

Photography and photomontage in landscape and visual impact assessment

Landscape
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1.0 Purpose and background

The purpose of this Advice Note is to provide advice to the landscape professional on photography and photomontage methods in landscape and visual impact assessment. It does not consider the use of photography or photomontage for other purposes, such as promoting or exhibiting a scheme.

Photographs and photomontages often form an important part of planning applications and Environmental Statements, in which the preparation and presentation of reliable visual information is integral to the assessment of landscape and visual impacts. Photographs and photomontages are technical documents in this context, and should be produced and used in a technically appropriate manner.

It is essential to recognise that:

- Two-dimensional photographic images and photomontages alone cannot capture or reflect the complexity underlying the visual experience, and should therefore be considered an approximation of the three-dimensional visual experiences that an observer would receive in the field;
- As part of a technical process, impact assessment and considered judgements using photographs and/or photomontages can only be reached by way of a visit to the location from which the photographs were taken.

This Advice Note was prepared by members of the Landscape Institute (LI) Technical Committee, in consultation with LI members and technical experts experienced in photography, photomontage and landscape and visual impact assessment. It will be reviewed and updated as necessary to reflect the rapid pace of change in digital photography and related technologies.

2.0 Current guidance

- This Advice Note supersedes LI Advice Note 01/09. The LI's guidance on photography and photomontage in landscape and visual impact assessment in Appendix 9 of *Guidelines for Landscape and Visual Impact Assessment* 2nd ed (2002) remains relevant.
- Scottish Natural Heritage's *Visual representation of windfarms: good practice guidance* states that the guidance may also be applicable to other forms of development or within other locations (SNH 2006, para 15). **The LI endorses this guidance and strongly advises members to follow this where applicable in preference to any other guidance or methodology.**
- When regulatory authorities specify their own photographic and photomontage requirements, the landscape professional should carefully consider whether they are justified, or whether they would under- or over-represent likely effects, in the professional's opinion. Consideration may then be given to adding images to the impact assessment, or omitting them, and explaining the reasons for doing so.

3.0

Principles of photography and photomontage

3.1 Objectives

The overall aim of photography and photomontage is to represent the landscape context under consideration and the proposed development, both as accurately as is practical.

The objective of photography for visual and landscape impact assessment is to produce printed images of a size and resolution sufficient to match the perspective and, as far as possible, the detail in the same view in the field (SNH 2006, para C12-21) and which can also serve as an accurate aide-memoire once the observer has left the field.

The objective of a photomontage is to simulate the likely visual changes that would result from a proposed development, and to produce printed images of a size and resolution sufficient to match the perspective in the same view in the field.

3.2 Criteria for photomontages

Photomontages use photographs of an actual scene modified by the insertion of an accurate representation of the visible changes brought about by the proposed development. They are subject to the same inherent limitations as photographs, for example only showing the scene as it would appear under the same conditions that prevailed when the original photograph was captured. A properly constructed photomontage can serve as a useful means of indicating the potential visual effect of a future development, however.

The LI recommends that for landscape and visual impact assessment purposes a photomontage should:

- be reproduced at a size and level of geometric accuracy to permit impact assessment, which must include inspection at the location where the photograph was taken;
- be based on a replicable, transparent and structured process, so that the accuracy of the representation can be verified, and trust established;
- use techniques, with appropriate explanation, that in the opinion of the landscape professional best represent the scheme under consideration and its proposed environment accurately as possible;
- be easily understood, and usable by members of the public and those with a non-technical background;
- be based on a good quality photographic image taken in representative weather conditions

3.3 Viewpoint selection

The landscape professional should select a set of photographic viewpoints which are considered representative of the range of likely effects, viewing experiences and viewers, ensuring that none are under- or over-represented. Viewpoints should be agreed with the regulatory authority or authorities where possible, and with other parties as considered necessary.

3.4 Field of view

The most appropriate combination of lens, camera format and final presentation of image should be deployed to represent the relevant landscape. This is likely to include both the site of the proposed scheme and its context, so that a scheme's appearance and its place within its environment can be recognised and understood. The proposal under consideration and its relevant landscape context will determine the horizontal field of view required for photography and photomontage from any given viewpoint. This will in turn determine whether a single-frame image will suffice or whether a panorama will be required.

