in which aerial photographs are scanned into a computer and georeferenced with other layers of data sources, such as traditional cartographic maps, geology maps, soil surveys, and historic property maps. Direct comparison of multiple spatial data layers enables a more comprehensive understanding of the physical nature of cultural landscapes and the change that has occurred over time. (See *Landscape Lines 10: Geographic Information Systems*.)

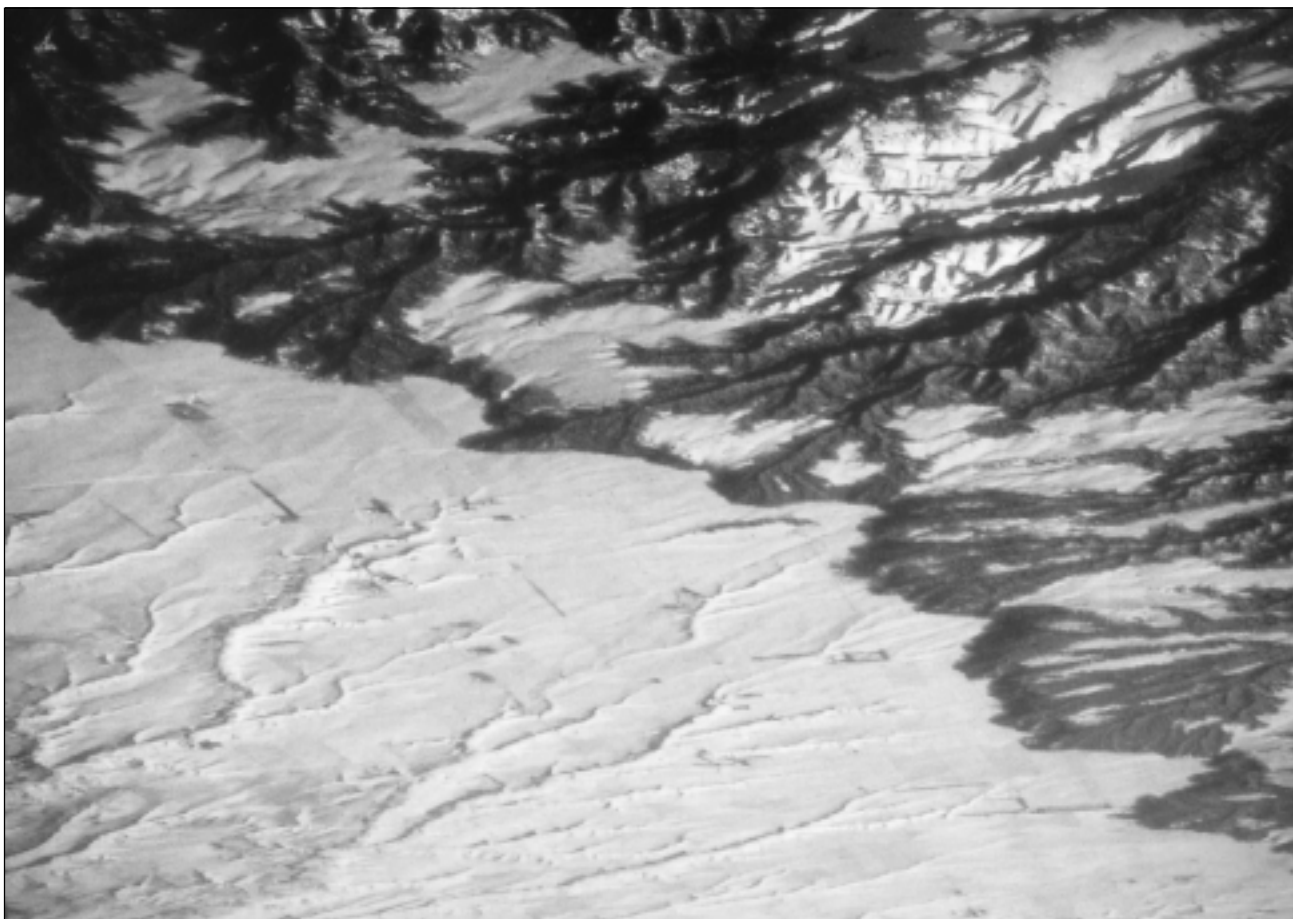


Figure 20. Aerial photograph of land near the Black Hills, South Dakota. Analysis of the photograph reveals information about drainage patterns, geology, geomorphology and climate. (NPS)

Aerial photographs may reveal the dynamics of change in landscape characteristics, such as the manipulation of topography, change in hydrologic patterns, the introduction of a particular land use, the settlement and development of a landscape, and modifications to a historic designed landscape throughout the twentieth century. Aerial photographs can also reveal patterns of physical disturbance and evidence of former human occupation that may not be apparent in the field, such as road traces, tree locations, and field patterns. Information derived from the analysis and evaluation of historic aerial photographs may be transcribed on a base map

to create a sequence of period plans. (Refer to “Line Drawing Documentation” earlier in this text for guidelines on plan drawing.)

