F – TRAC

Florida Forever
Tool for Efficient Resource Acquisition and Conservation

Model Documentation and
Project Evaluation

Florida Natural Areas Inventory

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All of the major decision points in this modeling process received consensus support from a working group of natural resource and conservation experts, who also provided guidance and important insights throughout. The original working group in 2001 – 2003 consisted of Greg Brock, Doria Gordon, Richard Hilsenbeck, Tom Hoctor, Fran James, Randy Kautz, Duane Meeter, Reed Noss, David Stoms, Hilary Swain, and Jora Young. In October 2010 and November 2011 the group convened and provided recommendations for some revisions to the F-TRAC methodology. Participants in the 2010 meeting included Greg Brock, Doria Gordon, Hilary Swain, Randy Kautz, Tom Hoctor, Robert Christianson, Gary Cochran, Mike Hallock-Solomon, Dennis Hardin, Jim Muller, Beth Stys, and Joe North. Greg Brock, Jim Muller, Randy Kautz, and Tom Hoctor participated in the 2011 meeting.

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INTRODUCTION

F-TRAC is an analysis conducted by the Florida Natural Areas Inventory (FNAI) for the Florida Forever environmental land acquisition program. It is based on a computer modeling approach to conservation reserve design known as Iterative Site Selection (ISS). The primary purpose for developing F-TRAC was to provide a concise analysis to evaluate current and potential land acquisition projects for the Florida Forever program. The model approach could be useful for other conservation planning efforts, but the results described here were developed specifically for the needs of Florida Forever, and are not likely to apply to other programs without substantial modifications.

F-TRAC considers six types of natural resource categories—species, communities, surface waters, wetlands, sustainable forestry, and aquifer recharge—and identifies a portfolio of sites that efficiently protects those resources. Efficiency is the key to the model; it approaches an optimal solution of the greatest resource protection in a given amount of land. Our analysis resulted in two scenarios: the 2020 Statewide Scenario, which identifies a portfolio of sites throughout the state; and the 2020 on Projects Scenario, which identifies a portfolio of sites only within existing and proposed Florida Forever Projects. Both Scenarios approximate the amount of land likely to be acquired through the twenty-year duration of the Florida Forever program. These scenarios are discussed in more detail below.

F-TRAC is the culmination of efforts by the Florida Natural Areas Inventory to provide scientific support for the Florida Forever program. This effort began with the Florida Forever Conservation Needs Assessment (G. Knight et al. 2000) first produced in December 2000, and since updated on a regular basis (FNAI 2011a). Reports detailing these efforts and other documents relating to the Florida Forever program are available on the FNAI website (www.fnai.org).

The Conservation Needs Assessment includes data layers for 14 natural resource categories corresponding to specific goals and measures established for Florida Forever by the Florida Forever Advisory Council. These goals and measures are closely based on suggested goals for the program set out by the Florida Legislature in the Florida Forever Act (§259.105, F.S.). The Needs Assessment data layers allow FNAI to report progress of the program in terms of ha of resources acquired, and provide a means of evaluating Florida Forever projects based on any single resource. We continue to evaluate projects in this manner using the Single Resource Evaluation (SRE) method (FNAI 2011b).

Despite the utility of the Single Resource Evaluation method, our analysis prior to F-TRAC lacked a method for evaluating a project's overall value for protecting all resources concerned. This can be viewed in terms of both a project's value relative to other projects on the Florida Forever list (needed for prioritizing projects for acquisition), and a project's value relative to the distribution of resources statewide (needed for establishing whether a potential project warrants addition to the list, or whether areas not yet proposed should be considered as projects). F-TRAC addresses both facets in a single evaluation that allows concise reporting and relatively transparent interpretation of results.

To guide our work through the modeling process, we formed a working group of natural resource and reserve design experts. The original group from 2001 – 2003 included 11 members with a broad range of experience from the following organizations: Florida Department of Environmental Protection, Florida State University, The Nature Conservancy, University of Florida, Florida Fish & Wildlife Conservation Commission, University of Central Florida, Archbold Biological Station, and University of California – Santa Barbara. The group reconvened in 2009 – 2011 and was expanded to include Florida

Forestry Service, St. Johns River Water Management District (WMD), Northwest Florida WMD, and experts in the private sector. The working group proved invaluable to the process, and offered critical input and feedback throughout. We were able to achieve expert consensus on virtually all facets of F-TRAC.

As with all models, F-TRAC should be interpreted with appropriate discretion. The results should not be considered a final evaluation of projects for acquisition, but a tool to inform decision-making. No model can fully capture all nuances of a problem. Nevertheless, models such as F-TRAC are powerful because they synthesize a large amount of information in an objective manner, allowing decision-makers to focus on the most critical points of evaluation.

ITERATIVE SITE SELECTION

Iterative Site Selection (ISS) refers to a family of computational algorithms that evaluate large numbers of potential combinations of sites to find a set, or portfolio, that protects the largest amount of resources for the least cost. The algorithms most commonly used are heuristic, meaning that they do not evaluate every possible combination of sites (which is generally not feasible given contemporary computing technology), but proceed through a subset of combinations most likely to include the optimal solution. Each iteration involves the evaluation of one possible portfolio of sites. Generally, if the current portfolio being considered scores "better" than the previous "best" portfolio considered, the current portfolio becomes the "best," and is compared against others in each future iteration, until a better portfolio is found. Eventually a portfolio is found that cannot be improved upon, and is put forward in the model results as the best solution. Because the algorithms are heuristic, there is no guarantee that the solution found is the optimal solution (best among all possible combinations of sites), but by refining the model parameters through successive runs, users can be confident that the solution offered approaches the optimal solution closely enough for practical purposes.

The software we used to run ISS is known as Marxan, and was developed by Ian Ball and Hugh Possingham at the University of Queensland in Australia (Ball et al. 2009, Ball 2000, Ball and Possingham 2000). Marxan and its predecessor Spexan (also known as Sites, an ArcView user interface for Spexan, Andelman et al. 1999) have been used in many conservation planning studies (e.g. Ardron et al. 2002, Kelley et al. 2002, Leslie et al. 2002, Noss et al. 2002). Marxan offers a number of heuristic algorithms, the most commonly used being Simulated Annealing (Kirkpatrick et al. 1983). Simulated annealing is generally recognized to be the most effective algorithm available for ISS, and is the algorithm we used for all modeling in F-TRAC.

