



Handmade visual simulation of Macraes Mine (with permission from Boffa Miskell, 1993).



Evolving tools, enduring principles: maintaining accuracy, transparency and trust in visual representation

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Visual simulations have long played a role in landscape and visual effects assessment. At their best, they help practitioners, communities, councils, hearing panels and courts understand the visual consequences of landscape change. At their worst, they can create a false sense of certainty, overstate realism, or obscure the assumptions that sit behind an image. The New Zealand Institute of Landscape Architects' 2010 best practice guide provided an important foundation for credible photomontage-based visual simulation practice in Aotearoa New Zealand. Its core emphasis on technical accuracy, representative viewpoints, transparent method and appropriate presentation remains highly relevant. However, the technological context in which visual simulations are prepared, distributed and relied on has changed. Contemporary visual representation practice includes high-resolution elevation data, drone and terrestrial photogrammetry, point clouds, 3D GIS, real-time rendering, screen-based review, animation, augmented and virtual reality, and image production assisted by artificial intelligence. While creating opportunities to improve communication and assessment, these tools also introduce risks around apparent realism, scale, image manipulation, provenance and auditability. This paper argues that the professional challenge is no longer simply to prepare technically accurate photomontages; it extends to how to maintain trust in visual evidence across a wider, more immersive and more editable digital environment.

Introduction

Visual simulations have long been used as one tool within landscape assessment (Gobster, Ribe and Palmer, 2019). They are images, but they are not merely illustrations. In assessment and consenting contexts, they often function as evidence. Visual simulations help people imagine a future condition that does not yet exist. They can influence whether the viewer interprets a proposal as acceptable or intrusive, inevitable or avoidable, and/or temporary or transformative.

These functions give visual simulations power. They also introduce risk.

For many years, professional guidance focused largely on the technical preparation and presentation of photomontage-based visual simulations (Landscape Institute, 2011; NZILA Education Foundation, 2010). This most often entails selecting representative viewpoints and taking high-resolution photographs, before preparing accurate models, matching lens geometry, and presenting images at an appropriate scale and viewing distance. *The Best Practice Guide: Visual Simulations BPG 10.2* (BPG 10.2), which the New Zealand Institute of Landscape Architects (NZILA) published in 2010 (NZILA Education Foundation, 2010), remains a significant foundation for this work. The BPG 10.2's stated purpose is to promote best-practice standards and procedures in the landscape profession's preparation and use of visual simulations. It defines visual simulations as tools that can accurately portray a proposed change or modification in the landscape, while also recognising that they are not 'real-life views'.

That distinction remains critical. A simulation can assist judgement, but it is not the view itself. It is a constructed representation, shaped by method, data, judgement, software, framing and presentation.

The BPG 10.2 is not obsolete in principle, but the representational environment around it has changed. The task now is not simply to modernise a photomontage guide by

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adding a list of new tools. Instead, it is to carry forward the guide's concern with credible visual evidence into a more complex environment of digital models, screen-based review, immersive media and generative image technologies.

What BPG 10.2 got right

It would be easy, but wrong, to characterise BPG 10.2 as simply 'out of date'. The more accurate view is that its core principles remain sound.

The guide was prepared for photomontage-based visual simulations (figure 1). It expressly emphasises the need for accurate 3D models, accurate representation on photographic images, representative viewpoints, technical photographic knowledge, and documentation of the steps involved, including software used, assumptions and limitations. Those matters remain fundamental today.



Figure 1. From photograph to visual simulation (with permission from Boffa Miskell).

The strength of BPG 10.2 is that it treats visual simulation as an evidential practice, not simply as an image-making exercise. Rather than aiming to produce compelling pictures, its purpose is to assist more informed and transparent judgements about appearance and effects.

That is still the right starting point.

In practice, many disputes about visual simulations are not really disputes about technology. They are disputes about trust. Is the viewpoint representative? Is the proposal located accurately? Is the focal length appropriate? Has the image exaggerated or diminished apparent scale? Is mitigation shown fairly? Are lighting and atmospheric conditions reasonable? Can the method be checked? Has the image been presented in a way that allows the intended viewer to understand it properly?

Those questions remain as relevant to an image assisted by artificial intelligence (AI), real-time model or virtual reality (VR) scene as they do to a printed photomontage.

What has changed since 2010

The world in which BPG 10.2 was prepared was largely print-based, photography-based and photomontage-centred. The current world is much broader, as NZILA's own update process recognises. The 2025 call for expressions of interest in updating the visual simulation guidelines states that advances in technology have opened new and more accessible approaches to preparing and presenting visual representations. It identifies the need to build on and expand BPG 10.2, including through guidance around data gathering and management, preparing digital models and presenting visual representations.