Obtaining Archival Aerial Photographs for Cultural Landscape Analysis and Evaluation

The Earth Resources Observation Systems (EROS) Data Center in Sioux Falls, South Dakota, is the United States Geological Survey (USGS) archive center for federal agency aerial photographs. The photographs, dating from 1940, represent the collection of twenty federal agencies and programs.



Figure 21. Aerial photograph documenting President Theodore Roosevelt's home in 1992 during leaf-off conditions. Sagamore Hill National Historic Site. (NPS, 1992)

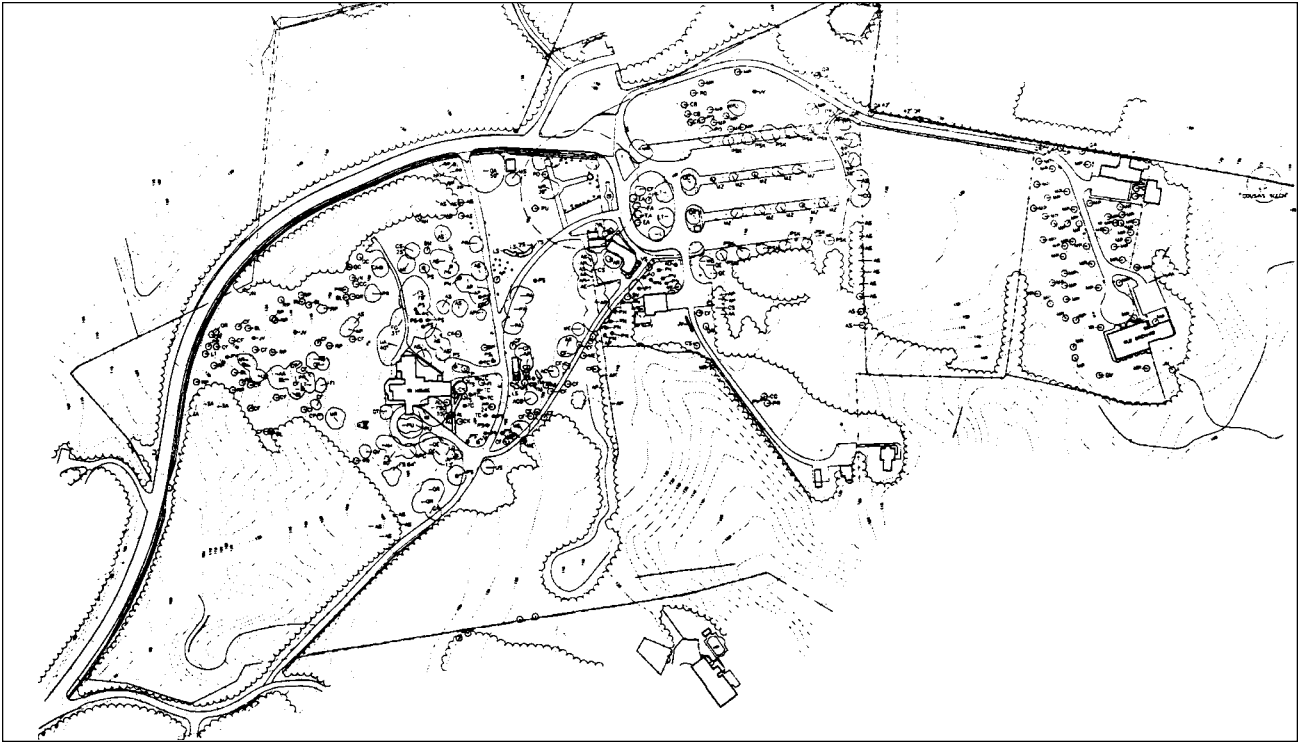


Figure 22. Existing conditions plan (1 inch = 200 feet scale) generated in AutoCAD using the 1992 aerial photograph of the property. Sagamore Hill National Historic Site. (NPS, 1993)

The photographs range in film type from color-infrared, black and white, and natural color, to black and white infrared. The federal government recently standardized aerial surveys to avoid repetition and achieve uniform quality and coverage. Before federal aerial surveys were standardized, photographs were shot in geographic locations where studies were being conducted. Photographs were taken from different altitudes using various types of film. As a result, coverage of the states is uneven among the older acquisitions in the collection.