The central equation used to evaluate site portfolios in Marxan is known as the Objective Function. Simply put, the Objective Function is as follows:

Score = Portfolio Cost + Resource Shortfall Penalty

Score is a unit-less value that the algorithm attempts to minimize. Portfolio Cost is the cost of the selected portfolio in terms of either area (e.g. ha, acres) or dollars. Resource Shortfall Penalty is a penalty received for not meeting conservation targets for resources. Targets are an important element of the model that will be discussed further below. Additional operands can be added to the basic function, such as a cost threshold penalty (penalty for exceeding a set portfolio budget), a boundary modifier (for clustering sites within the portfolio), etc. Basically, as more sites are added to the portfolio, cost increases while shortfall penalty decreases. The optimal portfolio will contain the most resource features for the least cost.

F-TRAC MODEL INPUTS

Although a variety of parameters can be adjusted in the model, there are six main inputs essential to the process: planning units, conservation features, targets, weights, minimum area threshold, and cost threshold.

Planning Units

An essential feature of ISS modeling is the use of discrete sites, or planning units. These can take a variety of forms, and previous studies have used everything from grids to hexagons to watersheds. The only requirements are that the planning units are mutually exclusive, they have definable area or monetary cost, and that the distribution of resources across planning units is known.

We used hexagons as planning units because we found that the model works better if planning units are of uniform size and shape. From May 2003 – May 2010 we used the smallest hexagons possible given that Marxan version 1.8.7 software does not function correctly with more than approximately 65,000 planning units. For the 2020 Statewide Scenario, which operates on planning units covering the state of Florida, we used hexagons of 220 ha resulting in 68,273 planning units. For the 2020 on Projects Scenario, which operates only within the boundaries of unacquired Florida Forever projects, hexagons were 20 ha resulting in 40,309 planning units. The latest version of Marxan (version 2.4.3) does not have the same limitation on number of planning units and in November 2010 we began using 100 ha hexagons for both Statewide (111,574 planning units) and on Projects (10,983 planning units) Scenarios so that these two analyses would be more consistent with each other.

An important exception to the regular hexagons was our use of actual boundaries for existing managed areas and Florida Forever projects in the 2020 Statewide Scenario. Contiguous managed areas were dissolved into a single planning unit that was locked into the model portfolio (since they are already protected lands). Aquatic Preserves were also included in the managed area planning unit. Managed area boundaries were from the FNAI Florida Managed Areas database as of September 2011.

Using precise managed areas boundaries, together with an irregular coastline, left many of our statewide hexagons in incomplete segments, some of which were tiny slivers. To correct for this, we selected all polygons outside of the managed area units that were smaller than 50 ha, or half the size of the standard planning unit. These small polygons were then dissolved into the smallest adjacent planning unit. The result was that for all planning units outside of managed areas and projects, planning unit size ranges from 50 – 150 ha (with the exception of small isolated planning units, such as outparcels within managed area boundaries, which could not be dissolved into adjacent polygons). As a final detail, any isolated managed areas smaller than 0.5 ha were dissolved into the surrounding hexagon unit and considered unprotected. Likewise, any isolated outparcels smaller than 0.5 ha surrounded by managed areas were dissolved into the surrounding managed area and considered protected. Figure 1 shows a subset of statewide planning units in Northeast Florida, illustrating the standard hexagon units as well as the irregular managed area units.

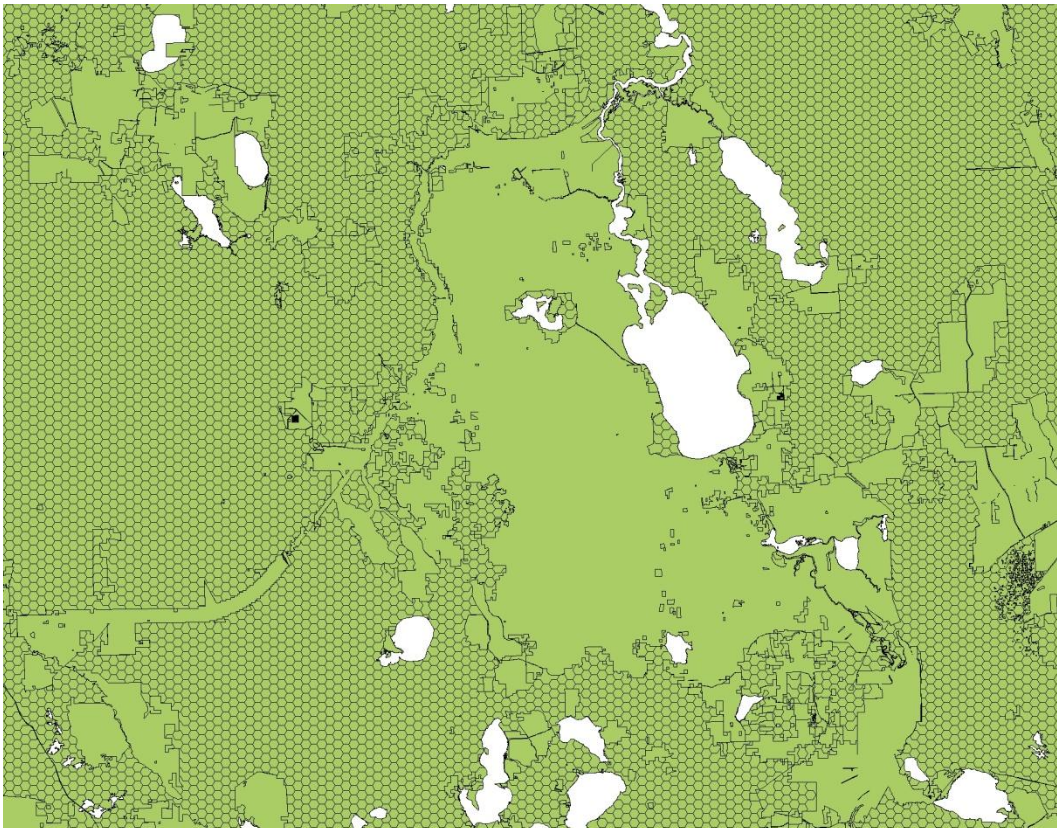

Figure 1. Example of planning units used in the 2020 Statewide Scenario.

