INTEGRATING THE DESIGN PROCESS INTO RECLAMATION PLANNING AND DESIGN[1]

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Abstract: Many reclamation specialists are often interested in tools, techniques, and methodologies which assist in the art of reclamation planning and design-- deciding what to do. One such methodology which assists in making planning and design decisions is the design process. However, in the reclamation literature, this methodology has not been widely reported and may be new to reclamation scientists and mining engineers. This document illustrates the utility and integration of the design process into reclamation planning and design activities. The design process is a methodology and vocabulary primarily employed by architects, landscape architects, and interior designers to generate solutions concerning place based spatial problems, but the process should become familiar to all reclamation specialists. Surface mine planning, operations, and reclamation are place based spatial activities which can benefit from the design process. The process begins with noting the goals and objectives of the client, and operationalizing these statements into program requirements for the project. Simultaneously, the landscape is inventoried. Then the landscape is analyzed for the suitability, capability, and appropriateness for accomplishing the program requirements. Based upon the analysis, a synthesis is compiled which embodies the essential contents of the program and structure of the landscape, converging upon a design concept to execute the design. Once the concept has been accepted, the project plans and operations are implemented and may be studied in a post-evaluation stage. The process is not always linear and is most often cyclic, requiring refinements and revisions. This approach allows for self-criticism, facilitates creativity for design challenges, and assists in bringing clarity to the overall goals of the project. Since the process is place based, solutions are unique to the site and client. Usually the process requires academic training, licensure, and professional practice to master. Nevertheless, reclamation scientists and others often benefit from documentation which illustrates how their important activities fit into the context of landscape reclamation planning and design and provides scientists with insight for communicating with planning and design professionals.

Key Words: site planning, land-use planning, landscape planning, environmental design, landscape architecture, design methodologies

Introduction

In many respects science and design are two different activities intended to pursue two completely different sets of questions. Science is an activity which intends to answer questions related to the description of observable phenomena and explaining relationships between phenomena. Meanwhile, design is an activity where architects, landscape architects, interior designers, and artists attempt to decide "what should be done?" or "how shall we proceed?" Therefore a scientist may describe the effects of a soil treatment upon an agronomic crop; while a designer may attempt to determine the location of an entry road or decide the contours of a landscape for site grading. One activity (science) is somewhat objective while the other activity (design) is quite heuristic. Science cannot tell one what to do and design can. But design is unable to describe phenomena and science can. Reclamation specialists need to understand the context of both activities to be effective.

Reclamation design and non-design (which is a design decision) have been present for many decades. For example, the Olmsted office, started by Frederick Law Olmsted, Sr., prepared a reclamation plan for a sand and gravel pit operation near Long Island Sound and designed landscape restoration plans for wetlands in the Boston area long before science had much to contribute to the body of knowledge on how to reconstruct landscapes. Frederick Law Olmsted, Sr. was the person who became the father of the profession of landscape architecture, back in the 1850s (Roper 1973). Landscape architecture along with civil engineering are the two major design professions of the exterior environment. However, Frederick Law Olmsted, Sr. selected the term landscape architecture to ally the profession with professions like architecture, a profession with a strong heuristic base and a process by which decisions could be made. In contrast, engineering did not embrace any heuristic decision making processes. Relatively recently, scientists have engaged the reclamation arena, describing the effects of many different types of treatments upon the disturbed and altered environment. The American Society for Surface Mining and Reclamation's proceedings are a testimonial to the contributions that science has made to understanding the effects of various landscape treatments. However these reclamation specialists may not necessarily be familiar with other methodologies affiliated with reclamation. They may understand how

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to study reclamation but may not know the fundamentals associated with creating a reclamation site design. Therefore, this paper is intended to present the fundamentals concerning the design process methodology applicable to reclamation site design, a heuristic activity that is not well documented in the reclamation literature. Nevertheless reclamation specialists should become acquainted with the knowledge base of the design process.

One of the reasons why the design process is not well publicized is that designers are not necessarily writers but instead creators of environments. Even today, many design academicians spend their creative scholarly time inventing new designs as opposed to writing about design. Most design academicians are not scientists. Therefore, the literature is sparse.

The seminal publication on the subject was written by John Ormsbee Simonds (1961), a graduate of Michigan State University, which has the oldest landscape architecture program in existence, started in 1898 (Landscape Architecture Program 1996), and which also began the oldest known university course concerning the design of the exterior environment (circa 1865). He describes the design process for developing a site plan for a school. A year later Kevin Lynch (1962) also added to the knowledge base concerning the processes associated with site design, especially as it relates to the implementation of a design. Rutledge (1971) illustrated the design process for recreational settings. This description is actually quite useful for many site design projects. Steinitz (1979) wrote a document describing various versions of the design process useful for larger regional landscape projects. In 1970 Jones had his detailed description of various design methods concerning the design process published. His effort was the first detailed description noting various techniques to apply, and listing their strengths and weakness. Without these somewhat late descriptions, the design process was a knowledge base and skill that was passed from both practitioner and professor to student and employee. Therefore, it is not surprising that reclamation specialists who are not designers may not be familiar with the design process.

