Changing Geography by Design

Selected Readings in GeoDesign

esri

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Introduction

Geographic information system (GIS) technology has a long history of driving environmental understanding and decision making. Policy makers, planners, scientists, and many others worldwide rely on GIS for data management and scientific analysis. As the challenges facing our natural and human environments evolve to new levels of complexity, our tools must also evolve. To this end, a dedicated group of people has been actively pursuing the development of GeoDesign theory, concepts, and tools.

Design is about purpose and intentions; it's about seeing in our mind's eye what could be, then creating it. Based on concepts found in Ian McHarg's seminal *Design With Nature,* GeoDesign integrates geographic science with design, resulting in a systematic methodology for geographic planning and decision making. GeoDesign brings geographic analysis into any design process, resulting in designs that more closely follow natural systems. This benefits both people and nature and provides a more synergistic coexistence.

Changing Geography by Design

Matt Artz, Esri

"Japan is famous for the master designers who harmonized the use of land and structures with the environment around them, finding the right balance between building and nature. Contrast this with the sprawling, monotonous suburbia so familiar today. It's a kind of crime against nature."

—Jack Dangermond at TED2009

When I first met Bill Miller more than 20 years ago, he was talking about design. And he hasn't stopped.

For many years, Miller directed the development of Esri's training and support infrastructure. Later as an engineer/architect, he was intimately involved in the design of Esri's state-of-the-art corporate headquarters and conference center. Perhaps his best-known contribution to the GIS community was development of the ModelBuilder environment released as part of the Spatial Analyst extension.

His vision for the integration of geospatial technologies with the design process was long shared by a group of people that included UC Santa Barbara's Michael Goodchild, Esri President Jack Dangermond, Harvard University's Carl Steinitz, and a handful of others. Miller made this vision "real" when he assembled a small team to develop ArcSketch, a free sample extension that allows you to quickly sketch features in ArcGIS; it was Esri's first small step toward what is now commonly referred to as GeoDesign.

The *sketching* concept is key to GeoDesign. "GIS has grown to serve the *data* and *analysis* components of workflows quite well, but up until now it has played little role in serving the *design* component," said Miller. In other words, users of GIS have not been able to do their design work in GIS because GIS did not support that segment of their workflow. "This is now beginning to change." The ability to easily sketch alternative design scenarios

and quickly get feedback on suitability by comparing the design proposal to geospatial databases removes the barriers.

Miller retired from Esri last year, but remains passionate and vocal about the promise of GeoDesign. "GeoDesign lets you use the full power of GIS while you are actually creating your various design proposals," Miller said. "In this way—and this is what I feel is most significant—GeoDesign links design to science and science to design. In short, GeoDesign gives the designer the power to do science-based design."

Is GeoDesign New?

"We've been doing GeoDesign for years" was a statement commonly overheard at the first GeoDesign Summit held in January 2010. "I think GIS, CAD, BIM, neogeography, the GeoWeb, and other concepts are all a part of GeoDesign," said geospatial blogger and WeoGeo evangelist James Fee. "The GeoDesign tools you use depend on the subject matter—NEPA [National Environmental Policy Act] work (gravitates toward GIS), site planning (incorporating CAD or BIM), Web sites and visualization tools (the GeoWeb), or nontraditional geo-sources (neogeography). I think we've all been doing GeoDesign with these tools for years, even decades, but not as a whole concept to implementation practice."

Michael Goodchild, professor of geography, University of California, Santa Barbara, presents at the GeoDesign Summit in Redlands, California, January 2010.

Building on these compartmentalized experiences, GeoDesign formalizes and expands the role of geospatial technologies in design workflows, as well as across the entire life cycle of a project.

"GeoDesign brings together the NEPA work that leads off projects, the engineering work, feedback from citizens, and its presentation toward all on the Web," said Fee. "In the past what happened was all these disciplines were off doing their own thing and it was up to a project manager to bring them all together. Most of the time this resulted

in a document that ended up sitting on a shelf, feedback not being delivered to the groups working on the project, and little collaboration to improve the end results. What GeoDesign does is allow these groups to work together to produce plans and designs that will better interact with the environment around them."

Even with the potential for so much benefit, questions remain about possible overlap between GeoDesign and specific disciplines—and the likelihood that these disciplines will embrace the concept. "GeoDesign and urban planning are probably the same thing," said Atanas Entchev of ENTCHEV GIS Architects. "An urban planner who uses GIS daily to its full potential (I know none) is probably a GeoDesigner. GeoDesign brings a fascinating set of tools to the urban planning profession. But is GeoDesign going to claim some of the planners' territory?"

Definitions Abound

One of the challenges noted by participants at the GeoDesign Summit was that of communication: How could this small group of people best share the vision of GeoDesign with the broader community? To that end, several formal definitions of GeoDesign were proposed at the Summit, and discussion and refinement has continued on Wikipedia and elsewhere. Miller proposed his own, more simple definition:

GeoDesign is the thought process comprising the creation of entities in geographic space.

"I don't think this definition will grab anybody's immediate attention," noted Miller, "but it might help to clarify the power and extent of GeoDesign."

"GeoDesign is both an old idea and a new idea," said Dangermond. "It's timeless." Integrating geospatial technologies into the design process with the goal of living more harmoniously with nature leads to Dangermond's simplified definition:

GeoDesign is designing with nature in mind.

Entchev described GeoDesign in different terms:

GeoDesign is a smart strategic shift from "what is" to "what will be."

Steinitz, whose model of landscape change was highly influential in the development of the GeoDesign concept, stated that "not all geography changes by design, and not all design changes geography." In this context, he proposed what is perhaps the most elegant definition:

GeoDesign is changing geography by design.

The Future

Although much work remains, the first GeoDesign Summit met its goal of creating a community to advance knowledge and understanding of GeoDesign concepts, technologies and tools. "I'm extremely pleased that so many people are taking an interest in this nascent field and want to be part of its creation," said Miller. "Without this discussion, the idea of GeoDesign would come and go in an instant, leaving us with a huge lost opportunity."

With a concept this powerful—one offering so much hope—the discussion will likely continue for some time.

(Based on an article published in Directions *Magazine, March 11, 2010)*

Designing Our Future

Jack Dangermond, Esri

"Man may perish by his own explosive and insidious inventions. For an adjustment to them he leaves himself precious little time, and progressively less as his technological wizardry runs wild and rushes on. If he is to survive at all, it cannot be through slow adjustment. It will have to be through design more subtly considered and circumspect, through more cautious planning in advance."