All of these manipulations were done to keep planning unit size as uniform as possible, simplify planning unit boundaries, and reduce the total number of planning units. Number of planning units is a significant factor because it is directly related to model running time. Finally, because there is not sufficient statewide land value data for Florida, we used area as our planning unit cost.

Planning Unit Status

Each planning unit is assigned a status that determines how it is evaluated in the final portfolio. Most units are assigned a status of "0" meaning they receive full evaluation in the iterative process and may or may not be selected for a portfolio. Units may also be 'locked in' or 'locked out' of the final portfolio. Prior to November 2010, managed areas were 'locked out' of the on Projects Scenario so that the amount of each conservation feature (i.e resource) that was already protected was not factored into the final portfolio selection. In October 2010, FNAI and the expert working group recognized that the on Projects portfolio should represent areas that most efficiently protect target resources *in addition* to what is already protected. Therefore, beginning in November 2010, the status of managed areas was 'locked in' for both Statewide and on Projects scenarios, so that remaining planning units were evaluated in light of the amount of resources already protected. Tribal lands were 'locked out' of both Statewide and on Projects scenarios.

Conservation Features

Conservation features are the actual natural resources to be considered in the model. Often they are individual species and natural community occurrences or habitats. If occurrences are used, all planning units having an occurrence of a given species or community will score a 1 for that resource, while other planning units will score 0. If habitat area is used, planning units are scored in terms of acres or ha of habitat on the planning unit.

For F-TRAC, we were faced with a very different set of conservation features. Rather than individual species or community models, we needed to use the existing Florida Forever Decision Support Data Layers (FNAI 2011c) derived from the Conservation Needs Assessment data (FNAI 2011a). These data layers were required for two reasons. First, we needed to be able to report model results in terms of the standard data layers being used for all other Florida Forever analysis and reporting. Second, breaking the resource data layers down into individual species habitat models (of which there are about 300) and other individual resource types would have created an impractical number of conservation features (like planning units, the number of conservation features directly influences model running time). As a result, our conservation features represent priority classes of seven different resource types: species, communities, surface waters, wetlands, sustainable forestry, aquifer recharge, and ecological greenways. We did divide the natural community priorities into individual communities, so that we could set targets for each community separately. Several Decision Support Data Layers were further prioritized for input into F-TRAC, including Species, Natural Communities, and Ecological Greenways (described in the Decision Support documentation, FNAI 2011c). Table 1 shows these resources broken down into their respective conservation features.

Not all of the Florida Forever Decision Support Data Layers were included in F-TRAC. Archaeological and Historical Sites, and Recreational Trails did not fit well with the ISS/Marxan modeling environment for various reasons. Cultural sites were not included because cultural resource experts have not identified a method for prioritizing these sites in a quantifiable manner. Recreational Trails were omitted because they are linear rather than area features, and also depend on feature connectivity. All of these resources are still used to evaluate Florida Forever projects using the Single Resource Evaluation method (FNAI 2011b).

<u>Targets</u>

Marxan requires that a target be set for each conservation feature in the model. The target is necessary so that the Resource Shortfall Penalty can be calculated. For each conservation feature, the shortfall penalty is based on the difference between the target for that feature and the actual amount of the feature held in the current portfolio. The penalty is at its maximum if none of the resource is held in the portfolio. If the portfolio includes at least as much of the resource as specified in the target, the shortfall penalty is zero.

Targets for the resources used in F-TRAC were set with consensus of our expert work group, and are shown in Table 1. These are working targets set by informed expert opinion. They are not acquisition targets, and were not set with the acquisition scope of Florida Forever in mind. Rather, the experts considered an ideal conservation scenario for Florida. The targets are set higher for higher priority resources, as these represent the rarest and most sensitive and/or highest quality resources that will likely require managed area protection in order to persist. Also, the targets were not set with current protection status in mind. Some lower priority resources already have more area protected than prescribed by the target (pine flatwoods, surface waters 5 - 7, forestry 4, recharge 3 – 6). To keep those conservation features as factors in the model, we added an additional 5 percent of the original target ha for those resources to the final target used in the model (as shown in the Target Ha column).

Table 1. Conservation Features, Targets, and Weights Used in F-TRAC in November 2011