That shift matters. The professional task is no longer limited to how to prepare a verified photomontage. It includes how to select, prepare, disclose and review a wider range of visual representation tools.

In the United Kingdom, the Landscape Institute has already made a comparable move in terminology. Technical Guidance Note 06/19 is titled *Visual Representation of Development Proposals* (Landscape Institute, 2019). The Landscape Institute explains that this guidance replaced earlier photography and photomontage advice, and its purpose

in preparing it was to help landscape professionals, planning officers and others select, produce and present types of visualisation appropriate to the circumstances in which they are used. The guidance itself emphasises clear, open and transparent communication and fitness for purpose.

The use of ‘visual representation’ in the title marks another important difference from BPG 10.2. Broader than ‘visual simulation’, the term ‘visual representation’ acknowledges that assessment and communication may involve different types of image, model and display, each with its own strengths, limitations and level of evidential status.

Better data, higher expectations

One of the most significant changes since 2010 has been the availability of higher-resolution spatial data.

As a result, visibility analysis and digital terrain modelling no longer necessarily rely on coarse contour intervals or simplified bare-earth assumptions. In Aotearoa New Zealand, Toitū Te Whenua Land Information New Zealand (2025) now provides open-source Light Detection and Ranging (LiDAR)-based elevation data for much of the country, including a national 1-metre Digital Elevation Model (DEM) assembled from current LiDAR surveys. This creates obvious benefits for viewshed analysis, landform modelling, model placement and terrain understanding.

But improving data does not remove the need for judgement. If anything, it raises the standard of explanation expected of the practitioner.

A Zone of Theoretical Visibility (ZTV) based on a bare-earth DEM may identify theoretical visibility that is substantially screened by vegetation or buildings. A Digital Surface Model (DSM) may include surface features, but these may be temporary, simplified, out of date or captured at a particular point in time. A point cloud may be highly detailed but still require classification, filtering and interpretation (figure 2). Vegetation may be modelled as present or absent, retained or removed, and/or established or mature. Each assumption can materially affect the apparent visibility of a proposal.

The implication is not that visual representation guidance should require a single, correct dataset. That would be unhelpful and quickly outdated. Rather, guidance needs to require clear disclosure of data source, date of production, resolution, vertical datum, processing assumptions and limitations. Higher-resolution data improve the potential for accuracy, but also increase the need for transparency.

The field device has changed

Another major shift since 2010 has been the collapse of the distinction between specialist capture technology and everyday field devices.

In 2020, Apple introduced LiDAR scanning to the iPad Pro, promoting its depth-sensing capability and potential to support augmented reality (AR) workflows. While useful, the contribution of this technology to a landscape assessment should not be overstated. Its effective range is limited to only a few metres, making it unsuitable for capturing or verifying landscape-scale geometry, landform relationships or distant built elements. Its value is better understood as lying in its convenience as a field tool for close-range spatial recording, rapid site documentation and small-scale 3D capture.

By 2021, research was already testing the iPhone 12 Pro LiDAR sensor for geoscientific fieldwork. This work indicated that phone-based LiDAR could be useful to rapidly scan small- to medium-scale landforms, particularly where speed, portability and ease of use are important. However, it also confirmed important limitations to this technology, including that it has a restricted range and variable accuracy, depends on surface texture and lighting conditions, and is less suitable for landscape representation on a larger scale. Its role is therefore supplementary rather than authoritative: useful for field understanding and close-range recording, but not a substitute for surveyed data,

photogrammetry, terrestrial laser scanning, drone-derived models or other controlled methods where evidential accuracy is required.

