

IMPROVED ALIGNMENT EVALUATION AND OPTIMIZATION MODEL

Initial Presentation to the Maryland SHA

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Tasks Proposed

(major tasks)

1. Reduce input preparation requirements.
2. Develop a user-friendly interface.
3. Display the model outputs in more useful and user-friendly ways.

Main lessons from the Brookeville Bypass project

Tasks Proposed

(additional tasks)

4. Model bridge characteristics.
5. Incorporate hydrologic analysis.
6. Incorporate wetlands compensation analysis.
7. Enhance the analysis of emissions and air quality.
8. Incorporate noise analysis and mitigation.

Tasks Proposed (additional tasks cont'd)

9. Model roundabouts.
10. Consider retaining walls instead of sloped cut sections.
11. Incorporate prescreening and refining processes.
12. Prepare final report.
13. Provide model training to SHA personnel.

Model Performance

as shown in the
Brookeville Bypass project

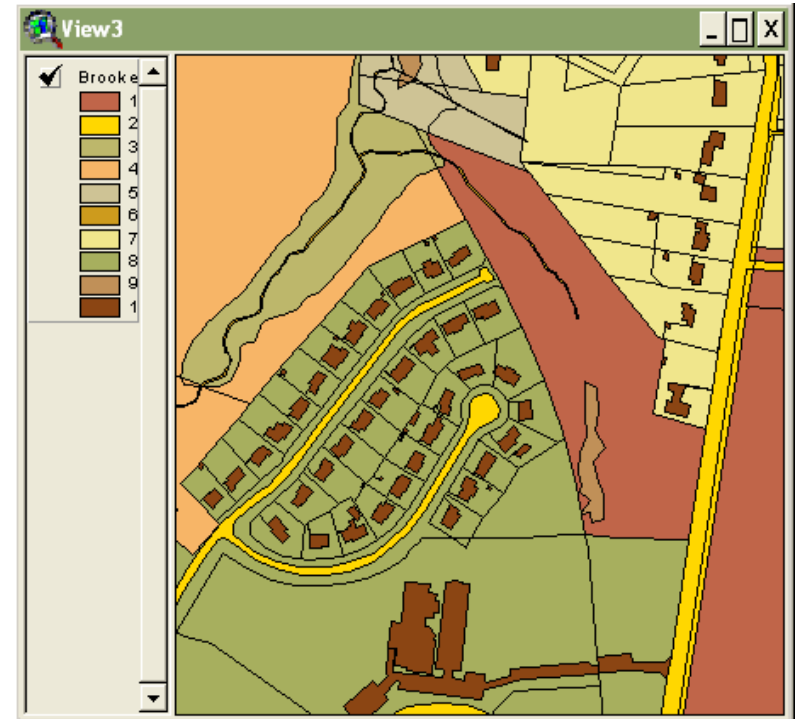
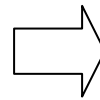
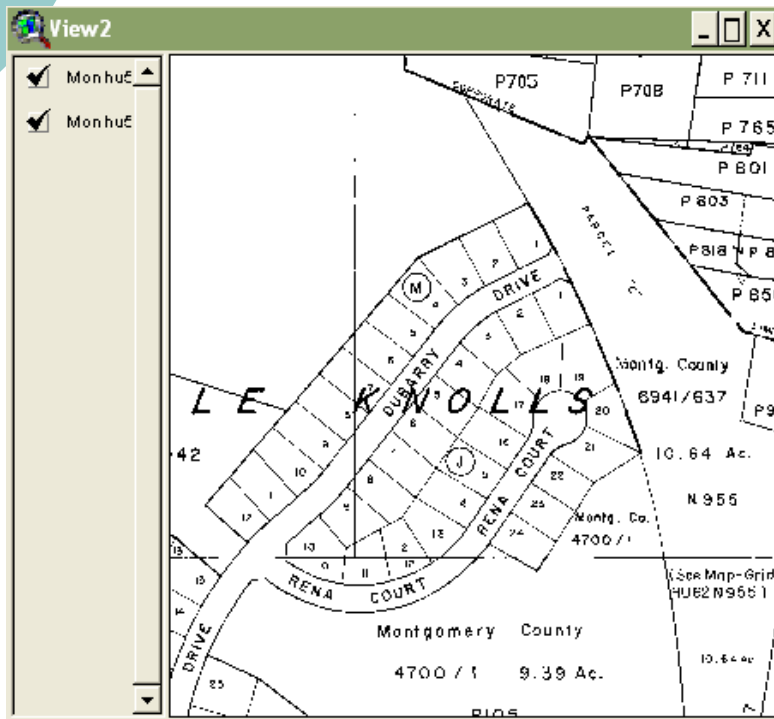
1. The model can effectively **evaluate** alternatives and **optimize** them (*simultaneously*, horizontal and vertical).
2. It allows numerous **combinations of objectives, preferences, and constraints**.
3. It considers **incomparably more design alternatives** than the SHA can presently afford to evaluate.
4. It **reduces the resources (money, time, etc.)** required for planning and design.
5. It exploits the massive information in **a GIS**

Task 1.

