Appropriate Combinations of Technology for Solving Landscape Management Problems—
Session F: Urbanization; Highway Development

Assessing the Visual Resource and Visual Development Suitability Values in Metropolitanizing Landscapes[1]

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Abstract: In response to urbanization pressures on the New England landscape, researchers at the University of Massachusetts have developed and tested two visual landscape assessment procedures as part of a comprehensive research project in landscape planning. The first procedure identifies those visually significant and unique areas within a town or region that warrant public intervention in decisions affecting their protection and preservation. The second procedure identifies the relative frequency of visual attributes within an area which enhance its liveability and hence its suitability and value for development. Both assessment procedures were constructed from research findings in the areas of scenic perception and preference, and resource econometrics. Application of the procedures seemed to show a strong corroboration between methods of scenic perception and econometric valuation techniques. The importance of relating visual values to other landscape values when making land use decisions was also demonstrated.

INTRODUCTION

If visual-scenic value is derived from the "significance that individuals place on various parts of their environment" (Zube 1974), then landscape planners, decision makers, land managers and the general public have generally recognized two distinct categories of scenic values. The first category includes those scenically unique areas whose status-quo protection provides such a public value that these areas warrant public involvement in preservation, protection, or development decisions. High slopes, natural river and stream corridors, and large diverse wetness systems when kept in public ownership may serve an entire population. But, when converted to private and unrestricted use, the benefits to be derived from such areas may be obtainable by a much smaller population.

A second category of visual-scenic values is that which enhances the quality of sites proposed for new development. For example, a forested, gently rolling hillside, providing the opportunity for distant views, is certainly more suitable for development than a flat, unvegetated parcel permitting only partial views or views of neighbors with little opportunity for screened privacy.

Our research has addressed these two categories of visual-scenic values by developing a visual resource and a visual development suitability assessment procedure. Both procedures focus on the qualitative attributes of urbanizing landscapes which seem to explain positive correlations of observer preferences for various types of landscape scenes. We selected landscape attributes and variables from the available literature which best describe major differences in visual resources and development suitability values in the region under investigation (see Craik 1971; Zube 1974; Wohwill 1968, 1978; Hendrix 1973; Kaplan 1973). In addition, attributes were selected for their evidence of applied technical utility in visual assessment techniques (Smardon 1972; Litton 1974; Forest Service 1973, 1976; Bureau of Land Management 1976; Greene 1972).

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It should be noted that the procedures are inferential in that they are based on interpretations of previous research supported by several assumptions and include a number of arbitrary ratings. As a partial test for procedural assumptions, a number of economic assessments were developed to correlate the perception/preference ratings with inferred monetary dollar values.

Application of the procedures utilizes a number of manual operations and computerized routines. For example, the identification of potentially unique scenic resource areas begins with a manual overlay of topography, surficial geology and land cover maps to select particular features such as drumlins wetlands and mountainous bluffs for detailed evaluation. For large areas, the computer could be used to perform this task as well. Land use, topographic quality and feature value are assessed with the aid of specialized computer programs that measure land use edge diversity, complexity and compatibility. A digital topographic data base is used for viewer position, VIEWIT view area and view potential assessments, which are part of both procedures.

The specific focus of this paper is on the visual development suitability procedure. We first will describe the step by step application of the procedure. Then we will describe its econometric dollar value estimation procedure followed by application to a town in western Massachusetts. Finally we will describe a comprehensive framework for integrating visual values with other landscape parameters such as wildlife productivity, flood hazard and development suitability construction costs.

VISUAL DEVELOPMENT SUITABILITY

As previously introduced this procedure assesses the visual attractiveness of land in terms of enhancing the land's liveability and hence its suitability for development. Three subvariables were selected for inclusion in this procedure. These are: (i) <u>view potential</u>. (a function of view size, site landform and land use), (ii) <u>land use compatibility</u> and (iii) <u>on-site vegetation</u>. The procedure for combining these is, in concept, simple: the ratings for each component (some of which are positive, others negative) are ultimately added together to produce the final combined rating for suitability.
Large number of maps which are generated in the interim stages of the procedure and are overlaid several times, make the computerization of the whole process advisable. The principal manual tasks become the digitizing of input data and the issuing of commands to the computer to operate certain stages of the program. The steps in this technique are diagrammed in Figure 1. "View potential" is assessed in steps 1 to 3; "land use compatibility" is assessed in Step 4. These two subvariables are combined to produce a "view/setting rating" in Step 6. "On-site vegetation" is assessed in Step 5. Finally, in Step 7, all of the subvariables are considered together to derive the rating of visual development suitability.

