# An Overview of GIS-based Corridor Analysis

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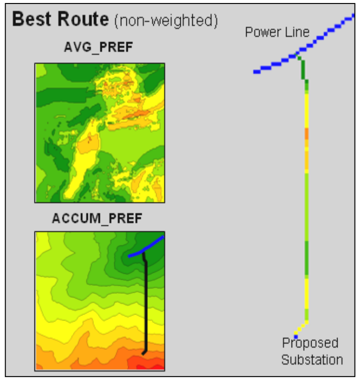
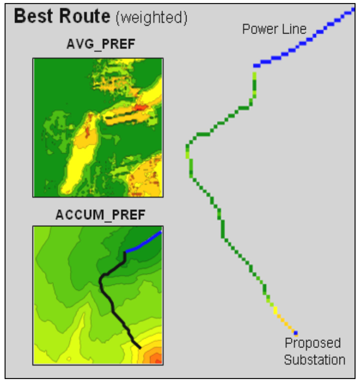





# Background

**GIS-based approaches for siting electric transmission lines utilize relative rankings and weights in considering factors affecting potential routes…**

***The weights for numerous factors, such as slope, proximity to existing roads, visual exposure and population density, are established for each grid cell location then analyzed for the overall "most preferred path" in a project area. In practice, the criteria rankings and sub-model weights are altered to identify a set of alternatives to evaluated for the best route.***

**A quantitative process for establishing objective and consistent rankings and weights is critical in developing a robust transmission line routing methodology…**

***This workshop is designed to establish baseline criteria ratings and sub-model weights based on different group perspectives of the relative importance of the various routing considerations.***



# GIS-based Corridor Analysis Overview

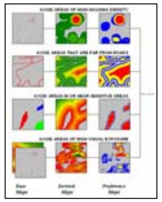
**Study Area** *Statewide database of major factors in siting a transmission line*

**Macro Corridor Generation** *Based on statewide data to identify an encompassing area for collecting and assembling high resolution data (e.g., aerial photography, building/house location, existing utilities, census data, etc.) required for a specific proposed transmission line*

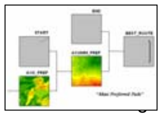
Macro Corridor

**Route Corridor Selection** *Relative preference for different routing criteria are used to identify alternative routes for transmission line routing—*

- **Base Maps** *(high resolution data within macro corridor)*
- **Derived Maps** *(derived decision criteria as needed)*
- **Interpreted Maps** *(apply criteria ratings reflecting relative preferences)*
- **Discrete Preference Map** *(weighted average of criteria preferences)*
- **Accumulated Preference Surface** *(from start to everywhere)*
- **Most Preferred Route** *(from start to end point of new line)*
- **Alternate Route Generation** *(weighted average of preferences)*
- **Route Comparison and Summary** *(map display, geo-query and statistics)*



Preference Maps

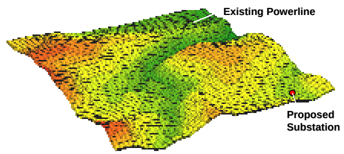


Most Preferred Route

**Route Design** *Engineering considerations are applied to define the centerline within the best route corridor*

# Transmission Line Siting Model *(Hypothetical Example)*

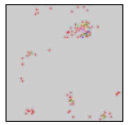
***Goal** – identify the **best route for an electric transmission line** that considers various criteria for minimizing adverse impacts.*




***Criteria** – the transmission line should…*

- ✓ *Avoid areas of **high housing density***
- ✓ *Avoid areas that are **far from roads***
- ✓ *Avoid areas **within or near sensitive areas***
- ✓ *Avoid areas of high **visual exposure to houses***

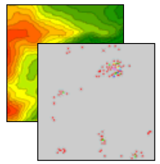
Houses



Roads

Sensitive Areas

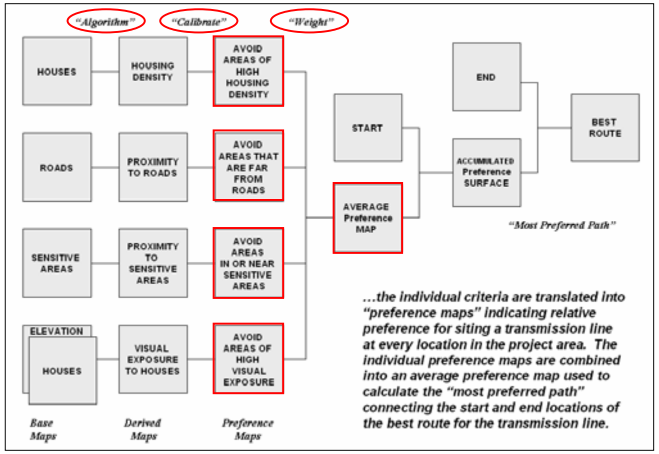
Elevation



Houses

# Siting Model Flowchart *(Model Logic)*

***Model logic is captured in a flowchart where the boxes represent maps and lines identify processing steps leading to a spatial solution***




