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A Network Connecting Science With Conservation

Integrating Conservation and Transportation Planning Through Decision Support Software

Or

The Missing Link Between Geodatabase & STEP UP?

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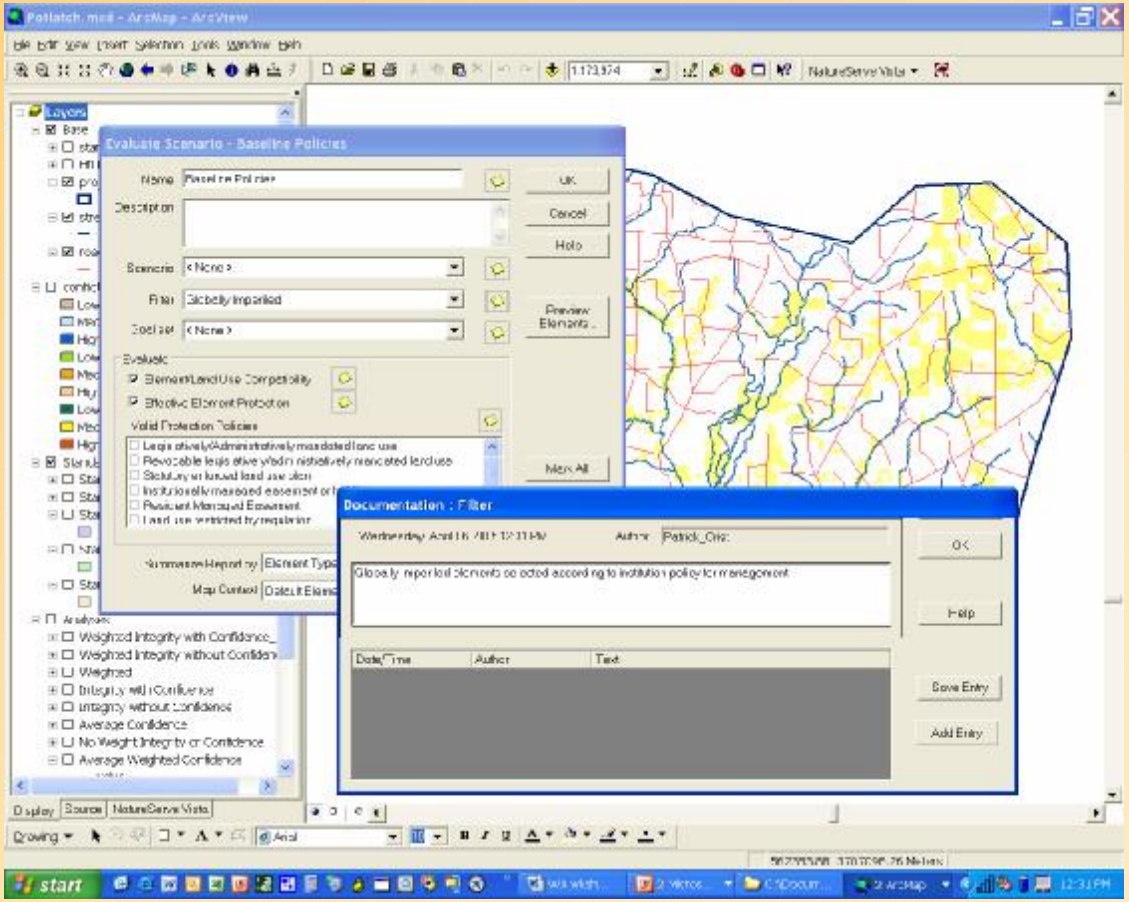
What is a Decision Support System?

- Helps you do specific activities vs general tools
- Guides you through a process
- Incorporates expert knowledge/models AND user values
- Provides automation and documentation of the process



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Some Uses of DSS for Integration Conservation & Transportation

- Guiding least-conflict routing of transportation
- Rapid evaluation of multiple route options
- Integrating multiple objectives (e.g., transportation, development, conservation) for long-term plans or short-term projects
  - Predicting and evaluating long-term cumulative effects
  - Revealing areas needed (irreplaceable) for any particular objectives
  - Revealing options for achieving objectives to mitigate conflicts

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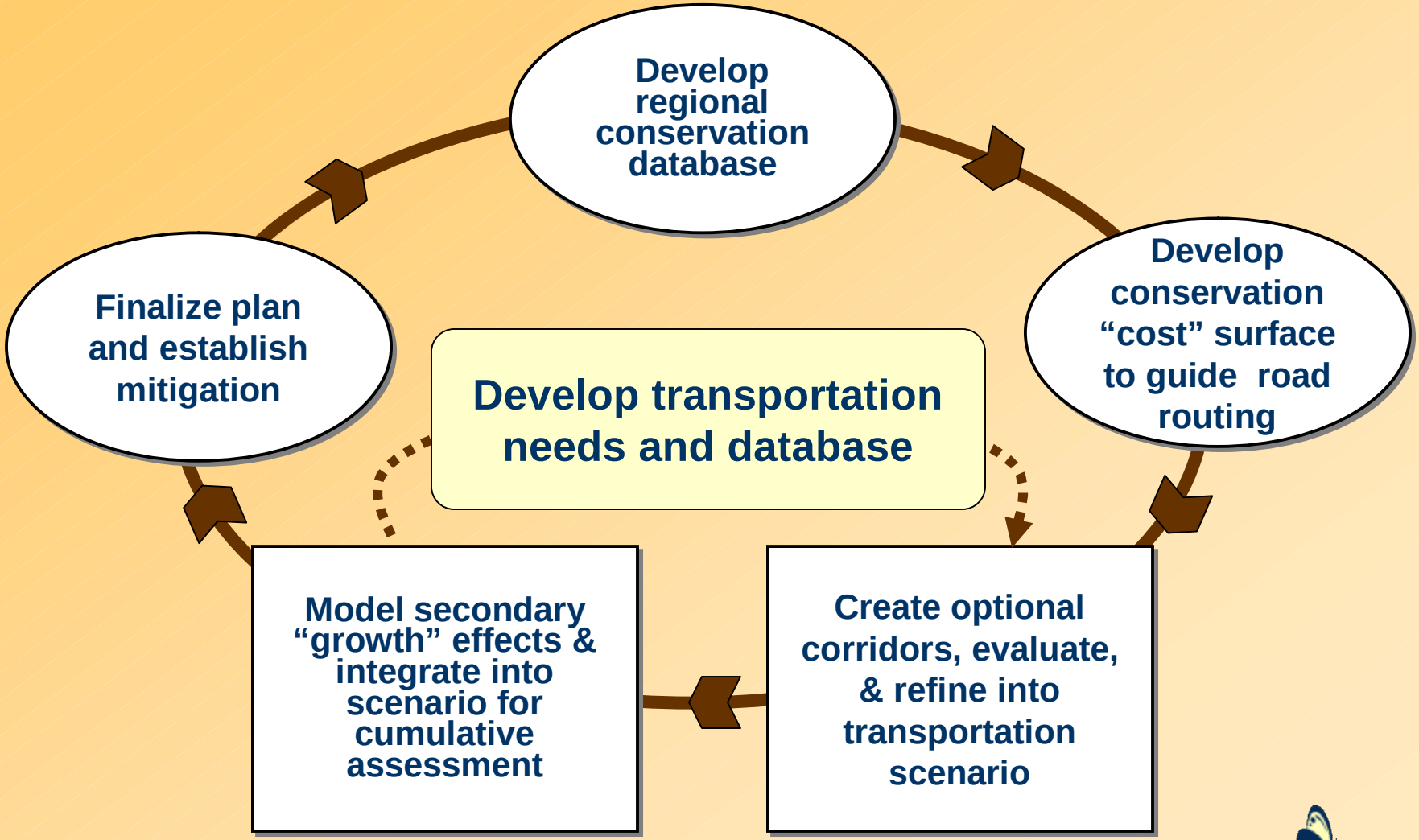
Example Process of Cumulative Regional Assessment & Planning



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Tool/Process Integration Demo

Method: Integration of Three Planning Tools

1. **NatureServe Vista used to identify high conservation value areas**
2. **Transportation planning tool Quantm used to suggest transportation routes**
3. **Land use planning tool CommunityViz used to predict resulting urban growth**
4. **NatureServe Vista used to evaluate impacts of land use on conservation goals**

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About the Tools

- Quantm: transportation route optimization tool applied through a service contract
- CommunityViz: land use planning framework tool applied as desktop software
- NatureServe Vista: conservation framework tool applied as desktop software

None of these tools are required to do this analysis or any can be used in any combination with other tools. NatureServe Vista has no formal relationship or linkage to any of these tools.

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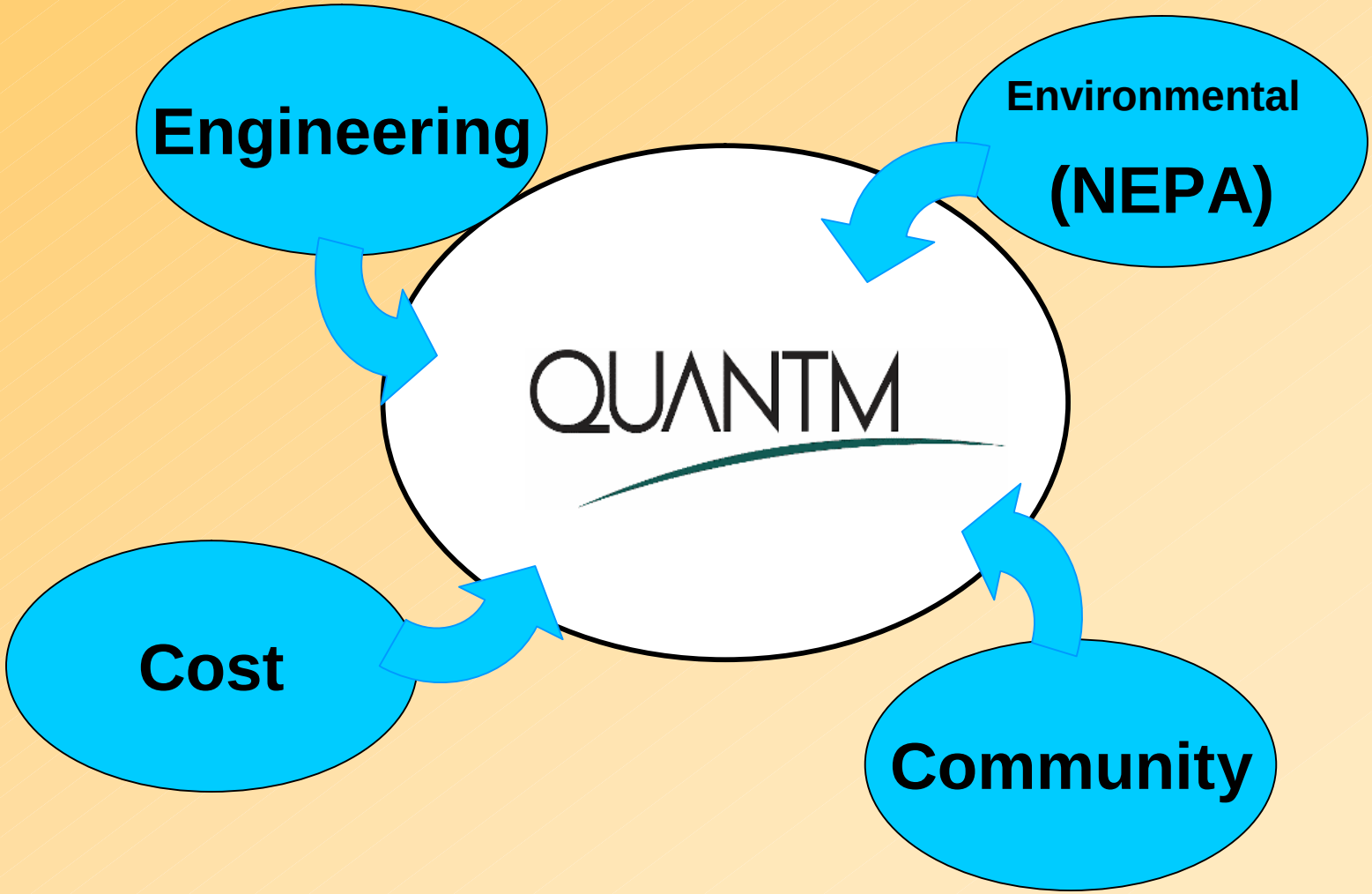
What is Quantm?

- Worlds first advanced planning system for corridor and route optimization developed over 15 years by Australian Government and Quantm.
- Addresses complex route planning issues, investigating millions of alignment options.
- A tool that empowers Planning Engineers with the ability to consider “all reasonable alternatives”, upfront and equally.
- Quantm provides training, support and system access – the system is applied by the agency or appointed consultant

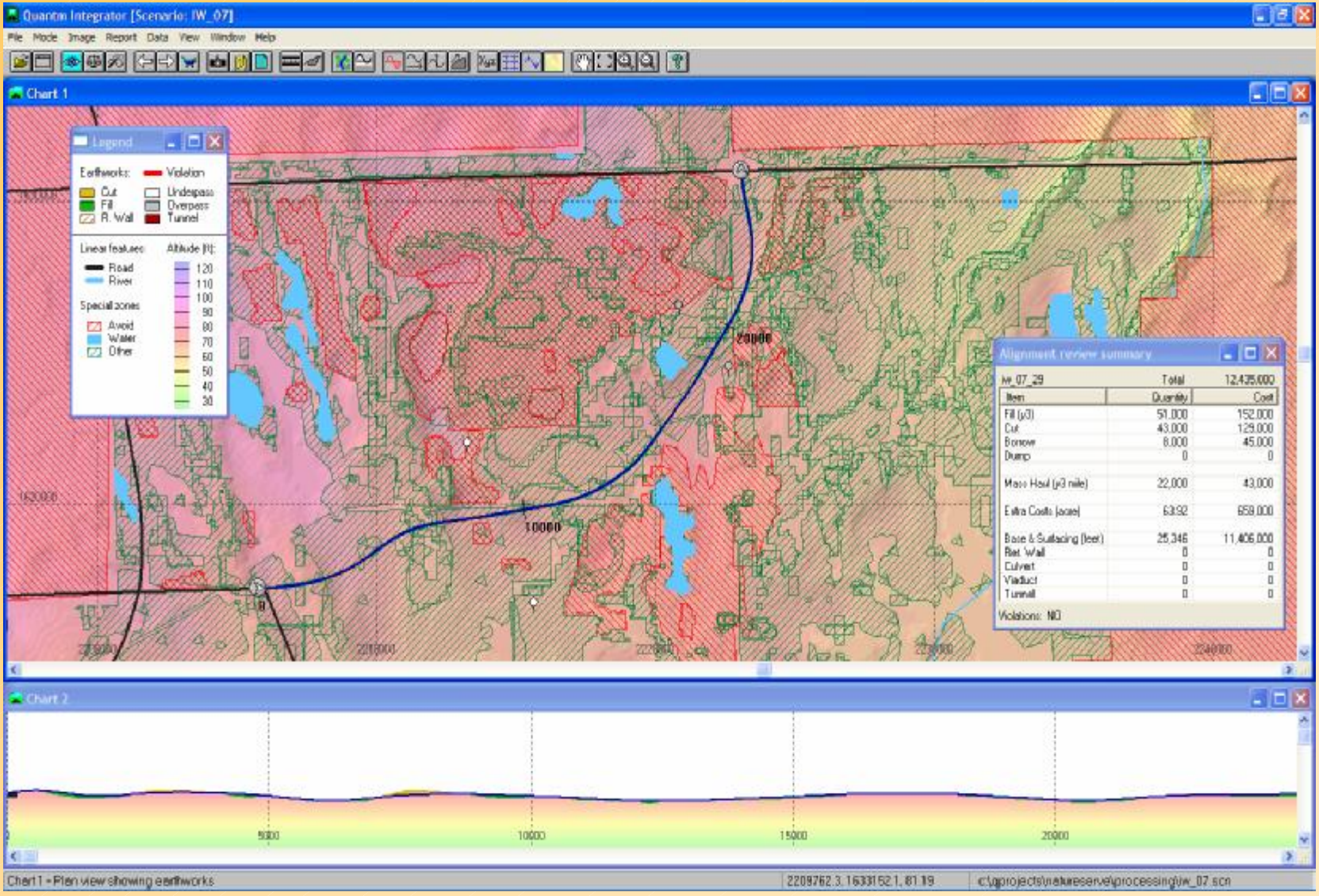
Facilitating integration of *all* planning aspects in a single analysis