Step-By-Step Description

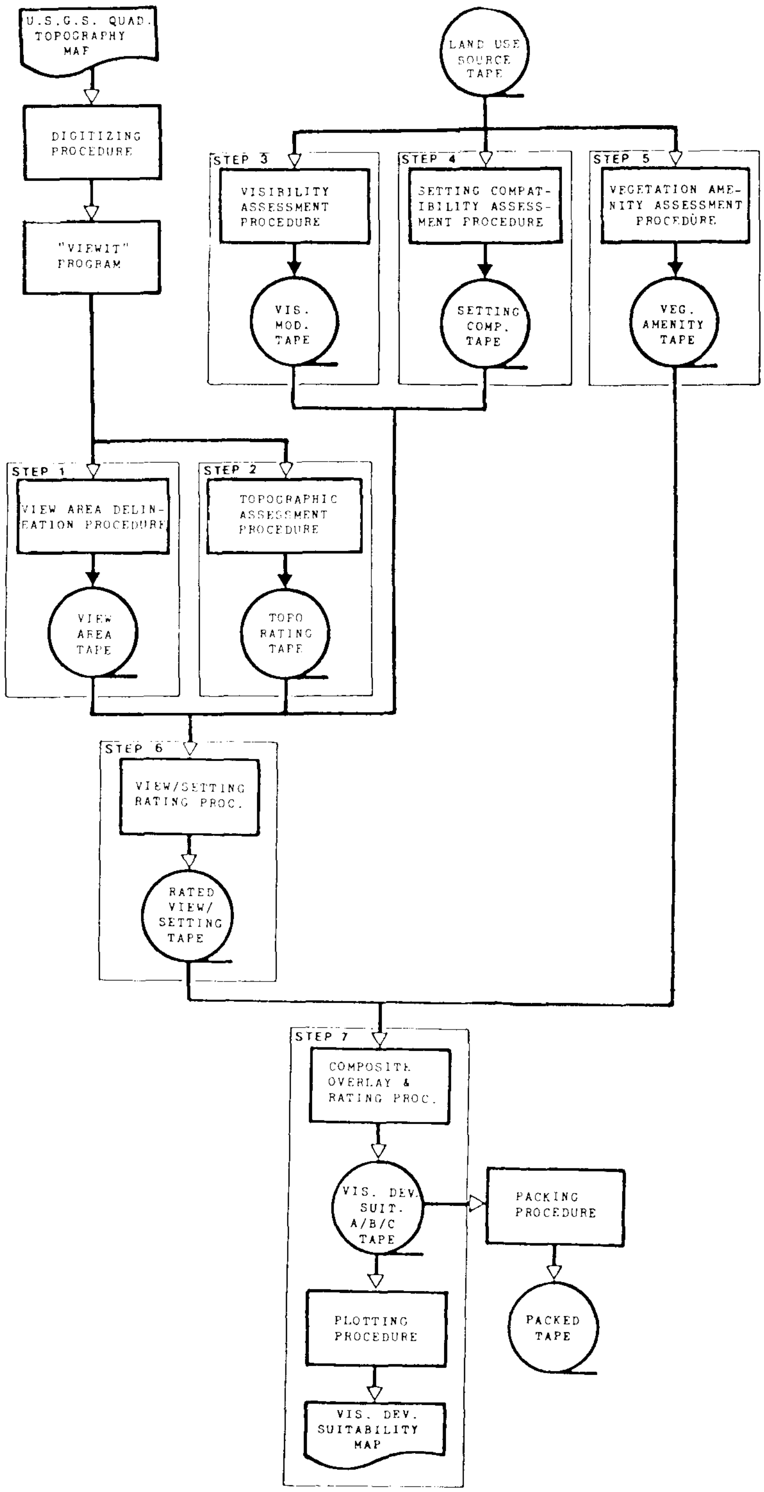
Step 1 - View Area Determination. This step is the first part of the view potential assessment. It differentiates between extensive views, moderate views and limited views. VIEWIT is utilized to assess view potential from all potentially developable sites in a given area. Three ratings (0, 2 and 4) are assigned to cut-offs along a continuum of view areas (0-5+ square mile view areas).