***Avoid areas of…***

***High Housing Density***

***Far from Roads***

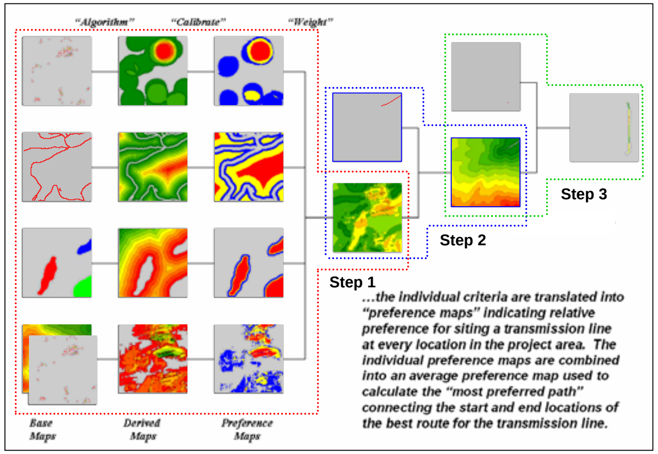
***In or Near Sensitive Areas***

***High Visual Exposure***



# Most Preferred Route *(Model Implementation)*

***Model logic is captured in a flowchart where the boxes represent maps and lines identify processing steps leading to a spatial solution***




***Step 1***

***Identify overall Discrete Preference (1-9 rating)***

***Step 2***

***Generate an Accumulated Preference surface from the starting location to everywhere***

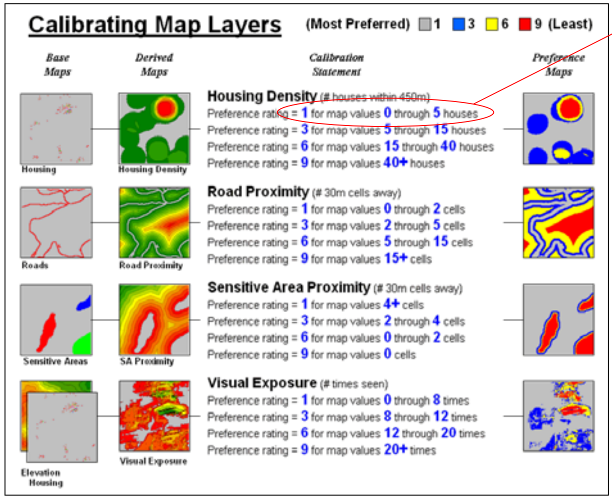
***Step 3***

***Identify the Most Preferred Route from the end location***



# Calibrating Map Layers *(Relative Preferences)*

***Model calibration refers to establishing a consistent scale from 1 (most preferred) to 9 (least preferred) for rating each map layer***




**1 for 0 to 5 houses**

***…group consensus is that low housing density is most preferred***

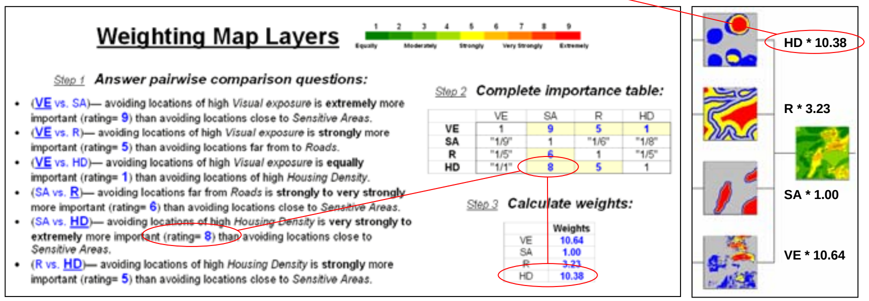
***The Delphi Process is used to achieve consensus among group participants. It is a structured method involving iterative use of anonymous questionnaires and controlled feedback with statistical aggregation of group response.***



# Weighting Map Layers *(Relative Importance)*

***Model weighting establishes the relative importance among map layers (model criteria) on a multiplicative scale***

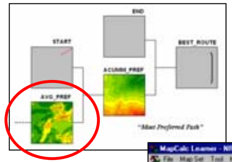
***…group consensus is that housing density is very important (10.38 times more important than sensitive areas)***



