

Combining Computer and Manual Overlays— Willamette River Greenway Study¹

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Abstract: We will present a method of combining computer mapping with manual overlays. An example of its use is the Willamette River Greenway Study produced for the State of Oregon Department of Transportation in 1974. This one year planning study included analysis of data relevant to a 286-mile river system. The product is a "wise use" plan which conserves the basic character of the land. The process offers a complete analysis and overview for sensitivity of land to human use. Visual qualities of the landscape as well as environmental and cultural resources were recorded and displayed in various combinations for analysis. Opportunities for specific use and management guidelines were also based on the integrity of the resource.

INTRODUCTION

There have always been a need and a desire for humans to adjust to their physical environment or to modify it in order to meet requirements of food, shelter, and setting. Today, economic and technological sophistication enables greater control for the physical environment than ever before.

The role of the landscape architect/land planner lies in contributing to solutions for both social and environmental problems. These professionals offer expertise as designers, planners, and communicators who are concerned with both visual quality and form of the

environment and the interrelationship of people and the land. Because of this concern, the landscape architect/land planner may work at any scale. The work includes design of small site projects with their related amenities and the orchestration of regional, national or international projects which attempt to develop policy for qualitative use of the land.

The environment is the visual, physical, chemical, biological and social setting in which people work, live and play. Consequently, a plan is usually devised for the relationships between any conflicting demands and desires in light of aesthetic, natural and social constraints.

Few study areas or sites are totally independent. External dependencies and impacts exist in most areas to a greater or lesser degree. These dependencies should be factored into an environmental evaluation.

Existing long-range planning efforts are reflective of the awareness that visual and land use management of the landscape is

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necessary. Such planning should not only be near term, but have a future legacy as well. Agencies at all levels utilize criteria established by master plans to make day-to-day decisions. New legislation has been passed, new enforcement agencies formed and old ones reorganized that have roles in land use planning. New participants in the planning process include citizen activists and planning teams with expertise in the two major aspects of all planning issues, namely the technical-scientific and the political-social.

The landscape architect/land planner has emerged as having the expertise to lead the multidisciplinary professionals involved in land use planning. This leadership includes evaluating and translating various points of view into a viable management plan that integrates those facets of visual and land use protection, enhancement and design into a quality end product. The exchange and processing of information are integral to the end results.

Methodologies are conceived as a means to deal with the processing of data for application of specific land use.

This paper presents one approach to dealing with a planning problem. The method is based on the combining of computer mapping with manual overlays. The process offers a complete analysis and overview for determining sensitivity of land to human use. The text will follow the planning process sequence and the Willamette River Greenway Study will be utilized to illustrate examples of the methodology. The objective of that study was to develop a comprehensive development/management plan for the River. The aims were to: a) protect and preserve the natural scenic qualities of lands, b) acquire and develop lands for recreation and c) preserve and restore historical sites, structures, facilities and objects on lands along the Willamette River in Oregon between the Columbia River and Dexter and Cottage Grove Reservoirs, including all channels, a total distance of 286 miles. The resultant document is a large scale working plan for use by all local and State agencies. Revising and updating may be done in segments using county boundaries as divisions.

A plan is a way for people to express their desire for the future. It must take into account the intent of legislation, the desires of the citizens and the visual, physical and cultural characteristics of the study area.

The Willamette River area involves visual, natural, recreational, urban and agricultural activities. The pressure for development

necessitated some plan which would preserve areas of natural beauty, areas of historical or scenic value as well as agricultural lands. The State of Oregon was the only agency which had jurisdiction over the entire River and had the authority to coordinate land uses along its entire frontage. With the passage of legislation in 1973, the State took the role of setting forth basic parameters for the use of the River and its adjacent lands.

The Greenway Law, as ORS 390.-368 has come to be known, provided a new statement of the elements to be included in the Willamette River Greenway. It required that a plan for the development and management of the Greenway be prepared and submitted to the Land Conservation and Development Commission (LCDC) for approval. The Law laid out some precise constraints on Greenway planning and implementation. These included a definition of the maximum and minimum area to be included in the Greenway and a prohibition of State and county use of condemnation procedures for acquisition of existing agricultural land in establishing the Greenway. It prevented public use of scenic easements and prescribed five areas for State park acquisition. It also made provisions for financial assistance to local governments to implement portions of the Greenway Plan within their jurisdiction.