With those words in 1954, influential architect Richard Neutra opened his seminal book *Survival through Design.* Neutra was an early environmentalist, taking an approach to architectural design that applied elements of biological and behavioral science—what he called biorealism, or the "inherent and inseparable relationship between man and nature." Fifteen years later, in his groundbreaking book *Design with Nature,* landscape architect Ian McHarg advocated a framework for design that helps humans achieve synergy with nature. Design and planning that take into consideration both environmental and social issues help us ensure that our resources are used appropriately and responsibly, to help us move toward a better future for all. McHarg's pioneering work not only had a fundamental influence on the up-and-coming field of environmental planning but simultaneously solidified the core concepts of the young field of GIS as well.

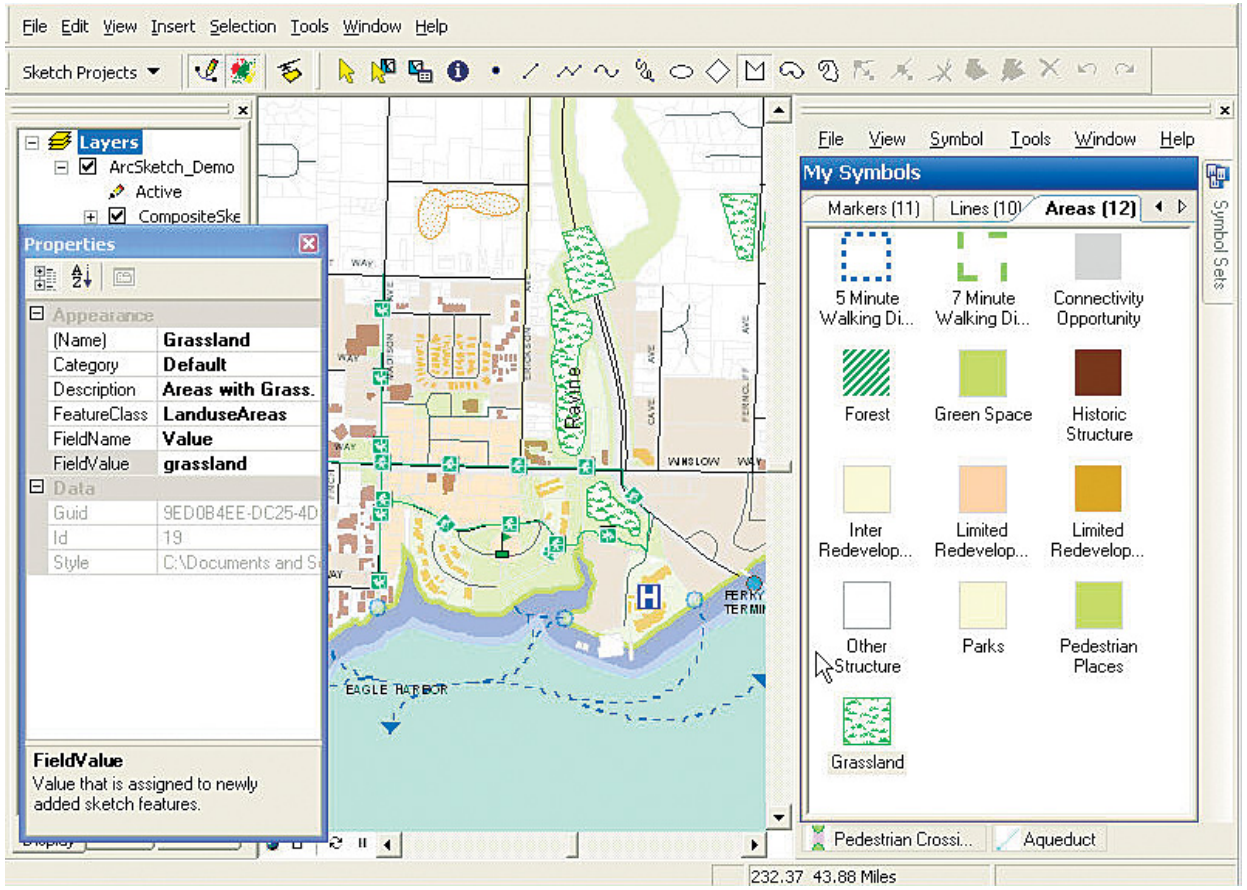
In the 40 years since *Design with Nature* was written, a better world is the common goal all of us—geographers, planners, scientists, and others—have been striving for. Discussing his book during the Keynote Address at the 1997 Esri International User Conference, McHarg laid out a process by which "environmental data could be incorporated into

the planning process." Rejecting the view of a future modeled after some idyllic environmental past, he instead was an early adopter of the view that we should be using our dominance of earth systems to help evolve the natural world and make it better, rather than conquer it. Powerful anthropogenic influence over earth systems represents not just a huge challenge but an equally huge opportunity—not humans versus nature, but humans with nature. "While traditional ecological research selected environments with a minimum human influence, I selected arenas of human dominance," McHarg said. Today more than ever, it is important to recognize the overwhelming impact of humans on the environment, that massive human impacts on the earth are a fact that's not going away, and that we stand at the crossroads. Thus, our challenge is to provide designers, engineers, planners, and others, with a set of tools and a framework for designing and managing the anthropogenic earth.

Design for the Anthropogenic Earth

The field of earth systems engineering and management (ESEM) concerns itself with the design, engineering, analysis, and management of complex earth systems. ESEM takes a holistic view of multiple issues affecting our earth—not only taking environmental, social, and other considerations into account up front in the design process but also looking at challenges from an adaptive systems approach, where ongoing analysis feeds back into the continual management of the system.

Braden Allenby, professor of civil and environmental engineering at Arizona State University and one of ESEM's founders, often emphasizes the undeniably dominant role humans have in earth systems. "We live in a world that is fundamentally different from anything that we have known in the past," says Allenby. "It is a world dominated by one species, its activities and technologies, its cultures, and the integrated effects of its historical evolution." McHarg was already moving in this direction in the 1960s, and today we understand that it is even more important to emphasize the anthropogenic elements of earth systems. In other words, at this stage of ecological evolution, humans are a significant, if not dominating, component of the natural environment, and all problems need to be addressed and decisions made with anthropogenic elements in the forefront.