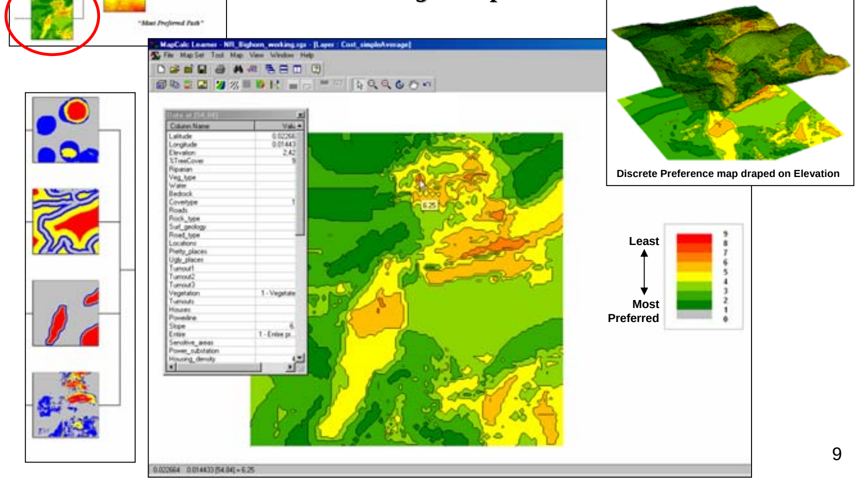

**(SA VS. <u>HD</u>)—** avoiding locations of high *Housing Density* is **very strongly to extremely** more important (rating= **8**) than avoiding locations close to *Sensitive Areas*.

***The Analytical Hierarchy Process (AHP) is used to establish relative importance among siting criteria based on group values. The procedure involves mathematically summarizing paired comparisons of the map layers' importance.***

## Step 1 Discrete Preference Map

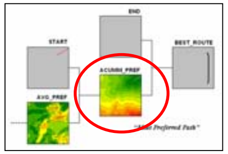



*… identifies the relative preference of locating a transmission line at any location throughout a project area considering multiple criteria*

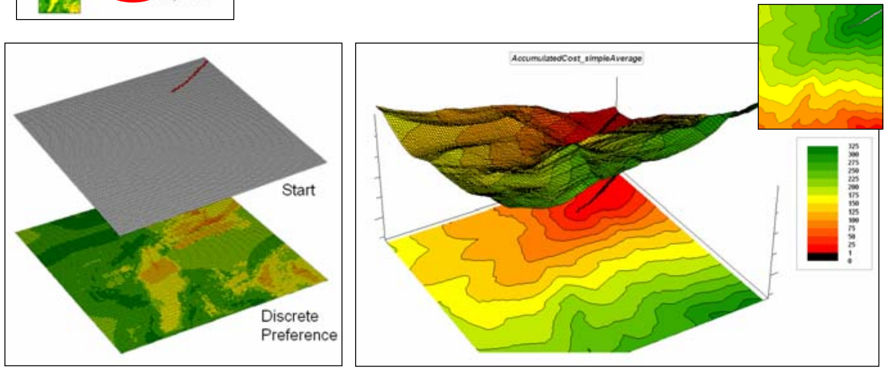





## Step 2 Accumulated Preference Map



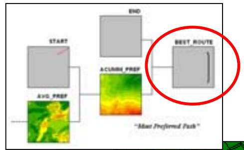

*… identifies the preference to construct the preferred transmission line from a starting location to everywhere in a project area*



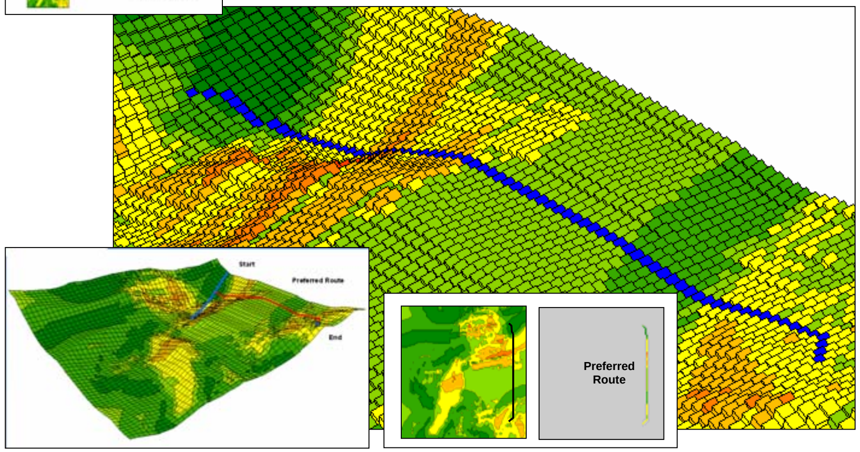

*Splash Algorithm – like tossing a stick into a pond with waves emanating out and accumulating costs as the wave front moves*