Study Area and Methodology

It is a creative and scholarly tradition for designers to present information through the case study method and this paper is no exception. Because each designed project is a somewhat unique entity without replication or randomization, it is difficult to treat designs as controlled experiments. Often the designer is faced with providing examples with "n-1" degrees of freedom and since a case study has a "n" of "1," the degrees of freedom are "0." So case studies defy statistical analysis in the traditional sense. Consequently, to illustrate the design process, a case study project conducted by the author for Meridian Mineral Company Aggregates in Wyoming will be employed. The study was entered into the National Stone Association design competition and won 2nd place in 1991. The study has not been previously published and will suffice to visually illustrate examples from the design process.

The site is about 20 miles west of Cheyenne, Wyoming, along Interstate 80, at about 7,200 feet elevation. The mining site still has about 50 years of extraction life, primarily providing ballast for railway lines. The site is adjacent to the Union Pacific Railway lines, the first United States of America transcontinental railway and along the old Lincoln Memorial Highway, the first transcontinental highway.

Design Process

To help make decisions in reclamation site design, designers rely on the design process. This process has been characterized as convergent and then reverses to become divergent action. The designer often begins with a set of goals and objectives which lead to the development of a program and conducting an inventory. A program is the operationalization of spatial and content needs for the environment, clients, and users. The inventory is the actual spatial baseline data. The program list and the inventory are usually quite substantial.

Rutledge (1971) has written a description identifying the various types of program information. The first type is known as tangible items. Tangible items are requirements with exact spatial sizes and with an exact count. In his book, Rutledge uses an example of 10 tennis courts, but in surface mining activities the tangible items could be composed of exact zoning requirements and setbacks. In addition, there are capacity items which can vary in size depending upon the actual design. For example a capacity item might be the requirements for crushing, sorting, and loading 50 tons per hour of class five road construction subgrade material. There are also physical benefit program items such as erosion control, clean water, wildlife habitat, and related requirements. Al Rutledge mentions intangible gains as program requirements. Intangible gains are items such as the perception of local residents that the surface mine operation is a good neighbor or having school kids learn the importance of mining resources. Finally, Rutledge also mentions agency policies, construction budgets, and maintenance funds as other important program items.

Individuals often unfamiliar with the importance of goals, objectives, and programming may

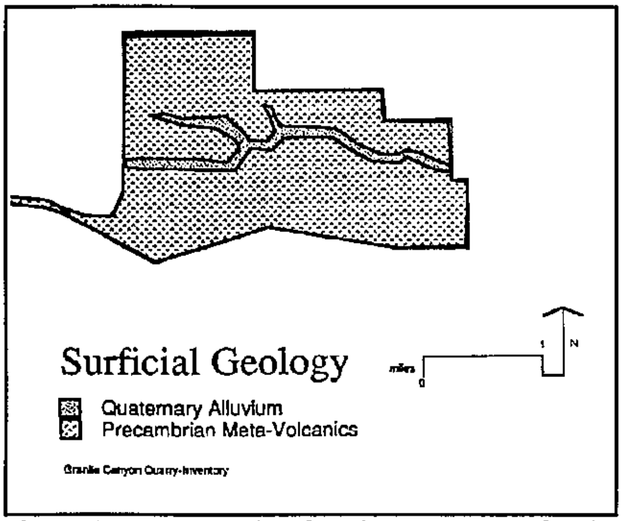

Figure 1. An example of an inventory map for the granite canyon quarry site.

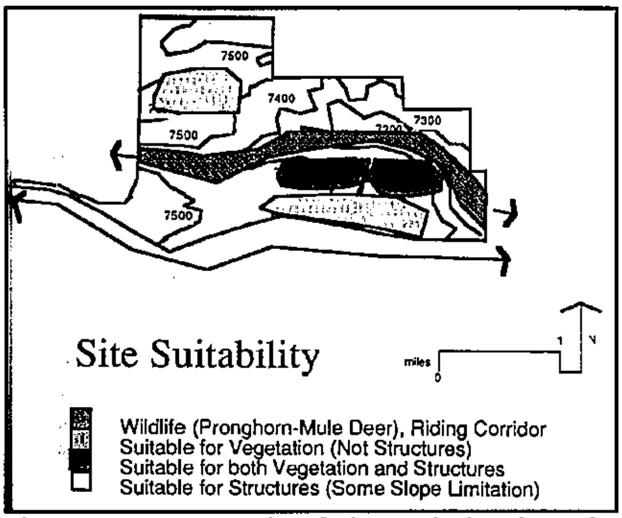

Figure 2. An example of site analysis where the meaning of spatial elements is determined.