Reduce Input Preparation Requirements

1. Automating map digitization

- digitize a map to be intelligent → **polygon map**



Use a commercial software package (e.g., Autodesk Raster Design)

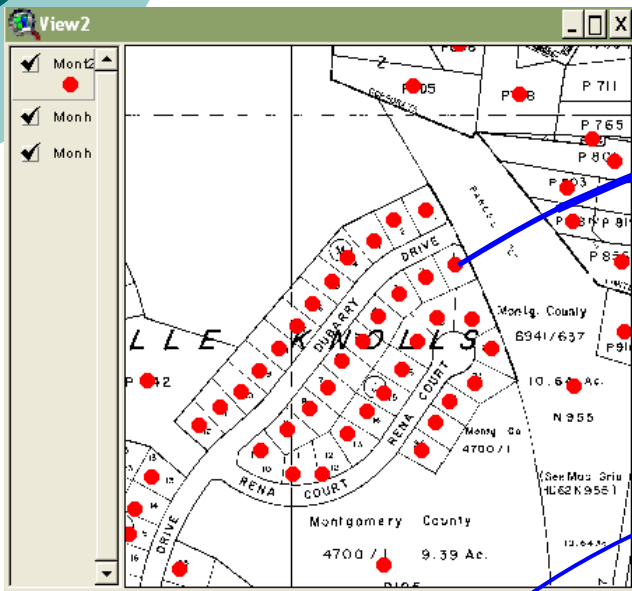
Task 1.

(cont'd)

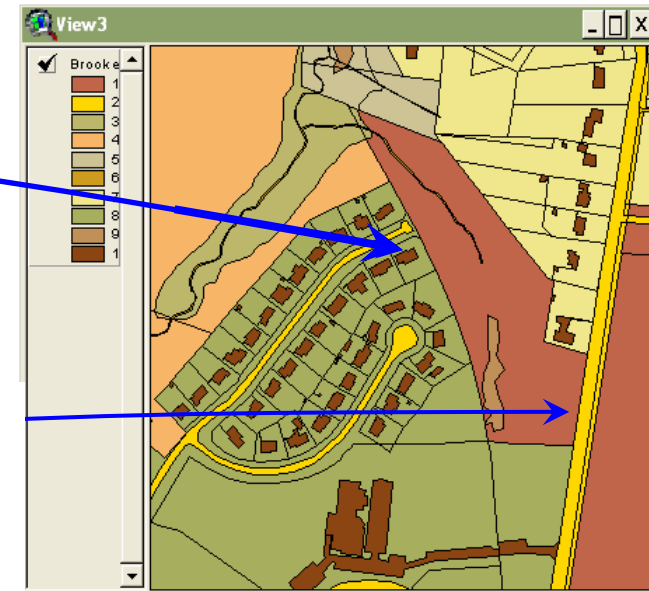
Reduce Input Preparation Requirements

2. Automated data preparation

- **extract** required info. from MD Property View



- Property area
- Property value
- Land-use detail



- Periodical water level
- Soil characteristics
- Traffic characteristics

- **obtain** additional info. from other sources



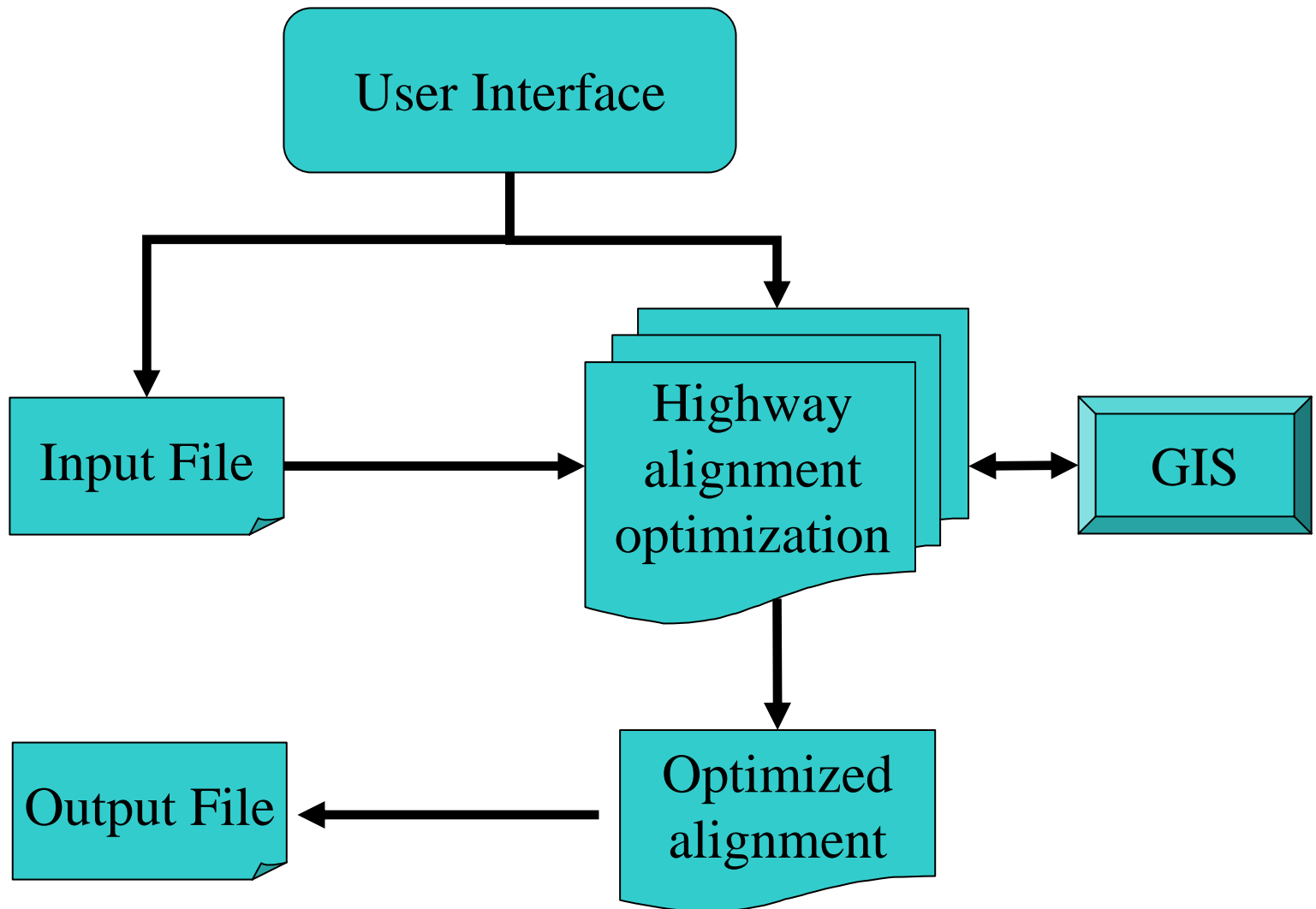
Task 2.