Step 2 - Topography Assessment. Topographic position is utilized to assess both potential view obstructability and preferential value for various viewer positions. Slopes, ridges, valleys and flatlands are rated for view potential (0, 1, 2).

Step 3 - Visibility Assessment. This assessment takes into account the fact that the various types of surface cover (such as trees, residential and cropland) serve to limit the ability to see distant views. Land uses are analyzed for their characteristic transparency and the relative permanence of that transparency. Visibility ratings are calculated in arbitrary grid cells (generally 200-400' on each side). Land uses are assigned classes, areas summed and visibility scores (-2 to 0) are assigned to each cell.

Step It - Setting Compatibility. Unlike the first three steps which deal with the potential for distant views, setting compatibility addresses quality in the near view. In this procedure, land uses are aggregated into groups based on the similarity of their visual characteristics. Similar land uses are then grouped into compatibility classes; classes are assigned to the adjacencies; and compatibility scores are calculated for grid cells using the following formula.

Figure 1
Visual Development Suitability Assessment Procedure



$$C_q = \sum_i C_i \cdot \frac{\lambda i}{\lambda q}$$

C_q = compatibility for grid cell q
C_i = compatibility for adjacency i
λi = length of adjacency i
•q = length of adjacencies in cell q

Values are modified by adjusting cell adjacency lengths up or down according to a comparison with an average edge density rating which is developed regionally to correct for the effect of land use complexity on the cell compatibility scores. Values are then assigned 0, -2 and -4 ratings.

Step 5 - Vegetation Amenity Assessment. This step assesses the visual amenity arising from on site vegetation. Land uses are aggregated into three vegetation amenity classes and assigned a +1, +2, or +3 rating.

Steps 6 and 7 - Composite Assessment. View area, topography, visibility and compatibility ratings are combined into composite view potential/setting ratings (A,B,C). The continuum of potential values (+6 to -5) is aggregated into A,B,C, letter classes and 3,2,1 numerical classes. Vegetation values are also grouped into similar letter and numeric classes.

The final rating for visual development suitability results from the combined contribution of view potential/setting and the existence of mature on-site vegetation. The 3,2,1, numeric values are combined producing a range of values from 6 to 2, which are then aggregated into A,B,C, classes to reflect values described in the following economic valuation discussion.

Economic Valuation

Introduction

Dollar values for the ratings which result from application of the visual development suitability model are derived from a study carried out with research team economists Robert Torla and John Foster. This effort utilized a housing behavior model which correlated house and site characteristics with the selling price of 205 houses in the Amherst, Massachusetts, area. "View-setting" values and "on-site vegetation" were evaluated together with thirteen other variables. View potential and on-site vegetation were measured for each of the house sites in the sample using the previously described procedures. The results of a multiple regression analysis of the 15 independent variables showed that both the "view-setting" and "onsite vegetation" variables were in fact significant contributors to the selling prices of houses in the sample.

Methodology

A model was developed which identified demand functions for various housing and environmental characteristics. The model required socio-economic data on the houses and purchasers respectively. Since socio-economic data on purchasers were not available, the study relied on implicit pricing for view, vegetation and other structural and environmental characteristics.

The implicit model was of the form:

$$P_i = F(P_H H, P_A(D)A, P_E E$$

where P_i = the price paid for the ith house
F = the functional form
P_H = vector of prices of structural characteristics
H = vector of quantities of structural characteristics
P_A = price per unit of land
D = distance from central business district
A = quantity of land
P_E = vector of prices of environmental characteristics
E = vector of environmental characteristics

(Note:) Estimation was with ordinary least squares.

Important characteristics were placed into three general classes: structural characteristics, accessibility and lot size, and environmental characteristics (i.e., flood plain location, noise level, proximity to open space, distant view potential, etc.).