While a standard lens giving a horizontal field of view of about 40 degrees may be suitable for some purposes, a single-frame photograph based on this field of view is unlikely to convey the breadth of visual information required to represent a proposed development and relevant context. If the required field of view is only slightly greater than 40 degrees, a wide-angle lens or wide-angle setting on a zoom lens may be appropriate. Where it is much greater than 40 degrees, a panoramic image produced by the careful 'stitching' together of single-frame images, or the use of a suitable true panoramic camera, can provide a more informative representation of the effect of a development in the landscape (SNH 2006, Technical Appendix B).

The horizontal field of view is usually more relevant to representations of rural and peri-urban landscapes. The vertical field of view may be more important in urban landscapes, however, in which case it may be necessary to use a wide-angle lens or wide-angle setting on a zoom lens. The camera may be used in portrait orientation for panoramic as well as single-frame images.

4.0

Photography

4.1 Cameras

A good quality camera and lens are essential to the production of photographs and photomontages for landscape and visual impact assessment work. Many good quality digital cameras are suitable, but it is essential to consider the whole process from field procedure to post-processing to printing in order to choose equipment which will give results of the accuracy required.

A camera with a fairly high resolution will be required to produce sufficiently good-quality images to be reproduced at the size required: a 12 megapixel sensor is usually sufficient. This resolution outperforms 35mm colour print film in terms of both image resolution and graininess. The lens used must be of a sufficiently high optical quality to take advantage of the sensor's resolution.

Change in all aspects of photography and photomontage have taken place over the last ten years. 35mm colour film and the associated cameras and lenses have been almost completely supplanted by digital cameras; digital image processing is now a fundamental element of photography, both within the firmware of the camera and as a subsequent operation on a computer, and printing has become wholly digital, using a wide variety of devices offering different qualities of output. Future changes will undoubtedly further change the parameters for landscape photography.

4.2 Lenses

The use of 35mm film and a 50mm focal length standard lens as a reference standard, while still valid, is now somewhat outdated. That combination of lens and film gives a horizontal field of view of a little under 40 degrees.

Use of a fixed focal length lens ensures that the image parameters of every photograph are the same, simplifies the construction of panoramas, and ensures compatibility of photography for all viewpoints. Fixed focal length lenses are often either unavailable or prohibitively expensive for many digital cameras however.

It is usually impossible to set a zoom lens to a specific focal length, apart from the longest and shortest ends of its focal length range. The zoom setting and focal length are recorded in the image metadata (EXIF data) stored with each image, however. The horizontal field of view for a given zoom lens setting can be calculated from the focal length and the camera's sensor size (see Technical Appendix for details). Theoretically zoom lenses are always of inferior optical quality to fixed focal length lenses, but the difference is not significant in modern lens design.

When a wide-angle lens or zoom lens at a wide-angle setting is used, a higher camera resolution may be required in order to obtain the same resolution in the finished image than would be needed for a 'standard' setting and an approximately 40 degree field of view (see Technical Appendix for details).

Use of a telephoto lens, or enlargement of part of a larger image, either single-frame or panoramic, may be necessary to show detail that is too small to be displayed at the correct viewing distance for the image as a whole. The purpose of the additional image should be explained when this is done.

4.3 Setting up and recording data

Wherever possible, cameras should be tripod mounted and levelled in horizontal and vertical axes. Where it has been necessary to raise or lower the horizon line by cropping, this should be stated.

It is recommended that the following data is recorded:

- Camera, lens focal length and horizontal field of view
- Date, time, weather, lighting conditions and direction of view
- The viewpoint's height above ground level and OS grid coordinates

5.0

Preparing and viewing images

5.1 Producing photomontages

A digital photomontage consists of a base photograph composited digitally with a computer-rendered image of the proposal under consideration. This compositing process will typically include digitally manipulating the masking of the proposed development by foreground features and may also involve digitally removing existing features such as trees. The compositing necessarily demands a level of digital manipulation and visual skill and judgement on the part of the person carrying it out.

It is critical that the scale of the proposal and its location within the scene depicted in the photograph are accurately represented. In order to achieve this, it is necessary to match the perspective parameters of the photograph accurately, to record viewpoint location and camera settings, and to use rendering software correctly (SNH 2006, para 209ff).

Explanatory text should be provided to describe the procedure used to fit the rendered image to the underlying photographic view. The accuracy of a photomontage may usefully be illustrated by means of a wireline image incorporating sufficient topographic or other features to allow a comparison to be made between the wireline and the photograph.

It should be borne in mind when preparing images that inkjet printing, laser printing and digital press technologies all have different colour rendition and resolution issues. A minimum resolution of 300 pixels per inch will generally be required for high-quality printing (see Technical Appendix). The image size and resolution together determine the number of pixels required to be captured by the camera.

