Appendix C
The Corridor Analysis Tool (CAT)

THE CORRIDOR ANALYSIS TOOL (CAT)

The Corridor Analysis Tool (CAT) has been proven effective in helping to streamline the NEPA process by providing planners and engineers with critical information from a standardized, inclusive, and defensible process with a turnaround time not possible when using conventional methods. The cost-effective tool processes large amounts of data quickly and results in corridors best suited to project and stakeholder specifications. Since the CAT allows users to interactively weight geographic features and attributes, they can be assured that corridors are developed with minimized impacts on the natural and human environment.

The CAT is a series of GIS-based functions designed to route conceptual corridor "footprints" among the identified community and environmental resources available from both public databases and project derived databases. These "footprints" are developed through a simple "opportunities and constraints" approach. In this approach values are assigned to site specific resources by experts in the field. The computer model routes preferred paths between user-selected endpoints through an artificial "terrain" created by the weighting of natural resources, socioeconomic, infrastructure and other values that have been assigned in the study area. Additionally, "avoid" areas can be included to effectively 'mask out' any areas where development should not be considered. The system uses a grid- (or cell-) based format for improved model efficiency. The resolution or grid cell size may be further refined as viable corridor alternatives are identified and higher resolution field data is incorporated into the system. The CAT will find the least-cost (least impact) path between endpoints and summarize the impacts for each corridor selection. Additionally, CAT will also display potential alternative corridor regions for each model run.

Corridor Alignment Alternatives

The tool incorporates the functions of ArcGIS 9, ArcGIS Spatial Analyst, and geodatabases to maintain information and perform the complex spatial calculations needed to effectively analyze each model run.

The CAT is organized in several modules designed to help store, organize, analyze and report critical information. These modules include:

- Scenario Manager
- Suitability Modeling Setup
- Cost Weighted Distance / Shortest Path
- Engineering Design Criteria
- Impacts Analysis

During the course of a project, numerous scenarios will be created to analyze potential alignments. **The Scenario Manager** provides an intuitive interface that automates the documentation of each scenario. The scenario description, creator, date of creation, as well as a graphical description of the scenario alignment are referenced in this component.

The **Suitability Modeling Setup** component allows the user to prepare the various model inputs. The user selects which layers are to be included in the scenario analysis and the relative suitability of the features in each layer. Within each layer, features should be given rankings on a scale of one through nine. Nine is considered the most costly in terms of unwanted impacts while a ranking of 1 would be assigned to those features of lesser impact (i.e. most suitable). Additionally, "avoid" areas are included to effectively "mask out" any areas where development should not be considered. Finally, the layers are combined to produce a single suitability grid using the process described below.

Cost Weighted Distance/Shortest Path - When creating a scenario, the user must enter the endpoints of a potential corridor segment. Based on these points and the values in the combined suitability grid, the CAT program creates the cost weighted distance raster for each point. This raster defines the least accumulated cost from each cell to the corridor end point. Next the system creates a direction grid which specifies the direction to travel from every cell in the cost-weighted distance raster to the corridor endpoints. Finally, using the cost-weighted distance and direction grids, the program then computes the least-cost (least impact) path.

Engineering Design Criteria - After the least-cost path has been determined, the user may refine the path to conform to basic engineering design curvature standards and define the corridor widths. The CAT program then adjusts the least-cost path to meet the design standards as closely as possible and creates a new corridor buffer that can be viewed with other scenario data layers. Note that due to software limitations the adjusted path should not replace an engineering alignment, but should be of sufficient quality to provide good impact calculations.

Finally, the **Scenario Reporting** tool provides a detailed report of impacts for each scenario. Total acreages for all impacted areas are listed by layer and attribute feature crossings such as existing roads, streams and rail lines are listed individually within the report.