Results

After data for each characteristic were collected and coded they were analyzed with a best fit (linear) multiple regression equation to estimate an implicit pricing value associated with each structural and environmental characteristic. Table 1 presents a summary of results from application of the best fit multiple regression equation.

Data for view potential and site vegetation were then analyzed to estimate the dollar value benefits to households to be derived only from these characteristics. View potential yielded a maximum dollar value assignment of $7,600 per acre. This generally corresponded to long panoramas or vistas situated high on moderately wooded slopes with a setting containing a visual character compatible with the housing studied. The middle range appeared to extend from about $2,000 to $5,500 per acre. These views were generally impressive but less significant, and the lowest dollar value range, 0 to $2,000, extended from a complete absence of view to moderately attractive partial views.

TABLE 1

CHARACTERISTIC MULTIPLE REGRESSION RESULTS

FACTOR	ESTIMATED CO-EFFICIENT (implicit price)	
Open space	3817.81	(1.35)
Noise levels	-1570.07	(1.12)
Year sold*	33.97	(0.79)
Lot size	2256.85	(4.42)
Average neighborhood lot size	-0.0297	(1.39)
Flood plain	-2887.40	(1.15)
Structure value*	1.05	(23.25)
Neighborhood condition	334.33	(0.80)
Non-conforming uses	-6.64	(0.19)
Tree density*	56.07	(2.63)
View rating*	274.30	(2.00)
Abandoned housing*	3323.21	(2.45)
Size of the house lot*	647.98	(2.24)
Size of lot/distance to town center*	616.72	(3.66)
(Square footage of lot)^2*	-12.93	(2.27)

*Significant characteristics r^2 = ,7821

Figures in parentheses are t values, estimated coefficient is significant if t is greater than 1.65.

On-site vegetation had a maximum attributed value of $4,300 per acre. This value was for sites with mixed dense mature vegetation. On mid-range of values spanned a continuum from a few stately trees to numerous hardwoods, softwoods and mixed species, while low end values (0-$1,000) reflected sites with little amenity value because of a complete absence or a minimum of mature on-site vegetation.

Data patterns offered no logical cut off points for assigning A, B, C ratings for three levels of aggregation. Therefore ratings were intuitively assigned to the range of view-setting and on-site vegetation dollar values based on a visual inspection of the data. In addition, slides of all the sites studied were examined to check the "visual-scenic" logic of those cut-off points. The A,B,C cut offs

View potential/setting (in dollars)--

A = $5,600-$7,600
B = $2,000-$5,000
C = $ 0-$2,000

Vegetation--

A = $2,700-$4,300
B = $1,000-$2,700
C = $ 0-$1,000

Visual Development Suitability--

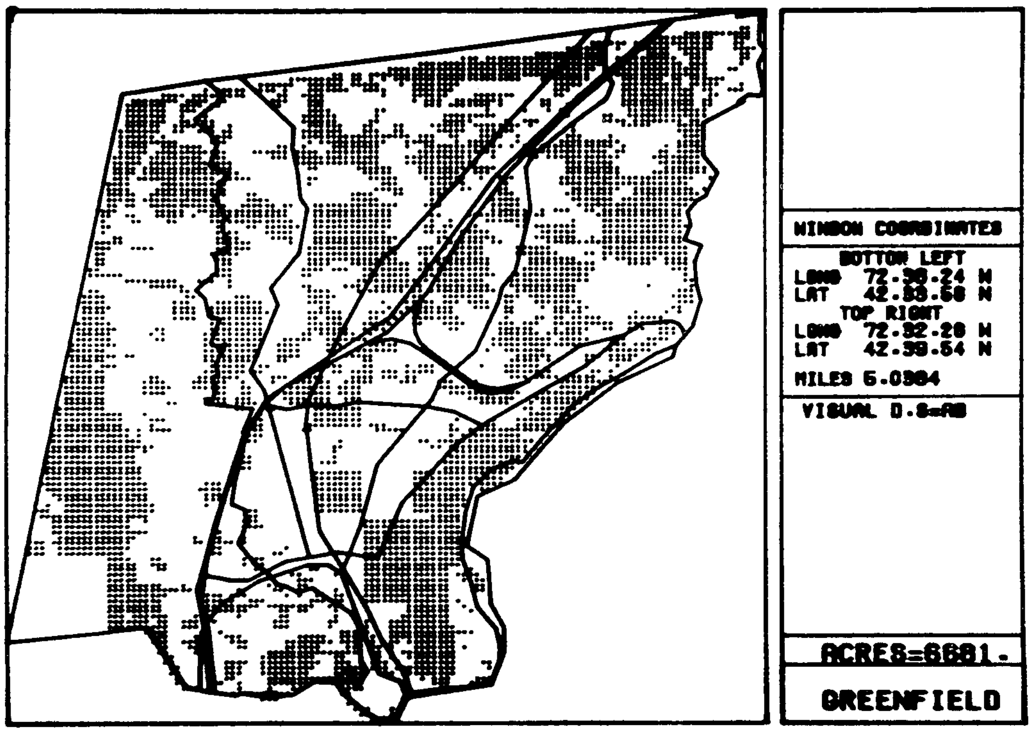
A = $6,600-$11,000
B = $3,000-$6,000
C = $ 0-$3,000

