

Visual Sensitivity of River Recreation to Power Plants¹

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Abstract: The consultants were asked by the Power Plant Siting Staff of the Minnesota Environmental Quality Council to develop a methodology for evaluating the sensitivity of river-related recreational activities to visual intrusion by large coal-fired power plants. The methodology, which is applicable to any major stream in the state, was developed and tested on a case study river.

The methodology involves two basic tracks: landscape character and recreational potential. The landscape character track defines and measures power plant visual characteristics and river-related landscape categories. These are correlated and the potential for visual absorption of a power plant is determined for each landscape type. These visual absorption values are then mapped along the case study river. The recreational potential track assesses the suitability of each segment of the river for various recreational activities. Each potential activity is assigned to one of three classes of importance and sensitivity to visual intrusion and the resulting recreation values are mapped.

A mapped correlation of the visual absorption values and the recreation values reveals power plant siting constraints and opportunities and can be used by the MEQC in regulating and guiding the location of proposed power plants.

INTRODUCTION

The State of Minnesota anticipates the construction of a considerable number of large new coal-fired power plants in the next one or two decades. Most of these will be located near a source of cooling water which means, generally, near a river, and the rivers in the state are heavily and increasingly used for recreation.

The larger scale and industrial character of a power plant conflict with the natural landscape values that are necessary, at least in some degree, to more river-related recreation.

In April 1977, the Minnesota Environmental Quality Council asked the authors to develop a methodology for assessing the relative sensitivity (with respect to recreational potential) of Minnesota's rivers to the location of large power plants.

The methodology is intended for use by the MEQC in regulating and providing guidance on the location of proposed power plants. The system can also be used by utility companies for identifying siting opportunities relative to river recreation and comparing the merits of alternative power plant sites on the same river or on different ones.

Although the methodology is based to some extent on subjective judgement, it offers the MEQC a consistent and rational approach to the review of power plant siting applications from river to river and year to year. The step-by-step process provides a framework for communications between the utilities and the MEQC.

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The methodology should lead naturally into more detailed studies of promising candidate sites. While no estimates of cost per proposed site or per river mile surveyed can be made at this stage of development, the system should prove rapid and economical as well as capable of being used by nonspecialized agency personnel.

It is envisioned that the methodology will be refined and improved each time it is applied.

The methodology was evolved and tested using, as a case study, two stretches of the Minnesota River.

The methodology proceeds along two parallel tracks:

- 0 The Landscape Character Track: Power plant and river-related landscape characteristics are determined. The visual absorption potential of various landscapes is determined and the absorption potential of the case study river is illustrated.
- 0 The Recreation Potential Track: The existing and potential recreational activities along the case study river

are identified. Their sensitivity to visual intrusion and their relative importance are assessed.