Directions for the plan development and implementation were clearly defined in the Law. However, additional refinement was necessary such as identifying existing land uses, and determining the role of urban areas and non-agricultural lands in the Greenway. Also, it was necessary to determine: 1) visual attractiveness, 2) natural, and 3) recreational qualities of the River and its adjacent lands and to what degree these qualities required protection and preservation. The Law laid out many of the Greenway definitions and parameters, but it was not all inclusive. It served as a foundation upon which the plan was constructed along with local governments and citizen policy input.

The Greenway planning process encompassed six major elements:

- Inventory and Visual Reconnaissance
- Information Process
- Public Involvement
- Analysis
- Design
- Implementation

PLANNING PROCESS

Inventory and Visual Reconnaissance

Data were compiled to be applied to planning questions. The procedures of

collecting up-to-date information were diverse among agencies and individuals. Sources of information included existing reports and field visits. Pertinent information was pooled into a reservoir or data bank. It included maps, photographs, texts, and other fact-bearing material.

In the delineation and description of the Willamette Greenway and its use potential, the planning team identified, collected, and analyzed a well-rounded information inventory concerning the Willamette River and its environs.

The resultant library consisted of pertinent Federal, State, county and city plans, texts and proposals. Analysis of this body of information served to determine data gaps and the need to generate additional materials.

Subsequent visual reconnaissance included familiarization with the site as well as collection and review of additional plans, reports, studies, and legislation. The entire study corridor was flown several times; first as an overview and subsequently for increasingly detailed looks at the visual value of specific areas. Varied land uses were observed and catalogued with an eye to their relationship with each other and with the River. Study of aerial photographs and more detailed site analysis was followed with a reconnaissance by boat to explore the River. Special attention was given to evaluating the varying characteristics of the River and their scenic qualities. Focus was also given to noting the potential problems and opportunities involved with providing public use of a sensitive resource while respecting existing land uses along the River. These observations were refined with a land reconnaissance by automobile along roads with potential for scenic river-related drives and by walking through typical farms and wild portions of the riverbank.

The visual site reconnaissance and review of inventory material were part of the macro-scale analysis of the study. The analysis determined that: the recreation potential along the 286-mile river system is varied and extensive. The 1973 Greenway Legislation (ORS 390.310.-386) requires regulation of existing land uses such as gravel quarrying along the River, and integrating of new uses with existing farmland. In addition, the sensitivity of the River's resource and adjacent environment limits human use. Thus, the requirement of the Law and the sensitivity will only allow selected public use of the River and its banks.

INFORMATION PROCESS

The inventory effort required a management framework to determine data requirement, standards and documentation of data flow.

Two alternative methods were available for the storage, retrieval, updating, and display of inventory material. They are computer and manual, or both. To determine the desirability of computer-based or manual-based information, the types of data and their application had to be identified. Typically, data fell into two basic categories: natural and cultural. Applications of the data were numerous. They included area-wide location decisions derived from geographically displayed data such as soils, vegetation, and topography. They included policy decisions derivable from citizen input. They also included design decisions related to projection of visual attractiveness, recreation or other land use.

Decisions were made on information as complete as possible using commonly accepted criteria and in coordination with participating agencies and citizens. The choices used to facilitate planning were varied. The feasibility of any system or approach was determined by raising and answering the following questions: who will implement or administer the plan decisions; what will the plan do; where will it be used; and how much will it cost?

Some data could be encoded for computer manipulation while other data could not. Manual techniques include writing, listing, drawing, rendering, and photographing. Their retrieval was via an index system from a library, flat file, photo file, or other filing systems. Computer storage information was a mechanical/electronic process. Thus, resource inventory material could be comprised of four different types of information: computerized natural data, non-computerized (complementary) natural data, computerized cultural data, and non-computerized (complementary) cultural data.