It should be noted here that similar economic valuations were developed for the visual resource procedure. In that case, however, procedures were utilized to identify implicit values to the public for status quo maintenance of visual resource areas.

Application of the Procedure

This section briefly describes application of the procedure to Greenfield, a town in the western Massachusetts study area. Figure 2 presents results of the development suitability procedure. Results reflect the diverse forest-farm-town land uses and steep hillside and stream channel dominated landforms. Areas rated C which are approximately 50 percent of the town include broad valleys and urbanized areas. Such areas when traditionally developed often lose their view potential by virtue of design, siting and construction of new development. A number of forested ridges and hillsides proved to offer potentially panoramic views and a mature forest cover which offer the potential for both high site and distant view amenities.

Figure 2--Visual Development Suitability Class A and B Areas in Greenfield Massachusetts



Compatibility actually proved to be the least significant dimension as the town is still lightly developed and industry free. View potential based on view area, topography, land use, and on-site vegetation was important as a significant range for these values was identified in the town.

In summary it is felt that the technique as developed represents a significant beginning in this area. It should be noted that although the extent of distant views is assessed in this procedure, the <u>content</u> of the views available from a site is net a factor here. It is for this reason that the view rating generated here is best considered as denoting "view <u>potential</u>." An effort to incorporate an assessment of the quality or character of views as a function of the land use pattern in any viewed area was made in this research, but the volume of data required for manipulation in this process proved beyond the resources of the project during this phase. However, this is an area where future refinement of this technique will probably prove fruitful. The most significant element of this research is undoubtedly the effort to corroborate the quantified measurement of visual quality, (based on professional judgments and laboratory research) with the expressed economic value of parcels of land. Not only did this effort yield an encouraging indication that the visual assessment technique developed here was headed in the right direction, it served to aid in the refinement of the aggregation of the visual development suitability classes themselves.

INCORPORATING VISUAL ASSESSMENT INTO METROPOLITAN LAND USE PLANNING

As part of the Metropolitan Landscape Planning Model (METLAND), both the visual resource and visual development suitability assessments can be readily incorporated into a much broader analysis of urbanizing areas. The ability to combine information about the visual attributes of urbanizing areas with information on valuable resources, such as prime agricultural lands, wildlife habitats, and groundwater resources; on hazards, such as flooding and landslides; and, on development suitability, may be critical to incorporating visual values into land development and protection decisions. The three following examples of how visual values could influence land use decisions in Greenfield, Massachusetts, show the importance of relating visual values to other landscape values.

