PICTURE THIS

A visual simulation of a proposed stream corridor restoration project. (Courtesy of Robert Corry)

By Gary Bentrup and Gary Wells

"What will it look like?" Natural resource professionals often hear these words from landowners who have difficulty understanding a proposed conservation plan.

Despite the use of planting plans and engineering drawings, many landowners find it difficult to conceptualize what a future conservation practice or system will actually look like on their landscape. This lack of understanding can create challenging barriers in the planning process and is exacerbated by the long-term commitment that many conservation systems require from landowners. Landowners often lament if they could only see a picture of the proposed action on their property, then they could make a decision. Fortunately, natural resource professionals have a tool called visual simulations to help address this dilemma.

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Visual simulation is a term used to describe a graphic or model that portrays a change from the existing condition (Sheppard, 1989). Simulations can range from perspective drawings and image-editing to complex 3-D models and animations. While some of the methods to create simulations are time consuming and difficult to learn, the use of computer image-editing techniques to illustrate proposed landscape changes in 2-D digital photographs is a realistic skill to acquire for many resource professionals. Using image-editing software, proposed designs can be created by adding images of plants and other materials onto a base image of a landowner's property that has been acquired from either a scanned or digital photo. In a relatively short time, windbreaks, riparian buffers, and other conservation practices and systems can be illustrated at various stages of development with different species compositions and arrangements.

FROM POLICY TO PROGRAMS

Photo-realistic simulations communicate ideas in ways that line drawings and words cannot, making this technology appropriate for any activity, program, or project where visual media would enhance communication. Historically in natural resource planning, simulations have been used to illustrate visual impacts of issues such as timber management scenarios, mine land reclamation, and locating electrical transmission lines (Bishop and Lange, 2005; Sheppard, 1989; Stoltman et al., 2004). For conservation planning on agricultural landscapes, visualizations offer great opportunities ranging from policy development to program implementation. Policy makers and regulators can assess the potential impacts of their decisions as demonstrated by Nassauer and others (2002) who used oblique aerial visualizations to depict different landscape scenarios based on changes in agricultural policy. Visualizations can be used as a marketing tool to inform the public about conservation programs such as the Wetland Reserve Enhancement Program or the Conservation Security Act. Planners can also explore design and management alternatives with landowners and stakeholders for site-scale projects such as constructed wetlands for tile drain outlets or for community-scale ventures including installing a vegetated buffer around a confined animal feeding operation. Visual simulations can be used to document and analyze visual impacts that might be required under the National Environmental Policy Act (NEPA). Visualizations can also illustrate new construction methods like streambank bioengineering and stormwater best management practices, while serving as a post-construction evaluation tool to assess project compliance. Ed Eitel, a Natural Resources Conservation Service district conservationist in Wyoming, created a simulation to help the landowner and contractor understand how sheet piling would be used to restore flows in an abandoned stream channel. "The simulation also played a valuable role in helping to acquire the Army Corps of Engineers permit," says Eitel.

One of the most beneficial uses of simulations is in the planning process where it can promote better stakeholder understanding of proposed alternatives and management actions (Bishop and Lange, 2005; Sheppard, 1989). The communicative and non-threatening nature of simulations encourages stakeholders to invest time in the design process and offer feedback on alternatives, facilitating the development of a shared vision for the landscape or watershed (Al-kodmany, 1999). This has proven to be the case in Kandiyohi County Soil and Water Conservation District where forester Rick Reimer has used visual simulations to promote and plan community shelterbelts to protect several Minnesota towns from wind and snow. "In addition to engaging community members in the planning process, they particularly valued simulations illustrating the shelterbelt at various stages of development. Showing what a shelterbelt was going to look like at ten years was important since most people have a hard time understanding plant growth rates," says Reimer. Using simulations in a participatory process greatly increases a sense of ownership in the plan, which leads to enhanced acceptance and adoption of the proposed action. All of these factors contribute to a more efficient and effective planning and design process (Al-kodmany, 1999).

A series of visual simulations illustrating a proposed poultry barn operation and a vegetated buffer at different stages of development.

Existing Condition

Year 1

Year 5

Year 10

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POTENTIAL USES OF VISUAL SIMULATIONS IN NATURAL RESOURCES

A planning tool to present alternatives and solicit feedback.

Existing view of Mt. Bakero

Alternative 1
Low density conifers with hardwoods

Alternative 2
Conifers with hardwoods

Alternative 3
Low shrubs in view

A policy analysis tool to evaluate proposed regulations.