The Willamette strategy was developed to facilitate comprehension of the potential intensity of human use throughout the Greenway. The analytical models needed were resolved and the types of data required to produce these models were defined. The process of coordinating existing data and filling data gaps could then proceed through the actual production of each analysis model and the delineation of a corridor of sensitivity and potential Greenway use.

Data evaluation efforts were focused into two groupings: computerized and non-computerized. The first group which was computerized, consisted of geomorphology, biotic processes,

soils, natural vegetation, topographic slope and floodplain. These data are representative of natural factors related to the River's environs. The second group concentrated on visual quality, history, archeology, land use, aggregate deposits, water quality and hydraulics, recreation demand, and citizen participation. These additional manual complementary factors established a broader basis upon which to weigh, evaluate and influence interrelationships.

Establishing visual and physical form determinants and potential impact categories was a significant task which had to be accomplished in order to perform a complete analysis.

Consideration of future land uses along the River required an understanding of the multi-dimensional potential use of the Greenway as defined by ORS 390.310.-368. A scope and vocabulary were established for a working definition of recreational open space, conservation and preservation areas. An existing land use and zoning map was prepared. Ecological constraints, i.e., areas of river flooding, course changes, water use, and biotic communities were reviewed. A list of possible issues involved in implementing a resource use system included land ownership, land use demand, and management. Regional and sub-area needs were considered and tabulated from State data. Parameters for elements of the Greenway were identified, i.e., natural elements, visual open space, conservation areas, active recreation areas, access points, preservation areas, agricultural lands, resource extraction, and urban elements.

Preparation of Base Grid Map

The choice of base map, scale and reference system varied from agency to agency. Data collected from many agencies was at many scales on many diverse base maps, or in other forms. All geographically referenced data had to be interpreted onto one common base map format. A common format was useful not only to the planner in making process decisions, but was necessary for ongoing administration of the project area, workshop presentations, and evaluation of the final plan.

A commonly acceptable scale for the Willamette Greenway project had to be one which covered the entire study corridor in a reasonable economy of space. It also had to be large enough to record adequate detail and allow fluent transmittal of plan design. The determining of the map scale then went hand-in-hand with refining the level of the study.

Map Scale--Following consultation with local and State agencies, it was decided that 1 inch equaling 2,000 feet was a suitable working

scale. A composite of 7-1/2 minute quadrangle U.S.G.S. maps was made. The 286-mile length of River study area was then divided into regions. Each region represented one of the four Councils of Governments (COG's) within the study area. This resulted in two maps per COG's, or a total of eight base maps. All subsequent recording of information was thus developed on a coordinated data mapping system.

Grid--The U.S. Rectangular Land System was selected for the study, though the Universal Transverse Mercator (UTM) and Lambert Grid were also considered. The Willamette Stone is the marking point for the Willamette Meridian which is the point of origin for all public land surveys. The meridian also is located on the U.S.G.S. maps. It became the starting point for the study's 1-mile grid.

Cell Size--A grid overlay was prepared for the encoding of information. The grid or cell size is a 1/8 mile square, 660 feet by 660 feet, or approximately 10 acres. The dimensions, although relatively large, still made the cell fairly sensitive to variables.

Study Corridor--A study corridor was defined by use of aerial photographs and topographic maps. The aim was to include the River, adjacent public and private lands, channels, water bodies, and vegetation within the influence of the River.

Wherever possible, the corridor was extended to a natural break in the River's influence such as highway, floodplain, bench line, or topographic features. The boundary in complex urban areas was limited to 1/4 mile. This zone was assumed to be most directly influenced by the River, and the design and study efforts were concentrated in this corridor.

Ultimately, the study corridor encompassed some 25,000 10-acre cell units. The average width was approximately 1 mile on each side of the River. Each of the data collection categories covered the entire study corridor.

Obtain and Display Physical Data

The sufficiency of existing data was evaluated and supplemented as necessary. Data was placed into categories typically based on standard taxonomy. For example, study factors included: 1) existing land uses, i.e., urban, agricultural and recreation, 2) man-made or cultural factors such as ownership, jurisdiction, circulation and transportation, archeological and historical, and 3) land characteristics, i.e., landform, soil, vegetation, hydrology, minerals and aggregate, and wildlife habitats.