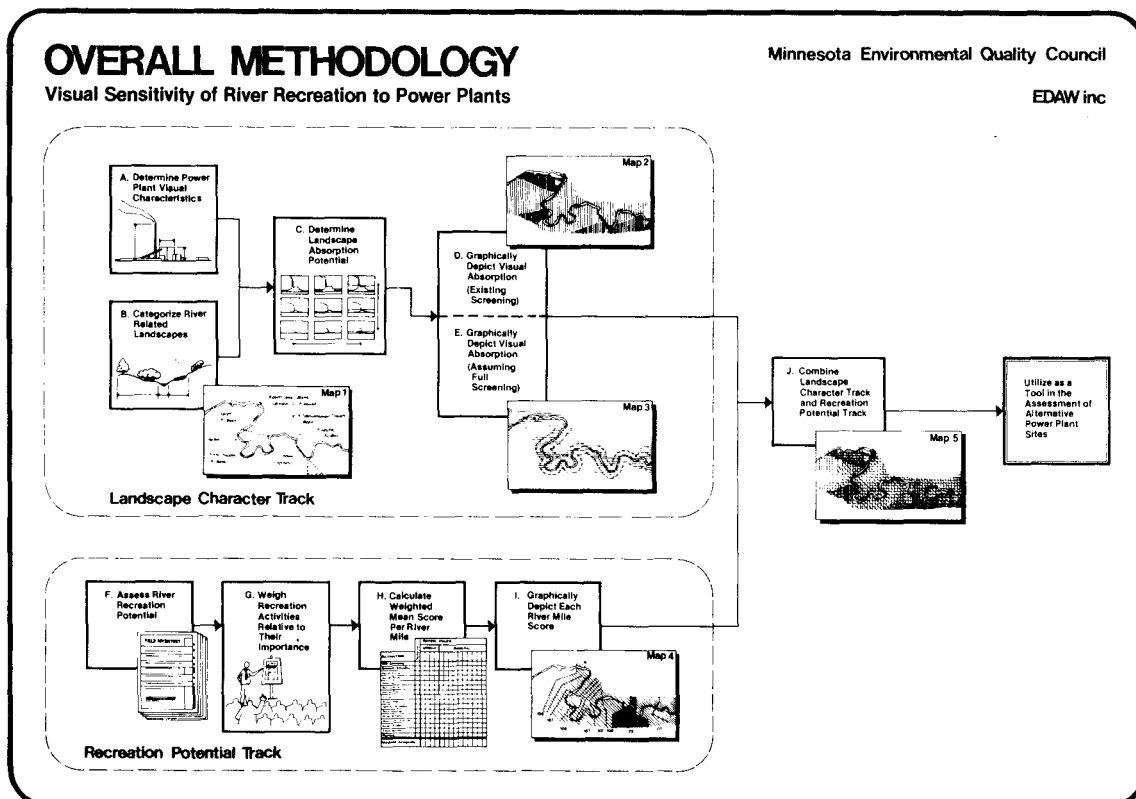
The steps along these two tracks are illustrated on the Overall Methodology Diagram.

LANDSCAPE CHARACTER TRACK

The Landscape Character Track (which proceeds parallel to the Recreation Potential Track), defines and measures two variables; power plant visual characteristics and river-related landscape categories. These are correlated and the potential for visual absorption of a power plant is determined for a range of landscape types. The absorption potential values are then mapped along the case study river. A methodology for numerically evaluating the relative intrusion value of proposed power plants is also presented. Note, however, that no specifically sited plants are evaluated in this study.

STEP A. DETERMINE POWER PLANT VISUAL CHARACTERISTICS

When a major new power plant is constructed near a river, it is likely to exceed by far, extent and in the scale of its structures, any



other facility within many miles. Large plants require a site of several square miles and have boiler buildings up to 250 feet high. Based on current air quality laws and pollution control technology, it is assumed that all future coal-fired plants in Minnesota will have stacks 650 feet high.

Figure 1 illustrates the visual characteristics of a typical power plant. The illustration is arranged to show, as far as possible, the "fuel in - electricity out" process from left to right.

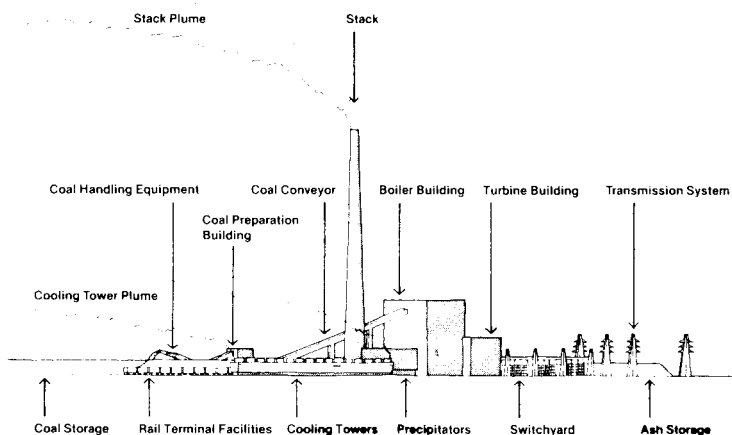


Figure 1

STEP B. CATEGORIZE RIVER RELATED LANDSCAPES

As a first move towards understanding any river corridor, its topography should be examined using maps and aerial photographs and its general physical characteristics noted.