Sketch tool-style editing makes GIS editing simpler.

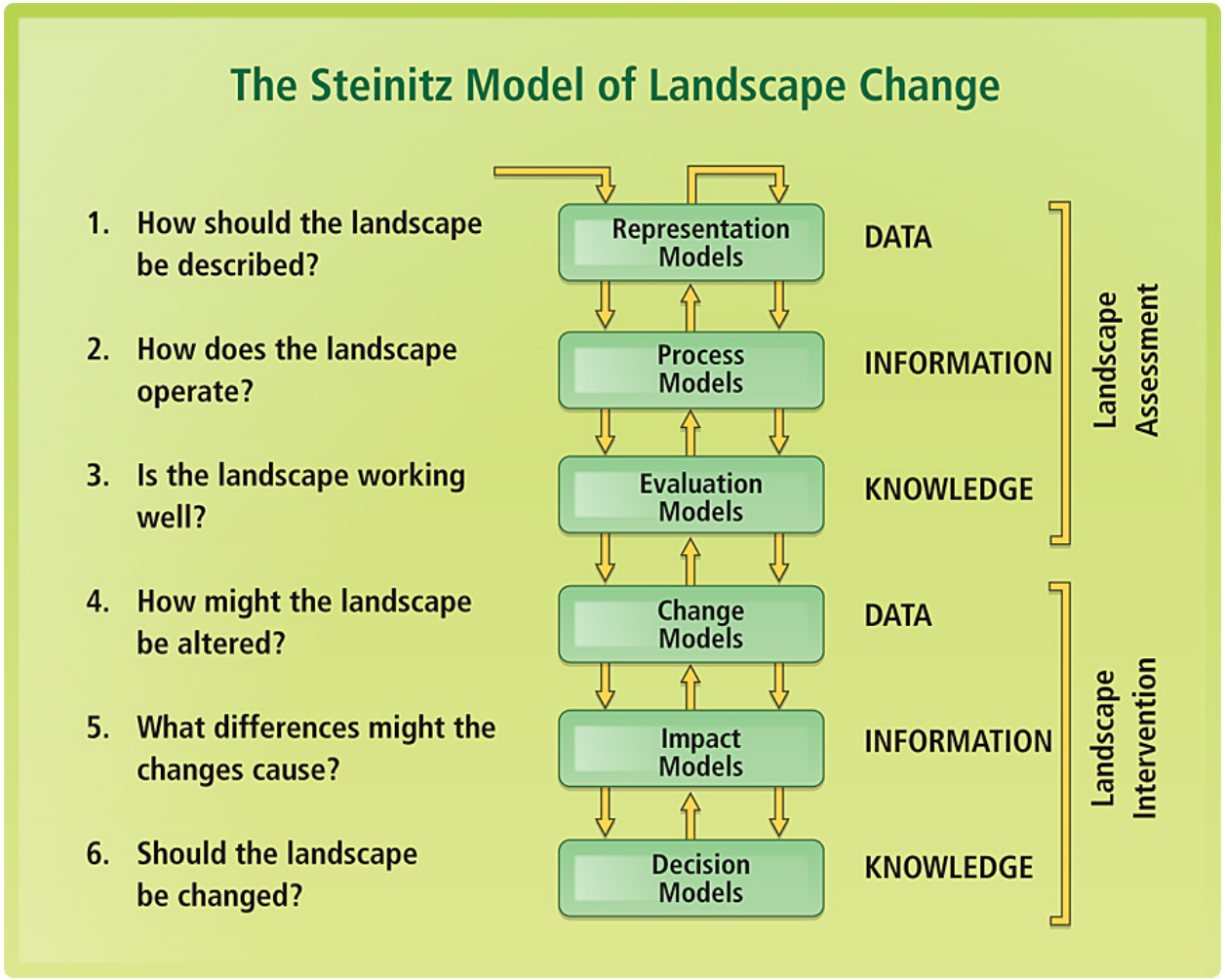
Allenby sees reasoned design and management in the age of the anthropogenic earth as our moral imperative, but the biggest obstacle to our success is that we are not set up to work, or even think, in this way. "We lack solid data and analytical frameworks to make assertions about the costs, benefits, and normative assessments of different . . . practices," notes Allenby in "Biomass Management Systems" in *Reconstructing Earth.* And this is why I believe that GIS and the emerging field of GeoDesign are critical to the

success of approaches such as ESEM and other logical and rational models for dealing with the environmental and planning problems of ours and future generations.

"We are being propelled into this new century with no plan, no control, no brakes."
– Bill Joy, Cofounder and Chief Scientist, Sun Microsystems

Designing Alternative Futures

The key to developing a true understanding of our complex and dynamic earth is creating a framework to take many different pieces of past and future data from a variety of sources and merge them in a single system. GIS is a sophisticated technological tool already in widespread use by planners, engineers, and scientists to display and analyze all forms of location-referenced data about the health, status, and history of our planet. GIS enables a GeoDesign framework for analyzing and managing anthropogenic earth issues by allowing users to inventory and display large, complex spatial datasets. They can also analyze the potential interplay between various factors, getting us closer to a true understanding of how our dynamic earth systems may change in the coming decades and centuries.



Carl Steinitz, an urban planner at Harvard University, originated many of the early ideas about the application of GIS for landscape analysis and urban planning. Steinitz developed a model of landscape change that enables design of alternative futures. Those alternative designs can then be evaluated in terms of their impact on the natural environment as well as their utility to the human population, and the alternative future

that is projected to achieve the best balance can then be selected for implementation. With a debt of gratitude to Steinitz, the GeoDesign framework also lets us design and test various alternatives, helping us make the most educated and informed decisions about the best possible future and allowing humans and nature to coexist more harmoniously.

Design with Nature

Design with Nature—rarely has a three-word title so eloquently summed up an entire tome. The most important word in that title is not *design,* nor is it *nature.* It's *with.* It sets the stage for design and nature working together in concert to achieve something that is bigger than the sum of the parts, a synergy of design and nature reaching toward the goal of the survival of the human species in particular and the planet in general.

It's not a stretch to say that the development of GIS technology and the entire industry around it was profoundly influenced by the work of McHarg. He popularized the overlay concept and laid the groundwork for what was to become GIS, thus taking a number of budding young landscape architects and geographers and changing their lives forever.