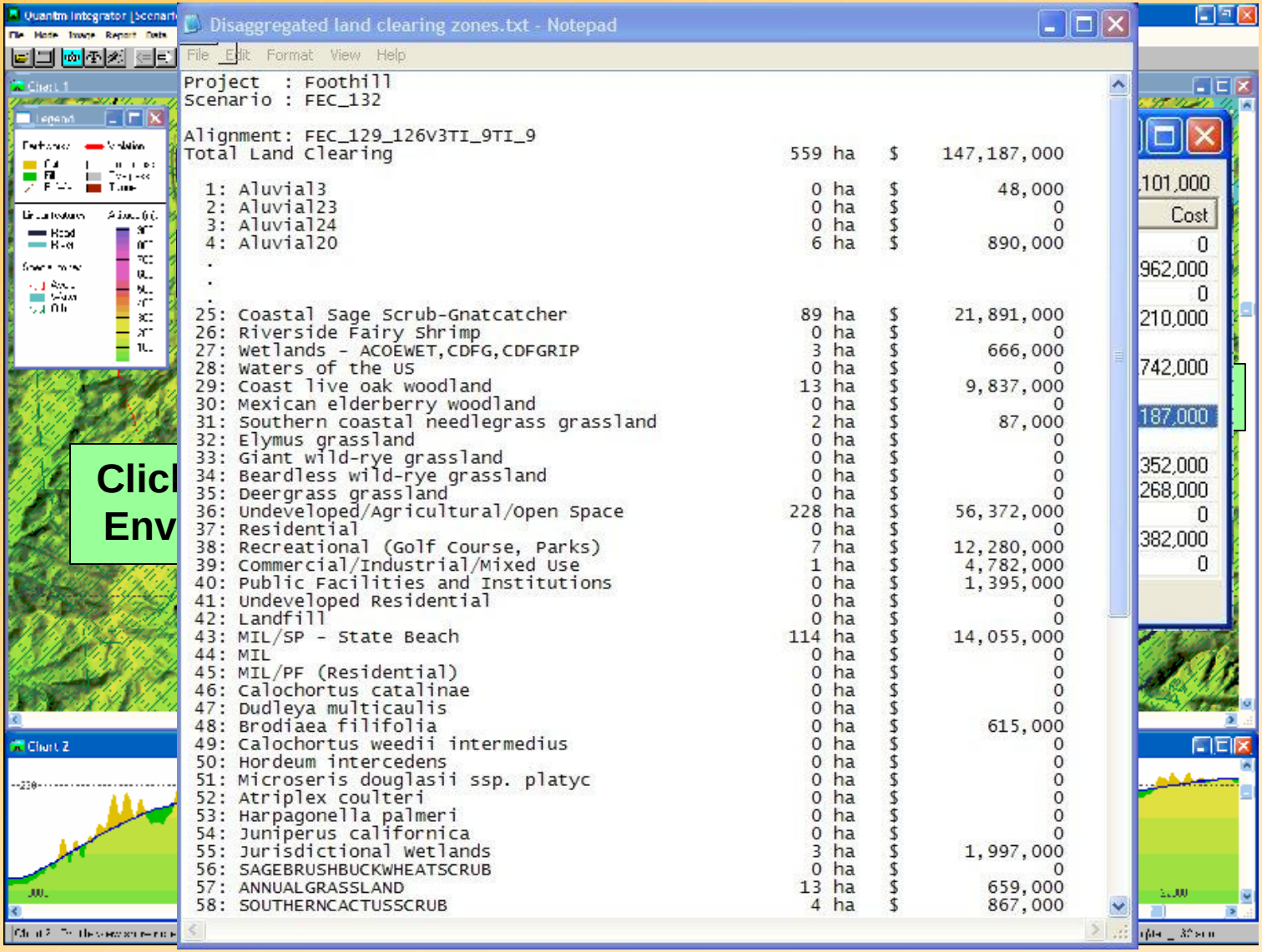
Inputs to QUANTM

- **Terrain model** (DEM and/or DTM)
- **Geology and Earthworks costs**
- **Geometry**
- **Structure Costs**
- **Constraints**
  - Linear – engineering criteria
  - Zone – **environmental, biological, cultural, resource, mitigation,** ROW, etc.

3-Dimensional analysis throughout

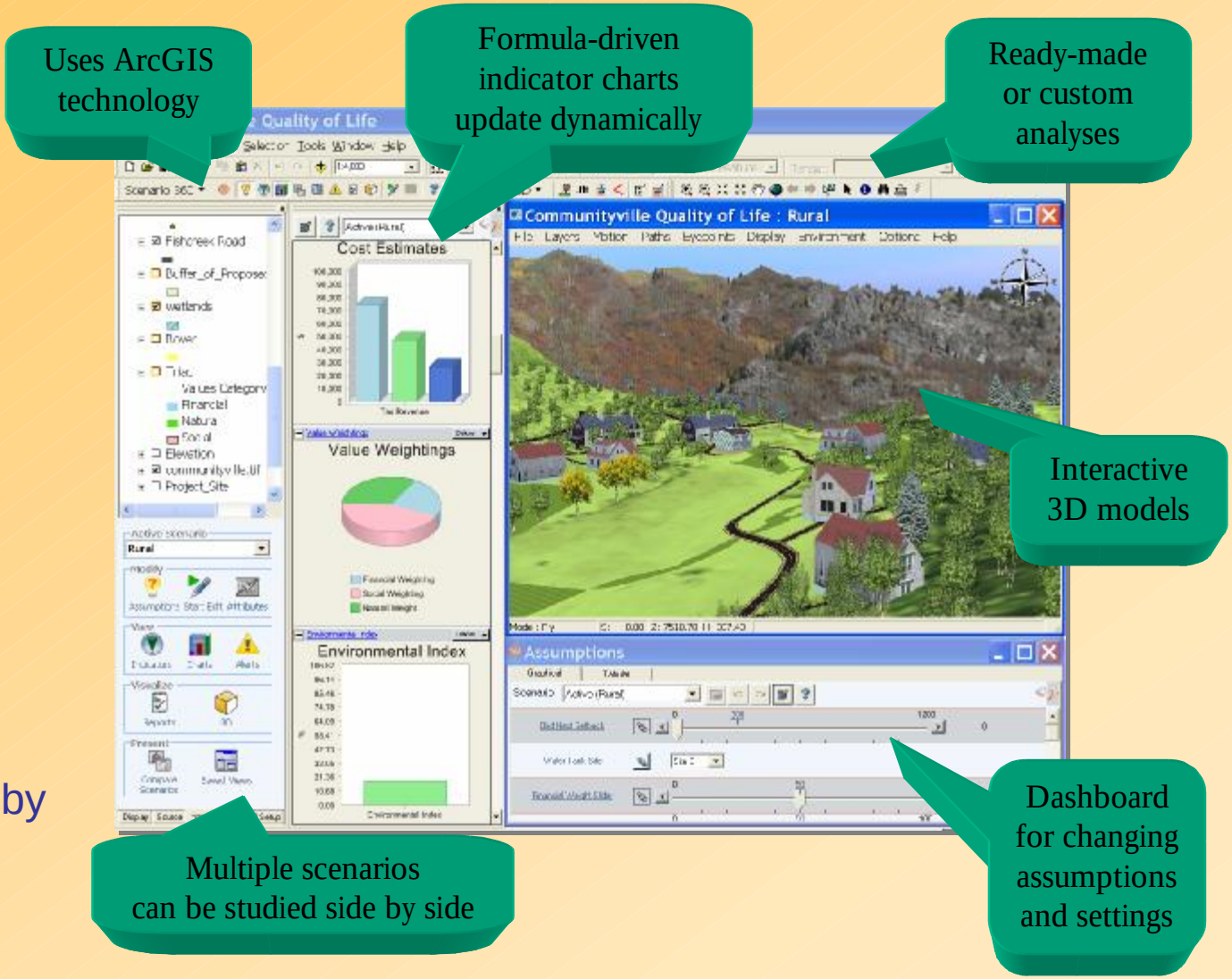


Alternative showing earthworks and constraints



About CommunityViz®

- GIS-based tool for geographic decisions
- Real-world 3D models
- Interactive scenario analysis
- Intuitive, powerful, and flexible
- Made available to the public at very low cost by the Orton Family Foundation



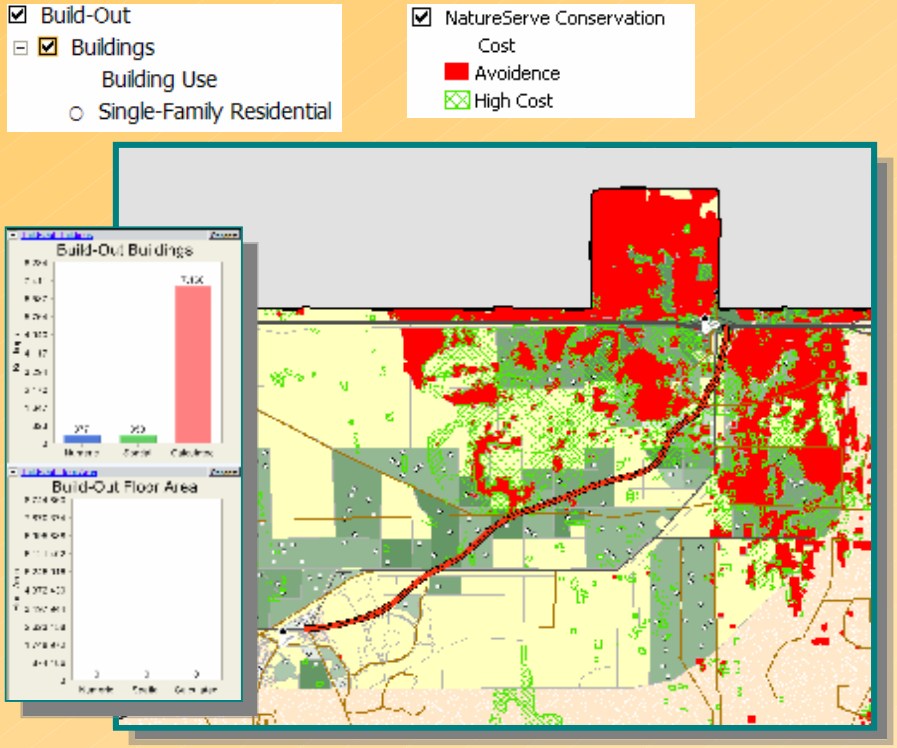
CommunityViz Growth Modeling

Hypothetical “build-out” capacity for each scenario:

Road Proposal 11 shown here. Note that “Avoidance” areas are constrained from building.

Scenario A:

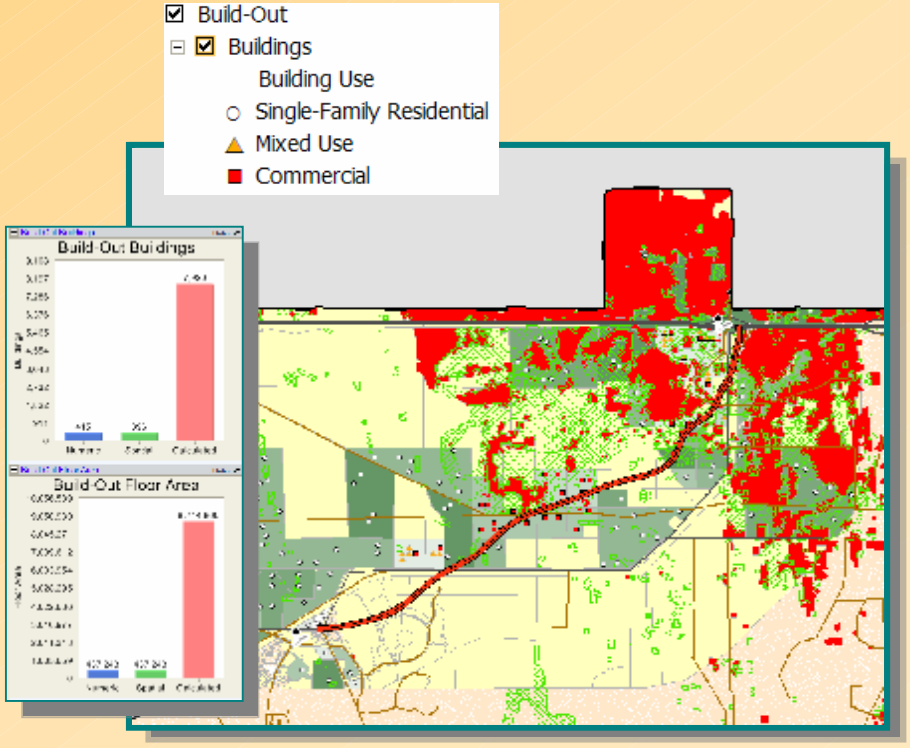
Large-lot residential development



Land Use
Scenario A

Scenario B:

Commercial and mixed-use zones

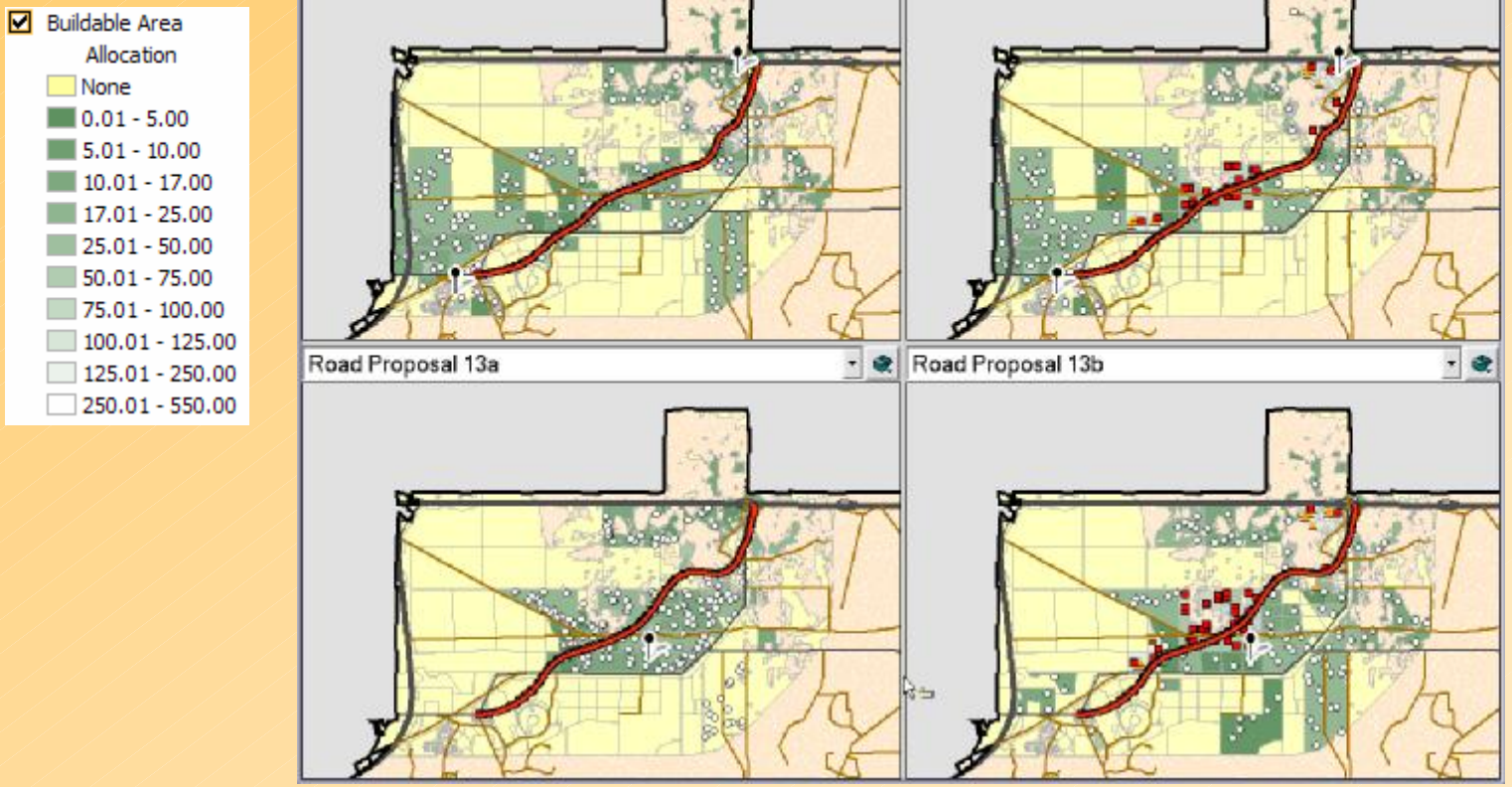


Land Use
Scenario B

CommunityViz Growth Modeling

Results are available for all 4 scenarios.

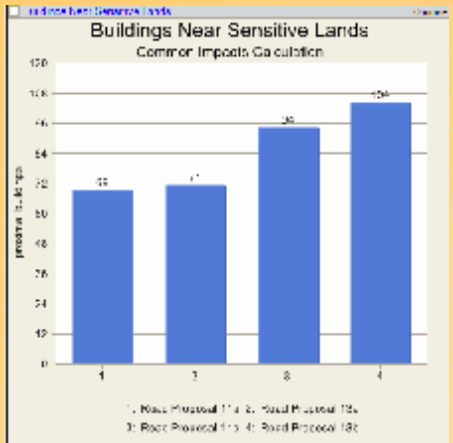
Potential changes to policies and assumptions can still be tested and explored.