The data resource maps were prepared at a common scale. All physical data were mapped at the standard format scale of one inch equaling 2,000 feet. Some data was subsequently computerized for future indexing and expedient manipulation to create analysis model maps. Other categories were prepared as manual overlay entries. Additional non-computerized (complementary) data included concepts and policies. The data bank provided a complete reservoir from which a logical case for a Greenway Plan proceeded through analysis and design.

Data Interpretation

Data were analyzed to reveal constraints and opportunities, and to formulate predictions. Once data had been stored in a computer, an overlay process to develop comprehensive information for planning was begun. Two types of overlays were possible. The first type involved overlaying or combining of several data maps to determine "what happens" at any given location. The second type allowed for the weighing, or the considering of one of the data maps to be more important than the others. Whereas manual overlay might have been limited to three overlays, the computer overlayed as many as twenty or more maps simultaneously. This allowed the planner to study the effect of different weights.

The most common application of the overlay capability is suitability or constraint mapping. This method was used for the Willamette Study. Three computer models, or analysis maps, were generated with an assigned combination of encoded environmental factors.

The three model maps were entitled, "Sensitivity to Human Use," "Agricultural Suitability," and "Opportunities for Use Intensity" (fig. 1). Together, these maps served as a productive tool in abstracting information or orienting planning decisions to the interrelationships of various components of the River's environment.

Manual Data Overlay

To sharpen further the perspective of man's relationship to the River, additional data were manually recorded. Data subjects included visual quality, history, archeology, land use, public ownership, aggregate deposits, water quality and hydraulics, and citizen participation. The supplementary data were processed in a variety of forms from verbal description to pictorial and factual elements, or zone locations on manual overlay maps.

PUBLIC INVOLVEMENT

The value of citizen participation lay not so much in the generation of new ideas, but in the tempering and clarifying of needs and concepts, and in the generating of public support. The understanding and the support of concepts by participants were significant contributions in the approval and implementation stages of the project.

Exposure by the media was enhanced through workshops. While the media coverage was not always favorable, the issues raised were addressed as part of the public forum.

The problems created for the planner were: 1) how to get citizens involved in a meaningful way so they could understand how the plan came about and 2) how to display the information that was used to make planning decisions in a manner that everyone can understand.

A defined format and well-defined issues for citizen response were essential to facilitate consistency in citizen input. Participants aided in establishing planning values and importance ratios for the data used for non-computerized (complementary) or computer overlay. At the same time, citizens had the reinforcement of learning how the process works through having participated.

For a project of the magnitude and importance of the Willamette River Greenway, public involvement and public information were crucial. About seventy percent of the State's population lives in the Willamette Valley, and the great majority of these live within ten miles of the River. Throughout the project, there was involvement with citizen, staff, and local government participation.

Four types of public meetings were held in each of the four districts or Councils of Governments (COG's): 1) a public forum to learn relevant issues and citizen's attitudes toward the Greenway, 2) a one-day conference to develop policies for which a study guide was prepared to stimulate discussion among participants, 3) numerous half-day staff conferences to receive technical input and brief city and county legislators, and 4) several one-day workshops to refine policies into goals and guidelines. After the conferences, the citizen's recommendations were incorporated into a single set of goals and guidelines for the plan. Adoption of these required all local planning jurisdiction within the Willamette Greenway to adhere to consistent quality of land use regulation.