McHarg and I may have disagreed on some things, but we clearly shared the vision of using geographic analysis techniques to design a better world. Although we've made much progress in building the infrastructure to help us accomplish this monumental task, we're still not quite there yet. In fact, 28 years after *Design with Nature* was published, McHarg issued a challenge of sorts to attendees of the 1997 Esri International User Conference in his Keynote Address:

"By and large, the ecological planning studies I did in the 1960s and 1970s have not been equaled, far less surpassed. And I think there has got to be a challenge; that is, we've got to be able to learn to do at least as well for regions and for the nation and, indeed, for the global environment as we are doing at the moment."

Like McHarg's *Design with Nature,* Esri is also celebrating its 40th anniversary this year. It's no coincidence that both the concepts espoused within *Design with Nature* and the GIS work led by Esri launched almost simultaneously. When McHarg advocated this new methodology of taking geographic considerations into the design process and workflow, he probably could never have imagined how far we'd come with GIS by 2009.

But the hard work we've been doing on developing GIS technology for the last 40 years does not mean we are finished, or even close to being finished. And I feel that all our hard work evolving GIS has led us to this pivotal point. The next logical step in the evolution of this technology is GeoDesign.

The Case for GeoDesign

GeoDesign borrows concepts from landscape architecture, environmental studies, geography, planning, regenerative studies, and integrative studies. Much like GIS and environmental planning before it, GeoDesign takes an interdisciplinary, synergistic approach to solving critical problems and optimizing location, orientation, and features of projects both local and global in scale.

Design is art within the framework of limitations—limitations that arise as a result of function, world view, bias, and other factors, but also limitations that arise as a result of place. Design considering place was at the core of McHarg's beliefs, and it is the basis for our research and development efforts in the emerging field of GeoDesign.

"*. . . design is always and necessarily an art as well as a problem-solving activity . . .*"
—*David Pye,* The Nature of Design

To a certain extent, this is already done today by numerous GIS practitioners in fields like urban and regional planning and environmental management. But GeoDesign makes this easier by making it an integral part of the workflow, both shortening the cycle time of the design process and improving the quality of the results.

Cycle time is shortened because GeoDesign moves analysis to an earlier stage in the design process. Rather than analyzing the potential impacts and effects of a proposed project after the design phase, critical factors are instead taken into consideration up front. The quality of the results improves because the project is designed around, in concert with, and/or to fully leverage certain geographic, environmental, and social features while simultaneously minimizing undesirable impacts to those same features.

Designing Our Future

"GIS: Designing Our Future" is the theme of the 2009 Esri International User Conference. When I talk of designing our future, I believe that combining the wealth of data available about our world with sophisticated analysis and management tools is the prescription for understanding and shaping the future of our planet—an anthropogenic

future where advances in human society, technology, etc., are designed in close collaboration with nature, resulting in the best of possible future worlds. It's a huge task and a delicate balance, for sure, but with help from GIS and GeoDesign tools, we readily accept that challenge. Because, frankly, we have no other choice.

What Is GeoDesign?

GeoDesign brings geographic analysis into the design process, where initial design sketches are instantly vetted for suitability against a myriad of database layers describing a variety of physical and social factors for the spatial extent of the project. This on-the-fly suitability analysis provides a framework for design, giving land-use planners, engineers, transportation planners, and others involved with design, the tools to leverage geographic information within their design workflows. Fully leveraging geography during the design process results in designs that emulate the best features and functions of natural systems, benefiting both humans and nature through a more peaceful and synergistic coexistence.

GeoDesign involves three activity spaces: the work environment (where designers do their work), the design tools (the tools designers use to do their work), and supportive workflows (how designers do their work). Having one of these out of sync can impede the design process.

- Work Environment—Today's work environment used by geo-based design professionals involves the field, the desktop, connection to enterprise servers and databases, the use of document management systems, collaborative environments (both inside and outside the enterprise), and interaction with outside agencies and organizations.
- Design Tools—Geo-based designers use a variety of tools to assist them as they create their designs. Probably the most frequently used tool, or type of tool, is the drawing tool. The particular type of drawing tool depends on the designer's domain and whether the designer is working in 2D or 3D space.
- Supportive Workflows—Most geo-based workflows, at least at a detailed level, are domain specific. Three workflows pertaining to the use of geographic information stand out, however, as being predominantly genetic: one related to land-use change;

one related to the design, construction, and management of built facilities; and one related to the use of 2D CAD.

Early Forays in GeoDesign

Although it might be easy to compare the two, GeoDesign should not be confused with computer-aided design (CAD). In fact, the first geographic design system was ArcCAD, Esri's earliest attempt to build a dedicated GeoDesign tool. Released in the early 1990s, ArcCAD was the first fully functional GIS system within the AutoCAD environment. While traditional CAD is a useful tool in the architectural design of a building, GeoDesign is concerned with designing that same building in and around the environment. ArcCAD was an attempt to integrate geographic data and spatial modeling into the design process. ArcCAD provided powerful mapping, data management, spatial analysis, and display tools that worked directly with AutoCAD's design and drafting tools.