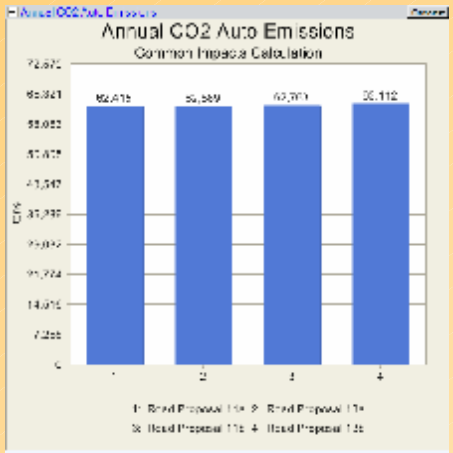


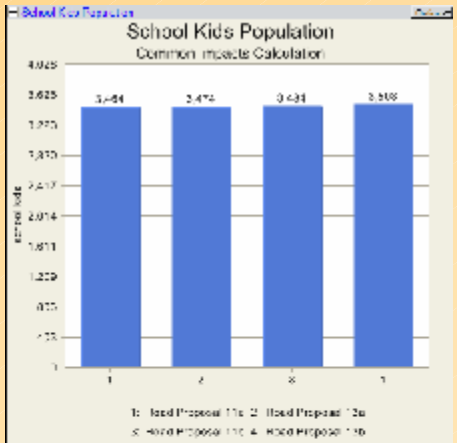
CommunityViz Growth Modeling

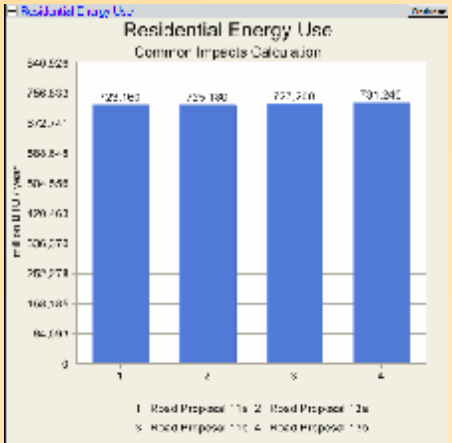
CommunityViz also estimates a wide variety of economic, environmental, and social impacts for each of the 4 scenarios:

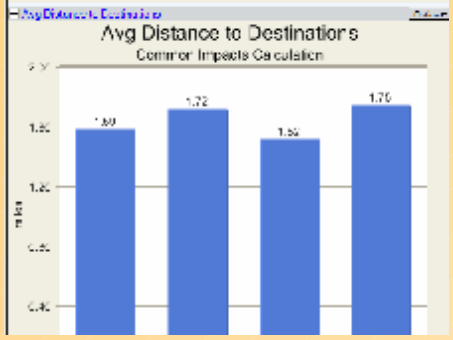
Just a sample of the many impacts available, all variable by year and other assumptions, are shown here.

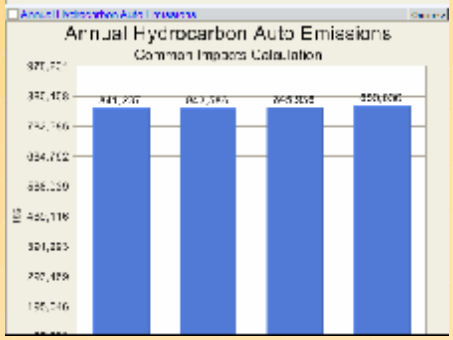


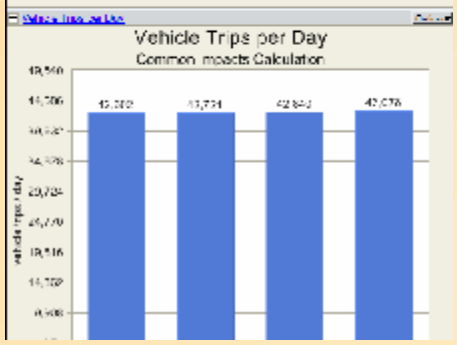


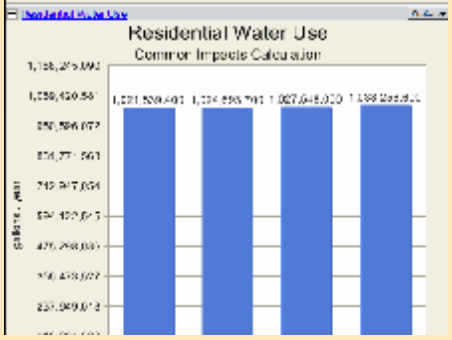












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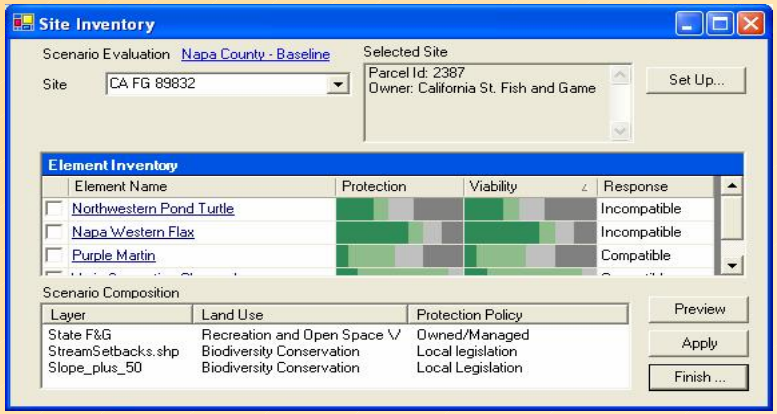
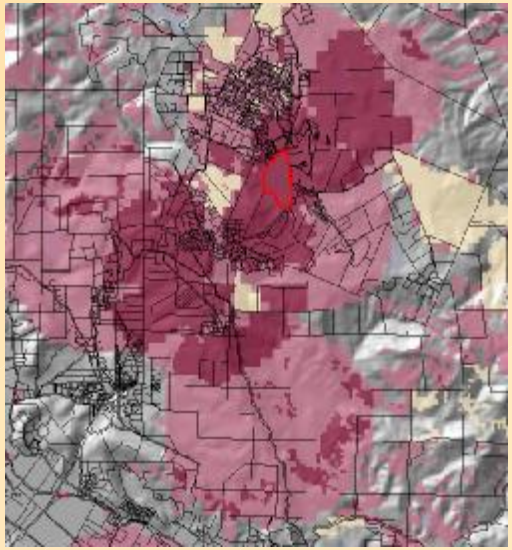
A Network Connecting Science With Conservation

NatureServe VISTA

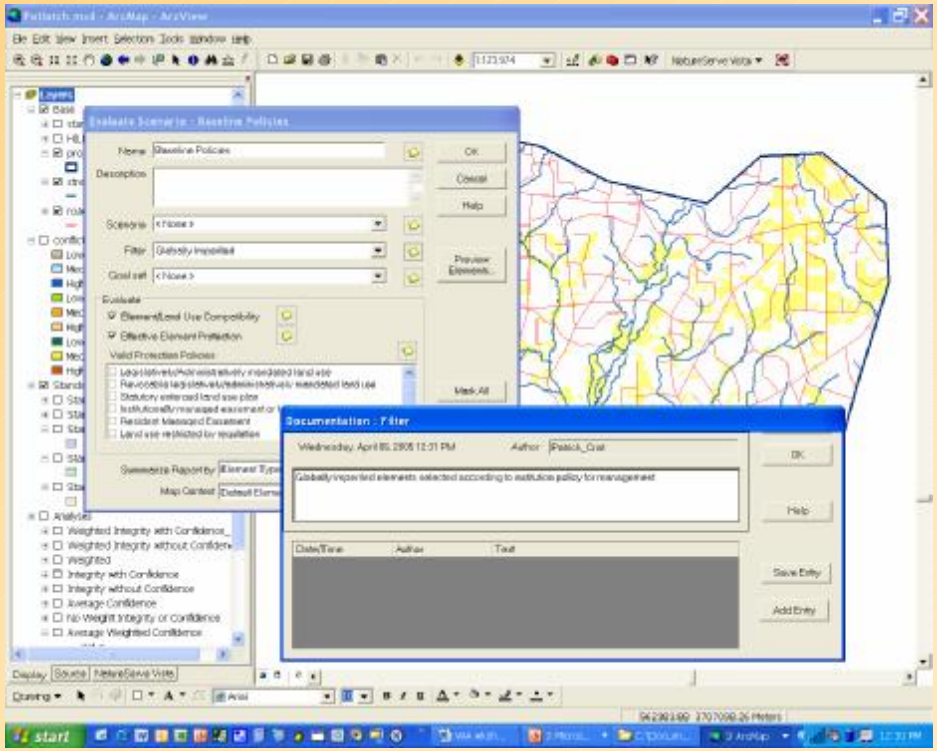
NatureServe's Conservation Planning Support System





About Vista

- Custom GIS application based as an extension of ESRI's ArcMap 9 with spatial analyst
- Licensed software with full integrated help manual, live technical support, available training
- Supports both conservation experts & planners/managers
- Incorporates expert knowledge/models AND user values
- Commercial grade design and engineering
- Provides automation, documentation, & repeatability of the process



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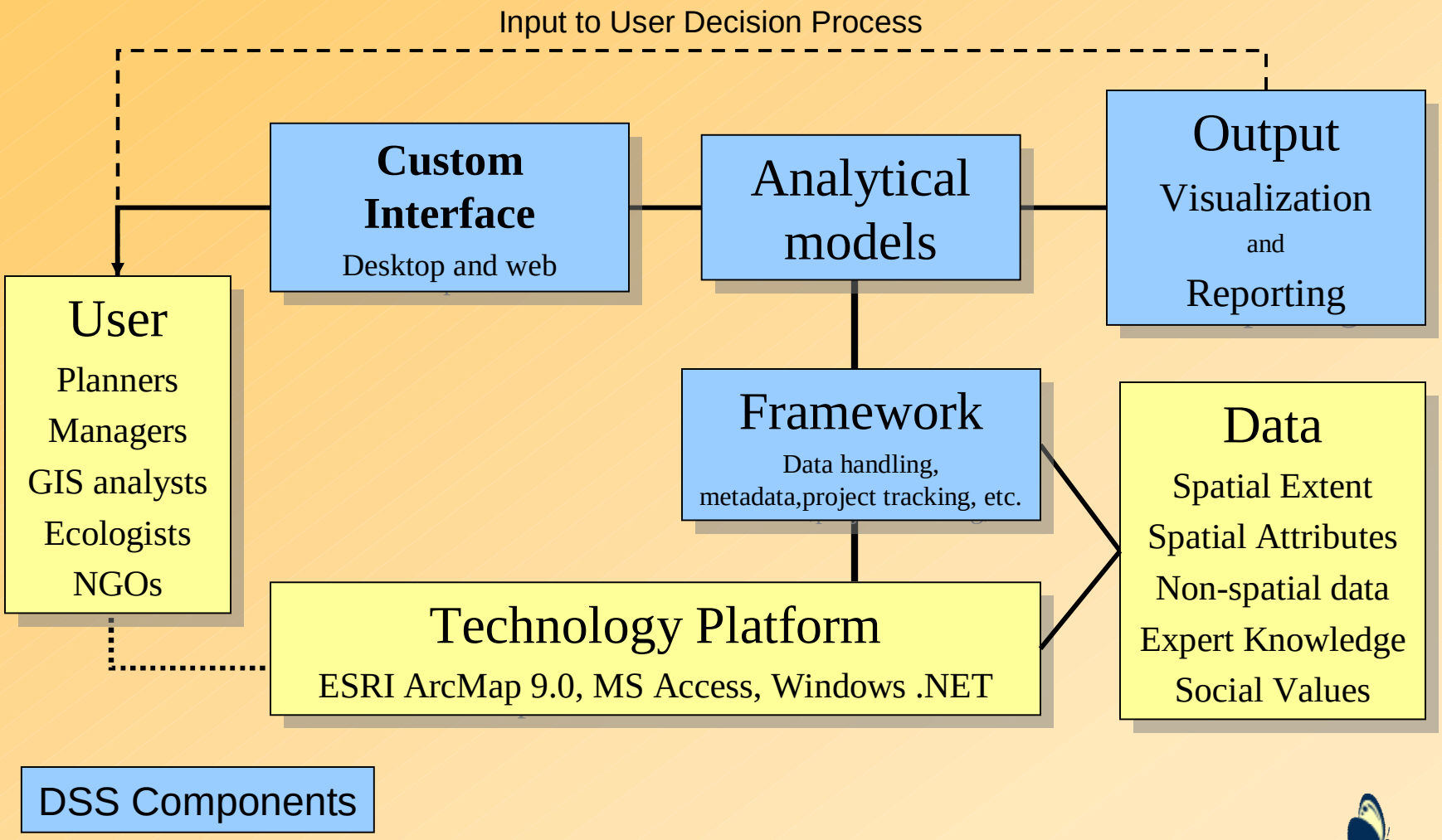
Basic Vista Extension Components



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Vista Status & Support

Software Versions

- Released Version 1.0 on March 1, 2005
- Version 1.3 released Mar 1 2006, 2.0 under development with possible release Mar 1 2007

Development Sponsors: ~$3.4M versions 1-2.0

DORIS DUKE CHARITABLE FOUNDATION

NASA

SURDNA FOUNDATION

e ENVIRONMENTAL DEFENSE finding the ways that work

Development Partners

- Environmental Systems Research Institute (ESRI)
- University of California –Santa Barbara
- US Geological Survey
  Florida and Wyoming Heritage Programs

Endowment ~$1.6M permanent maintenance and support

- Doris Duke Charitable Foundation
- The Nature Conservancy
- Centex

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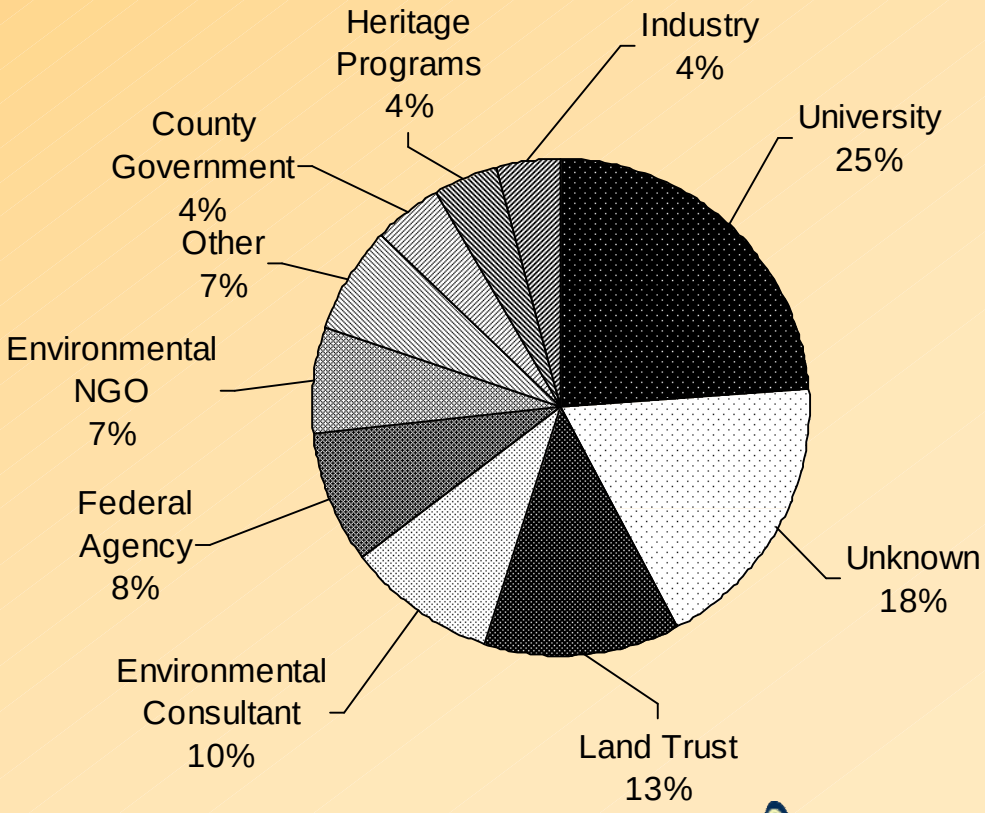
Applications So Far

- 20+ permanent licenses
- 100+ trial downloads
- 10+ direct NatureServe projects spanning:
  - Industry, government, NGOs
  - 30 k acres—12M acres
  - Forestry, Conservation, Land Use Planning, Public Land Management