Develop a User Interface

Objectives

- User-friendly
- Better control over model operation
- Better control over all input parameters
- Bypass tedious preparation of text input file

Functionality of the Interface



Sample Interface

The image shows a software dialog box titled "Search Space Information". The main content area is titled "Search Space Details" and is divided into three columns of input fields:

- Origin Coordinate:** Three input fields labeled "X Axis", "Y Axis", and "Z Axis".
- Number of Grids:** Three input fields labeled "X Axis", "Y Axis", and "Z Axis".
- Span of Search Space:** Three input fields labeled "X Axis", "Y Axis", and "Z Axis".

At the bottom of the dialog, there are four buttons: "< Previous", "Reset", "Cancel", and "Next >".

Sample Interface (cont'd)

Alignment Details

Start Point

X Axis

Y Axis

Z Axis

End Point

X Axis

Y Axis

Z Axis

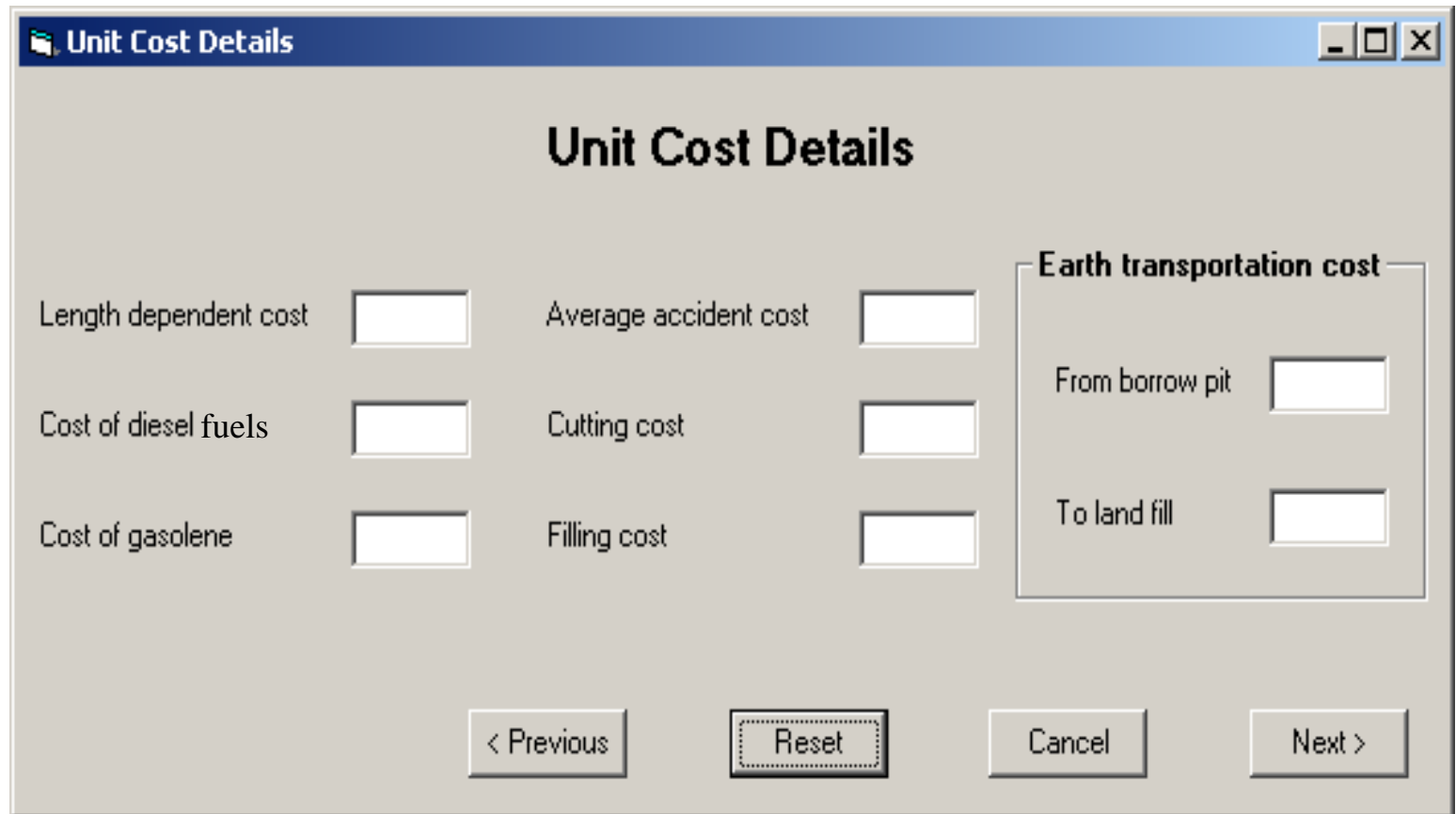
Alignment Width

Number of Intersections

Distance between station points

< Previous Reset Cancel Next >

Sample Interface (cont'd)



The image shows a software dialog box titled "Unit Cost Details". The dialog has a title bar with a blue gradient and standard window controls (minimize, maximize, close). The main area is light gray and contains the following elements:

- Unit Cost Details** (Section Header)
- Length dependent cost** (Text label) followed by an empty text input field.
- Cost of diesel fuels** (Text label) followed by an empty text input field.
- Cost of gasolene** (Text label) followed by an empty text input field.
- Average accident cost** (Text label) followed by an empty text input field.
- Cutting cost** (Text label) followed by an empty text input field.
- Filling cost** (Text label) followed by an empty text input field.
- Earth transportation cost** (Section Header) followed by a rounded rectangular container containing:
 - From borrow pit** (Text label) followed by an empty text input field.
 - To land fill** (Text label) followed by an empty text input field.

At the bottom of the dialog, there are four buttons: "< Previous", "Reset" (highlighted with a dashed border), "Cancel", and "Next >".



Task 3.

User-Friendly Outputs Display

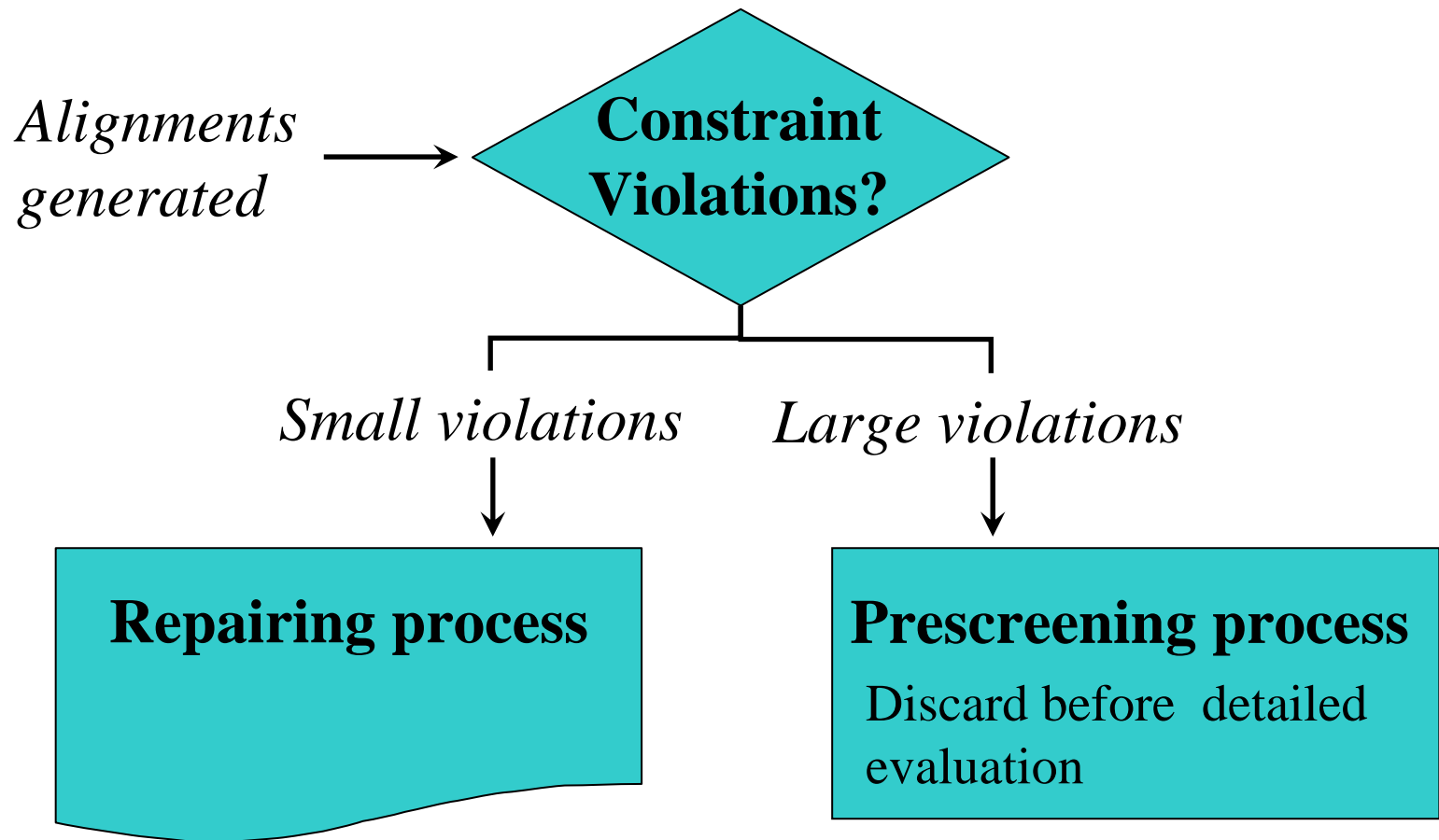
- Display model outputs in graphical and tabular form
 - Detailed presentation of alignment features
horizontal & vertical
 - Comparisons of alternative alignments
 - Cost breakdown by cost types & alignment segments
 - Environmental effects
 - Other performance measures