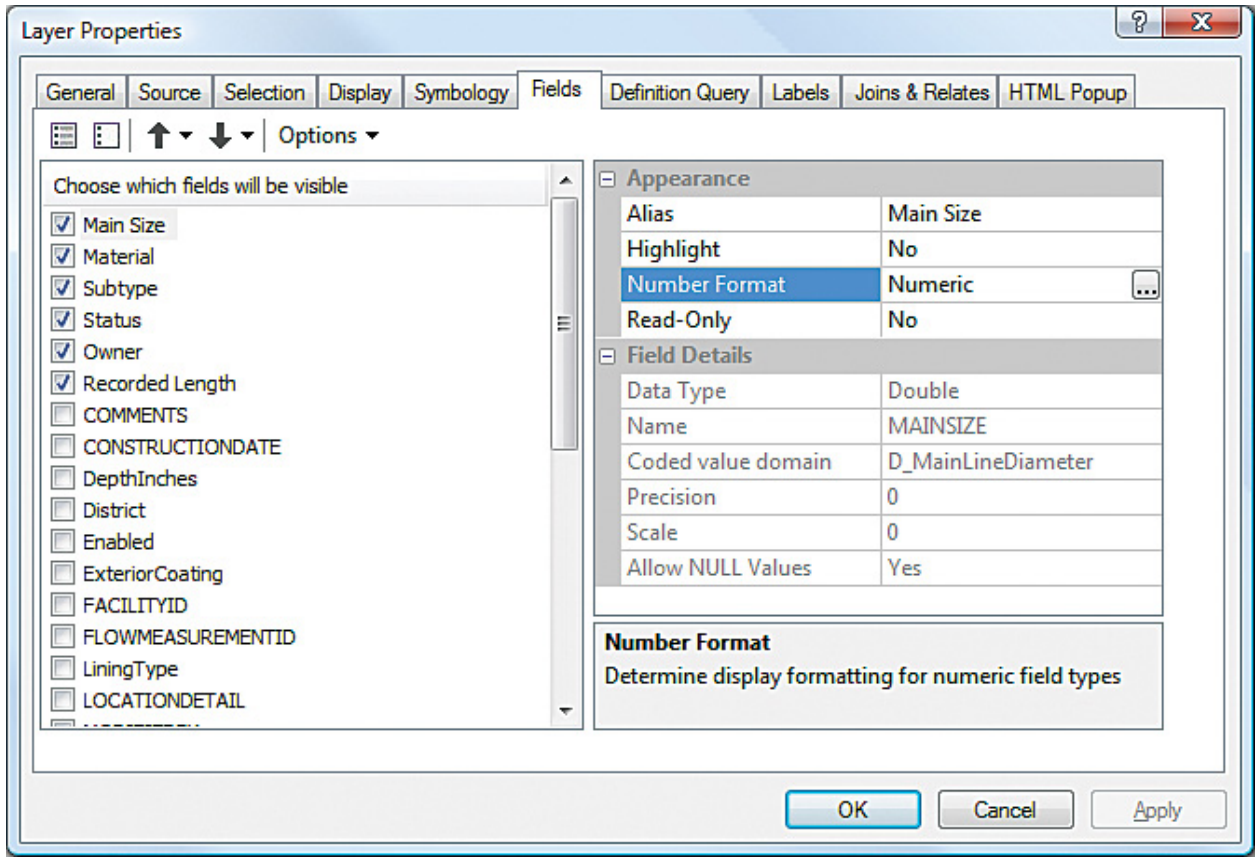
ArcCAD was followed by other Esri applications (including SDE CAD Client and ArcGIS for AutoCAD) that allowed designers and others within the CAD environment to leverage the full power of GIS functionality and GIS databases. ArcGIS for AutoCAD, a free downloadable tool that offers seamless interoperability between AutoCAD and the ArcGIS platform, is used widely today. ArcGIS for AutoCAD users are provided with quick and easy access, within the AutoCAD environment, to enterprise GIS data published by ArcGIS Server. This tool lets designers include the results of GIS analysis in AutoCAD designs, as well as create, manipulate, and define how CAD data is organized and attributed as GIS content.

Meeting the Challenge with GeoDesign

Integration of design tools with existing GIS functionality is important, but it's only the first step. Ultimately, our vision is to expand the utility of GIS to the point that it is a foundational design system. As humanity comes to grips with its overwhelming impact on the natural world, we are also gaining a much better appreciation for our inextricable link to nature. And with that, of course, comes an enormous responsibility—a responsibility made all the more gargantuan by the fact that we still have a long way to go toward fully understanding the dynamics of the various systems and developing a robust suite of comprehensive models and other tools to support these activities. As Neutra did with architecture in the 1950s, we need to advance a framework for design and planning that not just incorporates but also embraces technology; science; and,

ultimately, nature in a system that helps us design and choose the best alternative futures.

"There is now a growing interest in combining design functionality with the broader geographical context that geospatial tools offer in order to engage more deeply in land-use planning."
–Matt Ball, V1 *Magazine*



Imagine if your initial design concept, scribbled on the back of a cocktail napkin, has the full power of GIS behind it: the sketch goes into the database, becoming a layer that can

be compared to all the other layers in the database. The experience Esri has gained while developing CAD integration tools, ArcSketch, and the new tools in ArcGIS 10 has led to an appreciation of the power that could be derived by associating drawing tools, symbology, data models, and process models into one integrated framework for doing GeoDesign. Having "back of the napkin" design sketches available for immediate analysis and feedback is one of Esri's primary areas of research and development over the coming years, and our users will see the results of these efforts in upcoming releases.

And the need for such tools has never been greater. We live in an ever more complex world, where our impact on the natural environment is massive and can no longer be ignored. People are starting to recognize the importance Neutra placed on the inseparable relationship between humans and nature and to realize McHarg's vision of design with nature, and they want to act.

A GeoDesign framework will provide a robust set of tools for design professionals and finally meet the challenge of Ian McHarg, letting us truly design with nature.

(This article originally appeared in the Summer 2009 issue of *ArcNews.*)

Is GeoDesign an Activity, a Practice, or a Software-Enabled Modeling Approach?

Matt Ball, Vector1 Media

The concept of GeoDesign involves a more interactive interface to geospatial layers with the means for sketching and design upon those layers in a collaborative way while contributing and interacting with an evolving intelligent model. The concept itself isn't new, but various technology pieces have been missing, and the enabling software is now being worked on.

Solving the connections between various software tools and discipline workflows is a sticky problem that will take some time to address and unravel. Now is the time for more dialogue on the definition and practice of GeoDesign.

The definition is being considered by practitioners, associations and academics. As the concept, process and technologies come together, it's interesting to consider the question of whether GeoDesign is an activity, can be defined as a practice, or can become a software-enabled approach.

Changing By Design

The master of the idea of GeoDesign is Carl Steinitz from Harvard University who has been active in consensus-building urban design approaches for a long time. Steinitz has defined GeoDesign as *changing geography by design.* In this definition, the emphasis is on the active role of GeoDesign to shape and mold our surroundings to our desired uses. The desire to change geography looks at broader-scale plans beyond individual buildings for a better understanding and effect on the landscape.

GeoDesign as an activity centers on projects for specific outcomes in specific locations. The individual GeoDesigns for an area can be thought of as integrating over time in a larger planning-oriented repository, but in order for GeoDesign to be realized it must have funding as individual projects, perhaps even in a way that mandates the approach.