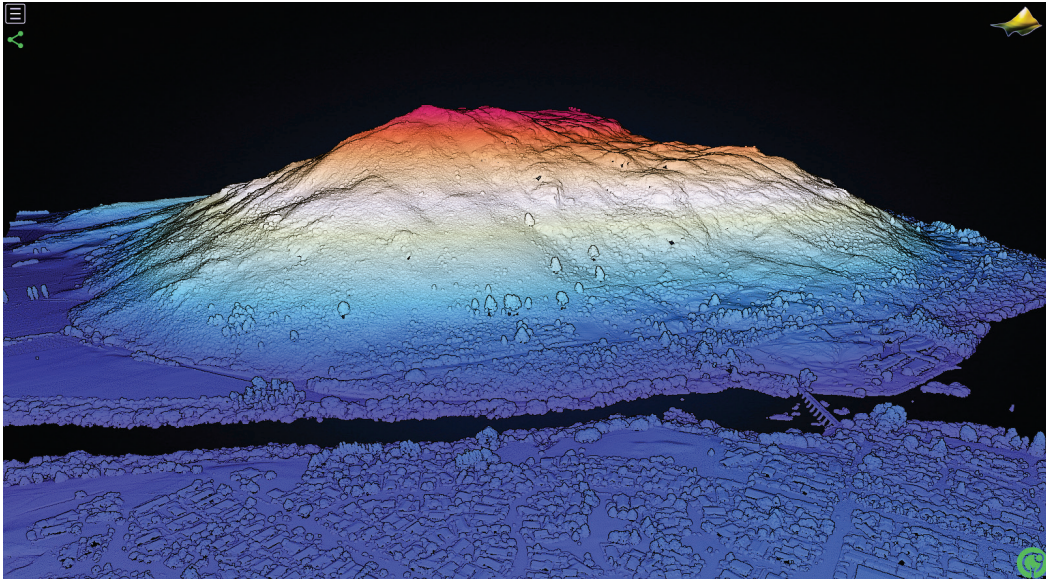


Figure 2. Point cloud image of Peninsula Hill, Queenstown, Aotearoa New Zealand (Land Information New Zealand, 2025).

The point is not that an iPhone or iPad replaces controlled survey, professional photography or verified modelling. It does not. What is the point is that practitioners now routinely carry devices capable of high-resolution photography, GPS-tagged imagery, video, panorama capture and LiDAR-assisted scanning. Progress has also been made in AR overlay, field annotation and cloud transfer.

These advances change practice. They support faster site reconnaissance, better field records, more iterative design review and more accessible communication. But they also blur the line between field note, engagement graphic, design visualisation and assessment-grade simulation.

Updated guidance therefore needs to distinguish between different levels of reliance. A smartphone image may be entirely appropriate for site recording, viewpoint scoping or informal engagement. It may be appropriate for some assessment graphics if location, lens, orientation and scale are sufficiently controlled. But where we rely on a simulation as evidence of likely visual effects, we need stronger controls: known viewpoint position, eye height, lens geometry, model placement, metadata, calibration and retained source files.

The issue is not the device. The issue is evidential status.

From print-first to screen-first review

BPG 10.2 was prepared in a world where printed reports and stated viewing distances were central. That concern remains valid. We can only assess a printed simulation properly if we understand image size and viewing distance.

However, most visual material is now reviewed first, and sometimes only, on screens. Simulations are viewed in PDFs, online portals, presentation slides, hearing-room screens, Teams or Zoom sessions, tablets and laptops. They may be cropped by report formatting, compressed by file systems, enlarged on a projector, or pinch-zoomed on a tablet.

These practices are not a minor issue. Apparent scale changes with screen size, pixel density, brightness, zoom level and viewing distance. A simulation prepared to be geometrically correct at a specified print size can become unreliable when casually zoomed, reduced, projected, or viewed on a small screen.

Future guidance needs to deal with this issue directly. It should not assume that landscape architects will return to print-first practice. Instead, it should provide practical direction for screen-first workflows: prepare images for their intended viewing medium;

include viewing instructions; avoid uncontrolled cropping; provide full-resolution files where appropriate; use calibration bars or scale references where useful; and be clear when an image is for general context rather than scale-sensitive assessment.

This is also an accessibility issue. If visual simulations are prepared to assist decision-makers and communities, then the method of viewing is part of the method of communication. A technically accurate image that its intended audience cannot view properly has not fully achieved its purpose.

The seduction of realism

The most difficult professional issue may not be accuracy. It may be realism.

Since 2010, rendering technology has advanced rapidly. Real-time rendering, physically based materials, real-time ray tracing, atmospheric effects and gaming-engine workflows can produce highly convincing images and immersive environments. Unreal Engine's 2019 discussion of real-time ray tracing in architectural visualisation, for example, described features that produce more accurate and believable architectural visualisation images and experiences (figure 3).



Figure 3. Basemap imagery and elevation (Esri World Imagery, rendered by Rhys Girvan in Unreal Engine 5, 2026).

This is useful. It can improve design testing, stakeholder engagement and communication. But it also introduces a professional trap.

Apparent realism is not the same as evidential reliability.

A highly polished render may be geometrically wrong. A cinematic animation may underplay scale by moving too quickly. A real-time model may omit existing vegetation or simplify landform. A virtual environment may feel convincing because it is immersive, while still being based on uncertain modelling assumptions. Conversely, a simple wireframe or verified model overlay may be less visually seductive but more reliable as evidence.