SENSITIVITY TO MAN'S USE

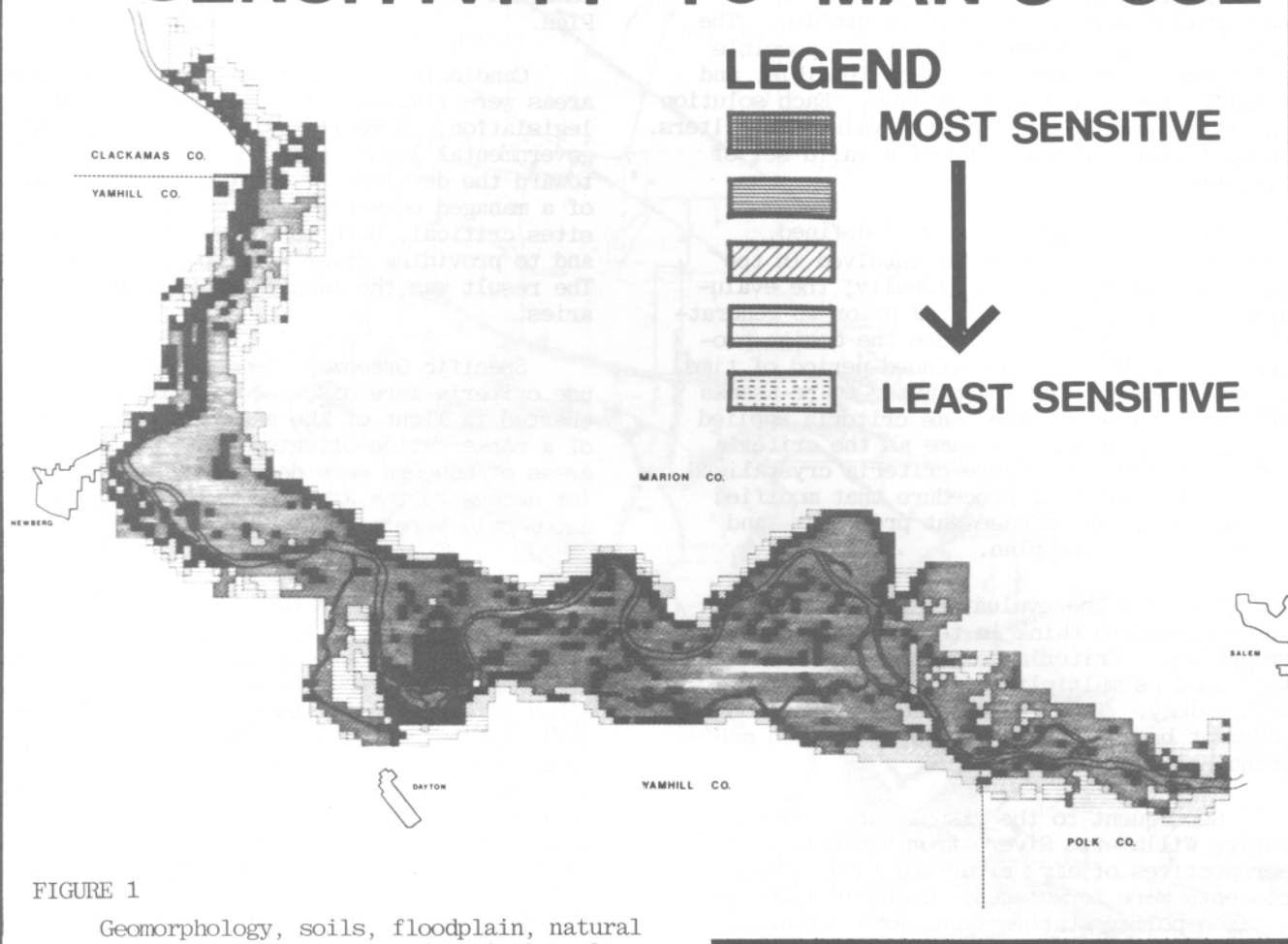


FIGURE 1

Geomorphology, soils, floodplain, natural vegetation, biotic process and agricultural suitability were inputted; the highest numerical importance of a cell determined the mapping category. The weighting was directed to take into account potential use of land and sensitive or endangered qualities of land, wildlife and vegetation along with pointing out non-conflicting best agricultural land.