Conservation Feature	Total ha	Protected ha	% Protected	Target (% Total ha)	Target (unprotected ha only)	Target (incl. protected)	2020 Weight
species 1 Wide-ranging	114,407	55,894	49%	50%	1,310	57,203	49
species 2 Wide-ranging	97,723	20,720	21%	50%	28,141	48,862	25
species 3 Wide-ranging	2,688,890	1,264,673	47%	40%	53,778	1,318,451	9
species 4 Wide-ranging	1,801,615	217,636	12%	25%	232,768	450,404	1
species 5 Wide-ranging	504,354	31,581	6%	13%	31,464	63,044	0.5
species 6 Wide-ranging	520,952	31,307	6%	10%	20,788	52,095	0.25
species 1 Standard	603,723	339,199	56%	98%	252,449	591,649	100
species 2 Standard	164,028	103,479	63%	98%	57,268	160,747	64
species 3 Standard	2,333,000	1,809,005	78%	80%	57,395	1,866,400	36
species 4 Standard	379,909	125,438	33%	50%	64,516	189,954	16
species 5 Standard	132,186	19,265	15%	25%	13,781	33,047	9
species 6 Standard	50,972	4,065	8%	10%	1,033	5,097	4
upland glade Very High	15	1	10%	98%	13	15	100
pine rockland Very High	6,727	6,342	94%	98%	250	6,592	100
pine rockland High	3	1	31%	75%	1	2	56
scrub- Very High	196,410	149,707	76%	95%	36,883	186,590	81
scrub- High	7,910	1,086	14%	75%	4,846	5,932	42
scrub- Moderate	2,418	302	12%	50%	907	1,209	25
rockland hammock Very High	7,308	6,164	84%	95%	778	6,942	81
rockland hammock High	344	118	34%	75%	140	258	42
rockland hammock Moderate	107	74	69%	50%	3	76	25
dry prairie Very High	59,711	38,250	64%	95%	18,475	56,726	81
dry prairie High	2,539	253	10%	75%	1,652	1,904	42
dry prairie Moderate	102	2	2%	50%	49	51	25
seepage slope Very High	2,659	2,618	98%	95%	126	2,745	81
seepage slope High	8	7	87%	75%	0	7	42
seepage slope Moderate	0	0	0%	50%	0	0	25
sandhill Very High	302,629	197,832	65%	95%	89,665	287,497	36
sandhill High	21,176	4,813	23%	75%	11,069	15,882	20
sandhill Moderate	5,823	542	9%	50%	2,369	2,912	9
sandhill lake Very High	22,685	5,070	22%	95%	16,482	21,551	36
sandhill lake High	4,842	46	1%	75%	3,586	3,632	20
sandhill lake Moderate	756	3	0%	50%	375	378	9
coastal uplands Very High	31,319	22,449	72%	80%	2,606	25,055	36
coastal uplands High	4,177	785	19%	67%	2,014	2,798	20
coastal uplands Moderate	955	67	7%	40%	315	382	9
upland hardwood Very High	105,937	15,582	15%	25%	10,903	26,484	16
upland hardwood High	52,003	1,156	2%	15%	6,644	7,800	12
upland hardwood Moderate	15,571	158	1%	10%	1,399	1,557	4
pine flatwoods Very High	810,852	457,865	56%	50%	20,271	478,137	16
pine flatwoods High	83,334	9,969	12%	33%	17,531	27,500	12
pine flatwoods Moderate	29,423	1,518	5%	25%	5,838	7,356	4
surface waters 1	278,517	172,451	62%	90%	78,214	250,665	81
surface waters 2	772,629	403,969	52%	80%	214,134	618,103	64
surface waters 3	2,847,578	1,613,343	57%	50%	71,189	1,684,532	49
surface waters 4	924,012	173,870	19%	30%	103,333	277,203	25
surface waters 5	4,313,949	1,208,592	28%	10%	21,570	1,230,161	9
surface waters 6	813,452	84,198	10%	5%	2,034	86,232	1
surface waters 7	2,887,342	391,198	14%	5%	7,218	398,417	0.25
wetlands 1	2,044,028	1,813,888	89%	90%	25,737	1,839,625	81

wetlands 2	791,118	384,264	49%	70%	169,519	553,783	49
wetlands 3	934,747	211,056	23%	50%	256,318	467,374	25
wetlands 4	576,878	56,194	10%	30%	116,870	173,063	9
wetlands 5	120,737	7,615	6%	10%	4,459	12,074	1
wetlands 6	116,238	4,991	4%	5%	821	5,812	0.25
forestry 1	697,629	336,641	48%	60%	81,937	418,578	81
forestry 2	945,491	382,719	40%	55%	137,301	520,020	49
forestry 3	1,982,508	514,119	26%	35%	179,759	693,878	25
forestry 4	14,919	7,464	50%	15%	112	7,576	9
forestry 5	1,460,512	117,163	8%	10%	28,889	146,051	0.25
recharge 1	407,102	86,288	21%	50%	117,263	203,551	49
recharge 2	1,316,796	208,792	16%	25%	120,407	329,199	25
recharge 3	2,519,918	440,432	17%	10%	12,600	453,032	9
recharge 4	3,067,263	641,595	21%	5%	7,668	649,263	4
recharge 5	2,726,049	682,993	25%	3%	4,089	687,082	1
recharge 6	3,491,006	1,677,186	48%	1%	1,746	1,678,931	0.25
greenways Crit. Link. 1	171,662	3,872	2%	80%	133,458	137,329	49
greenways Crit. Link. 2	341,025	21,230	6%	60%	183,385	204,615	25
greenways Crit. Link. 3	328,739	22,309	7%	40%	109,187	131,496	9
greenways Crit. Link. 4	258,889	19,619	8%	20%	32,159	51,778	1
greenways Crit. Link. 5	177,961	12,774	7%	10%	5,022	17,796	0.5
greenways Crit. Link. 6	103,292	10,424	10%	5%	258	10,682	0.25

Weights

Whereas targets tell the model how much of a resource to search for in assembling a portfolio, weights tell the model how hard to search for that resource compared to other conservation features. In model terms, the weight acts as a multiplier on the shortfall between a conservation feature's target and amount held in a portfolio. The higher the weight, the greater the penalty for not meeting the target. Weights are most important when model parameters are set so that not all targets can be met. In such a case weights prioritize which conservation features will come closest to meeting their targets.

As with targets, the weights used in F-TRAC, shown in Table 1, were set with the consensus of our expert workgroup. The weights used were originally based on weights developed for the Single Resource Evaluation, with adjustments made to fit the modeling environment. The weights began as a 10-point scale, but these were squared in order to calibrate them to the model. In general, weights were set based on resource priority (higher priority, higher weight) and the characteristics of each resource class.

Minimum Area

With some resource types it is desirable to establish a minimum area threshold; that is, to get credit for protecting the resource the project must contain a minimum number of acres of that resource. Minimum area is not a required model input. Although Marxan is set up to handle minimum area thresholds, we were unable to get this function to work properly in an early version of the software. Instead we manually adjusted the amount of resource per hexagon in the conservation feature input files. If the minimum area threshold was not met for the entire Florida Forever project (including areas already acquired plus remaining areas in the project), all hexagons that occurred within the remaining area of that project were assigned a zero value for that resource. These adjustments were made prior to running both the 2020 Statewide and On Projects scenarios. The minimum area thresholds are shown in Table 2.

Table 2. Minimum area thresholds applied in F-TRAC scenarios.