Figure 3 Areas of Conflict Between Visual Resource Amenity Class A, B and C With Visual Development Suitability Class A and B in Greenfield, Massachusetts

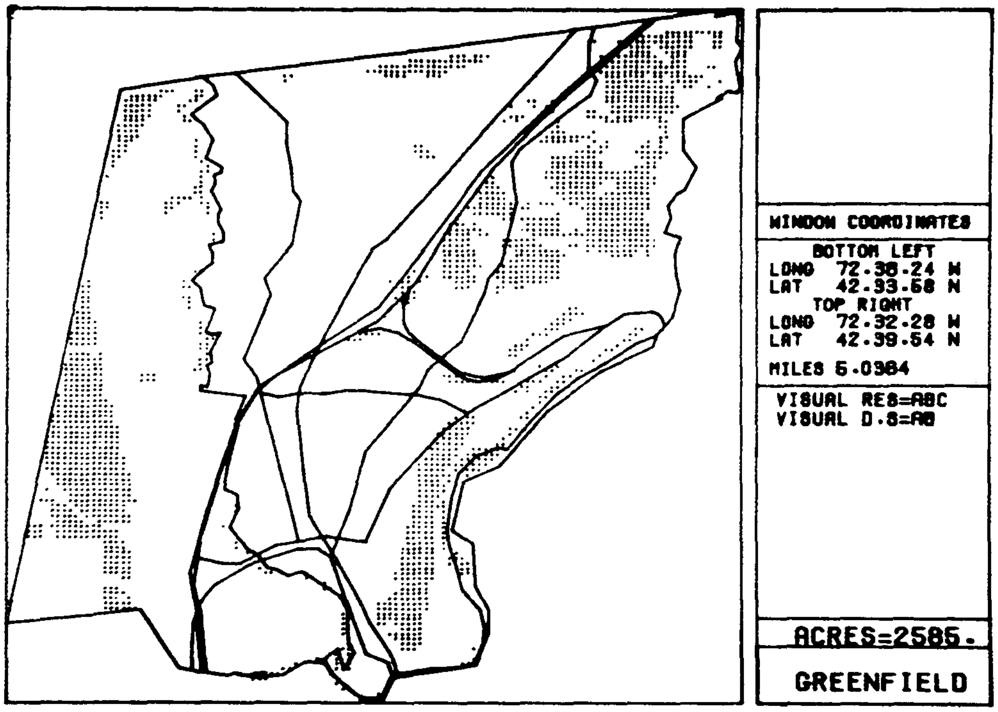


Figure 4 Areas of Conflict Between Visual Resource Amenity and Visual Development Suitability Where Residential Site Construction Costs Are High In Greenfield, Massachusetts

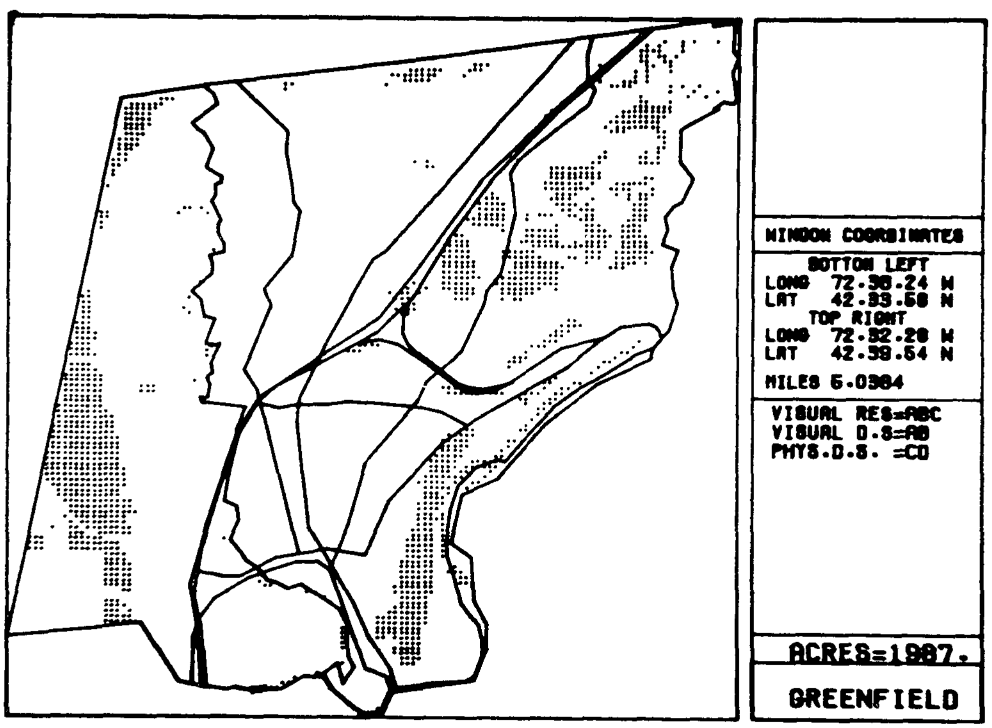


Figure 5 Areas In Greenfield, Massachusetts, Where Visual Development Suitability, Physical and Topoclimate Development Suitability, and No Flood Hazard Co-occur.