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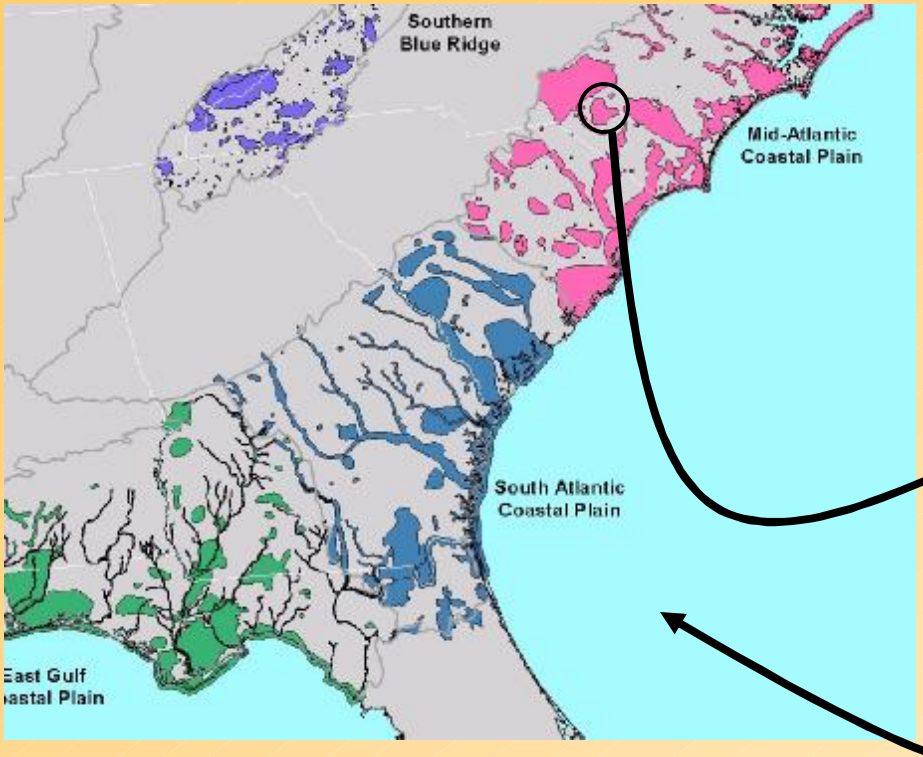
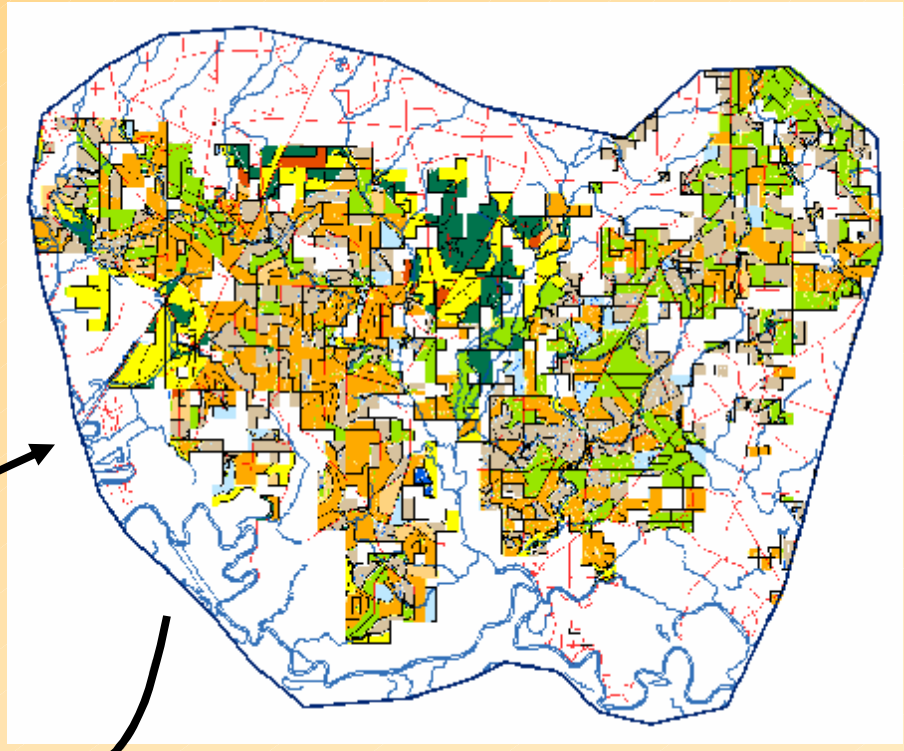
Regional Context for Site Decisions

How to get from here…

to here





And from site decisions to roll-up of progress toward regional goals

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Some Jargon

- **Conservation Elements:** the features you wish to conserve representing biodiversity & other conservation values
- **Element viability/integrity requirements:** representing the site or population needs for proper condition and minimum size
- **Element conservation goals:** representing the requirements for metapopulation persistence or ecosystem functioning in the planning region
- **Compatibility:** representing analysis of current or alternative futures to meet element requirements while maximizing options to meet other land use objectives
- **Scenario:** any mapped features representing land use or management practices, infrastructure, natural or human-caused disturbance, invasive species, pests, disease, etc.

Conservation Elements

Representing Composition, Structure, and Function of Regional Landscapes

- Species
  - Imperiled, Declining, Vulnerable, Endemic
  - Management Indicator Species
- Ecological Communities
  - Rare plant communities
  - Rare aquatic communities
  - Unique environments
- Ecosystems
  - Groups of communities interconnected on land and waterscapes;
  - Natural pattern and process at local scales useful for management and monitoring
- Non-Biological Elements
  - Scenic views
  - Historic & cultural sites
  - Valuable agriculture soils
  - Natural hazard zones

Defining Goal Achievement

Version 1:

- Adequate number of element occurrences or area in project region (metapopulation viability, ecosystem processes)
- Adequate size of occurrences (population potential, ecological functioning)
- Occurring in areas of compatible land use supported by reliable policies

Version 2:

- Same as version 1 plus:
- Adequate “condition” of occurrences (habitat quality)

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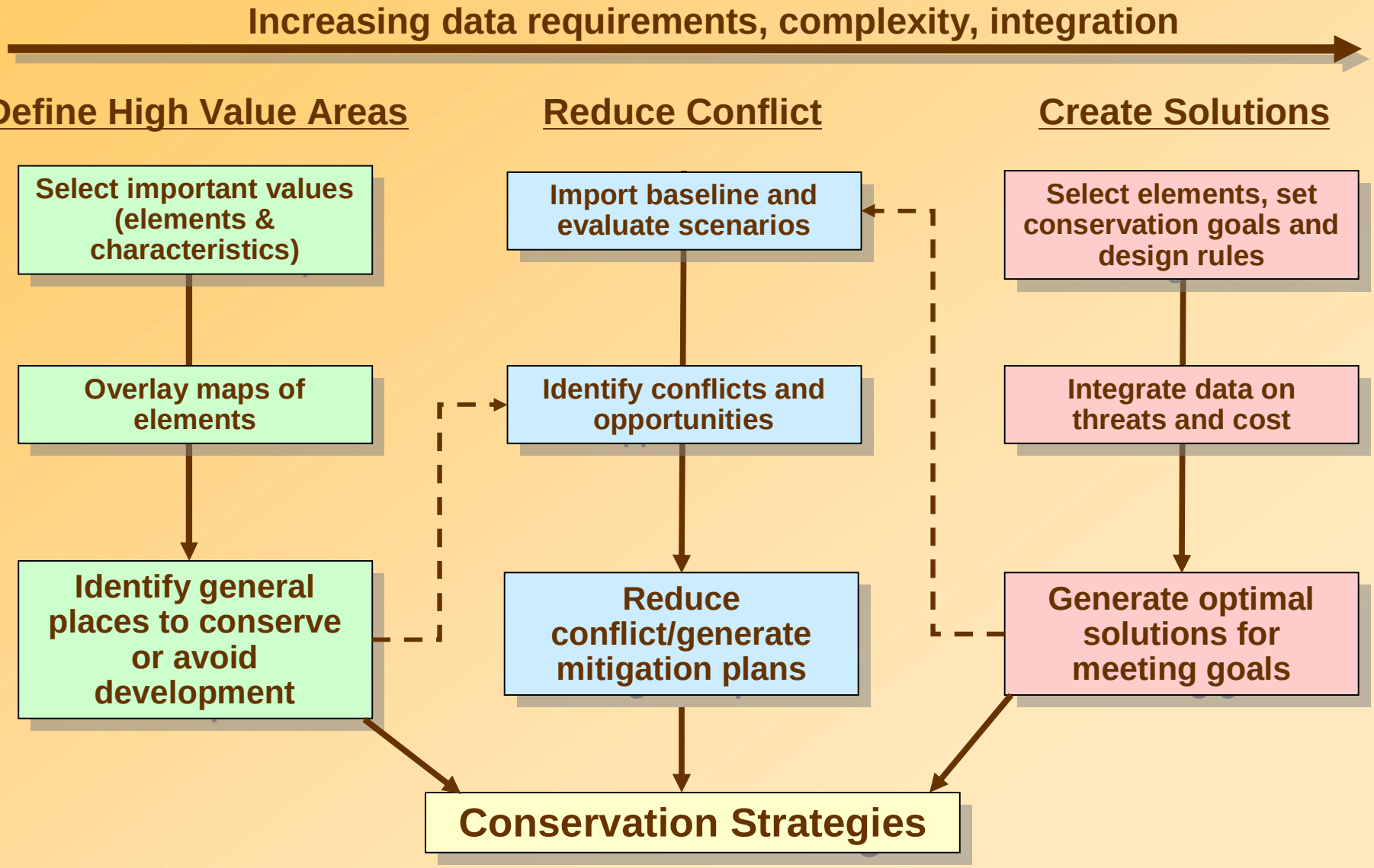
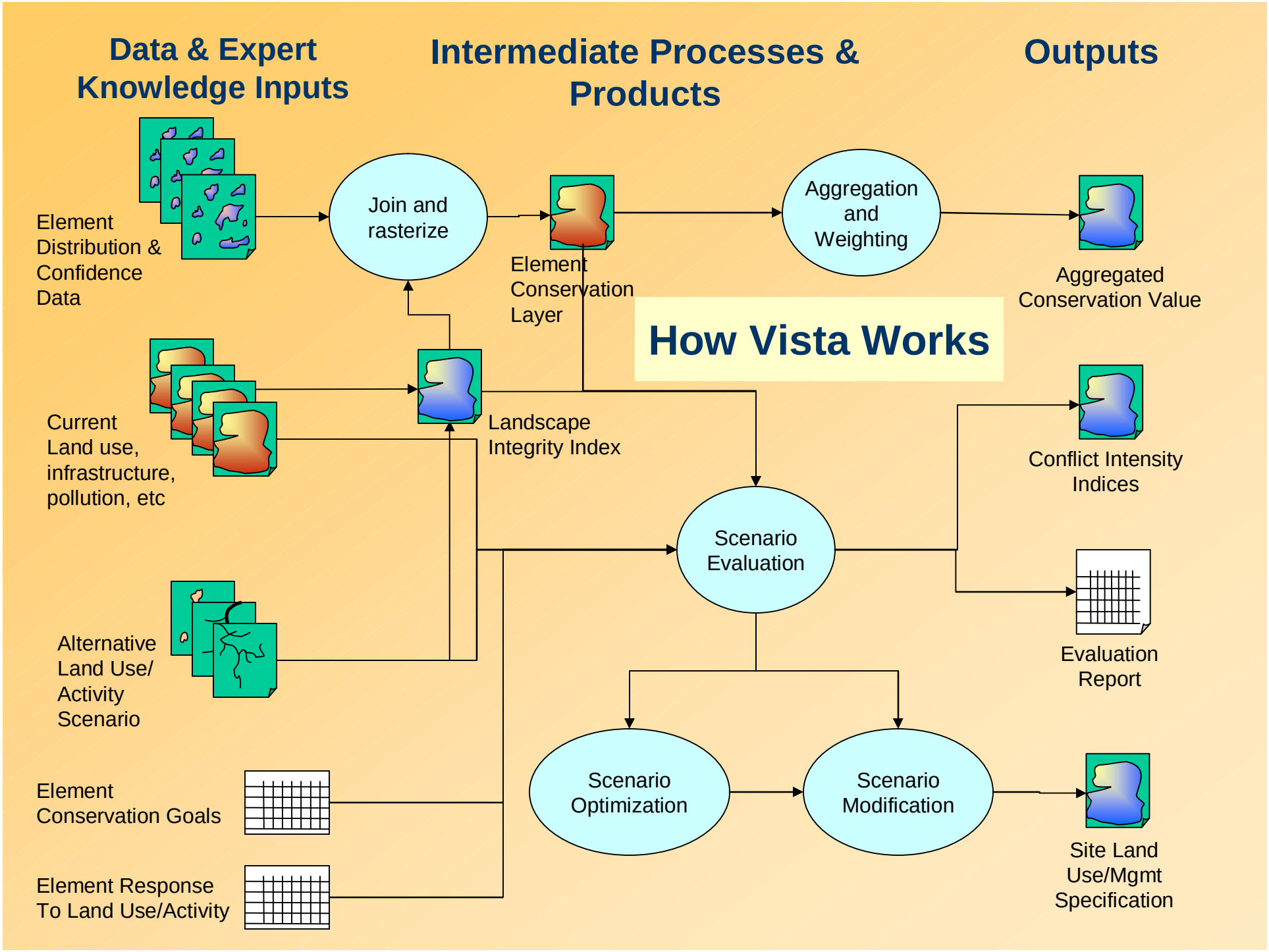
Three Analytical Approaches




Data & Expert Knowledge Inputs
Intermediate Processes & Products
Outputs
How Vista Works
Element Distribution & Confidence Data
Join and rasterize
Element Conservation Layer
Aggregation and Weighting
Aggregated Conservation Value
Current Land use, infrastructure, pollution, etc
Landscape Integrity Index
Conflict Intensity Indices
Scenario Evaluation
Evaluation Report
Alternative Land Use/ Activity Scenario
Element Conservation Goals
Element Response To Land Use/Activity
Scenario Optimization
Scenario Modification
Site Land Use/Mgmt Specification

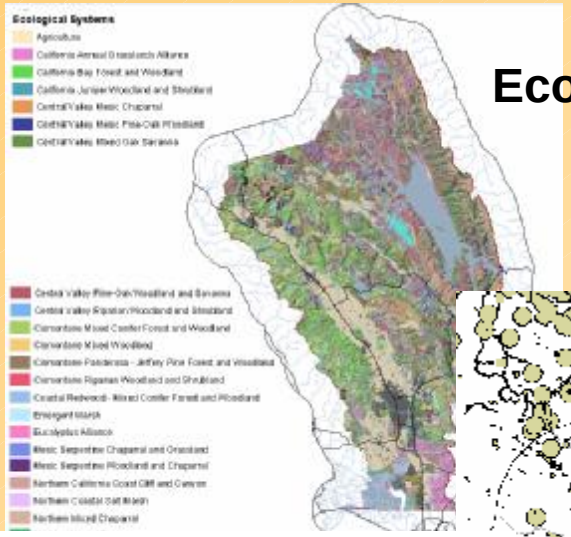
Where Does the Data Come From?