**Additional Tasks Suggested
to Enhance the Model's Capabilities**

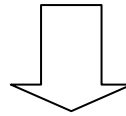
Task 11.

Prescreening & Repairing



Prescreening Processes

The model can evaluate all alternatives generated.



Introduce *prescreening stages* to the model

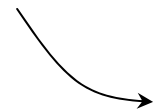
- ➡ To reduce model evaluation time.
- ➡ To discard unpromising alternatives early.

Prescreening Processes (cont'd)

Prescreen (Do Not Evaluate)

1. Alternatives affecting user-specified **untouchable areas**

- Residential areas, historic districts,
- Areas which are unsuited for bridge construction



sharply curved sections: along existing roads

unstable soil characteristics: along rivers

Prescreening Processes (cont'd)

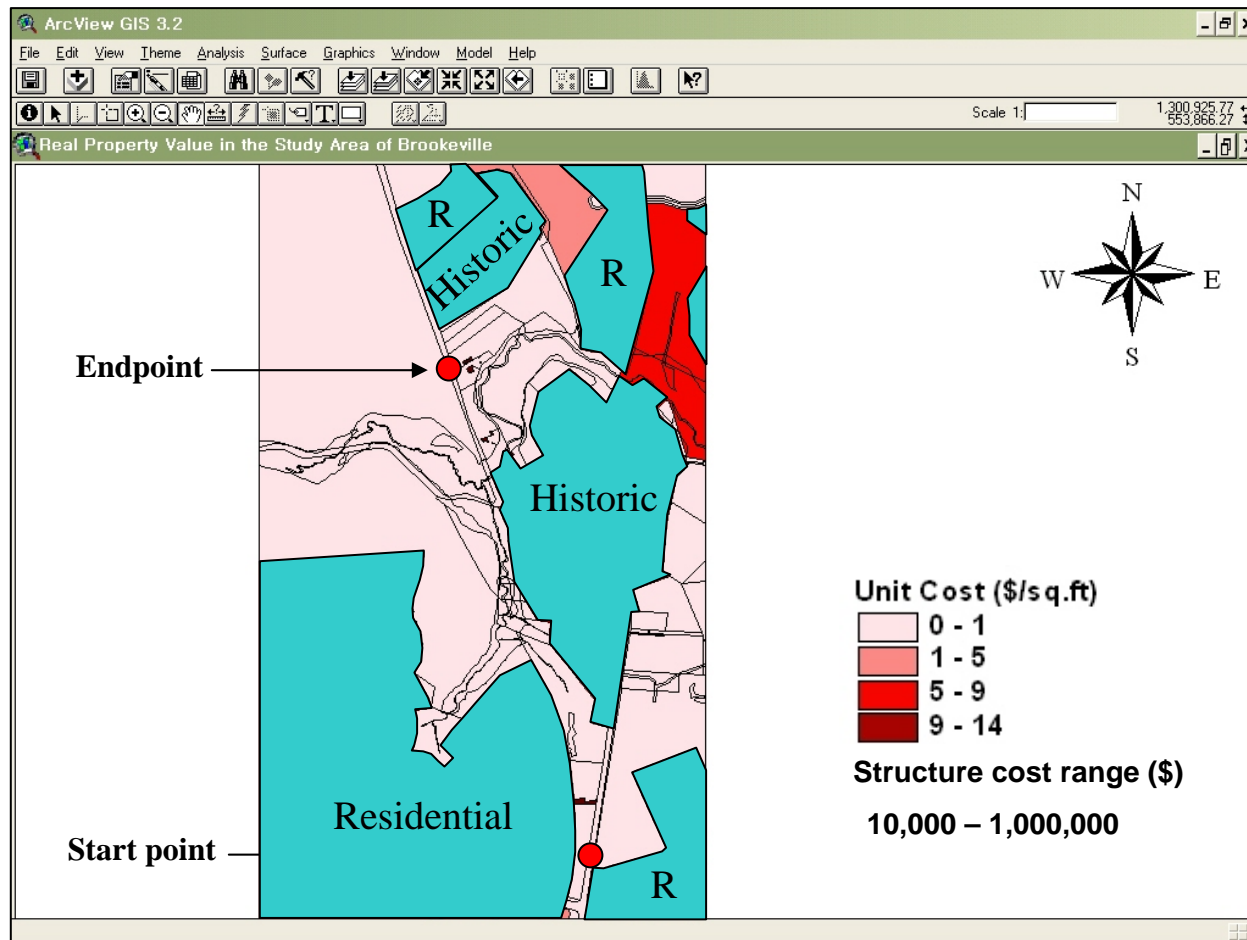
Prescreen (Do Not Evaluate)