The model map appeared in a breakdown of six levels of use categories: preservation, representing prescribed restricted use; three levels of conservation (1, 2 and 3) prescribing wise use with a greater or lesser degree of restriction required depending upon the level; farm, indicating areas now in and proposed other lands for potential "best" agricultural use; and recreation, lands which will accept the most intensive use. The map

shows that the majority of the Greenway falls into one of the three levels of conservation or the farm category. It should be noted that a use intensity designation does not necessarily reflect the present use of that land. An area given an intensity designation of conservation-2 does not imply that it is used as such; only that potential suitability for a conservation-2 level of use is indicated.

Analysis

The task of the planner was to find the optimum solution to a given problem. The procedure was to identify first all possible solutions, then those that were feasible, and finally, those that were optimum. Each solution identified was passed through evaluation filters. These filters are composed of a valid set of criteria.

The set was complete, well-defined, and approved by all parties involved in the decision-making process. Ideally, the evaluation criteria are identified prior to generating alternative plans. Since the design process can occur over an extended period of time, it was necessary for the planner to re-assess criteria. However, the same criteria applied to judge a plan was the same as the criteria used to design it. These criteria crystalized to form the rules of procedure that modified design decisions, management procedure, and maintenance of the plan.

To weigh the evaluation criteria, the planners had to think in terms of ratios of importance. Criteria weights (load factors) were used as multipliers in the analysis methodology. They represented a professional judgment backed by experience, intuition and technical know-how.

Subsequent to the visual survey of the entire Willamette River from the different perspectives of air, river and road, basic concepts were formulated. Combined with the citizen policy statement and manual complementary cultural data, a coarse filtering produced the first stage in the design process. This was a "Concept and Opportunities" map. This map was used as a working base for further review and refinement in establishing goals, guidelines, and overall plan formulation.

At another level, the computer data was geo-coded (data with geographical locations attached) and weighted, i.e., from hand drawn source maps, a mesh or grid was superimposed over each map and a data value assigned to each cell. This encoded information was then used to produce the computerized analysis models which illustrated both land sensitivity and opportunities for use of the River's environment.

DESIGN

Visual reconnaissance, technical input, such as projections of land use and development pressures and citizen policies, were integrated with the analysis. The sensitivity of the Willamette River system observed and

heard about was confirmed by the computer models produced. These various inputs were combined to arrive at a preliminary Greenway Plan.

Candidate recreation areas and open space areas were flagged. The existing Greenway legislation, as well as citizen, staff, and governmental input, pointed the direction toward the development of the Greenway concept of a managed conservation corridor connecting sites critical, both to conserving the River and to providing river-related recreation. The result was the mapping of Greenway boundaries.

Specific Greenway element locations and use criteria were discussed, defined and charted in light of the analysis and concept of a conservation-oriented system. Critical areas of concern were described. Opportunities for access to the River by trail, bicycle and automobile were also recorded.

IMPLEMENTATION

The recommendations of a study were evaluated and brought to fruition through the combined effort of citizens, staff, and elected officials. Acquisition, development, management, and updating are part of that program of plan implementation. The program is made up of many potential components that should embody a well-balanced need/use system in harmony with the sensitivities of the natural landscape.

The vocabulary of the Greenway includes terms of land use categories (river, urban, farm and non-farm), use intensity terms (preservation, conservation (1, 2 and 3) and recreation), goals and guidelines (environmental conservation, access, recreation, land use and development, management, and citizen participation).

The land use and intensity of use categories are described as to human activity, purpose, intent, management and special uses. All public and private lands within the Greenway, whatever their present land use, were classified as to the intensity of use necessary to conserve the River's environment.

TRANSFERABILITY

The extent of transferability utilizing both manual and computer processes can be geared to any project with large quantities of data to be synthesized. Measured application of the plan has been citizen and government adoption of specific plan elements and State acquisition of recommended lands for park purposes.



FIGURE 2

The product for the Willamette River Greenway is a conservation "wise use" plan. The plan map, combined with the analysis maps and background data, provided a tool for local planning bodies to analyze any site within the study corridor (fig. 2). They can evaluate the Greenway in terms of sensitivity to man's

use, levels of use intensity, agricultural suitability, existing land use, and historical significance. This will prepare them for the more detailed studies they must perform in order to make decisions relating to land use proposals for specific sites in the Greenway corridor.