Spatial distribution maps of each element come from:

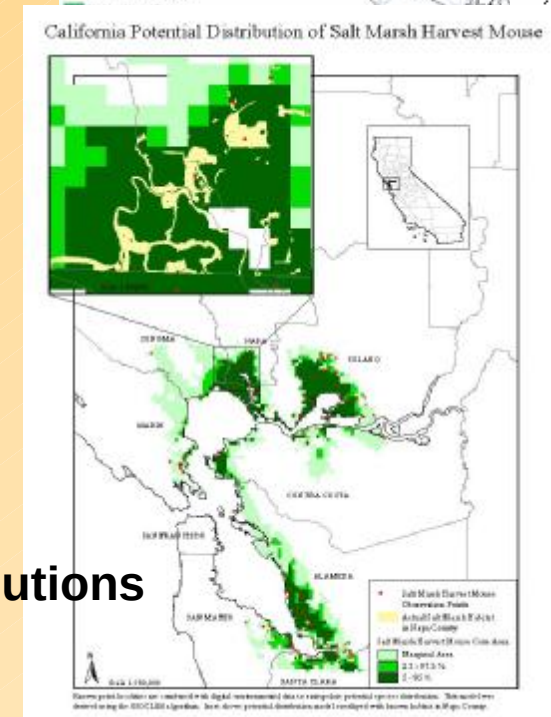
- Heritage data
- land cover maps
- modeled distributions
- museum collections
- local information sources

Each element occurrence has:

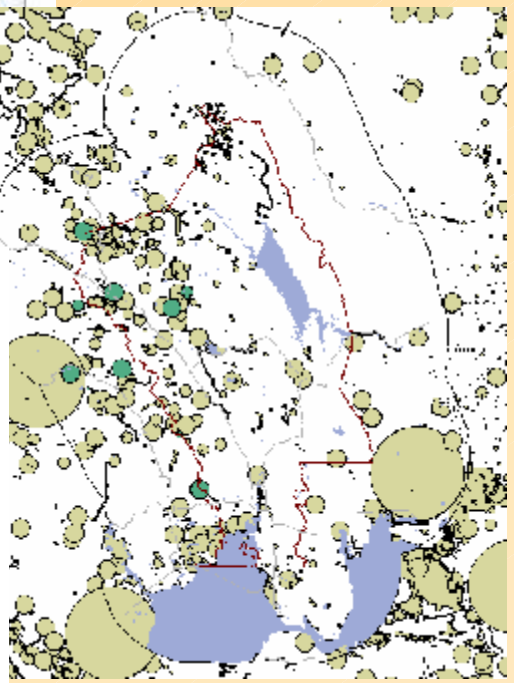
- A viability/integrity score
- A confidence score



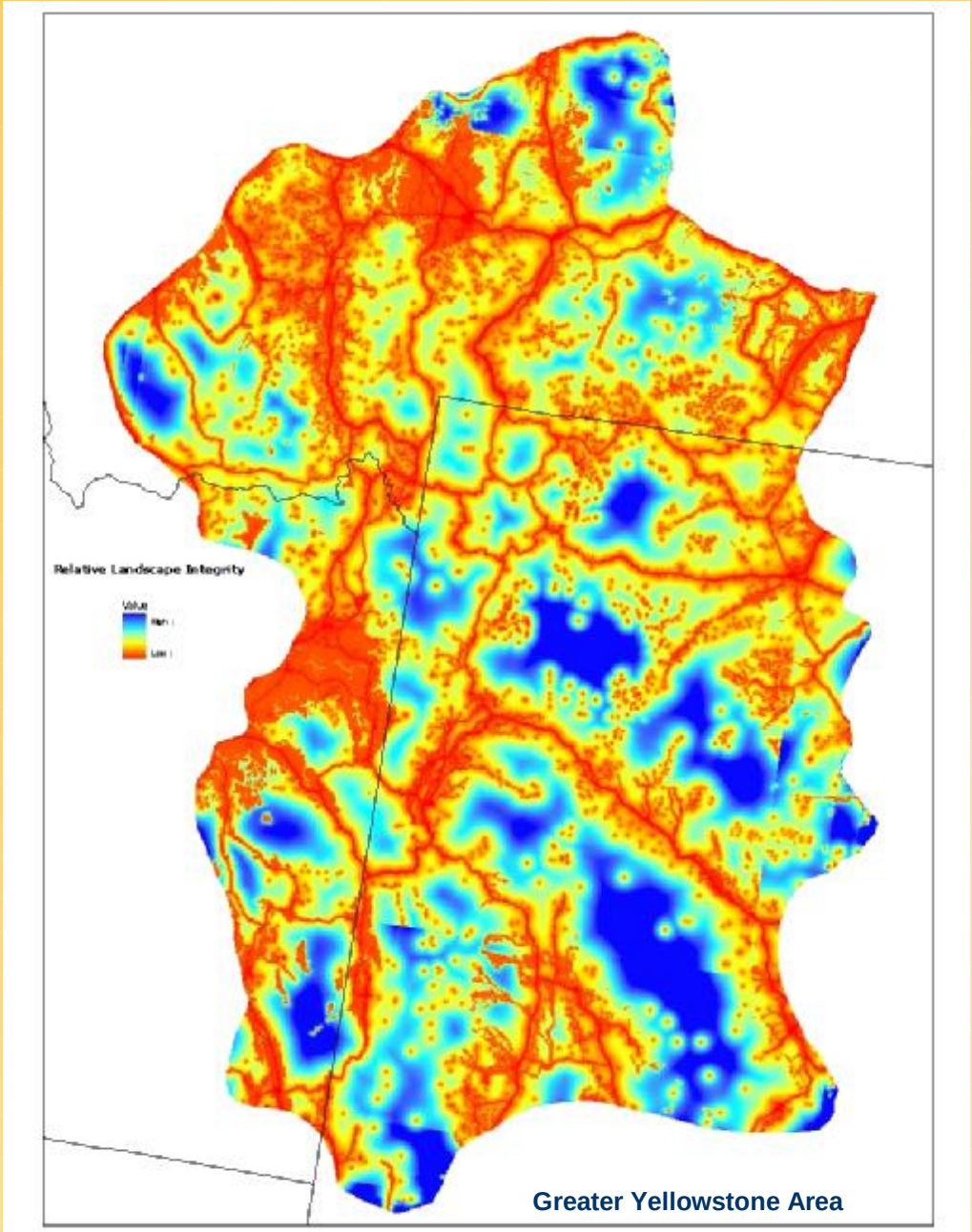
Ecological systems



Modeled distributions



Species and community occurrences



Modeling Condition

Landscape Integrity Indices

- –Combines land use, roads, infrastructure, pollution, etc.
- –Model weights effects, adds distance effect
- –Can be element-specific

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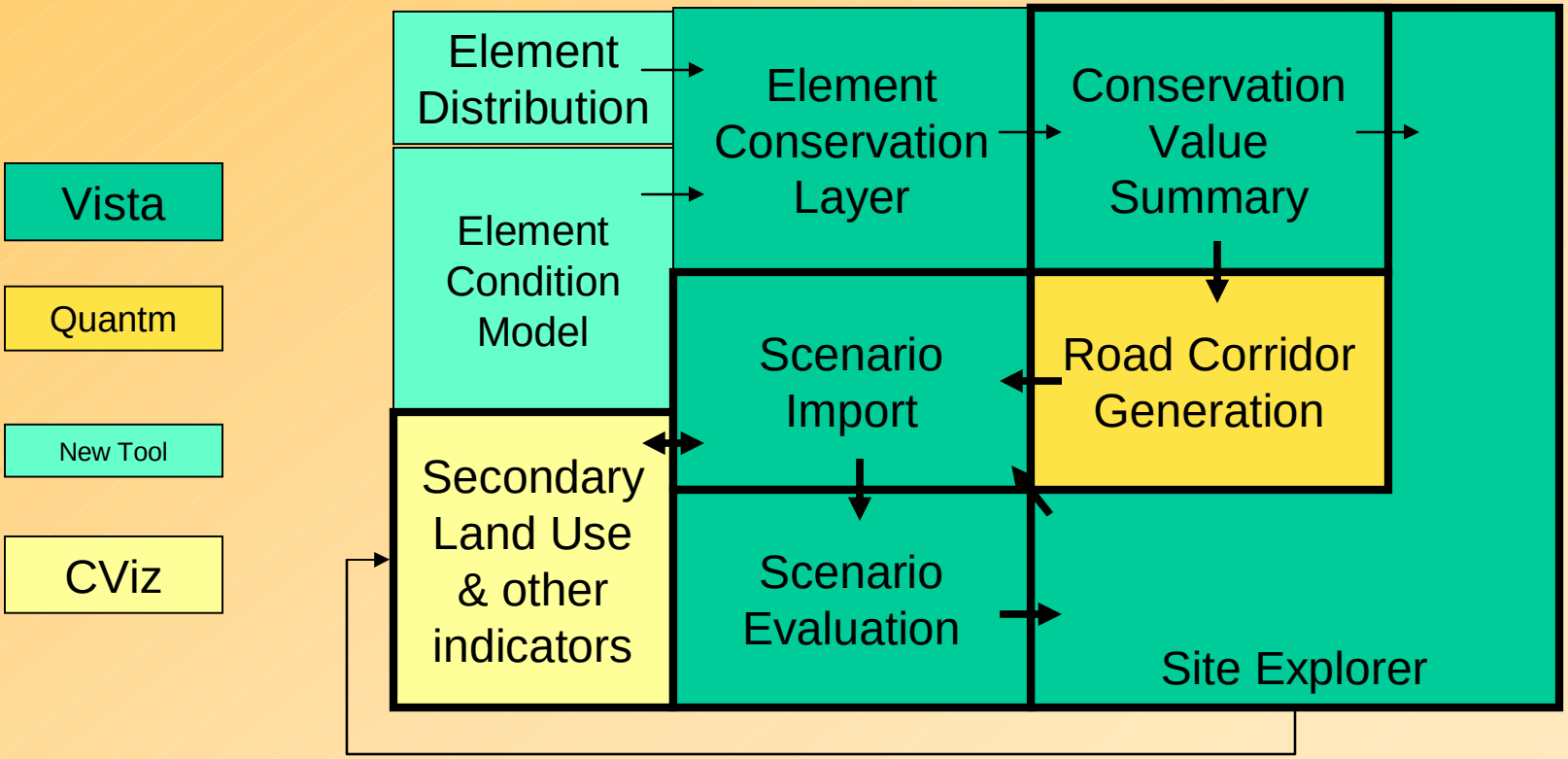
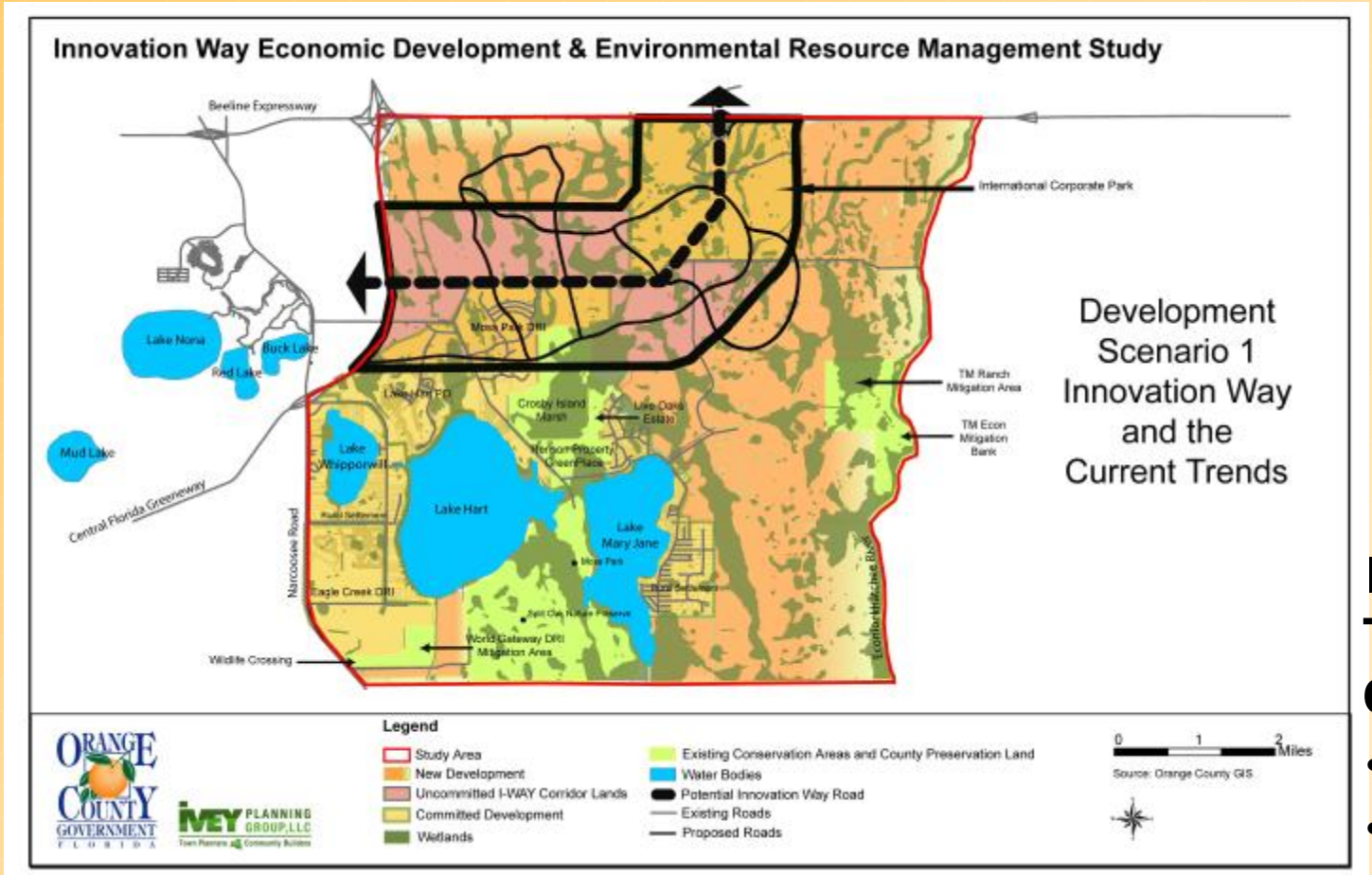
Tool Interoperability Model

Diagram indicates interactions among Vista, Quantm, and CommunityViz. Bold lined boxes and arrows indicate primary path of information to be demonstrated.



Case Study

Objective: Plan new tech corridor and mixed use while respecting natural resources



Innovation Way Technology Corridor

- **Orange Co, FL**
- **33,884 acres**

This Report

This report includes a description of the Community Planning Collaborative (CPC) initiative and outcomes of its 5 phases. The main body of this report has 3 sections: 1) training and capacity building for the Orange County Planning Division; 2) community visioning for the Innovation Way project ; and 3) details about Innovation Way alternative growth scenarios and public feedback from the CPC Summit held in Orlando, Florida, October 27-30, 2005.

A Special Thanks to CPC Partners

The Orange County Planning Division
Linda Chapin, Metropolitan Center for Regional Studies at the University of Central Florida
Jeffrey Jones, East Central Florida Regional Planning Council
Shelley Lauten, *myregion.org*

Three day charette process involving:

- Planners and decision makers
- Citizens and stakeholder groups
- Civic engagement facilitators
- Tool providers and planning consultants

1. Evaluated 5 existing scenarios
2. Determined strengths & weaknesses
3. Revised scenarios & re-evaluated
4. Identified best scenarios

Participating Tool Providers

Criterion Planners
Placeways/CommunityViz
Envision Sustainability Tools
ForSee Consulting
InfraCycle
NatureServe
Renaissance Planning Group
The Florida Natural Areas Inventory
The Project Integration Procedure
Winston Associates

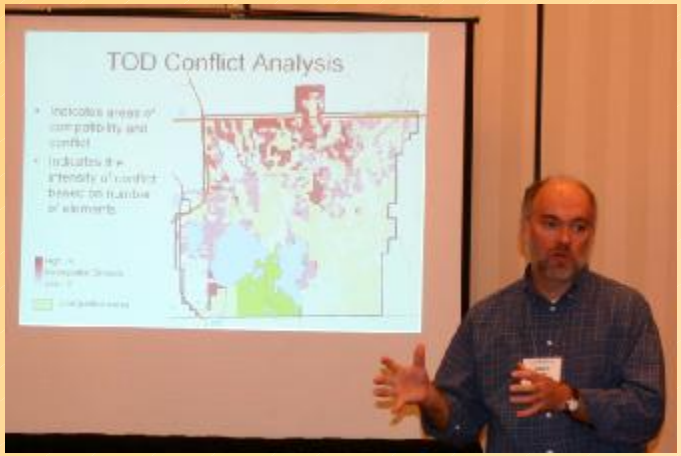
Public Participation Experts

Bill Lennertz, National Charrette Institute
Gianni Longo, ACP Visioning and Planning, Ltd.
George Janes, Environmental Simulation Center

Habitat Planning Charette

Objectives

- Understand the habitat content and its value to the region and Florida
- Understand the areas of importance, conflict, and compatibility with the scenario
- Develop policy recommendations regarding what should be protected and where



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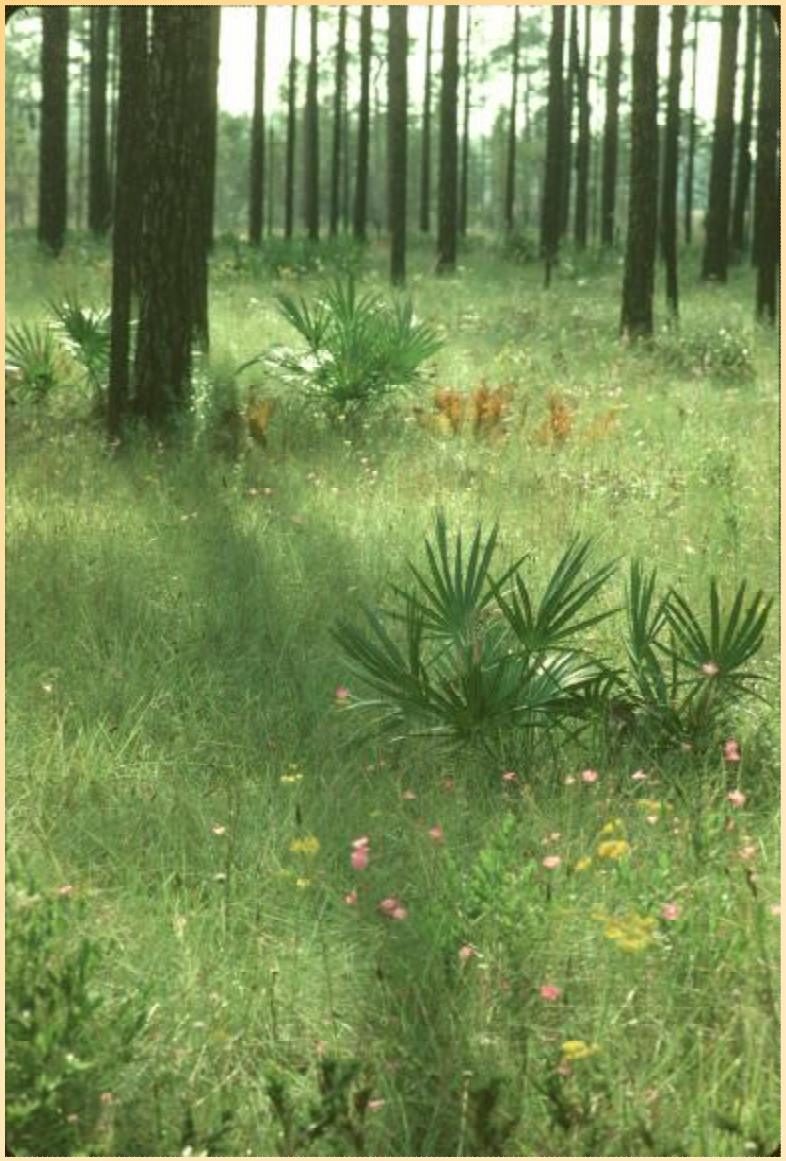
FLORIDA Natural Areas INVENTORY