not value the time spent developing these lists and the discussions leading to the refinement of these lists. Instead they may simply attempt to generate a design. This is a big mistake and extremely risky. Programming is essential in clearly developing consensus and agreement concerning what the project is supposed to accomplish and insight into how it may be accomplished. For complex projects, programming may occur over many months with considerable interviews, meetings, and discussions. For complex projects the programming list may be quite long and extensive.

At the same time that programming is being compiled, the inventory should be conducted. For mining operations, the inventory could be composed of maps defining the extent and composition of mining resources, topography, soils, vegetation, hydrological features, and related materials (Figure 1). This information is often placed in a geographical information system to facilitate analysis.

Based upon the program and inventory, the designer ascertains the meaning of the information by conducting an analysis. For example, the designer may determine the most suitable spatial locations for a specific facility (Figure 2). Sometimes empirical equations are employed, but there are often few empirical equations that are helpful in deciding where to locate a facility. Instead, heuristic models are often developed that reflect the needs of the clients, concern for the environment, and desires of the users. Empirical equations may be employed to calculate hydrological run-off rates or habitat suitability; however, the results from empirical equations are often incorporated into a greater heuristic model. Analysis in the design process allows the designer to evaluate alternatives and choices, and is the basis for modern environmental assessment.

During the analysis phase, designers attempt to interpret or give meaning to the inventory. Giving meaning to something is a highly subjective process; yet in design, this subjective process is what is meant by the term, "analysis." In other professions, analysis may mean the statistical evaluation of treatments or predetermined numerical processing activities. Design analysis may incorporate these procedures into a more comprehensive examination.

The designer then combines several types of analysis to develop a synthesis. In the synthesis, the designer attempts to answer the question "therefore!" For example, suppose in a spatial geographical investigation, no one location was sufficiently large to accommodate a facility but there were several small locations that could accommodate a portion of a facility. The designer might conclude that the design solution should be spatially divided to fit the spatial configuration of the landscape. Thus all of the data and information are condensed into a few simple ideas. Synthesis continues the convergent portion of the process where the designer began with a large programming list and inventory information leading to a few key and significant ideas that embrace the whole program and inventory. This is why this portion of the process is called convergent.

From the synthesis, the designer develops a concept to express the evolving form. Without a concept, there is no solution and no means to guide a design. If the designer has a strong concept, the development of the design solution is driven by the "big idea" and expressed throughout the design. Many designers are obsessed with developing a concept. A concept is often a very simple idea; yet a concept can be difficult to generate. Sources to develop a design

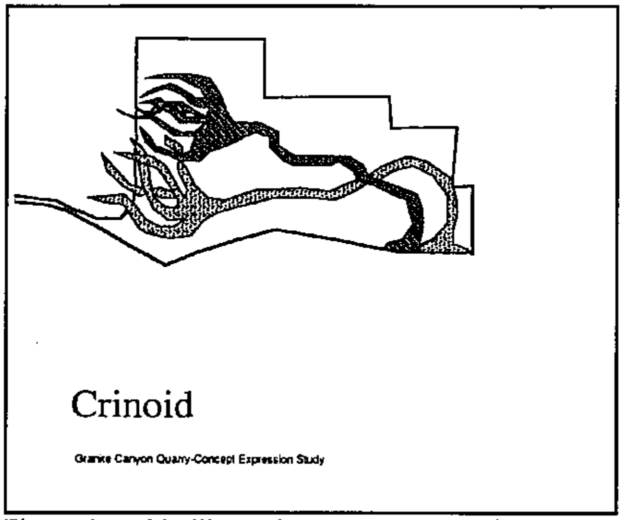

Figure 3. This illustration presents one of the many conceptual ideas explored in the design project.