Conservation Feature	Minimum Area (acres)
upland hardwood	50
pine flatwoods	50
watershed 1	500
watershed 2	500
watershed 3	500
watershed 4	1000
watershed 5	1000
watershed 6	1000
watershed 7	1000
forestry 1	500
forestry 2	1000
forestry 3	1000
forestry 4	1000
forestry 5	1000

Cost Threshold

Cost Threshold is not a required model input, but is needed if the model scenario is to be based on a limited budget or land area. The cost threshold takes the form of a penalty added to the objective function (increasing the portfolio score) if the portfolio exceeds the threshold. For the 2020 scenarios, the aim was to set a cost threshold so that the final portfolio would equal the amount of land likely to be acquired through the Florida Forever program. Staff at the Florida Department of Environmental Protection estimated that 481,800 acres are expected to be acquired on Florida Forever Board of Trustees (FFBOT) projects from July 2008-2021. Between July 2008 and September 2011 approximately 8,170 acres have been acquired; therefore the estimated amount of land likely to be acquired from September 2011 through 2021 is 473,700 acres (191,686 ha).

MODEL RESULTS

In the course of model development we ran dozens of scenarios to determine the effect of different parameter settings. Some scenarios were designed to test model sensitivity and optimize the model result, while others focused on alternative conservation scenarios. One of the more important sensitivity tests was conducted to determine the effect of increasing the number of iterations in each model run. Typical uses of Marxan set the number of iterations to 1 million for cases of around 10,000-15,000 planning units (D. Stoms, personal communication), while the largest study we found used 10 million iterations for a case involving 32,000 planning units (Ardron et al., 2002, J. Ardron, personal communication). We ran several tests to determine the appropriate number of iterations for a case of 44,000 planning units. Figure 2 shows the results of our tests.

These results indicate that the model score could be substantially reduced by increasing the number of iterations beyond 10 million. The results show diminishing returns with increasing iterations, and due to the amount of time required to run the model we chose 1 billion iterations as our final setting. These tests also showed that increasing the number of model runs (with the same number of iterations) has much less effect on the final score than increasing iterations (with the same number of runs). We plan to conduct additional sensitivity tests with the current set of 120,000 planning units.

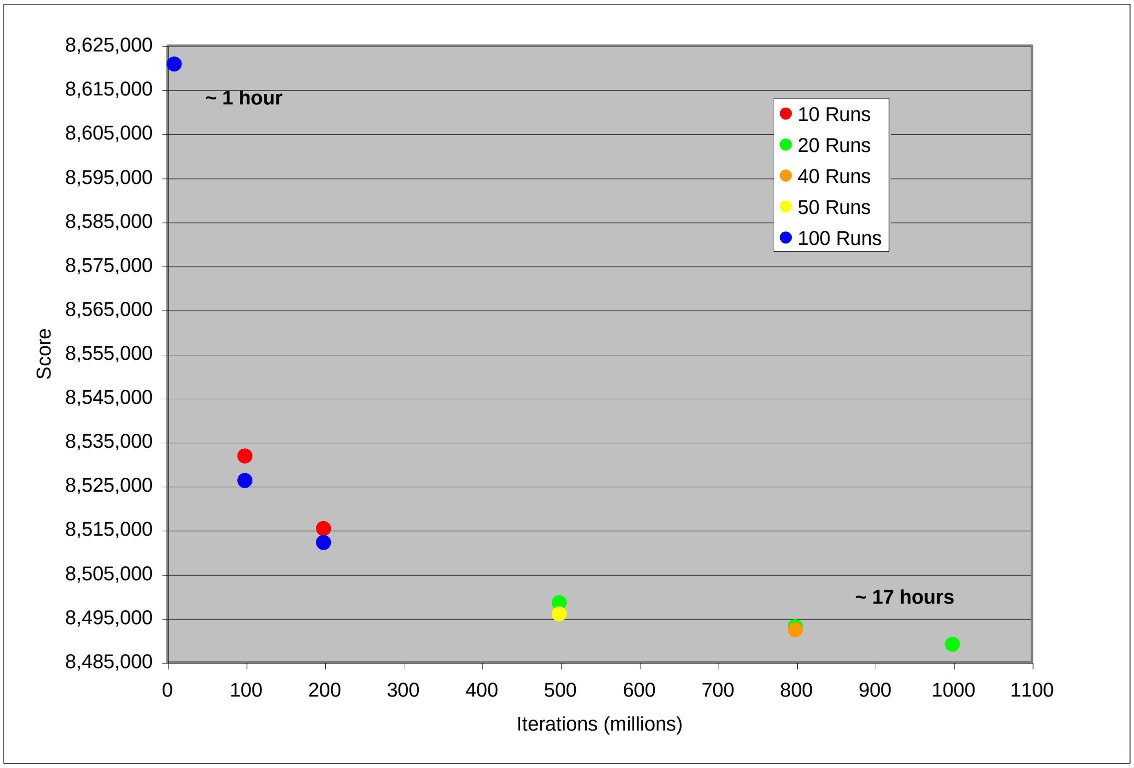

Figure 2. Effect of iterations vs. runs on model results

<u>2020 Statewide Scenario</u>

As noted above, the purpose of the 2020 Statewide scenario was to identify a portfolio of lands statewide with a total area limited to the amount of land expected to be acquired on Florida Forever BOT projects through the 20-year duration of the program. Table 3 lists the amount of each conservation feature included in the portfolio. With conservation lands excluded the portfolio consists of 191,686 ha which approximates the cost threshold described above.

Not all targets could be achieved in the 2020 Scenario, but many targets were exceeded. These "surplus" ha were due to overlap between these resources and other resources whose targets the model was still trying to achieve. Also note that lower priority resources tended to come closer to meeting their targets. This is due to the fact that lower priorities generally had lower targets to begin with.

<u>2020 On Projects Scenario</u>

The purpose of the 2020 On Projects scenario was to identify a portfolio of lands within the unacquired portions of Florida Forever BOT projects with a total area limited to the amount of land expected to be acquired on Florida Forever BOT projects through the 20-year duration of the program. Table 3 lists the amount of each conservation feature included in the portfolio.