5.2 Viewing distance

Given that the objectives of photography and photomontage are to produce printed images of a size and resolution sufficient for use in assessment work in the field, the exact dimensions of these images will depend on the characteristics of the view under consideration.

All photographs, whether printed or digitally displayed, have a unique, correct viewing distance - that is, the distance at which the perspective in the photograph correctly reconstructs the perspective seen from the point at which the photograph was taken (SNH 2006, para A18-25). The correct viewing distance should be stated for all printed or digitally displayed photographs and photomontages, together with the size at which they should be printed. All photographs and photomontages used in a document should have the same viewing distance whenever possible.

The viewing distance for hand-held photographs and photomontages should be between 300mm and 500mm (SNH 2006, para 126). The viewing distance and the horizontal field of view together determine the overall printed image size.

Photographs and photomontages should be printed or published digitally at an appropriate scale for comfortable viewing at the correct distance, noting the limitations of the printing process particularly with regards to colour and resolution. Guidance should be provided on viewing the image in order to best represent how the proposal would appear if constructed, such as the required viewing distance between the eye and the printed image, and an indication of whether the image is a single-frame or panorama. Panoramic images should be curved so that peripheral parts of the image are viewed at the same intended viewing distance, or viewed by panning across a flat image with the eye remaining at the recommended viewing distance (SNH 2006, para B20). It is important to indicate the correct viewing distance for single-frame or panoramic images to allow consistent comparison between different image formats

provided from the same viewpoint.

The 'before' photograph and the 'after' photomontage should be presented on the same page and/or at the same scale to allow comparison if practicable.

The selection of an appropriate combination of camera, lens and printing technology requires informed technical decision-making. Other aspects of photography and photomontage such as choice of view, post-processing, and presentation of the final images are a matter of professional judgement.

A suitable digital camera for environmental impact assessment work will need to have a fairly high resolution sensor, good quality lenses, and manual focus and exposure settings. Most digital SLRs and some non-SLRs are likely to be suitable. The quality of the printing process is critical in producing finished images which successfully reproduce the digital data captured by the camera. As much care and consideration should be applied to the selection of a print process as to the selection of a camera.

Landscape Institute Technical Committee
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Landscape Institute and IEMA (2002) Guidelines for landscape and visual impact assessment (2nd ed). London: Spon.

Scottish Natural Heritage (2006) Visual representation of windfarms: good practice guidance. Inverness: Scottish Natural Heritage. SNH report no. FO3 AA 308/2

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Technical appendix: Digital photography

This appendix provides technical background information on digital photography relevant to landscape and visual impact assessment work, as little detailed advice is available on this subject. This appendix should be read in conjunction with the Technical Appendices in the SNH guidance *Visual representation of windfarms: good practice guidance*, referenced below by the relevant paragraph number in brackets.

Focal length and field of view

As with any camera, a digital camera's horizontal field of view is determined by the focal length of the lens and the size of the sensor (A26-28). The formula given in (A27) provides a method of calculating the field of view.

The sensor size will usually be stated in the documentation supplied with a digital camera, but may not be specified in millimetres. For example, the commonly used 23.7 x 15.7mm size may be expressed as 1.8" or as APS-C. It may require some online research to discover the actual dimensions.

For a fixed focal length lens, the focal length will usually be marked somewhere on the lens barrel. A zoom lens will generally have the range of focal lengths marked on it. To determine the focal length used for an image taken using a zoom lens, it is necessary to refer to the EXIF metadata stored with the image. Lens focal length is one of the fields of information usually stored in the EXIF data. This value needs to be known to at least one and preferably two decimal places in order to calculate the field of view accurately. Different cameras store this information to different degrees of numerical precision. Software also varies in the number of decimal places it shows for the focal length value.

Some models of digital camera have been found to store inaccurate information in the EXIF data. It is prudent to take advice on this before purchasing a camera.

35mm equivalent focal length

The focal length of lenses on digital cameras is sometimes expressed in terms of the '35mm equivalent focal length'. This value is what the focal length of a lens on a 35mm film camera would be with the same horizontal field of view as the camera and lens combination under discussion. For example a lens with a focal length of 32.9mm on camera with a sensor 23.7mm wide would have a horizontal field of view of about 39.6 degrees, the same as a 50mm lens on a 35mm film camera. A 32.9mm focal length lens in this context might therefore be described as a 50mm equivalent lens.