2. Alternatives **violating the design standards** (AASHTO)

- Minimum radius
- Minimum length of vertical curve
- Maximum gradient
- Required vertical clearance at the crossing points with **rivers** or **existing roads**

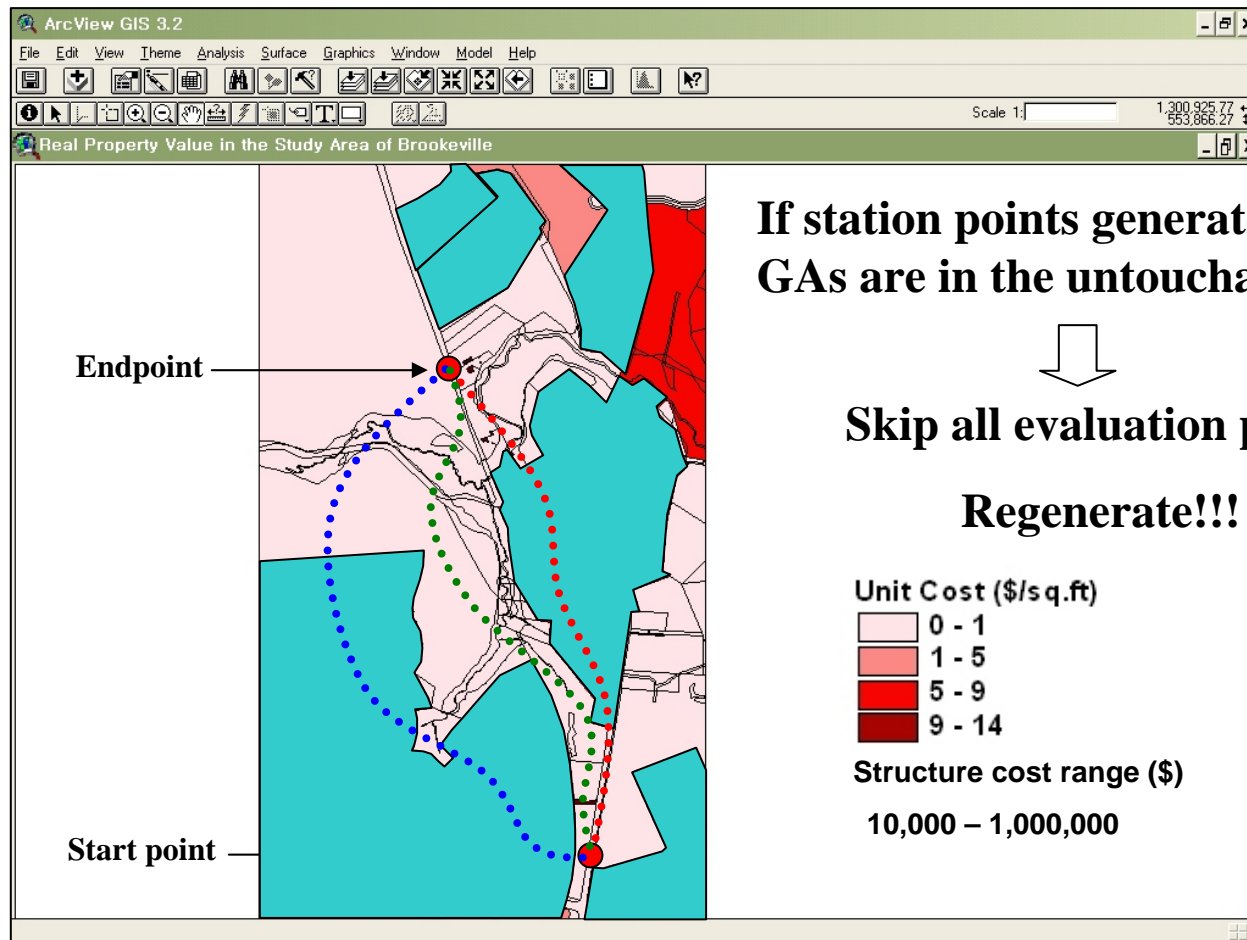
Prescreening for Untouchable Areas

Specify untouchable areas



Prescreening for Untouchable Areas

 : Specified untouchable Areas



Task 4.