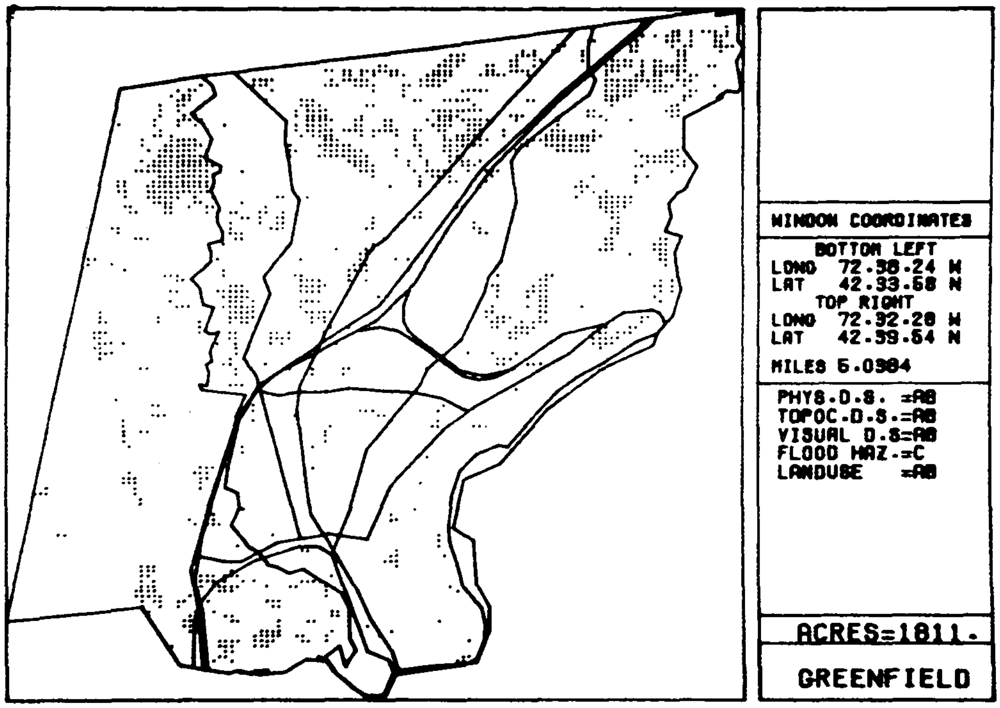
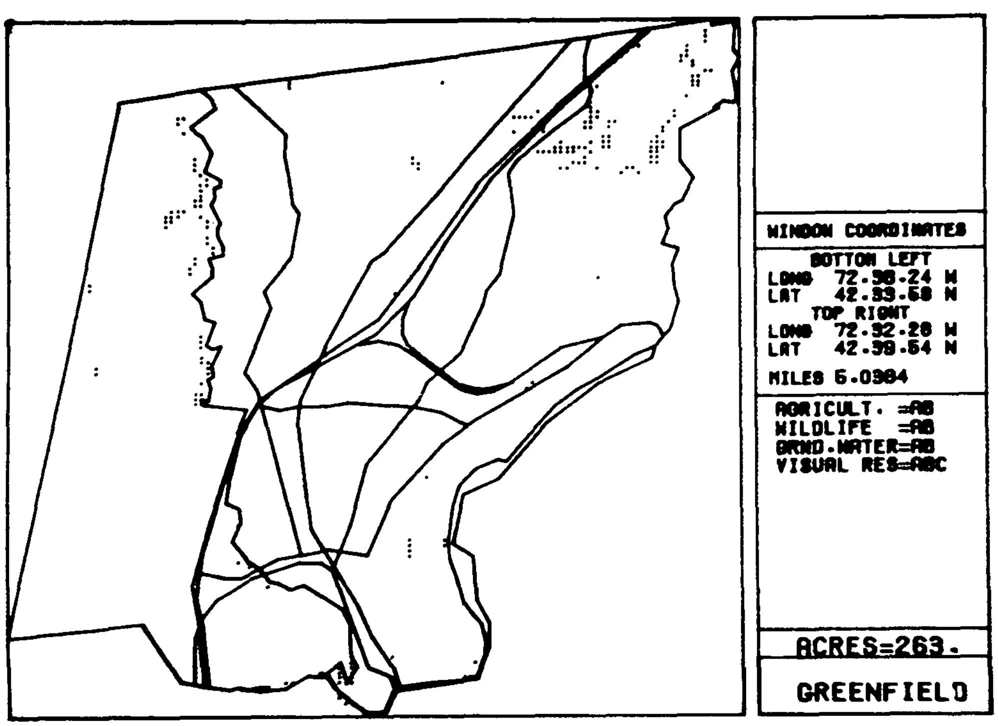