The Conservation Elements

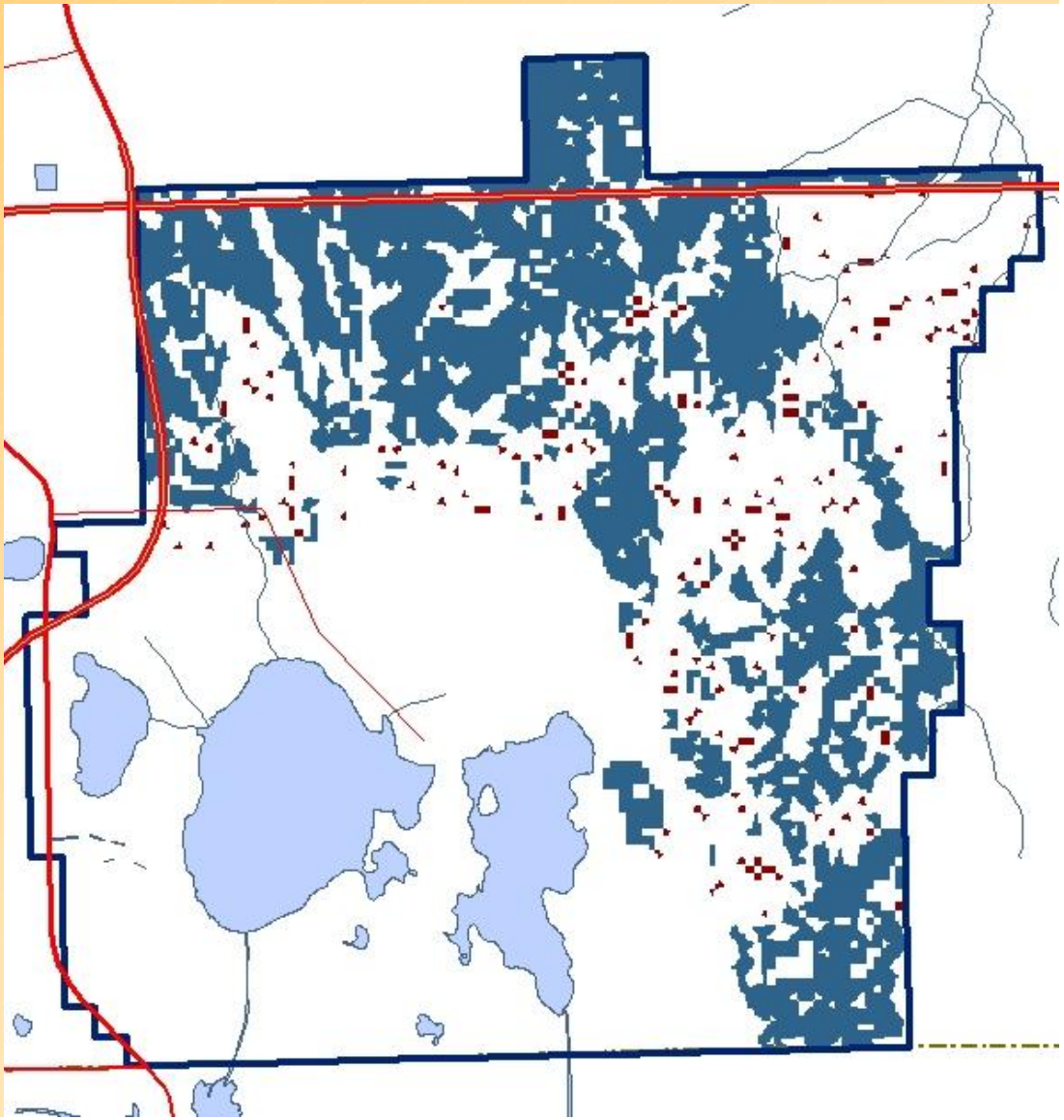
Selected Elements

- scrub
- sandhill
- gopher frog
- red-cockaded woodpecker
- celestial lily
- wood stork
- bald eagle
- Florida sandhill crane
- flatwoods
- eastern indigo snake
- wetlands
- watersheds



Red Cockaded Woodpecker

- A Federal Endangered Species with required protection
- Distribution based on potential habitat
- Ground surveys required to verify
- Development restrictions and/or HCP may be required



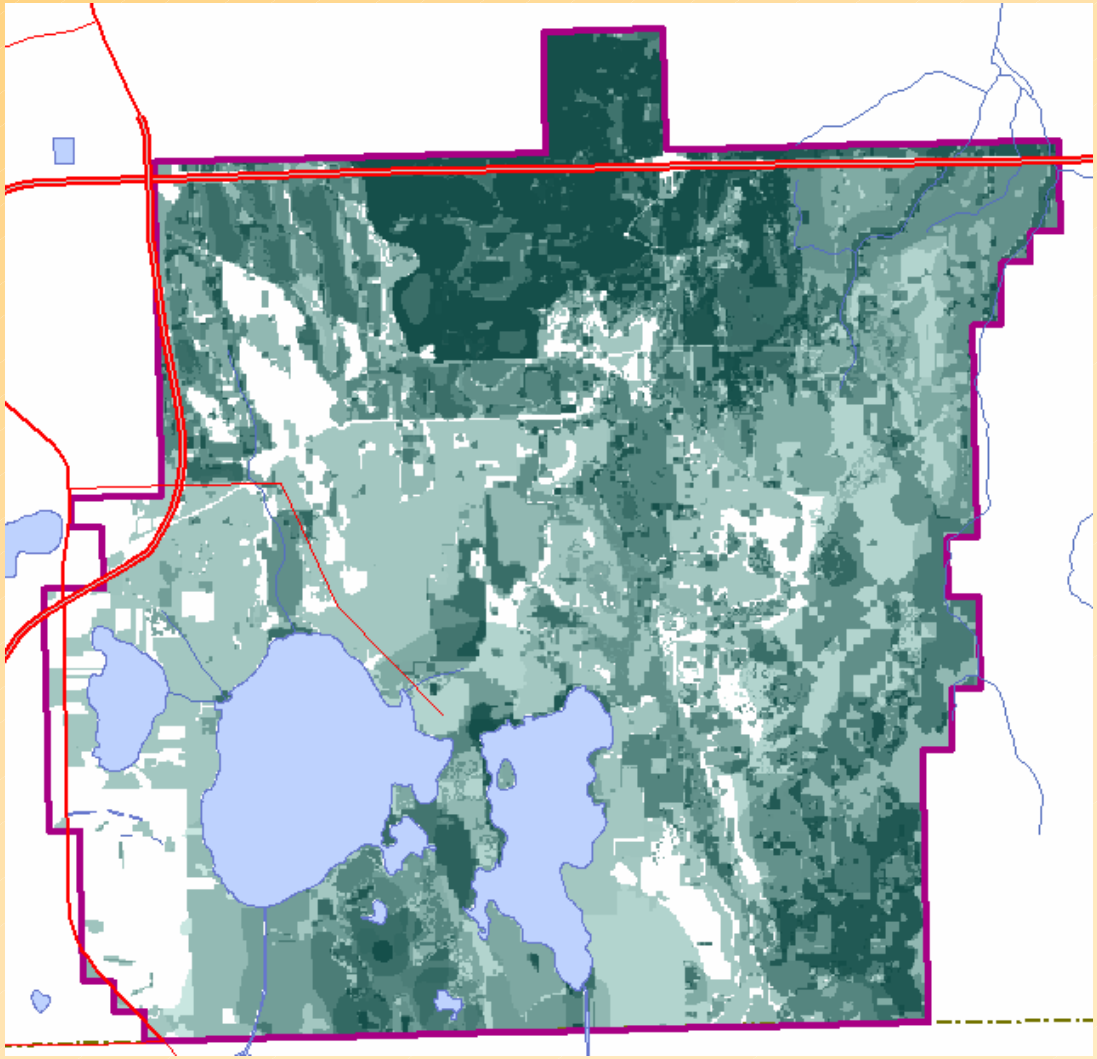
Blue occurrences meet adequate size requirements, red areas are below minimum size but still may provide habitat.

Summary of Conservation Value

Overlays elements to show importance by richness and habitat condition

Most valuable area is within core of proposed development

Upland habitats are often undervalued for conservation in Florida



Demonstration

Live Vista w/existing inputs from Quantm & CommunityViz

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Conclusions & Recommendations

- **Goals are more appropriately set and are more flexibly met over large regions**
- **Optimization of conservation solutions saves time and facilitates focus on implementation but must be done iteratively with transportation and land use tools**

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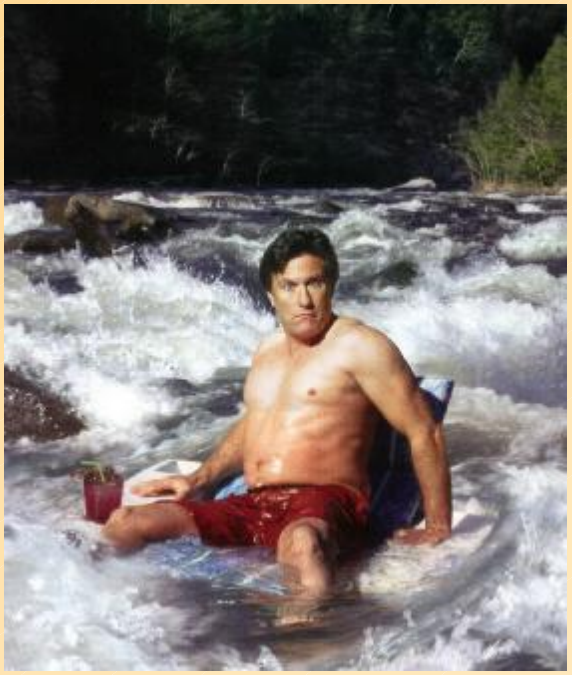
FL Demo Level of Effort

Activity	Source	Approx. Time
Input conservation data into NatureServe Vista	Florida Natural Areas Inventory	2 weeks
Identify high conservation value areas	NatureServe Vista	<2 hours
Generate proposed highway routes	Quantm	1 week
Generate secondary growth effects	Community Viz	1.5 weeks
Identify areas of conflict between proposed transportation routes and conservation values	NatureServe Vista	1 day
Create optimal plan via alternative land use decisions and mitigation efforts	NatureServe Vista	4 hours
TOTAL		~4 weeks

Planned Features for Vista 2.0

- Multiple uses per land unit (for compatibility/conflict mapping)
- User-defined element response to land use
- Assisted import from heritage Biotics system
- Tools for modeling landscape condition
- Calculating sub-region goals



- Aquatic analysis support?
- N-SPECT integration under evaluation

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Getting Started

- Start analysis early enough to make a difference
- Appropriate definition of the regional context
- Public process for establishing values
- Investigation of existing studies, plans, priorities for conservation
- Discipline experts required
  - Ecological scientists
  - Conservation planners
  - GIS specialists

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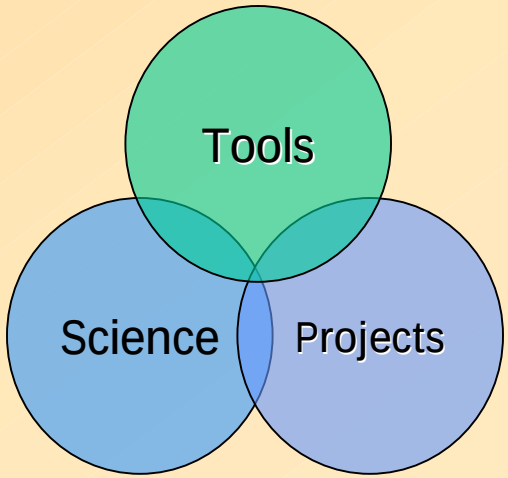
EBM Tools Program

Program Objectives

- Identify available tools that may be useful for performing ecosystem-based management.
- Characterize the tools in a knowledge base
- Prioritize the tools for further description and investigation for investment
- Develop and coordinate a network of tool providers and practitioners
- Conduct outreach and training



Acknowledgments & Questions

- FHWA
- Quantm
- Placeways/Orton Family Foundation (CommunityViz)

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Screenshots in lieu of Demo

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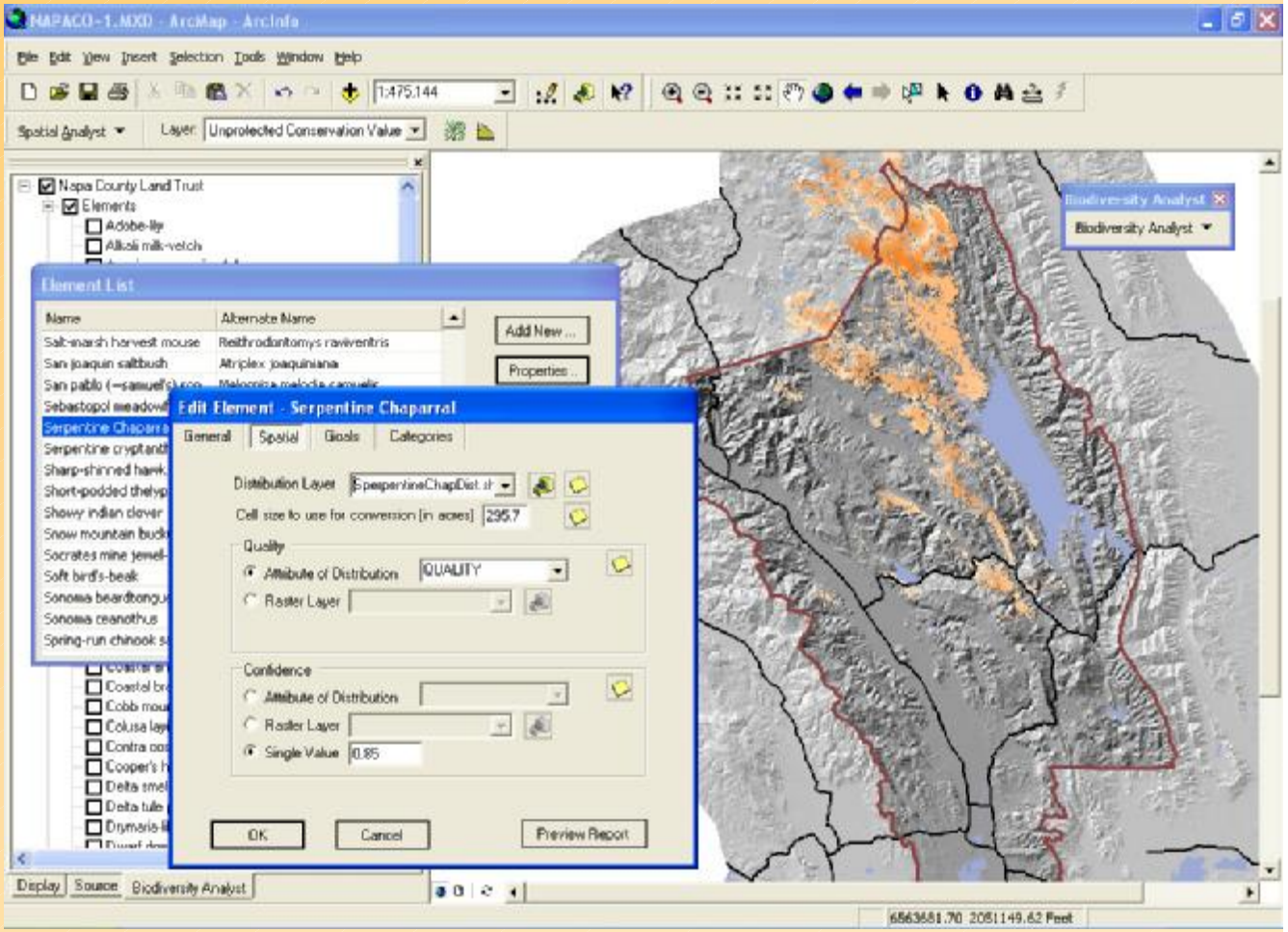
Building Element Information

Each element has:

- **A name**
- **A weight**
- **A conservation unit**
- **Categories**
- **A quantitative goal**
- **Compatibility to land use types**
- **A spatial distribution map**