Only a limited and general idea of the characteristics of a river corridor can be derived from published sources. In order to properly categorize its landscapes, it is essential to experience the river directly by floating it. For the case study river, this was done by canoe.

In the course of the survey, the following conditions were observed: bank height and type; screening; level and type of development; and views out to bluffs.

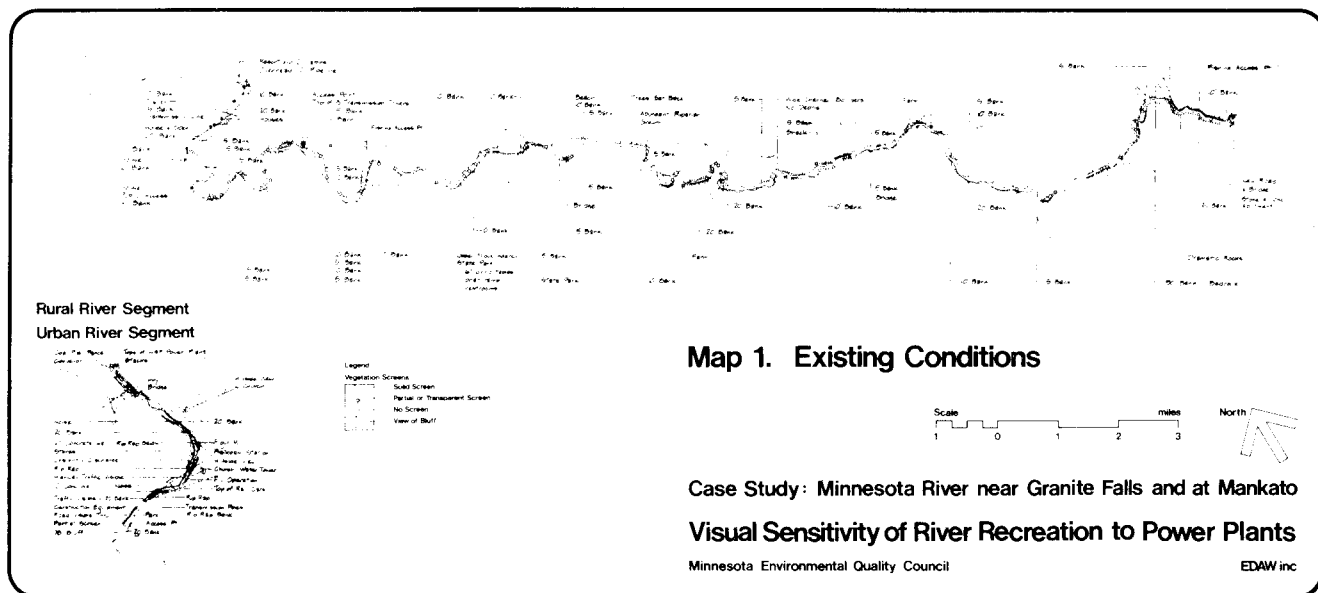
The observations were recorded on field notes, which became the basis of Map 1. Existing Conditions.

STEP C. DETERMINE LANDSCAPE ABSORPTION POTENTIAL

There are two reasons for examining landscape absorption potential:

1. To enable maps to be produced that reveal power plant visual siting opportunities and constraints. How this was done for the case study river is explained in Steps D and E.
2. To allow comparison of alternate sites by developing a methodology that applies a numerical intrusion value to power plants with various combinations of absorption factors. A proposed methodology is outlined in this step.

The most important factors that influence the intrusion that a specific power plant has on a specific recreational use are:



0 Level of Development: The higher the existing level of development, the lower the intrusion. The following categories are used:

- Natural
- Rural
- Transitional
- Urban
- Industrial

0 Screening. The value of screening in reducing visual intrusion is self-evident. However, low screening that conceals the many low, but widespread and untidy elements of a power plant may be of disproportionately high value.