This distinction needs to sit at the heart of updated guidance. That guidance must recognise that visual simulation for evidential purposes should be judged not by how realistic it appears to be, but by whether it is accurate, representative, transparent, fair and auditable.

The more realistic the image, the greater the risk that viewers will overlook the assumptions it contains.

Immersion and interaction

AR and VR have also shifted from specialist demonstration environments toward more accessible platforms (figure 4). In landscape terms, these platforms most often remain limited to near-field mobile experiences rather than offering precise, auditable landscape-scale simulation – however, technology continues to evolve quickly.



Figure 4. Construction workers using Trimble SiteVision to view digital site information in its real-world context (Trimble SiteVision product page, retrieved 2026).

Immersive technologies can be valuable. They can help people understand spatial relationships, experience scale, test design options and communicate change to non-specialist audiences. Lincoln University’s own 2026 Landscape and Visual Representation Symposium recognises that digital modelling, virtual worlds and generative AI are relevant to how spatial, cultural and environmental change is interpreted.

But immersion can also make the image more persuasive as evidence for the viewer without necessarily increasing its accuracy. AR and VR outputs vary with camera position, eye height, headset optics, frame rate, field of view, model quality, lighting, movement speed and user interaction. Using them only to increase the viewer’s engagement may be acceptable provided appropriate caveats are also made clear. If a landscape architect is relying on them to make an assessment or provide evidence, they need fixed reference points and a clear audit trail.

These differences in approach point to a useful distinction between assessment-grade visual simulations, explanatory visual representations, engagement tools and design development tools. The same technology may be used across all four categories, but the evidential expectations should not be the same.

AI and the provenance problem

The most recent and most disruptive shift has occurred with generative AI.

In 2026, generative image technology has moved beyond early text-to-image systems and become embedded in mainstream creative and production workflows. OpenAI currently identifies GPT Image 2 as its latest image model, supporting both image generation and image editing from text prompts, including modification of existing images either partly or entirely (figure 5). OpenAI also enables the user to develop images through a series of prompts and refine them step by step as part of a wider workflow.

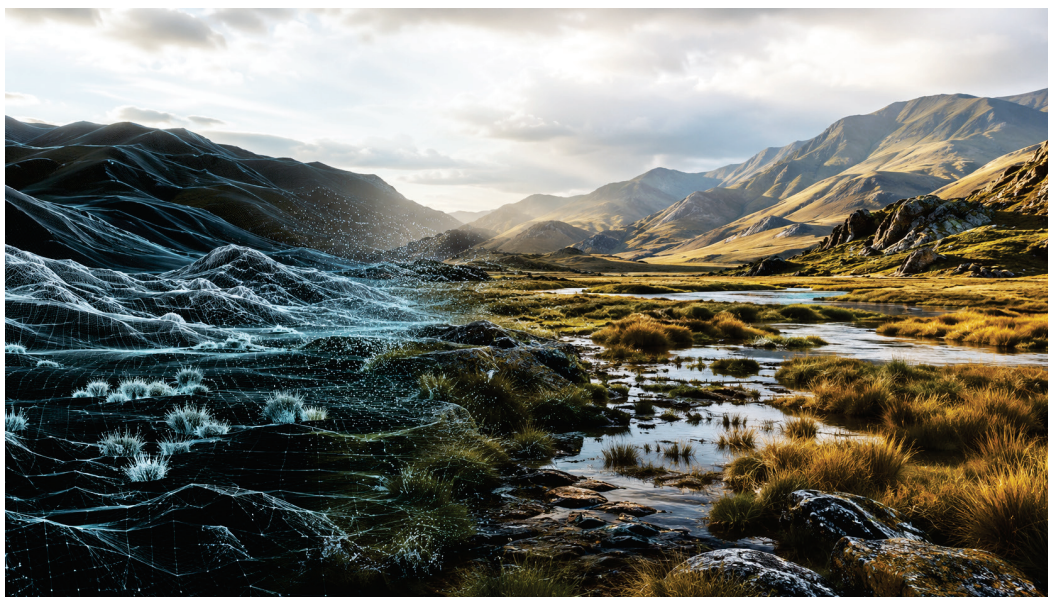


Figure 5. AI-generated conceptual image showing a digital terrain model transitioning into a photorealistic landscape (image generated by Rhys Girvan using ChatGPT (OpenAI), 2026).