NatureServe

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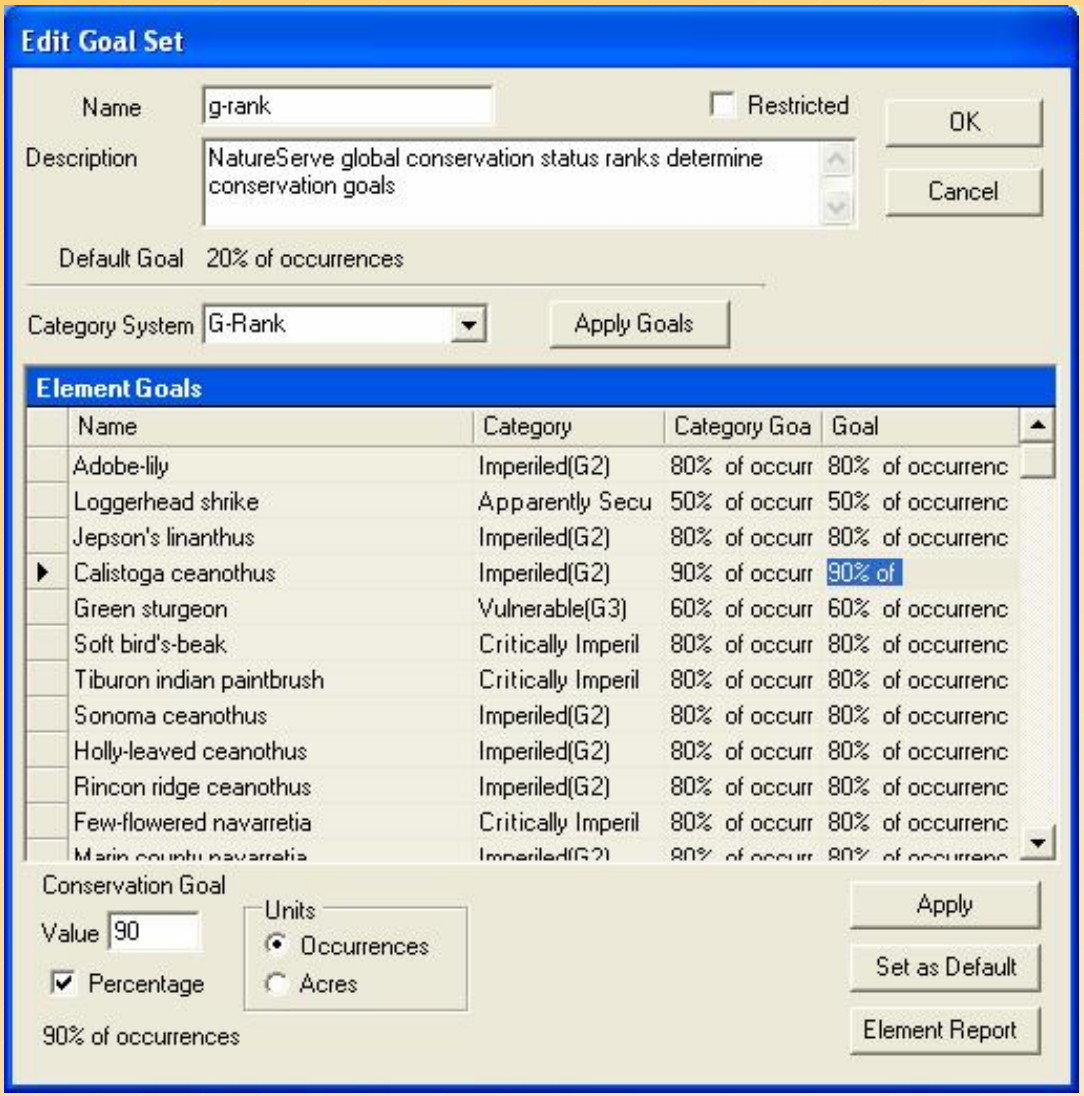
Setting Goals and Weights



- **Weight elements for relative importance**
- **Establish goals for protection**
- **Used in scenario evaluation**
- **Typically assign minimum retention vs preferred goalsets**
- **A single scenario can be evaluated against multiple goalsets**
- **Goals based on % of habitat, % of occurrences, absolute amount of habitat, or absolute # of occurrences**

NatureServe

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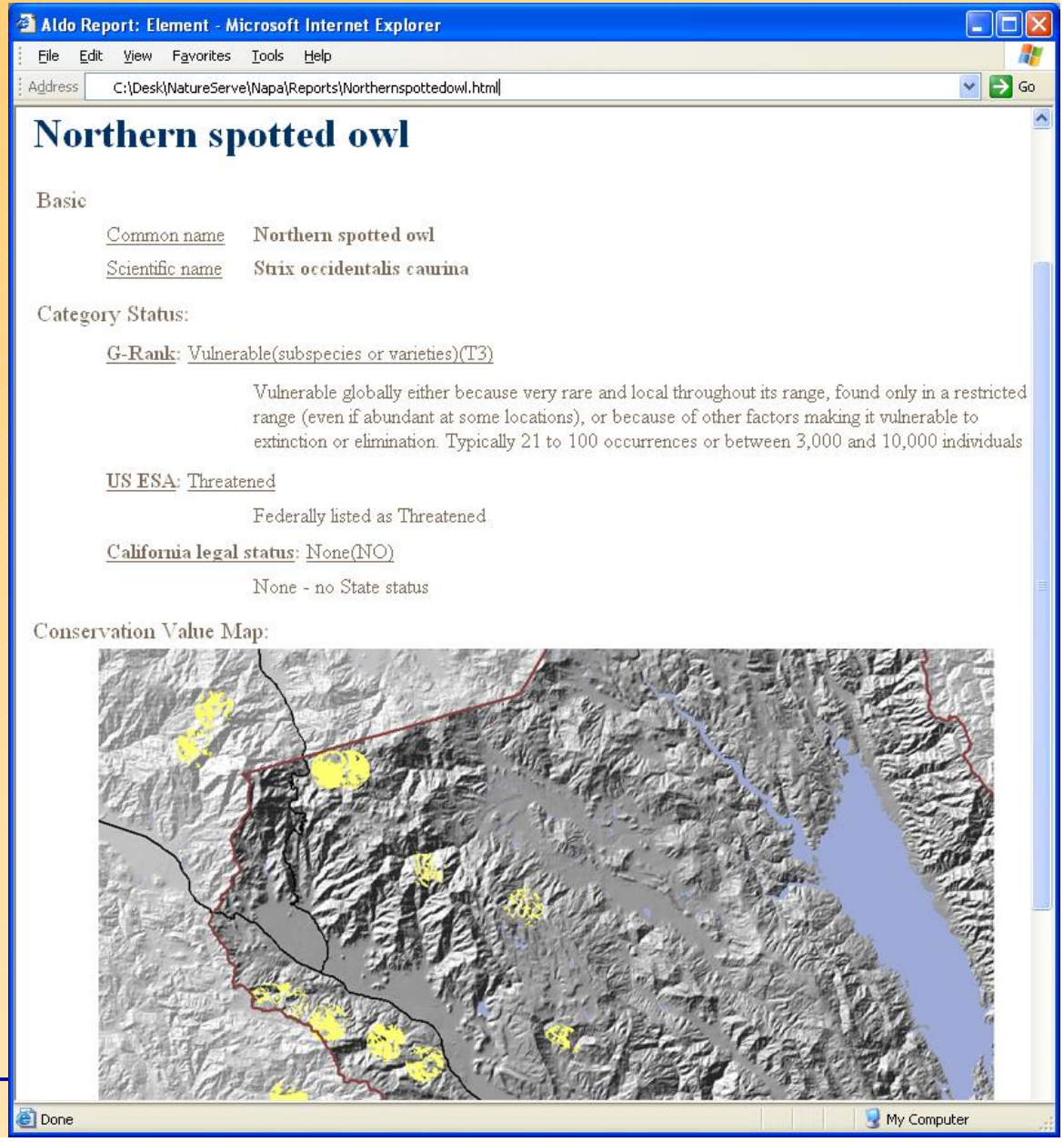
Element Report

Shows all attributes of an individual element

- Written in XML
- Presented in browser using HTML



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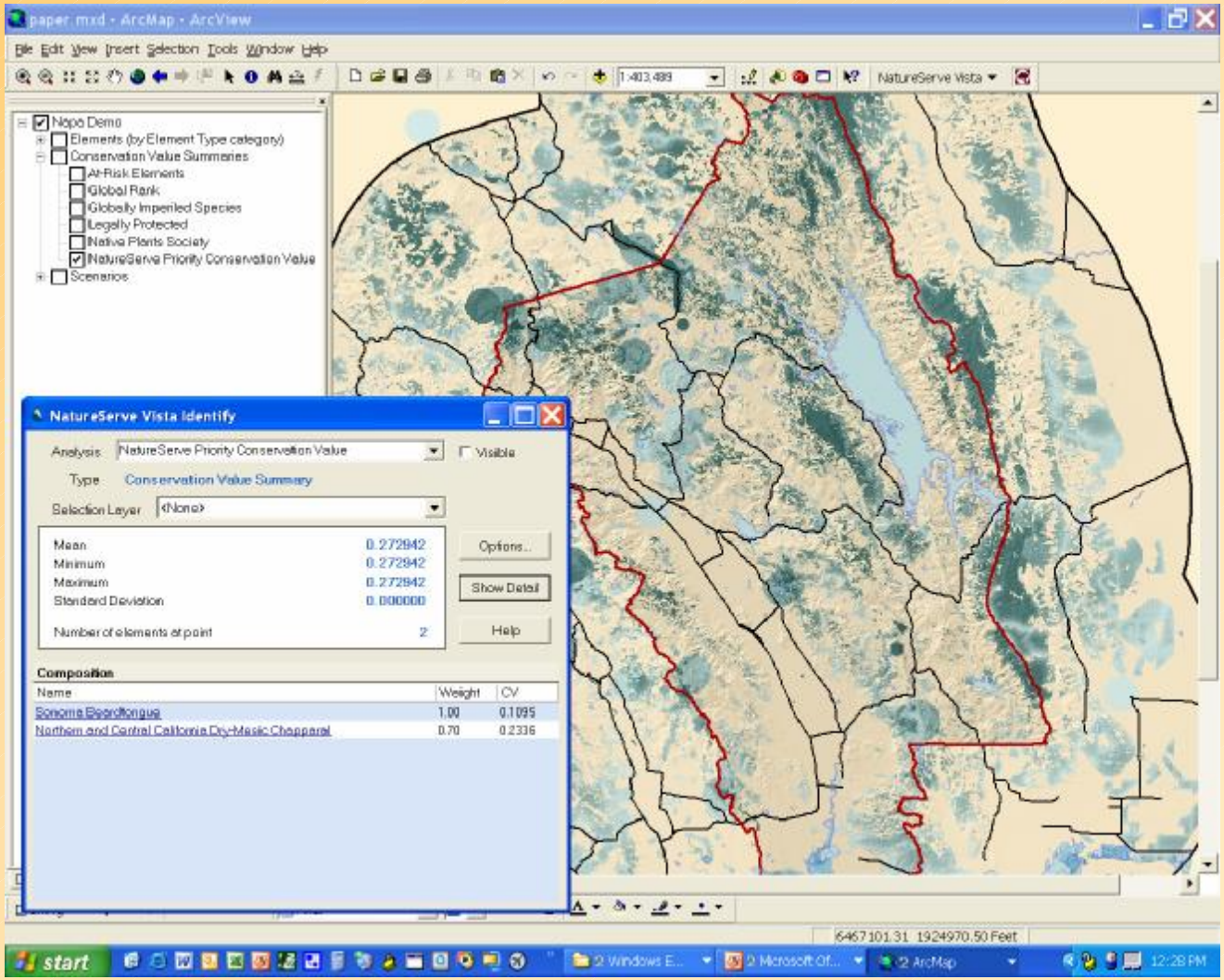
Indices of Conservation Value

Allows the user to:

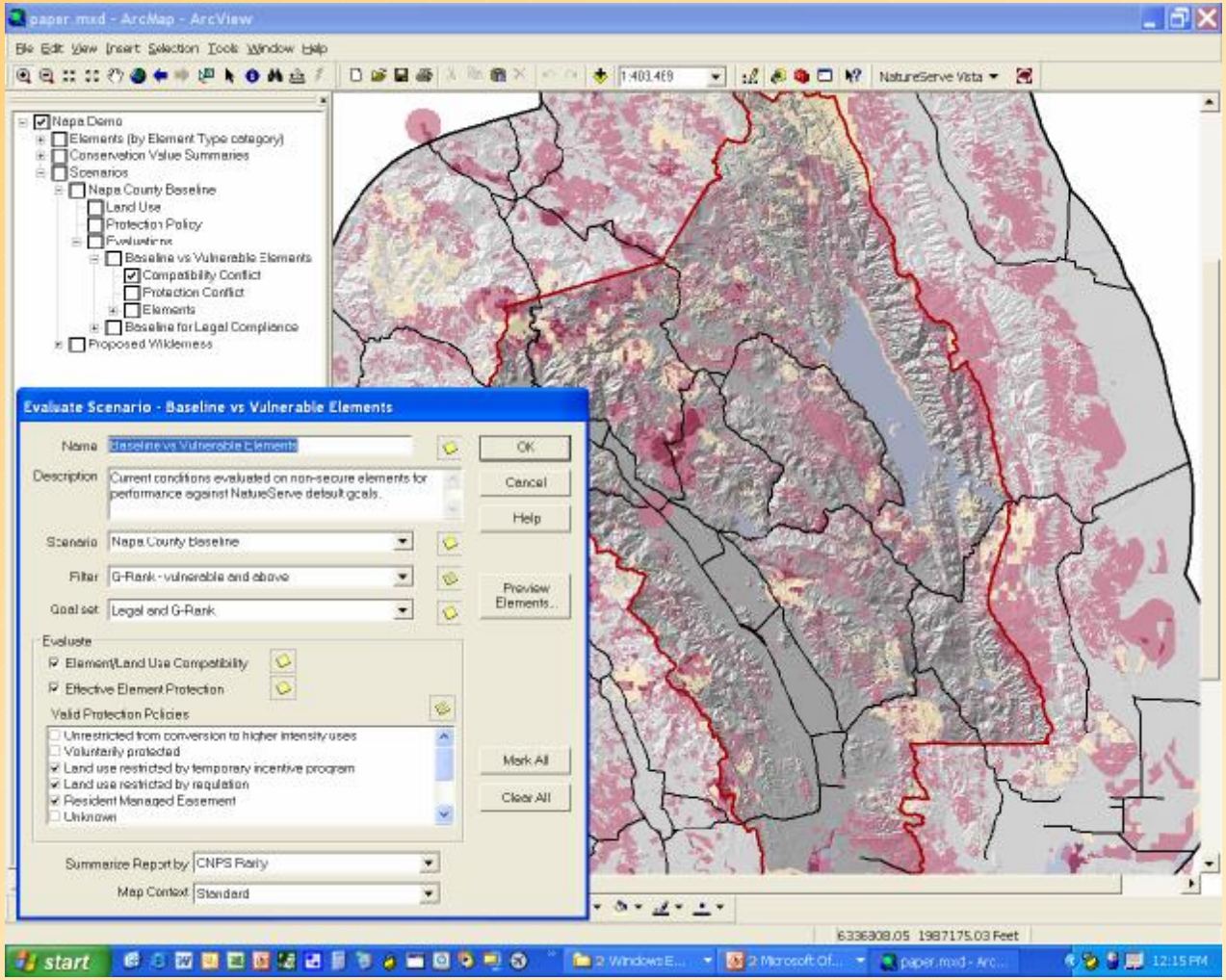
- Select elements to be included.
- Select the factors to be included such as quality, confidence, and weight.
- Each combination reveals different information (e.g.)
  - Integrated Cons. Value
  - Element richness
  - Viability
  - Ave. confidence



Scenario Evaluation Report

Land Use Conflict Map

- Red areas indicate elements with unmet goals and incompatible land use intent.
- Darker shades indicate richness of elements in conflict.