The 35mm equivalent focal length is one of the fields of information stored in the EXIF data of a digital image but unfortunately not all cameras store this information and those that do round it to the nearest millimetre of focal length, which is not sufficiently precise for field of view calculations.

Print resolution

Given that the objective is to produce a printed image, the required print resolution is the starting point for calculating the required camera resolution. This appendix therefore addresses these issues in the order that they should be considered.

The limit of acuity ability to resolve detail of the human eye is about 1 minute of arc (C1). At a viewing distance of 300mm, this equates to a spatial dimension of 1/291 inch. A good target resolution for printing is therefore 300 pixels per inch PPI giving a pixel size of 1/300 inch for images to be viewed at 300mm viewing distance.

At greater viewing distances, larger pixels may be used and still be too small for the eye to resolve individually. For 400mm viewing distance, the minimum resolution is 225 PPI and for 500mm viewing distance, it is 180 PPI.

Note that pixels per inch, PPI, is not the same as the dots per inch, DPI, usually used to describe printer resolution. Each pixel in a photographic image consists of 256 levels of brightness in each of red, green and blue, giving 16,777,216 possible different colours and this is what is displayed on a monitor. Most printers can only lay down dots of pure primary colours of ink or toner, depending on technology. Many printers can deliver variable ink drop sizes and many have more than the minimum of four primary colours of ink available, but each printed dot is still limited to far fewer colours than the number required to reproduce the contents of a pixel. The technical solution to this is to lay down many very small dots to represent each image pixel. For this reason, the printer resolution required to deliver a 300 PPI image may be as high as 2400 DPI depending on the printer technology used.

It may in practice be difficult to achieve 300 PPI printing, which may lead to a decision either to accept a lower print quality or to use a viewing distance greater than 300mm.

It is important to understand the limitations of the print process chosen, whether the printing is being done in-house or by an external print bureau. It will probably be necessary to print some test images to check the print quality.

Calculating the required camera resolution

Having decided the image resolution required to print images at the sizes recommended in the 2006 SNH Good Practice Guidance, it is possible to arrive at the minimum camera resolution needed to achieve that.

Printed image size is defined by horizontal field of view and correct viewing distance (D2). It therefore follows that the horizontal scale of an image, which may be expressed in millimetres per degree of field of view, is determined solely by the correct viewing distance. For example, a 360 degree panorama with a correct viewing distance of 300mm is 1885mm wide; see (B22-29) for formulae. The image scale will therefore be 5.24mm per degree. For a panorama with a viewing distance of 500mm, the scale is 8.73mm per degree.

A panoramic image has a constant horizontal scale, so the millimetres per degree calculated above, will be correct across the whole width of the image. A single-frame image, however, has a scale increasing radially from the centre. The values calculated above will therefore only be correct at the centre of a single-frame image and will increase towards the sides of the frame; see (A11-13) and (B17-18).

At 300 PPI print resolution, these calculated scales correspond to 61.8 pixels per degree for 300mm viewing distance and 103.1 pixels per degree for 500mm viewing distance.

These resolutions are therefore the minimum angular resolution that it is desirable to capture in the original digital image in the camera for eventual use at 300mm and 500mm viewing distances.

It is not mathematically correct simply to multiply the pixels per degree resolution by the field of view of the lens to obtain the required number of pixels across the image. The true value will always be less than a simple multiplication. However, as this calculation is simply a way of checking that enough image detail is being captured, a simple

multiplication is a good enough estimate, especially as it is guaranteed to be an overestimate.

If the lens used has a horizontal field of view of 39.6 degrees equivalent to a 50mm lens on a 35mm camera (Table A1), then for 300mm viewing distance printing, the required image width in the camera is $61.8 \times 39.6 = 2448$ pixels rounding up to the nearest pixel, which is about equivalent to a 4.5 megapixel image. For 500mm viewing distance, the required image width is $103.1 \times 39.6 = 4083$ pixels, equivalent to about 12.5 megapixels.

If it is necessary to use a wide-angle lens or wide-angle zoom setting, rather higher numbers will result. If the lens has a field of view of 65.5 degrees equivalent to a 28mm lens on a 50mm camera (Table A1), then for 300mm viewing distance, the required image width will be $61.8 \times 65.5 = 4048$ pixels, equivalent to about 12.3 megapixels. For 500mm viewing distance, this becomes $103.1 \times 65.5 = 6754$ pixels, equivalent to about 34.2 megapixels.