The 1987-1991 National Aerial Photography Program (NAPP) produced cloud-free aerial photographs with color infrared film of the 48 contiguous states at a scale of 1:40,000 (1 inch = 0.6 miles). Each photograph shows an area of 5 x 5 miles. Black and white photographs, derived from the color-infrared film, can be ordered. Prior to the NAPP program, between 1981 and 1987, the National High Altitude Photography Program (NHAP) generated most aerial photographs for the USGS. The NHAP program shot black and white aerial photographs at a scale of 1:80,000 (1 inch = 1.26 miles), with each photograph showing an area of 11 x 11 miles. The NHAP program also shot color-infrared film with a scale of 1:58,000 (1 inch = 0.9 miles). Each photograph shows an area of 8 x 8 miles.

The EROS Data Center also receives, processes, and distributes data images from the National Atmospheric and Space Administration (NASA) Landsat satellites. These data include aerial photos in the scale range of 1:30,000 to 1:120,000. The

film coverage varies from color-infrared to black and white. These Landsat photographs can also be purchased from the center.

The availability of specific NAPP and NHAP photography can be determined using a microfiche-based indexing system keyed to areas of USGS 1:250,000-scale maps. Either microfiche or enlarged paper copies of the microfiche are available for the particular geographic area of interest.

Sources of Archival Aerial Photographs

Customer Services - NAPP

USGS - EROS Data Center

Sioux Falls, SD 57198

Aerial Photography Division (East)

U.S. Department of Agriculture

45 French Broad Avenue
Asheville, NC 28802

Aerial Photography Division (West)

U.S. Department of Agriculture

2505 Parley's Way
Salt Lake City, UT 84102

Aerial Photography Field Office

Agricultural Stabilization and Conservation Service

U.S. Department of Agriculture

2222 West 2300 South
Salt Lake City, UT 84125

Cartographic Archives Division

National Archives

Washington, DC 20408

The National Archives contains federal aerial surveys conducted by the Agricultural Stabilization and Conservation Service, Soil Conservation Service, Forest Service, Geological Survey, and Bureau of Reclamation between 1935 and 1942. The guide, titled *Aerial Photographs in the National Archives* (Special List No. 25), 1973, is available from the National Archives.

Contracting Aerial Photography Services

In preparing a project agreement (scope of work) for contracting aerial photography services, the following information may be required.

- Scale of aerial photograph. 1" = 200' is approximately the largest scale—the lowest altitude—that an aircraft can fly (due to aviation law). Although the level of resolution of the image is set by the scale at which the original photograph is taken, the scale of the image can be subsequently enlarged.
- Location of the aerial photograph. The location is most accurately denoted by UTM boundary coordinates. A contractor may accept boundaries drawn on a USGS 7.5 minute topographic quadrangle as an adequate guide to location.
- Lens size. The frame size of the photograph is determined by the camera lens size. Lens sizes in common use range from 6 to 12 inches, with 12 inches producing the larger frame. A 12-inch lens may be more appropriate for a large scale photograph.
- Type of film. Aerial photography film ranges from color-infrared, black and white, and natural color, to black and white-infrared.

Natural color photographs are grayer than natural color is ordinarily perceived. Color infrared and black and white infrared photos may be more revealing for environmental analyses than natural color. Infrared photographs may reveal different ecosystem or vegetation types more clearly than natural color photographs, and infrared can provide additional information on biomass production and ecosystem health.

- Type of shot—stereo or spot shot. If a relatively small landscape or area of a landscape can fit within a single aerial photograph frame, a spot shot may be most appropriate. However, for large landscapes, a series of photographs may be taken. A series of stereophotographs have the additional benefit of being useful for analysis purposes. Stereophotographs have 58-65 percent overlap between frames. Consequently, paired stereo frames can be observed through stereo glasses for three-dimensional analysis of the aerial photographs.
- Orientation of shot—vertical or oblique. It is assumed that aerial photographs are taken vertically (that is, oriented perpendicular to the earth's surface) unless otherwise specified. Vertical shots have the least horizontal distortion of the earth's surface. Oblique shots are taken for illustrative effects to expose the verticality of such elements as building facades and trees.
- Product format. Aerial photographs can be delivered as film negatives, film positives, contact prints, or as electronic files on computer disk or photo CD, and reproduced or enlarged onto mylar, blueprint, or bond paper

media. The form of product may depend on management objectives (that is, how the aerial photograph will be used) and archive considerations.

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Park Historic Structures & Cultural Landscapes