Defining a Practice

GeoDesign involves the modeling of desired outcomes that goes beyond building plans to incorporate the design of the broader geography. This purview for broader change involves the input of such disciplines as landscape architects, environmental scientists, engineers, urban planners, elected officials and citizens.

In order for GeoDesign to truly take off, it must take an interdisciplinary approach that is inclusive of all of the various parts in the planning process. The practice of GeoDesign would need to be taught and promoted in each individual discipline. The role of GeoDesigner might even involve being the coordinator and keeper of the central model, ensuring its integrity and compliance, while also spurring the project to completion.

GeoDesign from a practice perspective emphasizes collaboration and interdisciplinary cooperation toward the best and most sustainable design that takes into account livability (people), the environmental impacts (planet), and efficiency (profit).

The Role of the Model

The interoperability of the model between different disciplines is the central enabler of the GeoDesign concept. With a malleable central model that lives and is updated, we can realize the vision of more sustainable and more informed designs.

The key software requirements for GeoDesign include rich 3D visualization, an ability to store and search all project data regardless of format, the tools to model change through time, inputs from real-time sensors, and customizable interfaces for all participants and all workflows. Given the process-oriented nature of GeoDesign, another key component involves the means for individuals to communicate and design collectively. The model becomes the medium for project design, construction, management and maintenance.

Because digital design software and a rich 3D model are central to GeoDesign, it seems reasonable to think that software will be central to facilitating and enabling the GeoDesign approach. Without the tools to increase the communication and efficiency of the process, we might as well stick to today's repetitive and wasteful processes.

Thankfully, the hot concept of GeoDesign neatly coincides with an expanding foundation of enabling technology, an interest in interdisciplinary approaches, and a renewed interest in making our cities the most livable spaces for human habitation. The

advancement is also being spurred by new projects for green and livable city initiatives that have funding.

The emphasis of GeoDesign so far seems to favor an active design-centric vision with a process that can exist outside of software. Ultimately, however, the definition rests with the properties and capabilities of the collaborative model that are dependent upon some software advancements, and a public will to take a new approach.

(Reprinted from V1 *Magazine, March 14, 2010)*

Making Smart Growth Smarter with GeoDesign

Ahmed Abukhater, Esri, and Doug Walker, Placeways

GeoDesign is an emerging term for a technique that combines design and GIS technology to create cutting edge tools for urban planning, architecture, design and community development. This article describes how GeoDesign is reinvigorating Smart Growth plans and planning processes.

Why Smart Growth Needs to Be Smarter

Smart Growth is called "smart" because it seeks to strike an intelligent balance between unfettered sprawl and restrictive no-growth policies. Despite drawbacks, its principles of compact development, reduced automobile dependence, mixed uses, reduced resource consumption and increased emphasis on sense of community are widely admired. (Smart Growth detractors point, for example, to potential problems with population density and congestion, social equity, affordability and continuing consumer demand for conventional subdivisions.) But to move successfully from these academic principles to on-the-ground implementation requires a great deal of work.

One of the biggest hurdles is in understanding how to apply Smart Growth principles in a local context. For example, the mix of uses that is best for a growing city full of young professionals will be very different from the mix of uses needed for an area whose youth are migrating elsewhere and whose remaining population is aging.

Another significant hurdle is the conventional planning process.

At its best, Smart Growth seeks to balance a wide spectrum of needs that cover the economic, environmental and social systems operating in a community. That broad net means that planners, elected officials, the public and experts from many fields need to work together toward mutual understanding. But the conventional comprehensive planning and zoning process, which is mostly linear, expert-dominated and rigid, discourages needed collaboration and public engagement.

Smart Growth becomes smarter when innovative techniques and new technologies are used to help develop more context-sensitive plans and support a more flexible, collaborative planning process. An increasingly powerful part of this help comes from tools for GeoDesign.

GeoDesign for Smart Growth

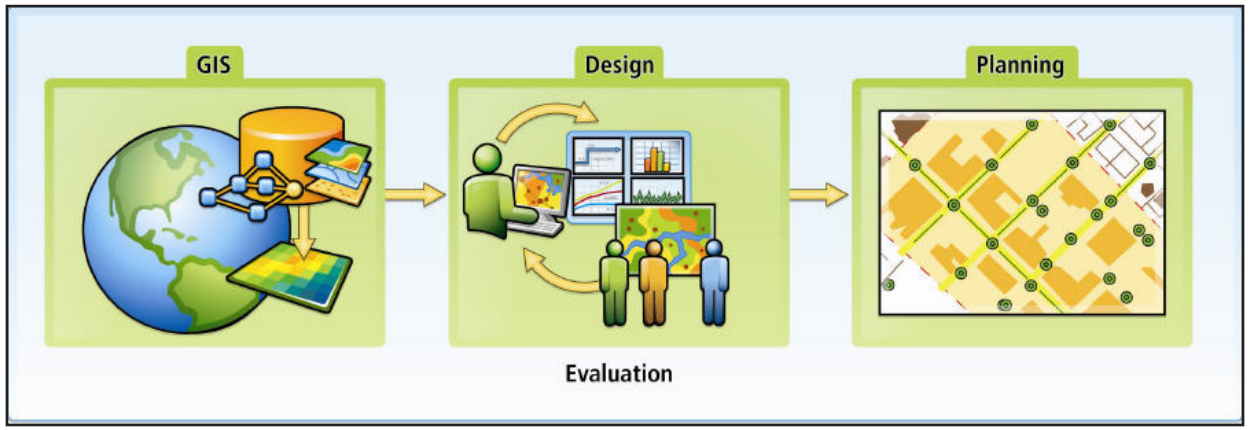
Most planners are already using GIS at some level. At the least, their future land use maps are made with GIS tools, and their parcel data are stored in GIS databases. This type of use does not take advantage of full GIS capabilities. GeoDesign combines the information capacity of GIS with the decision making process of design, yielding tools that are informative, interactive and ideal for Smart Growth plans and planning processes.

While GeoDesign is still a loosely defined term, it includes at least four elements:

- Sketching is the concept of drawing potential designs or plans, usually with approximate parameters and few details. It does not need to be limited to lines and colors; it can include any data changes like putting numbers in tables, changing building heights, or turning on a new power plant. Some planners have always

done sketching naturally in their heads; GeoDesign allows them to demonstrate and communicate their ideas even at the earliest stages of invention. With GeoDesign, sketching is often public. It provides a collaborative brainstorming environment.