0 Backdrop. Backdrop to a plant is generally felt to reduce its visual intrusion. In other words, if in a given view, a plant is fully silhouetted against the sky, its visual intrusion is greater than if it is partly backed by topographic features, mainly because the tone contrast between power plant and sky is greater than that between plant and land.

0 Distance from Observer. When the sizes of the major elements of a power plant are known, given certain assumptions of the human "cone of vision", the appearance of the plant within the field of view at various distances can be illustrated and its intrusion assessed.

Figure 2 illustrates, in diagrammatic form, a typical 300 MW power plant at distances of one-half mile, one mile and two miles from the viewer with various combinations of screening and backdrop. The figure also shows, for illustration, a judgemental visual intrusion value for each combination of these factors.

If a number of potential power plant locations were being compared and reasonably exact data were available on the size and locations of the plants and their visibility from the river segments, actual numerical values could be evolved with the input of the recreational user of the river. The values would then be factored in three additional ways:

A. To modify, if necessary, for existing partial or transparent screens.

Visual Intrusion Values Relative to Distance, Screening and Backdrop 800 MW Single Unit Coal Fired Power Plant

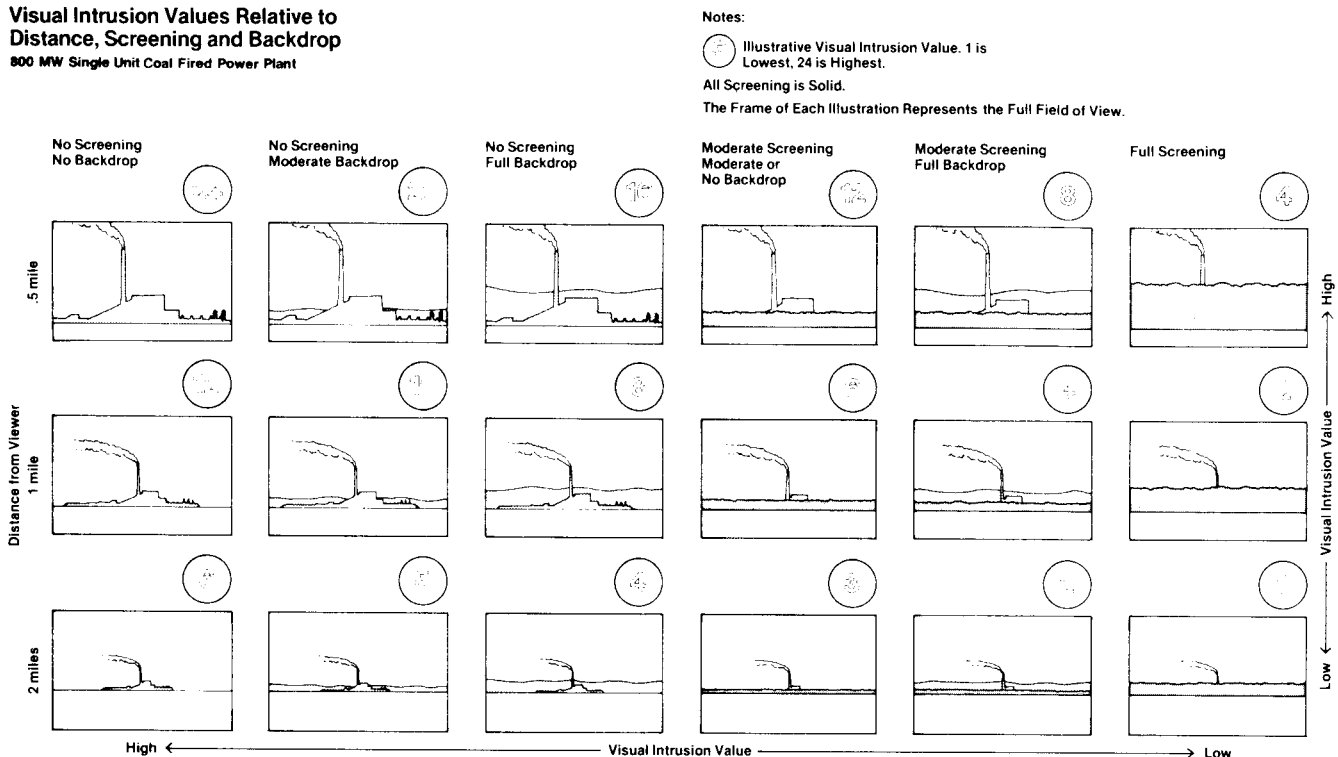


Figure 2