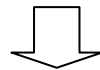
Model Bridge Characteristics

Three major purposes for bridge construction

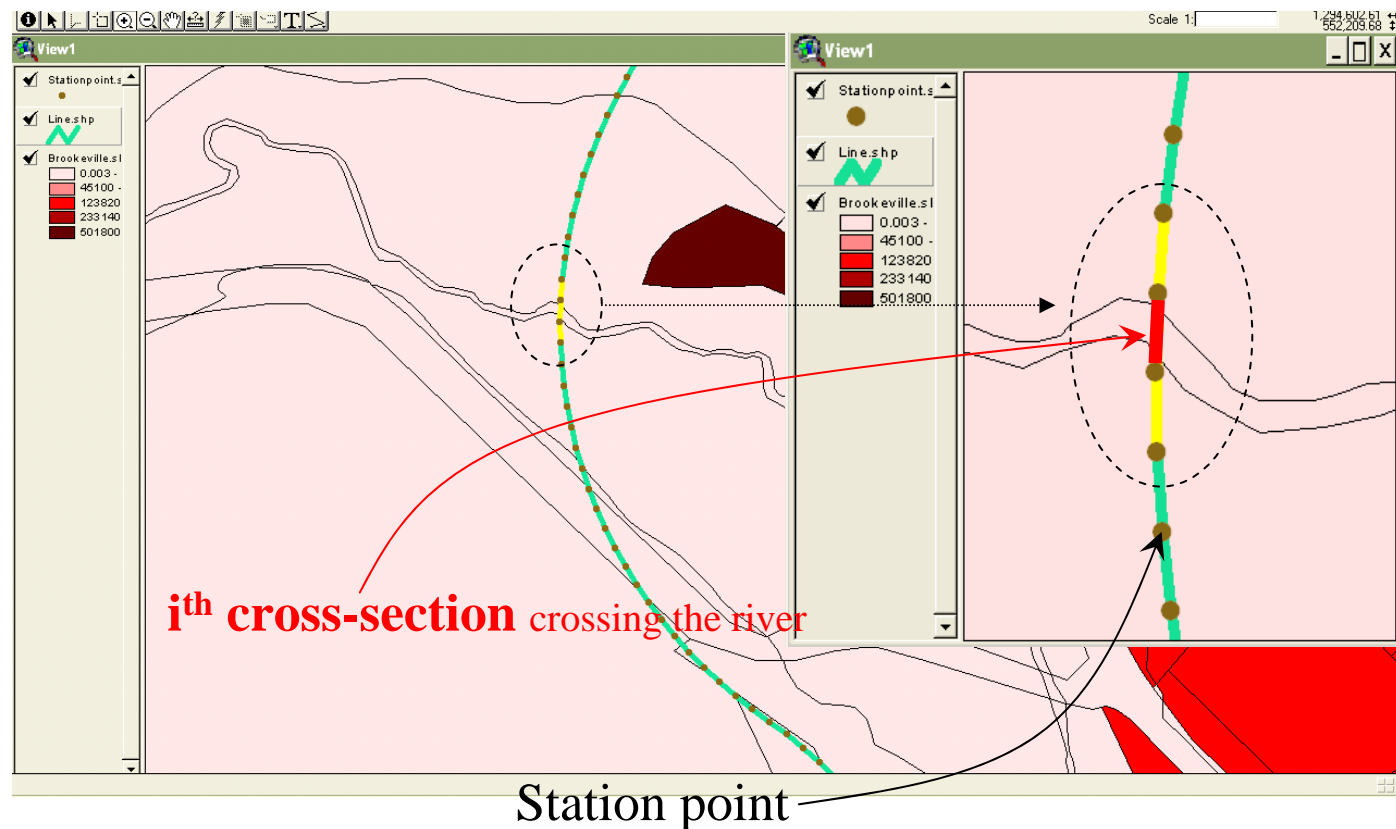
- Crossing rivers
- Crossing existing roads
- Cost minimization (bridge vs. fill)

Bridge Crossing a River

Find locations of the generated cross-sections that cross rivers



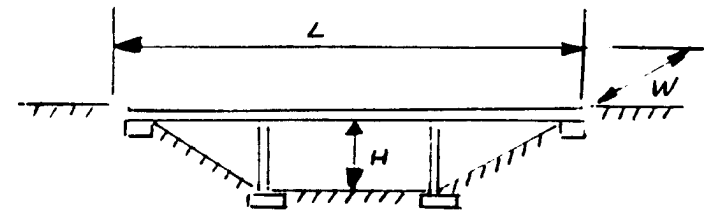
Obtain info. required for detailed bridge cost evaluation



Bridge Cost Evaluation

Factors affecting bridge construction

- Elevation difference (road vs. ground)
- Vertical clearance
- Bridge lengths
- Side slope
- No. and length of spans
- No. and height of piers



Task 5.

Incorporating Hydrologic Analysis

Preliminary hydrologic analysis

- Periodical water levels (vertical clearance)
- Water speed (impact to piers)
- River width (for bridge length)