- Spatially informed models estimate how various systems (environmental, economic, etc.) will respond to the plans suggested by the sketches. These models provide information on both impacts (like costs or water consumption) and change (like population growth rates or development patterns).
- Fast feedback gives near-immediate results from modeling the effects of a sketch. This means that a GeoDesign tool can support collaboration or a brainstorming session.
- Iteration is a hallmark of GeoDesign. You sketch an idea, find out its implications, make adjustments and try again, often many times within a single work session. The freedom to try many alternatives has advantages besides simple speed. For example, it encourages creativity, helps teams work together, and increases understanding of the complex systems that Smart Growth planning addresses.



GeoDesign is an art form because it incorporates elements of sketching and design. It is a science because it incorporates elements of modeling and analysis. In light of this, the functional definition of GeoDesign for Smart Growth is the art and science

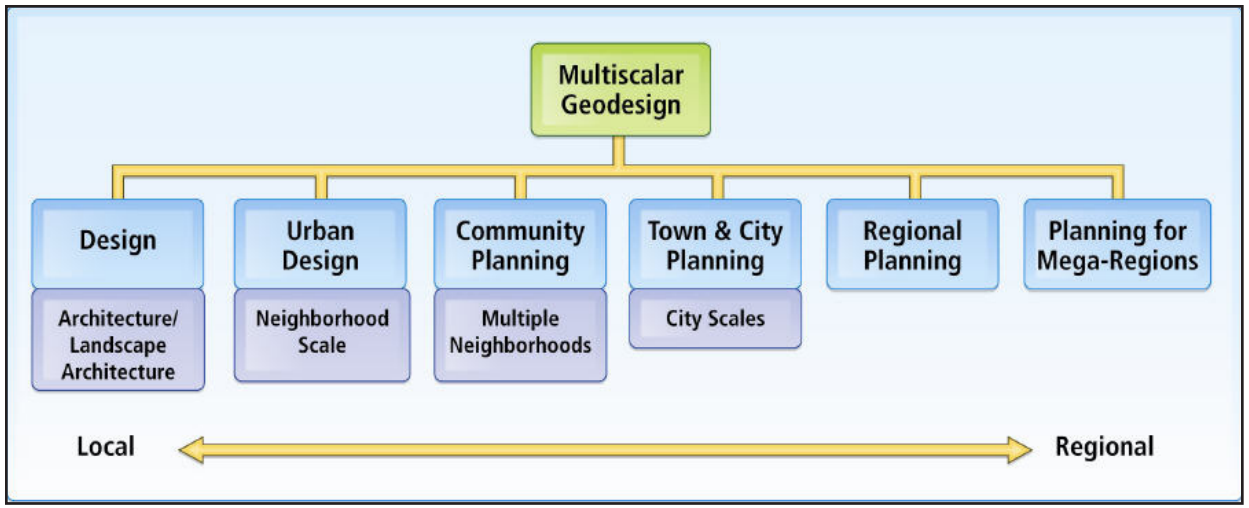
of geospatially enabled sketching and modeling. GeoDesign enhances collaboration, scenario generation, monitoring of implications, ongoing feedback, and evaluation and selection of optimal designs that reflect a community's needs and visions for the future.

Some planners are accustomed to the idea of scenario planning, in which potential alternative futures are modeled and measured as a way of making decisions about present-day actions. GeoDesign and scenario planning are closely related; their differences are mostly semantic. The simplest distinction is that GeoDesign allows real-time changes in the plan, while scenario planning relies more on comparing a few premade alternatives. Many tools that support scenario planning also support GeoDesign, and vice versa.

Collaborative/ Participatory GeoDesign

Historically, planning has been done by experts on behalf of the communities they serve. Public reviews of plans have been seen as inconvenient procedural requirements with mostly symbolic value. But a new paradigm replaces planning for people with planning with people. Residents are experts, too, in their own way; they know more than anyone about the history, values and culture of where they live, and they have a deep understanding of how the informal systems of the community work. Instead of parachuting planners into specific communities and expecting them to come up with smart solutions without a frame of reference about the history of the place or the local planning culture, we need to listen to and engage the real experts (the people who live there and know what works and what does not). Smarter Smart Growth considers these factors alongside conventional planning needs, and GeoDesign helps make it possible for the public to engage in the process and contribute in meaningful ways.

Multiscalar GeoDesign



Planners tend to think of design at a site scale, but GeoDesign covers a variety of scales, bridging the gap between the regional and the local contexts. This is important, because to be practically effective and politically prudent, Smart Growth plans need to make sense across a spectrum of scales and disciplines. This ranges from design, urban design, community planning, town and city planning, and regional planning, up to planning for mega-regions.

Technology for GeoDesign

GeoDesign is a new term for a technology that already has strong roots. ArcGIS itself has always had basic GeoDesign abilities, but with the release of ArcGIS 10, GeoDesign has become a centerpiece of the application. One of the best established GeoDesign tools for planners is CommunityViz, an ArcGIS Desktop extension designed expressly for scenario planning.