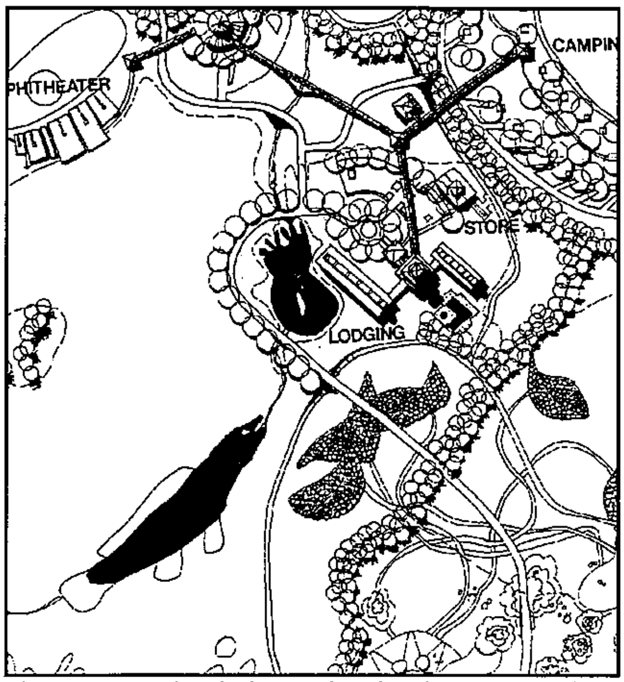

Figure 4. A site design embracing layers or various concepts, matching the design with the original program.

concept include geometry, nature, culture, and technology. Burley (1993) describes many design source ideas and their resulting form-giving solutions in a paper concerning design paradigms. In the case of a spatially divided site plan, a designer might select a constellation as a design concept, or something like a set of exploding subatomic particles as a symbolic concept. There are many to choose from (Figure 3). Usually the best concepts reflect the needs of the client and the environment and are not necessarily too arbitrary.

Non-designers often assume that entities like buildings are predetermined; however a designer understands that the shapes and forms of roads, houses, agricultural lands, and other created entities pose a wide range of choices and solutions. The noted architect Frank Lloyd Wright understood this potential and built structures that were unprecedented. Within the design community, designers are often highly regarded for creating solutions that have never been expressed before. This is true for painting, architecture, interior design, music, dance, landscape architecture, film, and engineering. Arriving at the concept is the convergent pinnacle of the design process. Presently, design concepts adopting ecological and behavioral criteria are often recognized as pushing the envelope of design.

In landscape architecture, Frederick Law Olmsted, a practitioner from the 1850s to the 1890s, was a master at developing new precedents in environmental design (Roper 1973). He developed innovative circulation systems, precedents for biological conservation, habitat design, agricultural land planning, erosion control, campus planning, suburban design, and forestry management.

Compared to the birth of modern sciences such as ecology, modern environmental design has a long history, beginning with Olmsted and his contemporaries. With the emergence of modern science and various other new professions and disciplines, many environmental designers have welcomed participation in design by scientists and other specialists. In the design professions, it is no secret that science has much to offer (Howell 1980). In the late 1980s and early 1990s, scientists have been incorporated as key members in major North American architectural, engineering, and planning firms, participating in the design process and helping to develop an environmentally sensitive design concept.

Once the concept has been generated, design development and implementation occur, the divergent portion of the design process. Master plans are developed, construction drawings are made, and construction specifications are written (Figure 4). Contracts and bidding documents are created. The construction and landscape management process is started, and upon completion, a post-construction evaluation may be conducted. The design process is not linear, but often circular with many reversing loops as a design consensus is developed.

The implementation of a design and the execution of an experiment are closely related. The implemented design is actually a case study experiment with zero degrees of freedom. Since constructed projects frequently cost millions of dollars per replicate, devising an experimental design with a diversity of treatments is often considered impractical. Instead, the designer attempts to ascertain which factor levels are the best combination to employ in the construction of a project. The post-evaluation stage in the design process is equivalent to a scientist assessing the treatments in an experimental design. Therefore design and science can be closely related.

The design process usually requires some guidance and time to be effective. Typically, to learn how to efficiently employ the design process requires three to five years of design education. While some scientists are excited about the opportunities to apply their knowledge in a design project, initial attempts at design by non-designers usually do not meet the expectations of the envisioned product. Unfortunately, one rarely becomes a designer instantaneously.

Sometimes individuals from non-design professions believe that they can create a design that is better than a trained designer. While it is true that a specialist may know more about one particular subject than a designer, they can rarely create a holistic, functional design. For example, a medical doctor may know something about design requirements of an operating room and may be able to design a respectable operating facility; however, that same person may not be able to design a functioning hospital, complete with water supply, electrical service, structural integrity, circulation ability, and aesthetic beauty, at an effective cost and on time. Unless the specialist has also been trained as a designer and is able to effectively employ the design process, fundamental design errors often occur when the non-designer attempts to create a space with complex requirements. It is clear that to become a successful designer requires dedicated study. Even with extensive study, most states require that designers become licensed before practicing their profession.

Concluding Remarks

The site design process is place based. This means that each solution is unique to the site and client. Usually the process requires academic training, licensure, and professional practice to master. Nevertheless, reclamation scientists and others often benefit from documentation which illustrates how their important activities fit into the context of landscape reclamation planning and design and provides scientists with insight for communicating with planning and design professionals.

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