Figure 6 Areas In Greenfield, Massachusetts, Where Prime Agricultural, Wildlife, Groundwater Supply, and Visual Resource Amenity Values Co-occur.



Conflict Resolution

One of the obvious problems in need of further research is how to determine what uses are appropriate for areas possessing both visual resource amenity and visual development, suitability values, This question arises in metropolitanizing landscapes as well as in wildland resort areas.

For those urbanizing landscapes possessing outstanding visual resource amenity value, implementing development controls may conflict with a developer's plan to take advantage of that area's visual development suitability value. Figure 3 shows that one sixth of Greenfield possesses areas where the conflict between visual development suitability and visual resource protection may range from $20,000 to $5,000 per acre for resource protection and from $11,000 to $3,000 for development suitability value.

One approach for selecting between those areas where development should be encouraged and those areas where visual resource values should be protected is to trade-off those areas of lesser visual resource value. (In this example-to allow development in C rated visual resource areas). A second approach might be to retain the original criteria expressed in Figure 3 while adding an additional factor such as physical development suitability (construction cost) for residential development. Figure 4 shows those areas in Greenfield where extremely poor soil and slope conditions exist for development and where visual development suitability and visual resource amenity values conflict. Since the added cost for overcoming these physical conditions exceeds their visual development suitability value it would be logical to suggest that the areas shown in Figure 4 are prime candidates for public intervention in their future use.

Improving The Visual Quality of Residential Development

The identification of areas possessing high visual development suitability value alone will not be sufficient to influence development into those areas. It may be possible, however, to connect, visual development suitability values with other land development factors. Figure 5 shows those areas in Greenfield where visual development suitability values of $11,000 to $3,000 occur where undeveloped land also possesses rood physical and topoclimate (energy conserving) development suitability characteristics and where no flood hazard exists. These areas become logical candidates for development. Further development suitability screening of candidate areas using the METLAND system could include factors such as availability of municipal water and sewer, fire protection services, access to schools, zoning, noise pollution and other locational considerations.

Protecting Visual Resource Values

In the urbanization of the New England landscape, the problem of protecting and preserving the visual character of the region can not be achieved by public intervention on those few truly significant landscape features. The problem is more pervasive. How to preserve those landscape features that are highly valued is not the problem. The problem is how to protect those landscapes that possess less than truly significant values, yet actively contribute to the overall visual resource value of a community.

Perhaps it might be possible to build a coalition of interested parties to support development controls on certain landscapes that contribute to a number of different, yet mutually supporting concerns. For example, Figure 6 shows those areas in Greenfield where prime agricultural, wildlife, groundwater, and visual resource amenity values occur together. The Green River corridor to the northwest and an area of mixed forest and productive agricultural land to the northeast are prime candidate areas for visual resource amenity protection that could also include arguments for prime agricultural land preservation, wildlife habitat protection, and groundwater resource protection.

In conclusion, we should remember that the visual landscape should not be viewed as a separate component of the total landscape. As visual resource managers our ultimate success in protecting those areas of visual resource quality and our success in encouraging development into those areas possessing high visual development suitability value may not be achieved through arguments based only on visual value. We should seek to link visual landscape values with other landscape values where this linking can help us achieve our visual resource management objectives.

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