Table 3. Resources included in the 2020 Statewide and On Projects Scenarios in November 2011

	2020 Statewide Portfolio					2020 On Projects Portfolio			
Conservation Feature	Total Resource Ha Statewide	Ha in Portfolio (includes protected)	Percent of Total Resource	Percent of Target		Total Resource Ha On Projects	Ha in Portfolio (excludes protected)	Percent of Resource Available that is in Portfolio	Percent of Target
species 1 Wide-ranging	114,407	57,203	50%	100%		15,462	61,685	25%	108%
species 2 Wide-ranging	97,723	29,484	30%	60%		19,063	36,635	133%	75%
species 3 Wide-ranging	2,688,890	1,288,332	48%	98%		246,954	1,316,405	100%	100%
species 4 Wide-ranging	1,801,615	231,295	13%	51%		103,343	228,491	197%	51%
species 5 Wide-ranging	504,354	35,337	7%	56%		31,286	37,504	168%	59%
species 6 Wide-ranging	520,952	35,998	7%	69%		41,589	36,343	143%	70%
species 1 Standard	603,723	358,793	59%	61%		52,330	367,801	161%	62%
species 2 Standard	164,028	113,614	69%	71%		11,199	111,786	144%	70%
species 3 Standard	2,333,000	1,824,688	78%	98%		98,075	1,843,577	101%	99%
species 4 Standard	379,909	137,116	36%	72%		20,153	133,354	142%	70%
species 5 Standard	132,186	22,765	17%	69%		7,860	22,247	149%	67%
species 6 Standard	50,972	5,287	10%	104%		5,374	5,097	100%	100%
upland glade Very High	15	15	98%	100%		7	9	172%	58%
pine rockland Very High	6,727	6,592	98%	100%		132	6,474	102%	98%
pine rockland High	3	2	75%	100%		0	1	218%	46%
scrub- Very High	196,410	154,837	79%	83%		9,332	154,669	121%	83%
scrub- High	7,910	5,549	70%	94%		220	1,304	455%	22%
scrub- Moderate	2,418	1,209	50%	100%		15	317	381%	26%
rockland hammock Very High	7,308	6,942	95%	100%		726	6,889	101%	99%
rockland hammock High	344	259	75%	100%		69	188	138%	73%
rockland hammock Moderate	107	80	75%	105%		2	76	101%	99%
dry prairie Very High	59,711	54,059	91%	95%		9,590	47,437	120%	84%
dry prairie High	2,539	1,904	75%	100%		442	693	275%	36%
dry prairie Moderate	102	58	57%	115%		5	6	785%	13%
seepage slope Very High	2,659	2,641	99%	96%		3	2,621	105%	95%
seepage slope High	8	7	98%	108%		0	7	104%	96%
seepage slope Moderate	0	0	100%	200%		0	0	0%	0%
sandhill Very High	302,629	202,052	67%	70%		12,448	205,301	140%	71%
sandhill High	21,176	8,725	41%	55%		167	4,926	322%	31%
sandhill Moderate	5,823	2,911	50%	100%		3	545	534%	19%
sandhill lake Very High	22,685	12,848	57%	60%		683	5,744	375%	27%
sandhill lake High	4,842	2,489	51%	69%		9	55	6659%	2%
sandhill lake Moderate	756	378	50%	100%		0	3	12349%	1%
coastal uplands Very High	31,319	24,789	79%	99%		959	23,157	108%	92%
coastal uplands High	4,177	2,469	59%	88%		66	850	329%	30%
coastal uplands Moderate	955	382	40%	100%		6	73	527%	19%
upland hardwood Very High	105,937	17,631	17%	67%		3,926	17,458	152%	66%
upland hardwood High	52,003	6,873	13%	88%		107	1,187	657%	15%
upland hardwood Moderate	15,571	1,556	10%	100%		4	158	982%	10%
pine flatwoods Very High	810,852	461,665	57%	97%		69,003	476,672	100%	100%
pine flatwoods High	83,334	10,766	13%	39%		2,423	10,356	266%	38%
pine flatwoods Moderate	29,423	1,986	7%	27%		94	1,537	479%	21%
surface waters 1	278,517	174,457	63%	70%		21,228	182,022	138%	73%
surface waters 2	772,629	410,104	53%	66%		50,813	416,797	148%	67%
surface waters 3	2,847,578	1,633,631	57%	97%		116,148	1,639,132	103%	97%
surface waters 4	924,012	180,083	19%	65%		52,949	183,275	151%	66%
surface waters 5	4,313,949	1,257,985	29%	102%		286,832	1,275,529	96%	104%
surface waters 6	813,452	93,591	12%	109%		60,981	96,102	90%	111%
surface waters 7	2,887,342	450,104	16%	113%		192,493	442,064	90%	111%
wetlands 1	2,044,028	1,821,476	89%	99%		61,592	1,837,186	100%	100%
wetlands 2	791,118	391,500	49%	71%		74,578	403,597	137%	73%
wetlands 3	934,747	216,819	23%	46%		103,815	231,064	202%	49%
wetlands 4	576,878	62,112	11%	36%		50,889	65,868	263%	38%
wetlands 5	120,737	9,771	8%	81%		5,178	8,956	135%	74%
wetlands 6	116,238	6,865	6%	118%		1,417	5,196	112%	89%

forestry 1	697,629	339,986	49%	81%		75,538	358,297	117%	86%
forestry 2	945,491	389,451	41%	75%		78,951	397,052	131%	76%
forestry 3	1,982,508	529,032	27%	76%		138,100	538,713	129%	78%
forestry 4	14,919	7,615	51%	101%		2,061	8,087	94%	107%
forestry 5	1,460,512	127,612	9%	87%		95,443	136,631	107%	94%
recharge 1	407,102	115,759	28%	57%		15,880	94,591	215%	46%
recharge 2	1,316,796	238,218	18%	72%		43,602	217,425	151%	66%
recharge 3	2,519,918	477,838	19%	105%		138,367	466,854	97%	103%
recharge 4	3,067,263	684,735	22%	105%		205,723	697,929	93%	107%
recharge 5	2,726,049	710,319	26%	103%		181,312	726,026	95%	106%
recharge 6	3,491,006	1,689,547	48%	101%		159,927	1,710,166	98%	102%
greenways Crit. Link. 1	171,662	27,929	16%	20%		81,281	80,202	171%	58%
greenways Crit. Link. 2	341,025	34,982	10%	17%		112,396	69,248	295%	34%
greenways Crit. Link. 3	328,739	30,738	9%	23%		83,536	38,388	343%	29%
greenways Crit. Link. 4	258,889	22,296	9%	43%		54,515	25,290	205%	49%
greenways Crit. Link. 5	177,961	13,385	8%	75%		38,679	17,752	100%	100%
greenways Crit. Link. 6	103,292	10,808	10%	101%		21,536	11,687	91%	109%

EVALUATING FLORIDA FOREVER PROJECTS

The main purpose of the F-TRAC analysis is to provide a comprehensive means of evaluating current and potential Florida Forever projects across several resource types. The 2020 Statewide scenario provides a picture of what the program could achieve under optimal conditions. We recognize that the achievements of the statewide scenario may not translate into realistic goals for the Florida Forever program. Not all landowners falling within the statewide portfolio will be willing sellers, for example, and of course not all natural resources were included in the model. But the scenario is a reasonable (and challenging) benchmark by which to compare actual program accomplishments.