Impacts for Corridor 2

Date: 5/24/2005

Layer Parameters

Name	Description	Layer Influence (%)
nwi_rec	Environmental (Wetlands, Sp. of Concern)	50
Pop_Den	Pop. Density	20
CultFeatures	Cultural (Infrastructure)	20
Roads	Roads (SCDOT)	10

Environmental Impacts	Area (Acres)
Wetlands	
Streams (3rd Order)	16.68
Ponds & Borrow Pits (N)	2.89
Ponds & Borrow Pits (I)	6.89
Bottomland Hardwoods (I)	4.00
Bay Forest (N)	19.13
Hardwood Swamp (N)	155.01
Pine Savannahs/ Wet Flatwoods (N)	0.67
Deciduous Shrub Swamp (I)	2.67
Hardwood Swamp (I)	56.93
Evergreen Shrub Bogs/ Pocosins (I)	5.12
Savannahs & Wet Meadows (N)	6.67
Bottomland Hardwoods (N)	9.79
Pine Savannahs/ Wet Flatwoods (I)	12.90
Bay Forest (I)	3.56
Deciduous Shrub Swamp (N)	0.22
	303.12
Uplands	
Upland Residential	147.23
Upland Transportation & Utilities	10.67
Upland Evergreen Forest (Irr. Fl.)	190.15
Deciduous Forest	4.67
Upland Mixed Forest	0.89
Upland Agriculture (Cropland/Past.)	624.48
Upland Commercial/ Services	13.12
	991.21
Totals	1,294.34

(N) - Not Previously Impacted by Development
(I) - Previously Impacted by Development

Cultural Impacts

Antioch Fire Station
Cool Springs Southern Meth

Corridor Impacts Report

CAT Implementation

The use of the CAT to help determine the best corridor alternative typically occurs in two phases. Phase I normally uses readily available data from a combination of federal, state and local regulatory agencies. These data are used to determine the preliminary alignments. Further investigation and field data can be added to the areas defined as preliminary alternatives for the Phase II analysis. The CAT implementation steps are very similar within each phase and can be summarized as follows:

1) ***Determine Data Requirements*** – One of the greatest challenges is determining what information is the most crucial within the study area. There is no single set of factors that are common to all areas of the country. It is recommended that Federal and State regulatory agencies or experts with local knowledge have input into which factors should go into the decision process and attempt to rank the importance of these factors in the overall calculations. Phase I data requirements may differ slightly from Phase II since the second phase will incorporate more detailed information from field investigations/surveys.

2) ***Data Collection*** – As stated earlier, Phase I typically utilizes existing data sources from federal, state, and local agencies. This information is usually requested by the consultant team on behalf of the project sponsor. When applicable, the consultant will sign confidentiality agreements with agencies to ensure that protected data is not displayed to the public but included in the analysis. An example of this would be archeological sites. These sites should be protected from encroachment by the corridor but must not be made public to protect from public looting.

3) ***Data Review*** – It is crucial that data included in the CAT be consistent on coverage and completeness. Missing information or information that is too coarse may lead to inaccurate results.

4) ***Data Conversion*** – It is likely that data will come from various sources and will need to be converted into the appropriate map projection for the study. Attribute tables may also need to be restructured during this process.

5) ***CAT Setup*** – After data is converted into the appropriate projection and format, the layers are converted from vector to raster (grid) format for use in the CAT.