Existing conditions

With new conservation practices


Existing conditions


With Wetland Reserve Enhancement Program

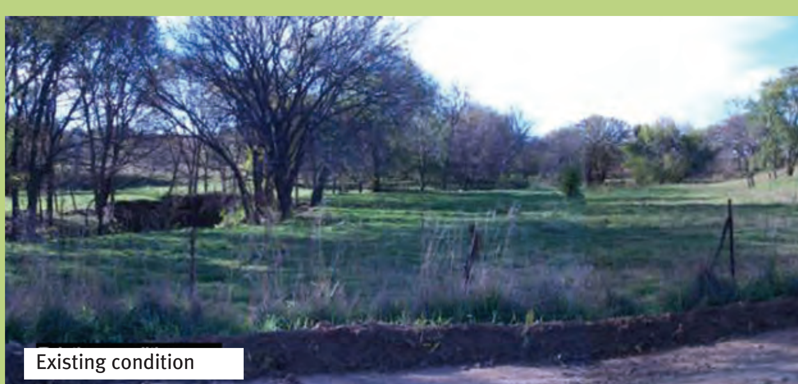
An informational tool to illustrate conservation programs and activities.

A construction aid to contractors.


Existing conditions


With constructed stormwater wetland

A visual-impact analysis tool for public meetings and documents.


Existing condition


With proposed flood control dam

A training aid to help convey management concepts.


Pine plantation prior to thinning


Pine plantation after thinning

IMAGE-EDITING TECHNIQUES

There are two primary techniques used in creating simulations when using image-editing software (i.e. Adobe Photoshop, JASC Paintshop Pro, or CanVis). Cloning is a method that takes a sample of textures from an image, which can then be applied on to another part of the same image. Each stroke of the tool paints on more of the sample. For instance, a riparian forested buffer can be created by cloning a group of trees already present in the image. Because this tool uses textures from within the base image, any element built with this tool is more likely to match the characteristics of the base image, creating a realistic simulation. When appropriate textures or objects are not available in the base image to be cloned, objects can be imported from other pictures or object libraries. For example, an object such as an animal or a fence can be cut from one image and inserted into the base image that is being used for the simulation. In some software programs like CanVis (see sidebar on page 149A), existing object libraries of plant materials, people, wildlife, and other features are available that greatly aid the construction of a visualization. These objects can simply be dragged and dropped into the image. Once objects have been placed in an image, they can be resized, color-adjusted, and shadows can be added to create a realistic simulation.

The most challenging, but important aspect of creating visual simulations is accurately sizing and locating objects in the image. There are two basic methods for sizing and locating objects in a digital image. One method that works well, particularly in sloped landscapes, is the use of markers. Using the proposed design plan as a guide, markers are located in the landscape at key locations to delineate design features prior to taking the picture. Once this image is brought into an image-editing program, the markers provide exact locations for placing imported objects. When markers of a known height are used, they can also serve as a reference for establishing the correct height of the imported objects. The markers can then be edited out of the final image. Another method is based on trigonometric principles and involves calculating the scale in the digital image so that objects can be sized and located using a ruler or scale. Since a scale is created for the image, one can continue to modify the design and the simulation without having to retake the image as with the marker method.

ETHICS AND VISUALIZATIONS

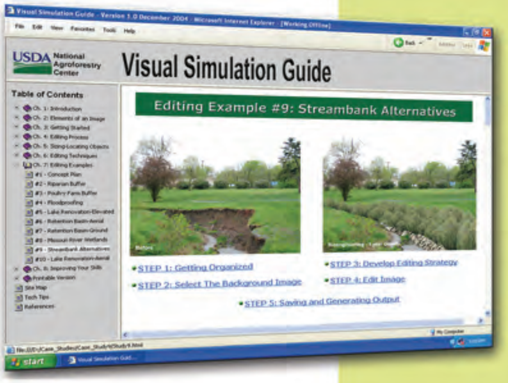
While visualizations can be an extremely useful tool, they must be used with some caution (Sheppard, 2001). When visualizations are crude as with diagrammatic illustrations, appropriate skepticism arises because the public generally recognizes these visual aids are abstractions. Photo-realistic simulations, however, tend to convey a high level of accuracy arousing a greater sense of expectation about what actually will be achieved (McQuillan, 1998). The "wow" effect of this technology can lead viewers to believe there must be significant precision associated with the predication. Consequently, creators of visual simulations must make sure they develop the skills necessary to accurately locate and size the proposed objects to illustrate a realistic depiction of the proposed scenario. Documenting the process by which the simulation was created is critical for establishing credibility of the visualization. For instance in natural resource-based visualizations, estimating plant height at different time periods is a common task. NRCS has estimated growth rates for many trees and shrubs by soil types, providing credible guidance for predicting plant height at a certain age in the visualization. Resource professionals must also be forthright in explaining limitations and assumptions that went into the visualization and should not bias decisions by manipulating the simulations to artificially achieve a desired decision by the public. Incorrect and misleading simulations will just frustrate landowners and stakeholders when the mature project resembles nothing close to the simulations, damaging the reputation of the resource professional and their organization while eroding away support for conservation of natural resources (Sheppard, 2001).

Another limitation for the use of 2-D visual simulations is that they represent only a snapshot in time and do not capture dynamic interactions like 3-D animation. For instance, 2-D visualizations can rarely depict active processes like flowing water or wildlife movement. In addition, only one viewpoint is often provided for each proposed alternative unless several 2-D simulations are prepared from different viewpoints. While interactive 3-D animation may overcome these limitations, this visualization technique is very time-consuming, necessitates expensive software and hardware, and requires users to develop very specialized skills, seldom an option for most resource professionals.