GeoDesign Project Planning Example

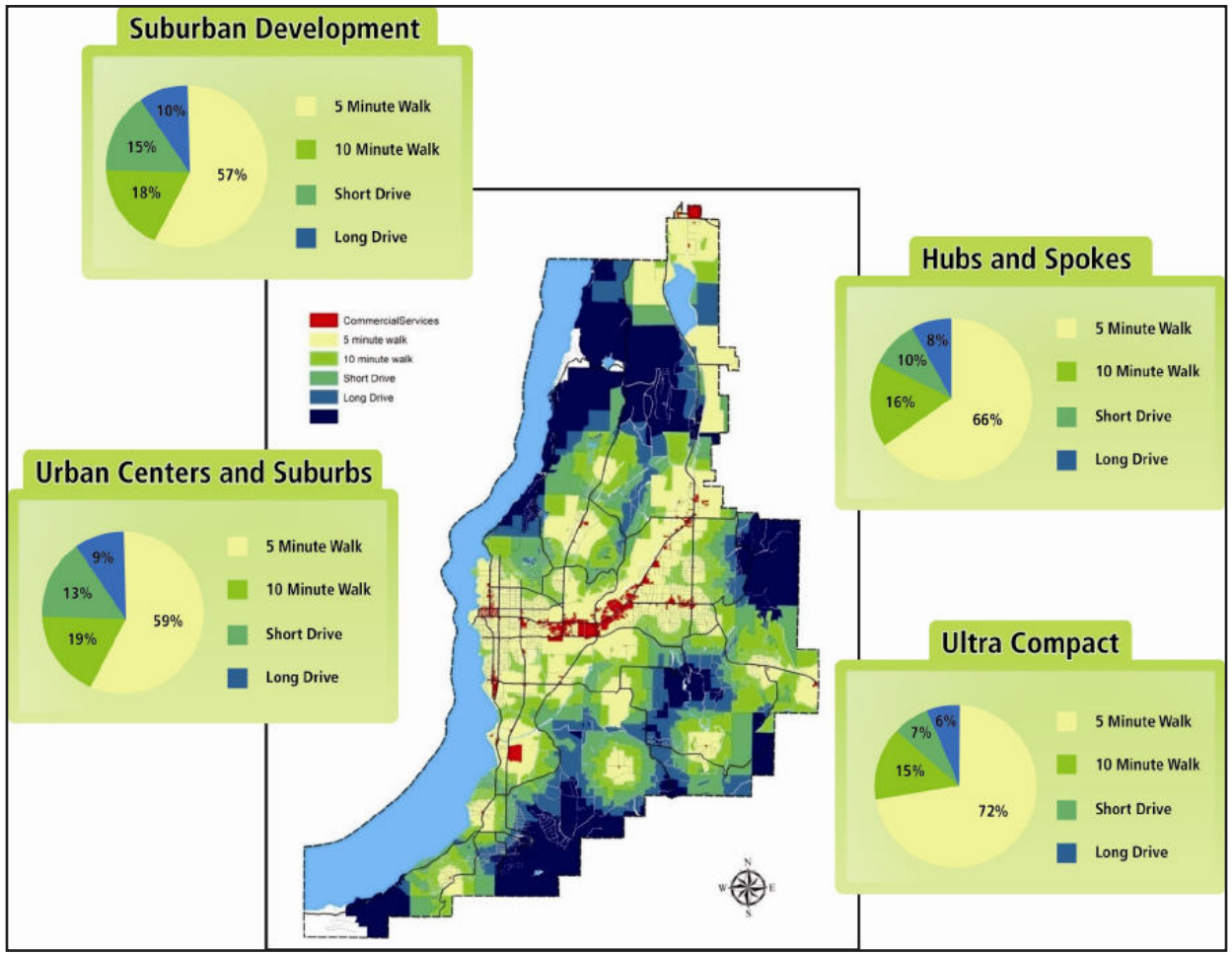
Kelowna, British Columbia, is a growing Canadian city of a little over 100,000 residents. In 2009, the city set out to update its Official Community Plan (OCP), which is like an American comprehensive plan. It placed strong emphasis on analyzing sustainability measures that are similar to Smart Growth principles, and retained Urban Systems, Ltd., and Placeways, LLC, to support the process with ArcGIS and CommunityViz software.

Sketching—A central part of the effort was sketching and analyzing potential future land use maps. Using CommunityViz, the project team created maps representing four contrasting development scenarios that ranged from suburban development to ultra compact. As they created each map, they were able to sketch small and large variations on the basic theme of the scenario. (In this case, the sketching was done via table input for added precision. They could also have used more conventional hand drawings on the map.)

Spatially informed models—CommunityViz provided a platform for setting up a wide variety of spatially-informed impact models that measured the sustainability effects of the sketched plans. One part of the analysis, for example, calculated the number of households that would be within walking distance of commercial services. Another looked at the area of open space and agricultural lands consumed, while still others monitored the mix of land uses.

Fast feedback—Data regarding impacts were displayed in several forms, including map symbology, dynamically updated charts, and Excel spreadsheets that had been electronically linked to CommunityViz.

Iteration—The plans went through several rounds of review that included small team meetings among planners, large public sessions, and more formal reviews with the city council. At many stages along the way, the sketched plans were tweaked and adjusted. However, the CommunityViz analysis did not need to change, because its models were set up to update automatically and produce new feedback on the basis of the new sketches.



This project demonstrated the successful use of GeoDesign technology to help the public and elected officials make informed policy decisions during a comprehensive planning process. Using ArcGIS and CommunityViz to analyze, visualize and communicate ideas helped make the project a success.

GeoDesign Benefits

GeoDesign can make Smart Growth smarter by improving both Smart Growth plans and the Smart Growth planning process.

The plans are better because they are based on more accurate, complete information. GeoDesign provides information about a plan's implications very early in the planning process, while plans still exist only as sketches and ideas. GeoDesign does not necessarily replace the more thorough, careful analysis that needs to follow as policies are written, budgets are drafted, and service capacities are engineered. Yet it does help ensure that the initial plan sets the smartest direction possible.

The process is better because it is more transparent and inclusive. The inclusiveness comes from GeoDesign's ability to engage broad audiences who would otherwise lack the means by which to contribute. The transparency comes from the way GeoDesign makes information and trade-offs explicit: everyone can see how this sketch leads to that result.

GeoDesign technology has been available for several years. With rapid increases in computer processing power and the release of ArcGIS 10, the tools are advancing even more rapidly.

The bottom line is that GeoDesign offers an opportunity for fresh improvements to old approaches for implementing Smart Growth and making Smart Growth smarter.

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Changing Geography by Design: Selected Readings in GeoDesign

Geographic information system (GIS) technology has a long history of driving environmental understanding and decision making. Policymakers, planners, scientists, and many others worldwide rely on GIS for data management and scientific analysis. As the challenges facing our natural and human environments evolve to new levels of complexity, our tools must also evolve. To this end, a dedicated group of people have been actively pursuing the development of GeoDesign theory, concepts, and tools.

Design is about purpose and intentions; it's about seeing in our mind's eye what could be, then creating it. Based on concepts found in Ian McHarg's seminal Design With Nature, GeoDesign integrates geographic science with design, resulting in a systematic methodology for geographic planning and decision making. Geodesign brings geographic analysis into any design process, resulting in designs that more closely follow natural systems. This benefits both people and nature and provides a more synergistic coexistence.

Esri president Jack Dangermond introduces the audience at TED 2010 to the concepts of GeoDesign.
Photo: TED / James Duncan Davidson

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