- B. To modify for development level. Some such scale as the following is suggested (using the development levels outlined above):

Natural	- multiply by 16
Rural	- multiply by 8
Transitional	- multiply by 4
Urban	- multiply by 2
Industrial	- multiply by 1

- C. To modify for recreational importance as explained in the Recreation Sensitivity Track.

The ultimate result would be a single numerical value representing the potential visual intrusion of each alternate plant site on its river.

STEP D. GRAPHICALLY DEPICT VISUAL ABSORPTION:
MAP VIEWSHEDS AT GROUND LEVEL WITH
EXISTING SCREENING & MAP EXISTING
DEVELOPMENT LEVEL

The map that illustrates this step (Map 2. Visual Absorption: Existing Screening and Development), shows the viewsheds that result from looking across the banks of the case study river (at ground level, without elevating the view, i.e., ignoring anything that might be visible above the trees), where the bank screening conditions remain as they exist at the time of the site survey.

The viewsheds were determined by placing an imaginary viewer on the river at each point along its centerline and mapping his viewshed out across each bank to the limits of the study corridor, the main bluff line. The

viewsheds were delineated as full when no bank screening was present and as partial when transparent screening existed. No viewsheds were shown behind solid screening.

STEP E. GRAPHICALLY DEPICT VISUAL ABSORPTION:
DETERMINE VIEWSHEDS FOR TALL POWER
PLANT STRUCTURES ASSUMING FULL
SCREENING

Figures 3 and 4 illustrate the average expected height of future power plants.