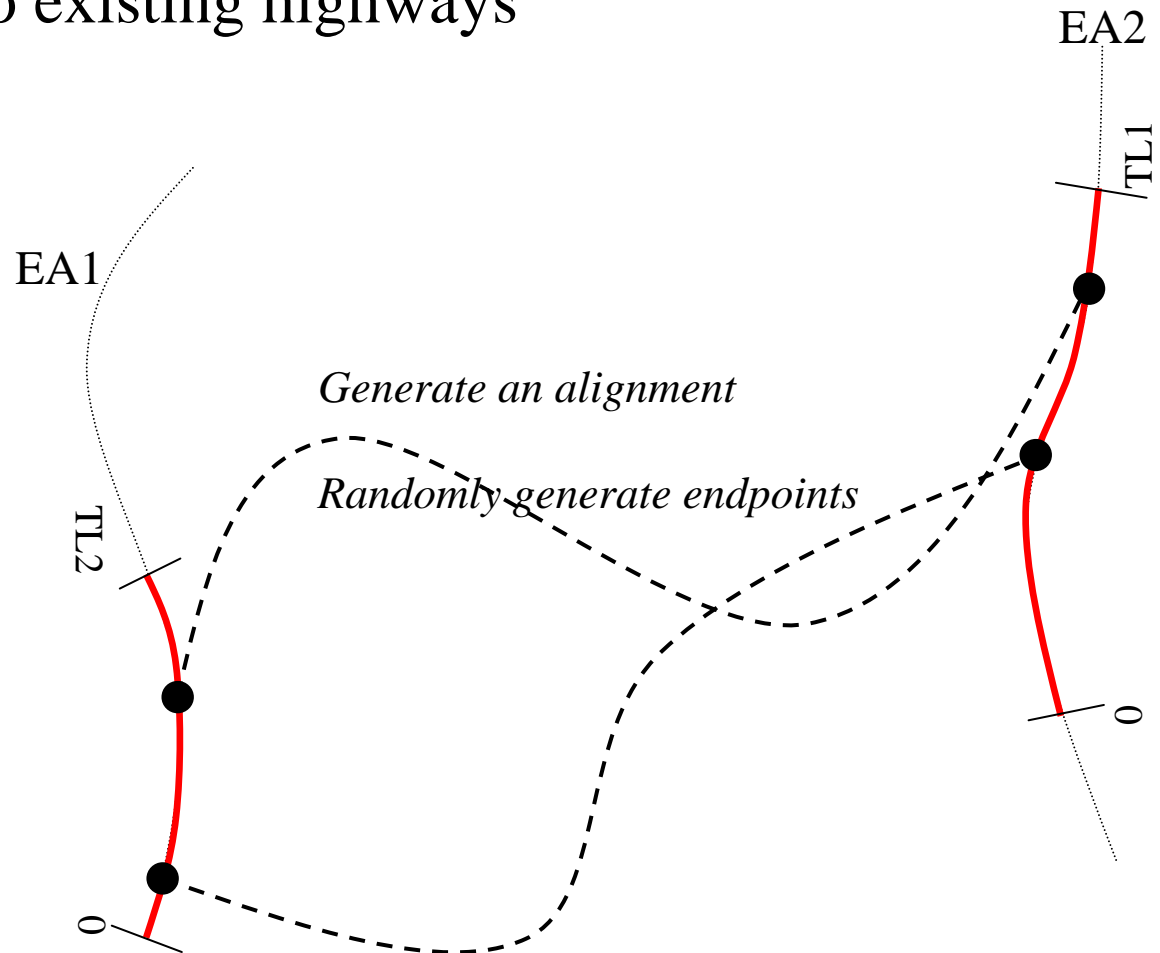


Additional Areas of Interest

Simultaneously Optimizing the Location of Endpoints and Alignments

Example: Two existing highways

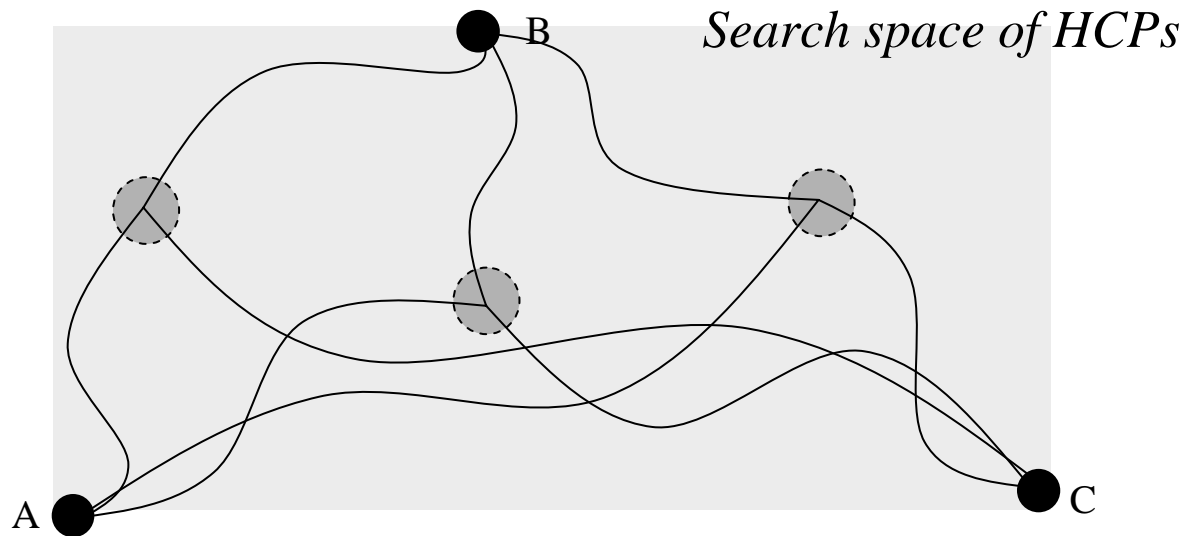
Find preferable segments for endpoints of a new alignment



Simultaneously Optimizing the Location of Highway Crossing Points & Alignments

Random generation of (x,y,z) coordinates of HCPs

E.g., A 3EPs, 1HCP, and 3NAs case



Total Cost = Costs for building new alignments {(HCP-A)+(HCP-B)+(HCP-C)} + constructing HCPs and EPs cost



END

Questions and Suggestions!!!