## Step 3 Most Preferred Route



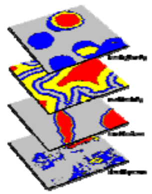

*… the steepest downhill path over the accumulated preference surface identifies the most preferred route — minimizes areas to avoid*




## Generating Alternate Routes

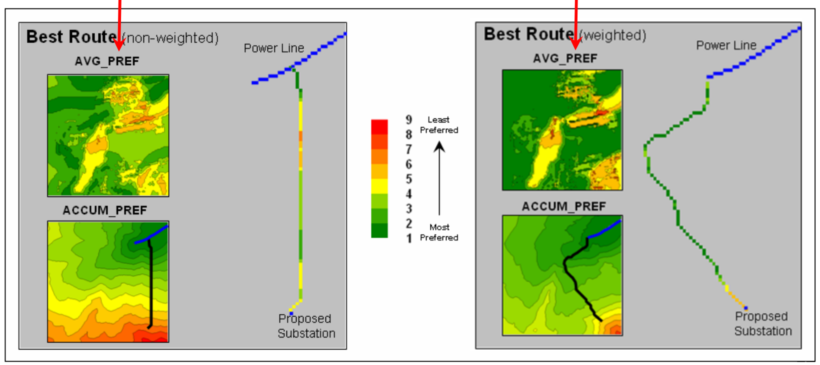
*All factors are considered equally important*

ANALYZE Pref_housingDensity TIMES 1
WITH Pref_roadProximity TIMES 1
WITH Pref_sensitiveAreas TIMES 1
WITH Pref_visualExposure TIMES 1
Mean FOR Pref_simpleAverage



*sensitiveAreas and visualExposure ten times more important*

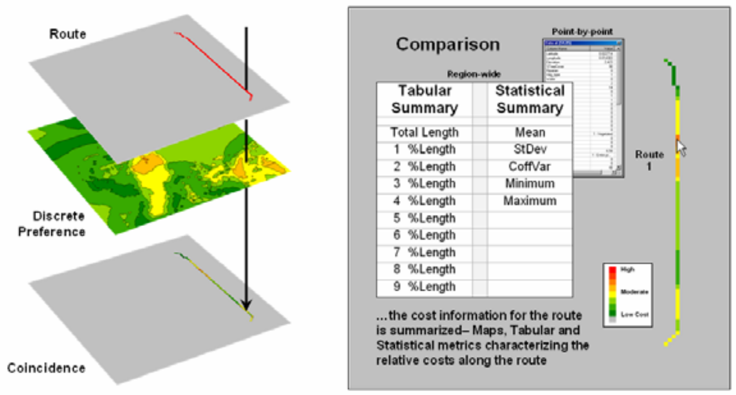
ANALYZE Pref_housingDensity TIMES 1
WITH Pref_roadProximity TIMES 1
WITH Pref_sensitiveAreas TIMES 10
WITH Pref_visualExposure TIMES 10
Mean FOR Pref_weightedAverage




*Simple Average, Environmental Factors; Built/Community Environment; Engineering factors*

# Assessing Alternative Routes *(Best Route Corridor)*

*…coincidence of the overall discrete cost map or any other map layer— display as map, drill-down inspection, tables or summary statistics*




**Route Design** *Engineering considerations are applied to define the centerline within the best route corridor*



# Group Meeting Agenda

- ✓ **Welcome / Overview**
- ✓ **GIS-based Corridor Analysis Overview** *Study Area, Macro Corridor Generation, Alternative Route Generation, Route Selection, Design (Centerline)*

**Geographic Information Overview** *Database Considerations, Base Maps, Derived Maps*

**Methodology** *Approaches for determining routing criteria Calibration and Weights*

**Breakout Sessions** *Group interaction and discussion using Delphi and Analytic Hierarchy Process (AHP) procedures to set—*

- **Criteria Rating Calibration (1= attract to 9= repel)**
- **Sub-Model Weight (Relative Importance weights sum to 1.0)**

**Wrap-up** *Summary and discussion of results, Critique and comments on Routing Model approach*