6) ***Define Ranking Criteria*** – The ranking criteria are the key to the performance and output of CAT. Ideally, a collaboration of state and federal regulatory agencies would define the criteria for the ranking of each attribute. This can be done with a single committee representing all agencies or through two separate stages. Below is a simplified diagram of how the attribute rankings are used to determine the suitability surface.
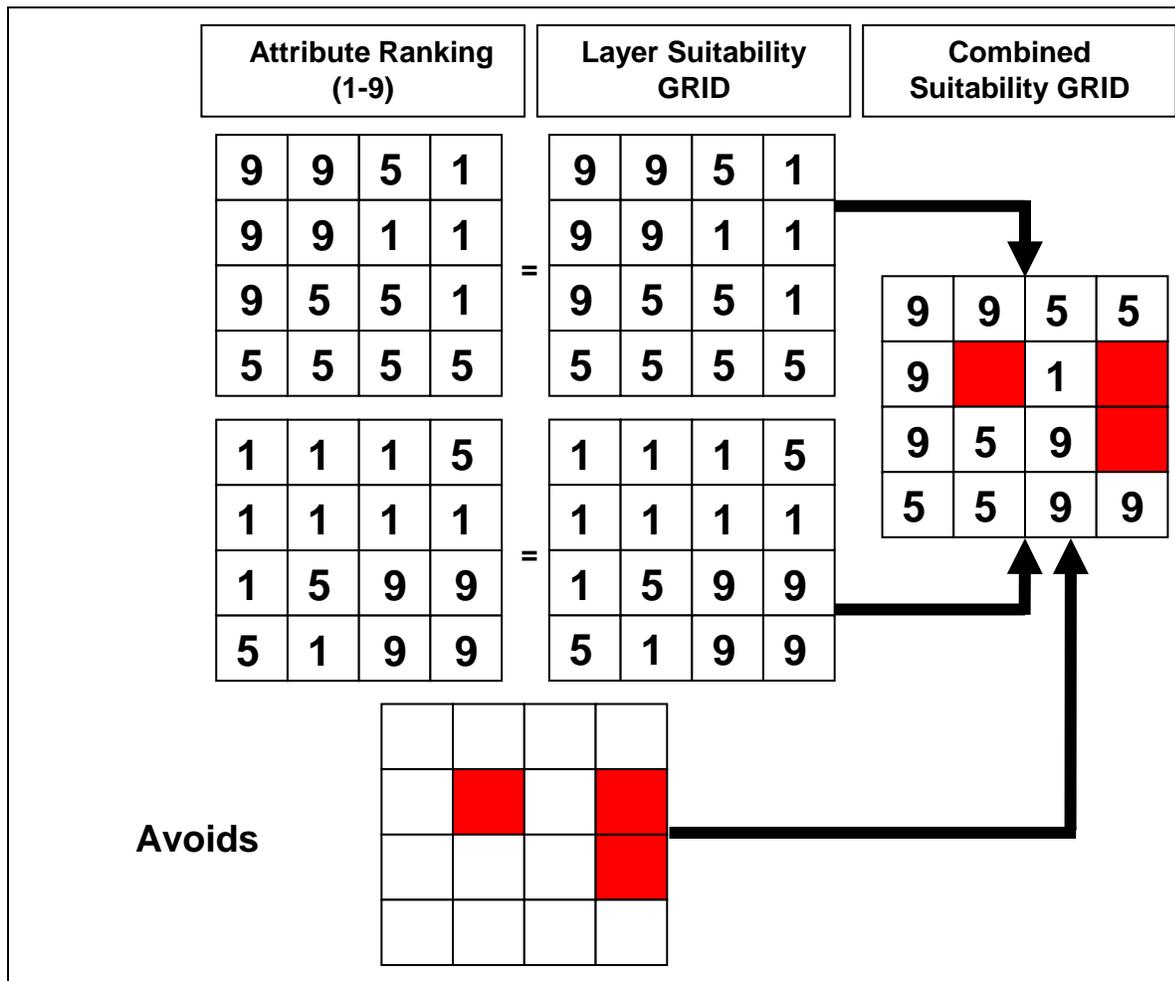
CAT Scoring Process

7) **Define Corridor Design Criteria** – These criteria are based on the type of facility that will be placed in the corridor. Whether it is an interstate highway, rail line or other facility, items such as the corridor width and minimum horizontal curve radius should be defined and entered into the system.

8) **Perform Preliminary Runs QA/QC** – Prior to making accepted runs with the tool, the CAT operator should perform manual checks to ensure that weighted calculations are correct. The entry of weighted values should always be double checked to avoid unwanted results. Buffered areas around features should also be checked to ensure that corridors do not encroach into protected areas.

9) **Identify Initial Start/End points and Waypoints** – The CAT requires that the operator indicate the beginning and ending points for each run. In most cases, initial starting/ending points are based on engineering considerations. An inspection of the results will help to identify potential waypoints and alternative endpoints.

10) **Perform CAT Runs** – Once the data is complete and all weighting parameters have been decided, the operator can begin the process of making runs. Depending on the amount of data to process, computing power and available disk space, individual runs can take from 30 to 90 minutes to complete. Each run includes the path determination, suitability surface generation, documentation of impacts, and map generation.