Minnesota River: Height of Bank Screening

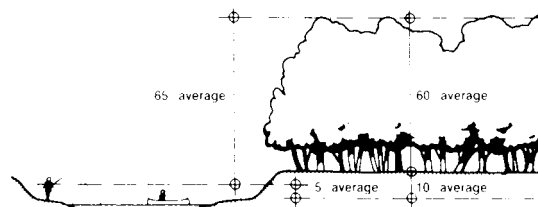


Figure 3

Power Plant Height

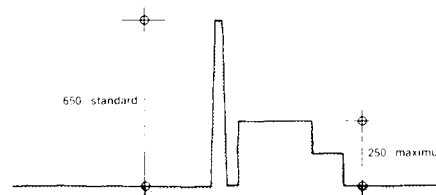


Figure 4

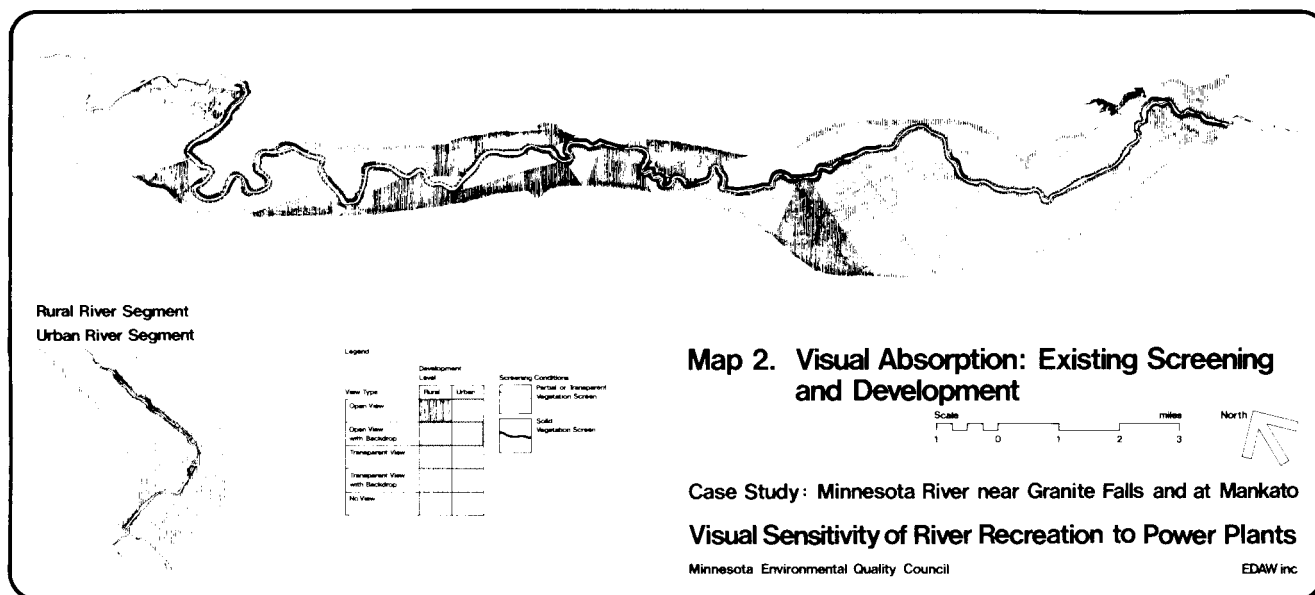


Figure 5 combines these two sets for facts, defines a reasonable visual intrusion level (where only the top half of the stack is visible) and shows how, on this river, a power plant must be set back behind the bank screen a distance equal to five times the distance between the observer and the screen.

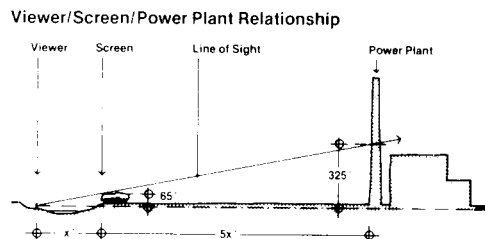


Figure 5

Other ratios will result from different screen heights and power plant heights. Other figures, resulting in different ratios, can be selected, as desired, to express more or less restrictive siting criteria.

The viewsheds over the fully-screened banks of the river can now be defined by applying the above ratios. For the case study river, the view was placed (a) at all points along the foot of each bank looking across the opposite bank screen and (b) in the center of the river looking up and down all straight river segments.

The viewsheds that resulted are illustrated on Map 3. Visual Absorption: Full Screening.