Adobe's current positioning of Photoshop similarly reflects the mainstreaming of generative editing. Across desktop, web and mobile, Photoshop is promoted as enabling users to crop and expand images, adjust colour, and add or remove objects. Adobe is also moving towards offering both Firefly and third-party AI models within its creative applications. For certain AI-generated outputs, Adobe attaches Content Credentials recording information such as the application and AI tool used, helping users identify whether content was generated using Firefly or a partner model.

For landscape assessment, the implication is blunt: generative image tools are now sufficiently accessible and convincing that they cannot be treated as peripheral. They may assist with non-evidential communication, masking, layout testing, stakeholder engagement material, or clearly labelled illustrative work. However, landscape architects should not use these tools to alter assessment-relevant geometry, visibility, scale, lighting, landform, vegetation, materiality, weather, atmospheric conditions, or the presence or absence of landscape elements in visual simulations relied on as evidence, unless they explicitly disclose the alteration, justify it and separate it from verified assessment imagery.

This practice aligns with *Landscape Review*'s own guidelines for authors, which state that authors can use generative AI tools to produce content provided they disclose such use. The guidelines also state that authors should cite original sources rather than use generative AI tools as primary sources, and that it is not acceptable to enhance, obscure, move, remove or introduce a specific feature within an image.

The lesson for visual simulation practice is direct. In an environment of AI-assisted images, answering the question, 'How was this image made?' is no longer the only task. Additional questions that now need answers are: 'What has been changed, by whom or what, and can that be verified?'

This is where provenance becomes central. The Coalition for Content Provenance and Authenticity (C2PA) provides an open technical standard intended to establish the origin and edits of digital content. Its technical specification describes provenance information as including assertions about asset creation, edit actions, capture device details and other trust signals.

Such tools will not replace professional judgement. Nor should they become a bureaucratic burden disproportionate to the amount of work involved. But they indicate the direction of travel: as images become easier to manipulate, provenance and auditability become more important.

Toward a trust framework

The future of visual simulation guidance should not be a software manual as software will change too quickly for it to keep up to date. Nor should guidance attempt to rank every emerging tool in advance. That too would likely be obsolete before publication.

A more durable approach is to organise guidance around principles of trust. Eight principles are particularly important.

- **Accuracy:** Is the proposal shown in the right place, at the right scale, from a known viewpoint or spatial reference?
- **Representativeness:** Does the visual material relate to a relevant viewing audience, viewing context and assessment question?
- **Transparency:** Can the viewer understand the method, assumptions and limitations?
- **Auditability:** Can another suitably qualified practitioner check the process?
- **Fairness:** Does the representation avoid exaggerating or minimising likely effects?
- **Proportionality:** Is the method appropriate to the scale, sensitivity and consequence of the decision?
- **Accessibility:** Can the intended audience view and understand the material properly?
- **Provenance:** Is the involvement of source files, edits, model versions, metadata and AI traceable?

These principles are not new in spirit. Many are implicit in BPG 10.2. What has changed is the importance of applying them across a broader range of outputs: photomontage, wireframes, ZTVs, panoramas, drone imagery, 3D GIS, real-time models, animation, AR, VR and AI-assisted material.

The practical implication is that updated guidance should help practitioners classify visual material by purpose and evidential status. Not every image needs to meet the standard of a verified visual simulation. But where practitioners are relying on images to support their conclusions about landscape and visual effects, they should prepare, present and document those outputs to a standard commensurate with that degree of reliance.

Conclusion

BPG 10.2 remains important because it established a professional expectation that visual simulations should be technically accurate, credible and transparent. That foundation should not be lost.

But the context has changed. Visual representation is now more data-rich, more screen-based, more immersive, more interactive and more editable. The tools available to landscape architects have become more powerful. So have the risks.

The central professional challenge is no longer simply how to prepare photomontages. It extends to how to maintain trust in visual evidence. As images become more realistic, guidance about accuracy must become clearer. As visualisation becomes more immersive, guidance about evidential status must become clearer. As AI makes altering images easier, guidance about provenance and disclosure must become clearer.

The future of visual simulation guidance is therefore more than technical; it is ethical and professional as well. It concerns how landscape architects represent change fairly, how they communicate uncertainty honestly, and how they retain the confidence of the public and decision-makers in the visual evidence they prepare.

Declaration of the use of generative AI

The authors used generative AI as an assistive tool to help identify potential source material, organise a technology timeline and test alternative article structures. They have

independently reviewed and verified the sources they relied on. The professional analysis, interpretation, conclusions and final text are the responsibility of the authors.

About the authors



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