11) **Review Suitability Surface** – It should be noted that the path generated by CAT is the absolute shortest-least impact path according to the model inputs. The suitability surface allows planners to see other potential alternatives that have similar impacts. The tool allows the operator to review the surface and reveal the percentage impact variance from the absolute 'best fit' line. The example below shows the best fit corridor and three variance classifications.
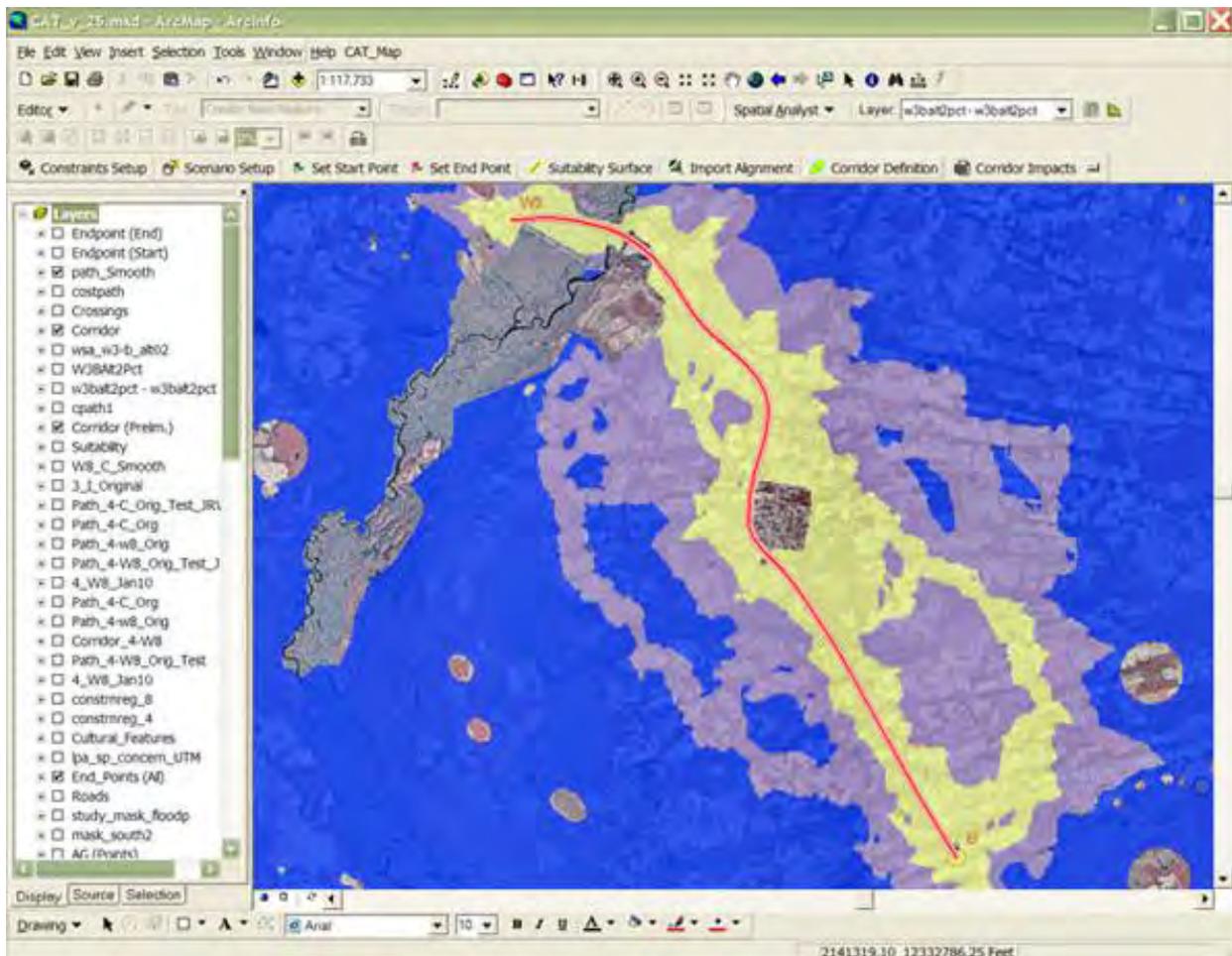
Output Corridor

12) **Engineering Review** – Any potential alternatives may be exported into a format that is compatible with engineering design software. Constraints and aerials and the suitability grid are also available to design engineers within the design environment that allow them to perform more extensive analysis that ensures the alignment meets the facility design criteria. If any adjustments are made to the alignment, it can be pulled back into CAT to quickly determine and document features that fall within the adjusted alignment.

13) **Document Run Scenario** – Each CAT run is referred to as a 'scenario'. CAT has a scenario manager that helps keep track of the numerous runs within the study area. The impacts and alignment for each scenario is stored for comparison. This comparison helps planners and engineers to identify the type and magnitude of impacts and thus make better decisions in choosing the best overall alignment.