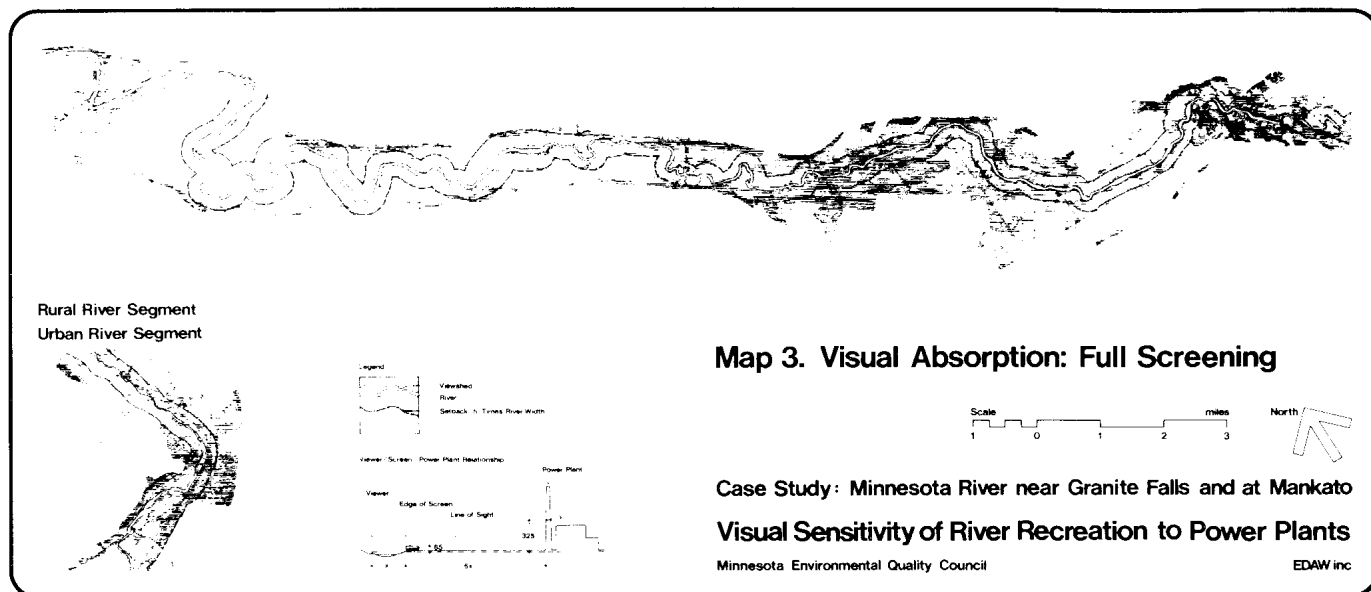
RECREATION POTENTIAL TRACK

Simultaneously with the performance of tasks along the Landscape Character Track, an assessment must be made of the recreation potential and sensitivity to visual intrusion by a power plant along the study river. This series of tasks is referred to as the Recreation Potential Track.

The assessment technique selected for use is the RIVERS Method.^{3/} Sixteen recreation activities are included in the evaluation. These are:

- o Wild canoeing
- o Hiking
- o Canoe camping
- o Trail camping
- o General canoeing
- o Small boating
- o Swimming
- o Nature study
- o Picnicking
- o Road camping
- o Hunting
- o Power boating
- o Water skiing
- o Pleasure driving
- o Bank fishing
- o Boat fishing

^{3/} Chubb, Michael and Eric H. Bauman, The RIVERS Method, A Pilot Study of River Recreation Potential Assessment. Department of Geography, Michigan State University and North Central Forest Experiment Station, U.S. Forest Service, 1976.



Map 3. Visual Absorption: Full Screening

Case Study: Minnesota River near Granite Falls and at Mankato
Visual Sensitivity of River Recreation to Power Plants

Minnesota Environmental Quality Council

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STEP H. CALCULATE WEIGHTED MEAN SCORE PER RIVER MILE

The unweighted score for each recreation activity is then multiplied by the weight, the products are summed by river mile and divided by 16 to give one score per river mile. This score is shown across the bottom of the matrix on Map 4. Recreational Importance and represents the importance of recreational potential per river mile.

STEP I. GRAPHICALLY DEPICT EACH RIVER MILE SCORE

The range of possible scores per river mile using the numerical weighting outline in Step G. is 0 (if no potential existed for any of the 16 activities), to 199 if conditions were ideal for all 16 activities). The weighted scores for the study river range from a low of 80 to a high of 129.

The range of 49 points was shown on Map 4. Recreational Importance as five graphic patterns each representing a 10-point spread. The darker the intensity of pattern, the higher the score, and thus the greater the importance of the river mile for potential recreational use.

STEP J. COMBINE LANDSCAPE CHARACTER TRACK AND RECREATION POTENTIAL TRACK

The map that illustrates this step (Map 5. Constraint/Opportunity Composite), results from overlaying Maps 2, 3 and 4. Each of these shows a range of siting constraints and opportunities by graphic textures; the darker the texture, the more constraining the siting consideration.

When these three maps are overlaid, the results (Map 5) show a complete picture of the visual siting constraints and opportunities along the case study river stretches, represented by dark and light composite textures.