The 2020 On Projects scenario evaluates planning units only within existing and proposed Florida Forever projects (remaining ha only) for the best places to acquire resources. An evaluation of projects based on this scenario provides a means of comparing projects relative to one another but does not provide a statewide context.

Because Iterative Site Selection works through random sets of planning units to assemble a portfolio that approaches an optimal collection of resources, each model run will achieve slightly different results. The standard procedure therefore is to include multiple runs for each scenario (as discussed in the documentation below). Marxan also provides a “summed solutions” result, tabulating how many times each planning unit was included in the best portfolio for each run. This statistic has been used by other modelers as a measure of “irreplaceability” of planning units (Ardron et al. 2002; Noss et al. 2002), and is considered to be more robust than using the single best portfolio from one run.

Our final 2020 Scenarios included 50 runs of 1 billion iterations each. We grouped the planning units into six classes based on the number of runs in which they were included in each portfolio. Table 4 provides details of how planning units were grouped. To evaluate Florida Forever projects, we treated the six planning unit classes the same as priority classes of one of our original Decision Support Data Layers (see FNAI 2011c), and scored the projects using the “weighted score” method (described in FNAI 2010b). Weights are shown in Table 4.

Table 4. How planning units in 2020 Scenarios were classed and weighted for project evaluation.

Summed Solutions Class	**Number of Runs**	**Project Scoring Weight**
Class 1	50	10
Class 2	40-49	8
Class 3	30-39	6
Class 4	20-29	4
Class 5	10-19	2
Class 6	1-9	1

Finally, the projects were broken into five groups for concise scoring on the Florida Forever Project Comparative Analysis. The breaks differed for the Statewide versus On Projects evaluation. Because the statewide portfolio planning units were not limited to Florida Forever project boundaries the scores overall were much lower than with the On Projects portfolio. Because the On Projects F-TRAC is intended to evaluate projects relative to each other we set the breaks based a comparison of the cost threshold to the total acres on the list. The cost threshold of 473,700 acres is 24% of the total remaining acres of projects; thus we expect an ‘average’ or medium ranked project to score at least 2.4. The breaks for the On Projects evaluation were set based on this rationale. The project groups as determined by scoring breaks for each scenario are shown in Table 5. Table 6 shows the final scoring and group of Florida Forever projects Florida Forever projects for the November 2011 evaluation.

Table 5. Project group based on scoring breaks for Statewide and On Projects Scenarios

Project Group	Scoring Breaks for Statewide Scenario	Scoring Breaks for On Projects Scenario
Very High	≥2.50	≥7.20
High	1.00-2.49	4.80-7.19
Medium	0.20-0.99	2.40-4.79
Medium-Low	0.01-0.19	0.01-2.39
Low to None	0	0

Table 6. Project scores and final grouping for Florida Forever Evaluation Summary Table, November 2011

	2020 Statewide Scenario		2020 on Projects Scenario	
Project	**Score**	**Final Grouping**	**Score**	**Final Grouping**
Adams Ranch	3.63	VH	7.32	H
Annutteliga Hammock	0.53	M	6.16	H
Apalachicola River	1.63	H	5.98	VH
Archie Carr Sea Turtle Refuge	7.75	VH	7.77	VH
Atlantic Ridge Ecosystem	0.02	ML	0.03	ML
Ayavalla Plantation	0.01	ML	2.81	H
Baldwin Bay/St. Marys River	0.00	ML	0.00	M
Battle of Wahoo Swamp	0.00	L	0.00	L
Bear Creek Forest	0.04	ML	1.62	L
Bear Hammock	0.00	L	3.14	M
Belle Meade	0.01	ML	0.00	VH
Big Bend Swamp/Holopaw Ranch	0.60	M	2.38	ML
Bombing Range Ridge	4.24	VH	7.01	M
Brevard Coastal Scrub Ecosystem	0.36	M	1.75	H
Caber Coastal Connector	0.27	M	7.10	ML
Caloosahatchee Ecoscape	0.26	M	3.00	H
Camp Blanding to Raiford Greenway	0.00	L	2.24	M
Carr Farm/Price's Scrub	0.00	L	9.95	L
Catfish Creek	0.00	ML	0.00	VH
Charlotte Harbor Estuary	0.04	ML	0.09	ML
Charlotte Harbor Flatwoods	0.00	L	0.01	ML
Clay Ranch	0.00	L	0.00	L
Clear Creek/Whiting Field	0.00	L	0.00	L
Corkscrew Regional Ecosystem Watershed	0.28	M	3.23	L
Coupon Bight/Key Deer	5.83	VH	7.56	M
Crossbar/Al Bar Ranch	0.00	L	1.28	VH
Dade County Archipelago	5.70	VH	6.12	M
Devil's Garden	0.55	M	3.45	VH
Dickerson Bay/Bald Point	0.06	ML	0.86	M
Escribano Point	0.02	ML	0.04	ML
Estero Bay	0.22	M	0.77	ML
Etoniah/Cross Florida Greenway	0.03	ML	1.68	ML
Fisheating Creek Ecosystem	1.83	H	5.94	ML