For most purposes, a 12 megapixel camera will produce images with detail at the limit of the print technology used to reproduce them. If however, it is necessary to print material for 500mm viewing distance based on original photographs taken with a very wide-angle lens, then either a very high specification camera will be needed or a slightly lower image quality may have to be accepted.

For comparison, it should be borne in mind that 35mm film has a resolving power about equivalent to a 9 megapixel digital sensor; a 12 megapixel camera will potentially capture far more detail than was ever possible with film. Also note that while 300 PPI print resolution is essential at 300mm viewing distance, 225 PPI will produce the same effect at 400mm viewing distance and 180 PPI at 500mm, although it will look a little 'blocky' on the page until held at the correct distance.

Choice of lenses

As noted in the SNH guidance, the main issue in the choice of lens focal length is the balance between detail captured and field of view (D7); there is no single best focal length that works best under all circumstances.

Irrespective of the focal length of a lens, its optical quality is of paramount importance. Many digital cameras offer very high resolutions in terms of megapixels. However, it is the case with some cameras, particularly cheaper ones, that the resolving power of the supplied lens does not justify the installed sensor resolution. The fact is that digital sensors and memory chips are quite cheap components whereas good lenses are relatively expensive.

There is no simple way of judging the quality of a camera lens; however, an informed choice can often be made based on in-depth independent technical reviews many are available on-line and a study of sample images.

Technical appendix: Digital photography

Camera settings

Most digital cameras come with a plethora of automatic settings designed to make the photographer's task easier. Some of these should be disabled or treated with caution while undertaking photography for landscape and visual impact assessment.

Autofocus: Many passive autofocus systems are sensitive to the presence of foreground objects and can result in the focus being at less than infinity. More seriously, the focus can be slightly different in successive frames of a panoramas, potentially precluding a clean splice. Autofocus should be switched off and the lens manually focussed on infinity (E8-9). Note also, that as focussing involves physically shifting the lens back and forth along its axis, focussing other than on infinity will change the principal distance of that image (A21-22).

Digital zoom: Many inexpensive digital cameras offer both 'optical zoom' and 'digital zoom'. 'Optical zoom', as the name implies, uses the optics of a zoom lens to enlarge the image projected onto the sensor. 'Digital zoom' is a simple enlargement of the digital image and adds no information. 'Digital zoom' should never be used in photography for landscape and visual impact assessment.

Automatic exposure: Automatic exposure greatly speeds opportunistic photography, but rarely results in optimum results for landscape and visual impact assessment work. Manually setting an aperture of about f/5.6 or f/8 will usually yield the sharpest possible photographs (E11). The ISO setting for the sensor should generally be set to 400 or less to limit image noise. Some cameras have a special panoramic setting which enables the shutter speed, aperture and ISO setting of the first frame to be maintained for successive frames. If that facility is available, then it may be possible to use an aperture-priority automatic mode, otherwise it is safer to meter a typical frame in the panorama and then set the exposure manually (E10).

Automatic white balance: Many digital cameras have a facility to automatically compensate for ambient colour temperature, so that, for example, photographs taken under indoor lighting do not appear yellow compared with those taken in daylight. This facility can have unforeseen consequences when taking panoramas. For example, the presence of a red telephone box in the foreground of one frame may result in a cyan cast on the colour in that frame only. White balance should be set manually to daylight.

Image sharpening: Many digital cameras have a facility to sharpen the photographic image in the camera. This option should be switched off. Compositing a photomontage is much more difficult to do satisfactorily if the base image has already been sharpened, particularly if it is over-sharpened. Any image sharpening required for printing can be done in a more controlled manner in image processing software.

Image format: All digital cameras offer a range of formats in which the image will be stored on the camera's memory card. Typically these will be JPEG at a variety of quality settings, camera 'raw' and on some cameras, but increasingly supported Adobe DNG digital negative format. Raw and DNG both serve the same function of storing the contents of the sensor unaltered hence 'raw' together with a series of parameters recording the camera's current settings. Thus post processing stages, such as white balance and sharpening are recorded as parameters but not actually applied to the image. Raw and DNG provide the user with the maximum possible opportunity to get the best quality out of the image. Their disadvantage is that the image sizes will be 2-6 times as large as JPEG equivalents, requiring more storage space on memory cards and computers and also requiring more time and effort to post-process. Unless there is a compelling reason to use raw or DNG, the highest-quality JPEG format usually provides sufficient image quality. Some cameras provide the option of automatically storing both raw and JPEG, which allows the choice of format to be made on an image by image basis but of course requires even more storage space than raw alone.

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