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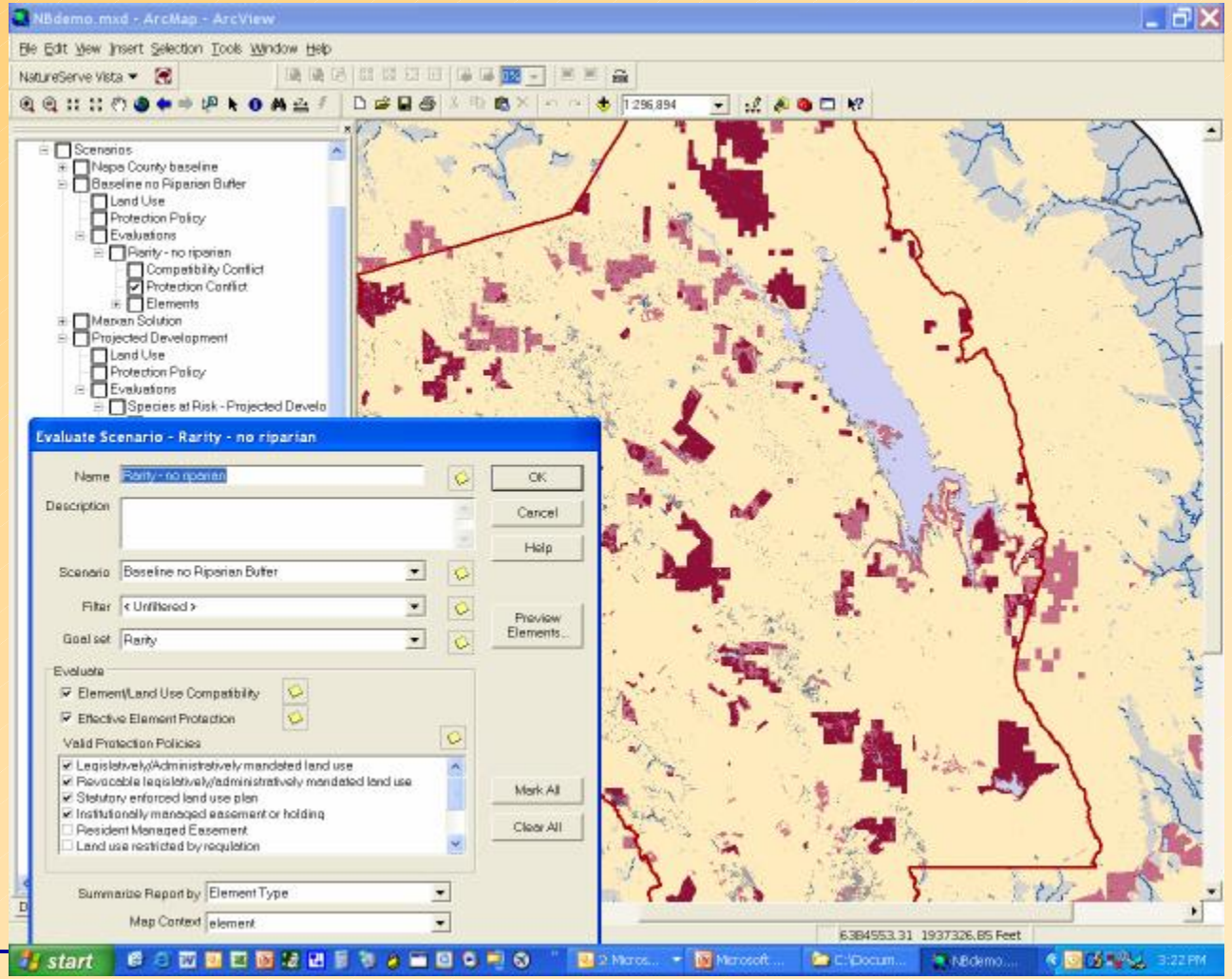
Scenario Evaluation Report

Policy Conflict Map

- Red areas indicate elements with unmet goals and unreliable protection policies.
- Darker shades indicate richness of elements in conflict.



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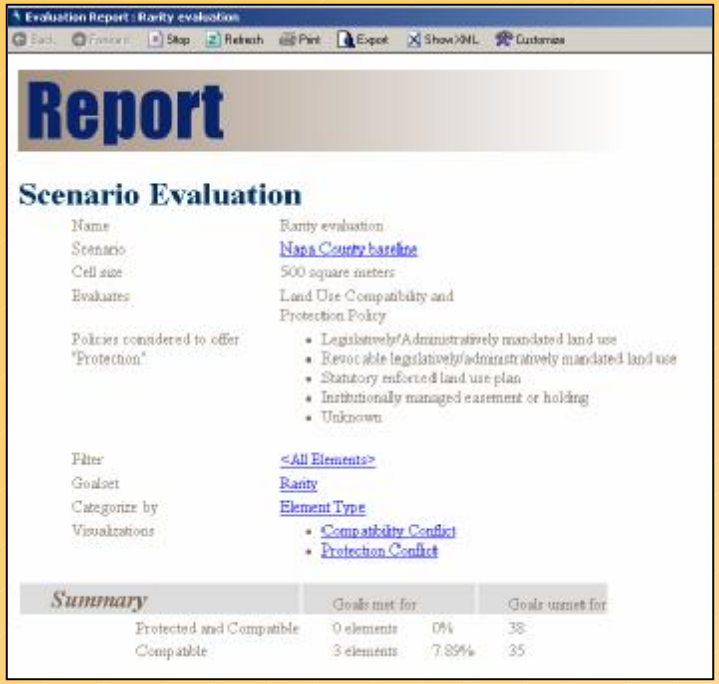
Scenario Evaluation Report



Evaluation Report : Rarity evaluation

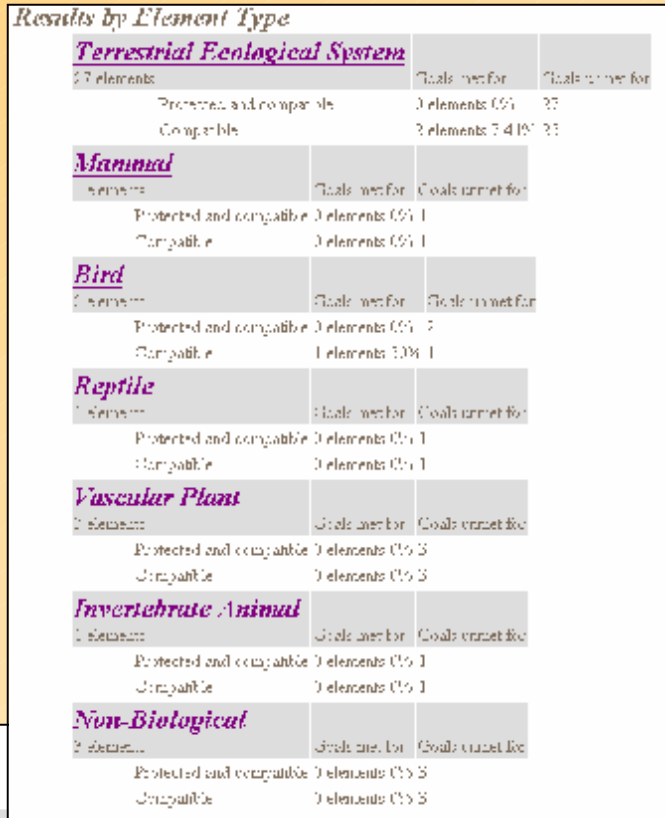
Back Forward Stop Refresh Print Export Show XML Customize

Report

Scenario Evaluation

Name	Rarity evaluation
Scenario	Napa County baseline
Cell size	500 square meters
Evaluates	Land Use Compatibility and Protection Policy
Policies considered to offer "Protection"	• Legislatively/Administratively mandated land use • Revocable legislatively/administratively mandated land use • Statutory enforced land use plan • Institutionally managed easement or holding • Unknown
Filter	<All Elements>
Goalset	Rarity
Categorize by	Element Type
Visualizations	• Compatibility Conflict • Protection Conflict

Summary	Goals met for		Goals unmet for
Protected and Compatible	0 elements	0%	38
Compatible	3 elements	7.89%	35



Results by Element Type

Terrestrial Ecological System 27 elements	Goals met for	Goals unmet for
Protected and compatible	0 elements 0%	27
Compatible	3 elements 7.41%	23
Mammal 1 element	Goals met for	Goals unmet for
Protected and compatible	0 elements 0%	1
Compatible	0 elements 0%	1
Bird 2 elements	Goals met for	Goals unmet for
Protected and compatible	0 elements 0%	2
Compatible	1 elements 3.03%	1
Reptile 1 element	Goals met for	Goals unmet for
Protected and compatible	0 elements 0%	1
Compatible	0 elements 0%	1
Vascular Plant 3 elements	Goals met for	Goals unmet for
Protected and compatible	0 elements 0%	3
Compatible	0 elements 0%	3
Invertebrate Animal 1 element	Goals met for	Goals unmet for
Protected and compatible	0 elements 0%	1
Compatible	0 elements 0%	1
Non-Biological 3 elements	Goals met for	Goals unmet for
Protected and compatible	0 elements 0%	3
Compatible	0 elements 0%	3

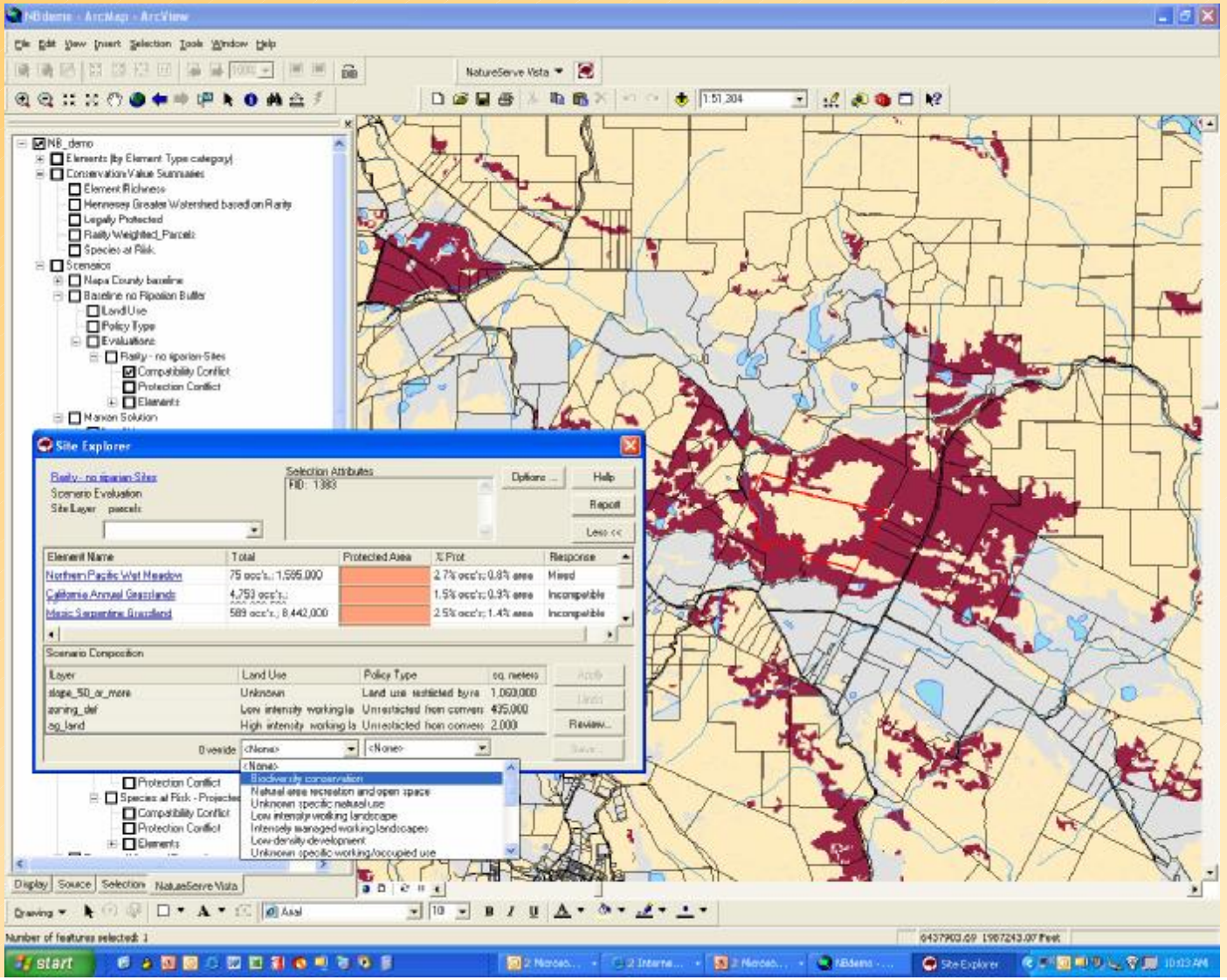
Element details

Terrestrial Ecological System 27 elements

			Distribution			Protected and Compatible			Compatible		
P&C	C	Name	Area (square meters)	Occs	Goal	Area (square meters)	Occs	Percent of goal	Area (square meters)	Occs	Percent of goal
		California Annual Grasslands Alliance	862,855,899.01	4893	50 percent of area	7,442,000	70	1.72	113,828,500	982	26.38
		California Coast Ranges Cliff and Canyon	11,304,992.7	407	50 percent of area	501,500	16	8.87	3,485,500	150	61.66
		California Mesic Chaparral	84,559,441.82	1280	50 percent of area	485,000	33	1.15	24,247,000	460	57.35
		Central Valley Mixed Oak Savanna	932,641,717.29	2807	50 percent of area	14,601,500	90	3.13	89,983,000	698	19.3
		Central Valley Riparian Woodland and Shrubland	31,738,281.81	350	50 percent of area	30,500	2	0.19	2,669,000	55	16.82
		Coastal Closed-cone Conifer Forest and Woodland	500,780.67	1	50 percent of area	0	0	0	0	0	0
		Eucalyptus Alliance	2,288,757.62	79	50 percent of area	88,500	1	7.73	241,000	8	21.06

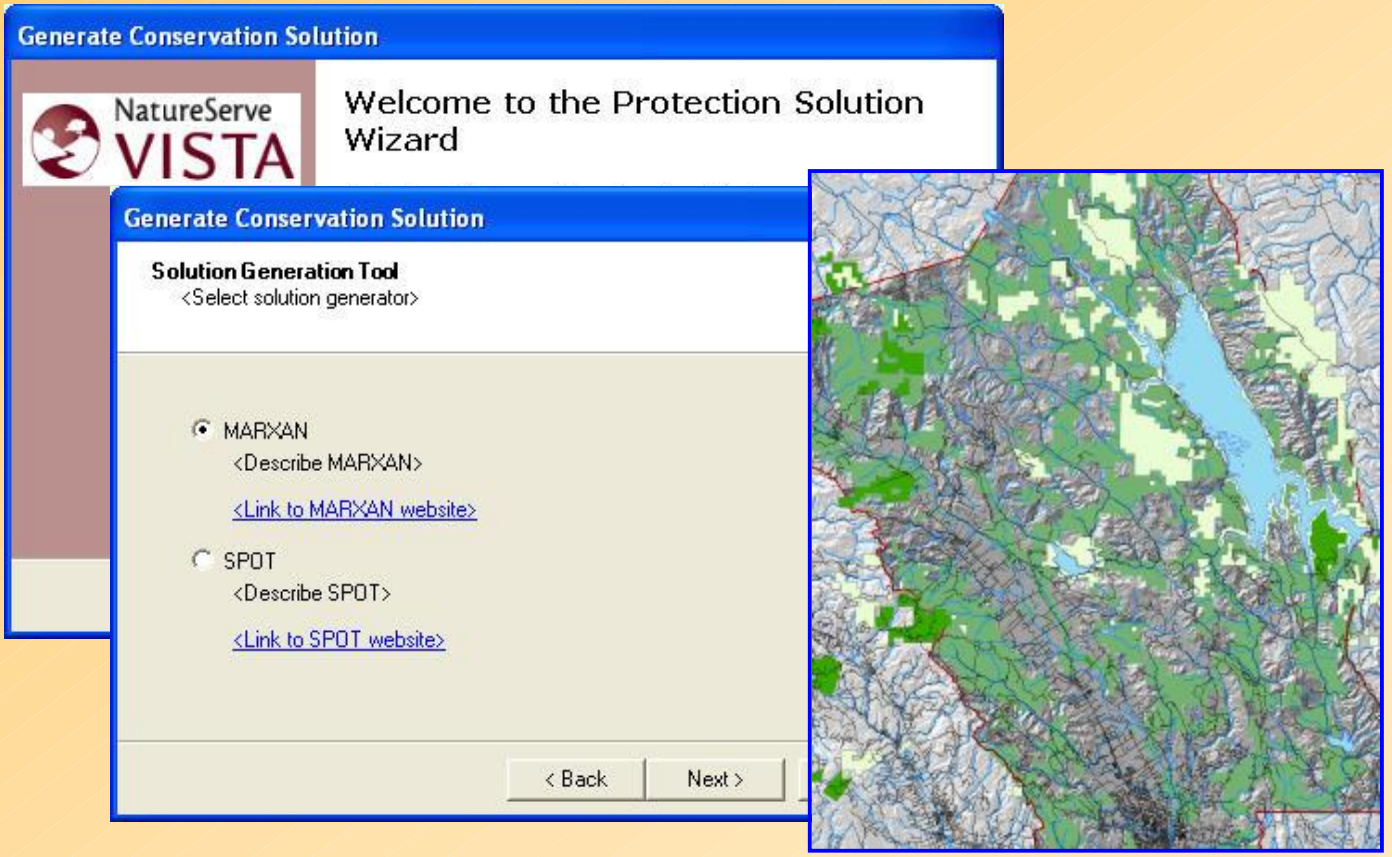
Site Explorer

- Select unit of interest
- View site and element information
- Propose alternative use
- Select implementation mechanism
- Build mitigation plan



Scenario Generation

- Prepare inputs for MARXAN and SPOT
- Provide policy context for refining optimized output



Create Solutions, Identify "Irreplaceable" Sites

Identify a set of locations that can meet conservation goals at least cost or conflict with production objectives

Calculate the relative irreplaceability of sites for meeting conservation goals