Flagler County Blueway	1.42	H	1.88	M
Florida's First Magnitude Springs	0.74	M	4.28	H
Florida Keys Ecosystem	4.05	VH	6.90	VH
Florida National Scenic Trail	0.00	L	0.00	L
Florida Springs Coastal Greenway	0.31	M	3.07	ML
Garcon Ecosystem	0.00	L	1.16	H
Green Swamp - Hilochee Corridor	0.00	ML	0.00	VH
Green Swamp - Peace River Headwaters	0.00	L	0.00	ML
Green Swamp - Pine Island Recharge Area	0.00	ML	0.09	L
Green Swamp - Withlacoochee River Headwaters	0.00	L	0.12	L
Gulf Hammock	0.00	L	0.81	ML
Half Circle L Ranch	0.60	M	8.27	ML
Hall Ranch	0.00	L	1.27	ML
Heather Island/Ocklawaha River	0.00	L	0.00	L
Hixtown Swamp	0.00	L	0.00	M
Horse Creek Ranch	0.00	L	0.00	L
Hosford Chapman's Rhododendron Protection Zone	0.00	L	1.26	ML
Ichetucknee Trace	0.00	L	0.00	ML
Indian River Lagoon Blueway	0.28	M	1.03	ML
Kissimmee-St. Johns River Connector	1.05	H	2.53	L
Lafayette Forest	0.00	L	0.00	ML
Lake Hatchineha Watershed	0.00	L	0.00	H
Lake Santa Fe	0.00	L	0.90	L
Lake Wales Ridge Ecosystem	0.55	M	3.91	ML
Little River Conservation Area	0.00	L	0.00	VH
Lochloosa Wildlife	0.00	L	0.48	L
Longleaf Pine Ecosystem	0.13	ML	6.83	ML
Lower Perdido River Buffer	0.00	L	0.00	L
Lower Suwannee River and Gulf Watershed	0.03	ML	3.06	H
Maytown Flatwoods	0.20	M	3.76	ML
Middle Chipola River	0.01	ML	1.36	L
Mill Creek	0.00	L	0.00	L
Millstone Plantation	0.00	L	0.00	H
Myakka Ranchlands	0.00	L	0.00	M
North Key Largo Hammocks	3.37	VH	4.12	ML
Northeast Florida Blueway	0.22	M	1.55	VH
Northeast Florida Timberlands and Watershed Reserve	0.04	ML	0.74	L
Ochlockonee River Conservation Area	0.00	L	3.33	L
Okeechobee Battlefield	0.00	L	0.00	ML
Old Town Creek Watershed	0.00	L	0.00	ML
Osceola Pine Savannas	0.29	M	4.98	ML
Pal-Mar	0.01	ML	0.02	L
Panther Glades	0.63	M	3.82	L
Peace River Refuge	0.00	ML	0.00	H
Peaceful Horse Ranch	0.00	ML	0.00	L
Perdido Pitcher Plant Prairie	0.00	ML	0.00	M
Pierce Mound Complex	0.02	ML	0.46	L

Pine Island Slough Ecosystem	1.60	H	2.89	L
Pineland Site Complex	0.00	L	0.00	ML
Pinhook Swamp	0.36	M	6.46	ML
Pumpkin Hill Creek	0.17	ML	0.80	VH
Raiford to Osceola Greenway	0.00	ML	1.24	ML
Rainbow River Corridor	0.03	ML	2.84	L
Ranch Reserve	0.25	M	6.34	L
San Felasco Conservation Corridor	0.00	L	0.00	M
San Pedro Bay	0.00	L	0.00	L
Sand Mountain	2.77	VH	5.95	M
Save Our Everglades	0.02	ML	1.17	L
Seven Runs Creek	0.01	ML	1.02	H
Shoal River Buffer	0.00	L	0.00	M
South Goethe	1.15	H	7.25	ML
South Walton County Ecosystem	0.52	M	2.30	VH
Southeastern Bat Maternity Caves	0.00	L	1.21	M
Spruce Creek	0.00	ML	1.87	ML
St. Joe Timberland	0.30	M	1.84	L
St. Johns River Blueway	0.00	ML	0.00	L
Suwannee County Preservation	0.00	L	0.00	L
Terra Ceia	0.02	ML	0.04	L
Three Chimneys	0.00	L	0.00	L
Tiger Cattle Company Ranch	0.07	ML	4.04	VH
Tiger/Little Tiger Island	0.00	L	0.00	H
Triple Diamond	5.50	VH	7.54	ML
Twelvemile Slough	2.37	H	7.79	VH
Upper Shoal River	0.00	ML	0.00	ML
Upper St. Marks River Corridor	0.00	L	0.86	M
Volusia Conservation Corridor	0.01	ML	1.84	M
Wacissa/Aucilla River Sinks	0.29	M	1.25	VH
Wakulla Springs Protection Zone	0.00	L	0.00	VH
Watermelon Pond	0.00	L	2.86	L
Wekiva-Ocala Greenway	0.02	ML	3.90	L
West Aucilla River Buffer	0.00	L	0.00	ML
West Bay	0.00	ML	0.08	ML
Windover Archaeological Site	0.00	L	0.00	ML
Wolfe Creek Forest	0.00	ML	0.09	ML

In summary, F-TRAC is a valuable tool to help decision makers evaluate a large amount of natural resource data in a concise format. We reiterate here that F-TRAC does not represent a final acquisition plan for the state of Florida, but is a tool to inform those who must make the final decisions regarding land acquisition projects. Also, F-TRAC is designed to be the primary tool to evaluate Florida Forever projects, but should be used in conjunction with the Florida Forever Single Resource Evaluation, and any other relevant information not captured by quantitative natural resource data.

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APPENDIX A

Marxan Input Parameters for November 2010 F-TRAC Scenarios

<u>2020 Statewide Scenario</u>

Number of Planning Units:	111,574
Runs:	50
Boundary Modifier:	0
Run Options:	Simulated Annealing only
Iterations:	1,000,000,000
Temperature Decreases:	10,000
Annealing Schedule:	Adaptive
Cost Threshold:	5,031,957 ha
Penalty Factor A:	3155
Penalty Factor B:	0.01
Starting Proportion:	0.01
Random Seed:	No

<u>2020 On Projects Scenario</u>

Number of Planning Units:	10,983
Runs:	50
Boundary Modifier:	0
Run Options:	Simulated Annealing only
Iterations:	1,000,000,000
Temperature Decreases:	10,000
Annealing Schedule:	Adaptive
Cost Threshold:	5,031,957 ha
Penalty Factor A:	2105
Penalty Factor B:	0.01
Starting Proportion:	0.01
Random Seed:	no