> The communicative and non-threatening nature of simulations encourages stakeholders to invest time in the design process and offer feedback on the alternatives.

USING VISUAL SIMULATIONS

Although photo-realistic simulations offer many tangible benefits for the planning process, this technology has not yet been used extensively in natural resource management. Historically, editing digital images required expensive software and hardware but these barriers have generally been removed. Developing the essential skills to create accurate simulations is now the primary challenge. For resource professionals interested in learning to create truthful simulations, the necessary skills can be within the reach of people willing to spend the time to learn a new tool. Two types of skills are needed for creating simulations. First, users need to be able to read plans and understand spatial relationships of proposed design features. Knowledge of land surveying, drafting, and basic engineering are beneficial when creating visualizations. The second skill set involves basic understanding of art and computer graphics. To learn more about developing visualization proficiency, refer to the Visual Simulation Kit sidebar. Resource professionals who are interested in using simulations in their work but who are unable to dedicate the time to develop the skills may find it beneficial to train or hire an individual who can prepare simulations for their organization. In other cases, managers may find it more feasible to acquire visual simulation expertise on an as-need-basis from landscape architects and land planners who usually provide this service. For those organizations willing to devote resources to preparing and using visual simulations, the dividends in efficient and effective conservation planning should easily exceed the investment.



CONCLUSION

Integrating production and environmental protection goals on private lands is a challenge faced by many resource professionals. While scientific research and data on conservation practices will still be beneficial to planners and policy makers, we need to realize this information may actually play only a very limited role in promoting the adoption and acceptance of conservation by landowners. As Nassauer et al. (2001) state, we must go beyond providing tools that only address the ecological and economic aspects of sustainability and provide those which also enhance the cultural sustainability of our working landscapes; that is, it must elicit sustained human attention over time. Without this, benefits may be compromised as land ownership changes, as development pressure increases, or as different political viewpoints arise. Visual simulations can help build that foundation for cultural sustainability by communicating ideas clearly, by inviting feedback on alternatives, and by instilling a sense of shared ownership in the conservation system. As the old saying goes, a picture is worth a 1000 words!

VISUAL SIMULATION KIT

To promote the use of visual simulations in natural resource management, the USDA National Agroforestry Center (NAC) has prepared the Visual Simulation Kit, a 2-CD set consisting of the Visual Simulation Guide and CanVis image-editing software program.

VISUAL SIMULATION GUIDE

The Guide is a multi-media, reference manual on how to use image-editing software to create visualizations for resource planning. The manual provides instructions on how to plan a simulation project, acquire images and edit an image from ground-level, elevated-ground level, and oblique-aerial viewpoints. Extensive instruction is provided on how to use perspective principles, markers and scaling methods derived from trigonometry to correctly size and locate objects. Ten resource planning projects are provided on the CD as working examples. Videos are used to showcase these projects and users can develop and evaluate their skills by imitating these editing examples.

CANVIS

This image-editing program was developed specifically for natural resource management. Simulations can be created by cloning or by adding parts or objects from other images. Parts from other images can be cut out using the software and saved as objects in libraries for future use. A collection of over 500 objects are already contained in CanVis' libraries, which include:

- Agricultural elements
- Trees and shrubs
- Grasses and flowers
- People
- Vehicles
- Wildlife
- Hardscape and park elements

Objects can be resized, color-adjusted, and shadows can be added to create realistic simulations. The software also enables the insertion of text to put the finishing touches on a project. To learn more about the Visual Simulation Kit, log on to NAC's website at www.unl.edu/nac/simulation/.

References cited

Al-kodmany, K. 1999. Using visualization techniques for enhancing public participation in planning and design: Process, implementation, and evaluation. Landscape and Urban Planning 45:37-45.

Bishop, I. and E. Lange. 2005. Visualization in landscape and environmental planning: Technology and applications. Taylor and Francis Group, New York, New York. 296 pp.

McQuillan, A.G. 1998. Honesty and foresight in computer visualizations. Journal of Forestry 96(6):15-16.

Nassauer, J.L., R.C. Corry, and R.M. Cruse. 2002. Alternative future landscape scenarios: A means to consider agricultural policy. Journal of Soil and Water Conservation 58:44a-53a.

Nassauer, J.I., S.E. Kosek, and R.C. Corry. 2001. Meeting public expectations with ecological innovation in riparian landscapes. Journal of American Water Resources Association 37:1439-1443.

Sheppard, S.R.J. 1989. Visual simulation: A user's guide for architects, engineers, and planners. Van Nostrand Reinhold, New York, New York. 215 pp.

Sheppard, S.R.J. 2001. Guidance for crystal ball gazers: Developing a code of ethics for landscape visualization. Landscape and Urban Planning 54:183-199.

Stoltman, A.M, V.C. Radeloff, and D.J. Mladenoff. 2004. Forest visualization for management and planning in Wisconsin. Journal of Forestry 102(4):7-13.

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