

The SLAMM Dynamic Marsh Management tool allows users to integrate complex SLAMM uncertainty-analysis results over time and to evaluate them on a land-parcel basis. The relative values of ecosystem services across multiple parcels may be evaluated given inputs about stakeholder values, alternative simulation scenarios, and uncertain future sea-level rise (SLR).

For background on the conceptual model behind the tool, please visit:

http://warrenpinnacle.com/prof/SLAMM/NYSERDA2015/Description_Marsh_Management_Tool.pdf

This tool uses an Excel spreadsheet to store model inputs and outputs and uses Visual Basic to perform calculations based on modified user inputs. A basic understanding of Microsoft Excel is required to use this product.

This Users' guide is designed for the tool's end user that wishes to look at different scenarios and to modify the flexible assumptions about the relative values of various ecosystem services. Therefore, the guide assumes that the SLAMM model has already been run, that SLAMM model results have already been extracted on a parcel basis, and that results are properly stored in the "SLAMM Raw Data" and "Data Setup" tabs. To add new parcels or new sets of SLAMM results to the model is a task for advanced SLAMM users only. A separate reference sheet will be prepared to guide users through those tasks.

Getting Started

Moving through Excel tabs from left to right:

- The "**Instructions**" tab contains a link to this information.
- The "**Model Summary**" tab contains information about the sites and scenarios that are included within the model.
 - A "site" is a specific GIS parcel that can be evaluated using this tool. Its definition can be based on tax maps, or delineation of individual marsh systems, as two examples.
 - A "scenario" contains the results of a SLAMM simulation with a specific adaptation strategy explored. (These results may be uncertainty runs or deterministic). Multiple adaptation scenarios may be included in the tool at one time to examine different assumptions, management scenarios, or SLR scenarios. (In terms of costs and incremental benefits of adaptation strategies, the first scenario in the list is considered the "no action" scenario.)
 - Historic Percent Loss rates per year are also included for information in this tab. Historic marsh loss rates may be projected into the future and are considered additive to projected SLR losses. (In the NYC example, these rates were derived by comparing 1974 and 2008 wetland maps for each parcel. Marsh losses were assumed to predate significant acceleration in SLR in these sites.)
- The "**Model Inputs**" tab contains all other model inputs required to run the model
 - "Beginning year" and "end year" may be set to vary the planning horizon

- The “**Ecosystem Relative Rank**” fields (horizontal across the top of the page) carry the results of the survey question asking “Please provide the relative ranks for how important each of the following ecosystem services are to your decision-making process.”

	Nutrient Sequestration			Recreation			Habitat		Other			Total Relative Rank
	Carbon Sequestration	Nitrogen Sequestration	Phosphorus Sequestration	Dry-land Recreation	Wetland Recreation	Natural services to under-served communities	Nekton habitat	Habitat fragmentation/ connectivity	Flood Vulnerability Reduction	Political/Cultural/ Historic value	General preservation of natural areas	
<i>Ecoservice Relative Rank</i>	8.3	9.0	6.9	4.2	4.2	7.4	15.0	19.5	12.8	5.1	7.8	100

More information about the interpretation of the Ecosystem Relative Rank may be found in the Ecosystem Services Glossary document

http://www.warrenpinnacle.com/prof/SLAMM/NYSERDA2015/Ecosystem_Service_Glossary.pdf

- Site-specific weights: The ecosystem benefits examined here have been related to the acreage predictions of land-cover types that come out of SLAMM simulations (using “utility functions.”) However, these equations do not take into account quality of habitat, for example. (In one location with a higher marsh density, more carbon sequestration could be assumed to occur than another location with lower density.) For this reason, site-specific weights are provided for the user to add information about each site when available.

<i>Site-specific "Quality of Habitat," should not reflect the numbers of acres of a particular land-cover type</i>								
Site 1	Idlewild Inner and Outer	20.33	23.67	35.00	7.67	6.67	7.67	6.00
Site 2	Alley Creek, Queens	30.33	32.00	47.50	6.67	6.33	7.33	9.00
Site 3	Lemon Creek, Staten Island	28.67	30.33	45.00	6.33	6.67	6.33	6.50
Site 4	Pelham Bay Cove	27.00	23.67	35.00	6.33	6.33	6.00	10.50
Site 5	W.T. Davis	33.67	30.33	45.00	6.33	6.33	6.67	11.00
Site 6	Udall's Cove, Queens	28.67	30.33	45.00	7.00	7.00	7.00	8.50

Site-specific weights are especially important for such categories as “recreation” in which the location and historic use of a marsh may be considered in providing weights. The size of the marsh should not be considered, however, when providing weights.

- “Discount Factors:” Below the site-specific weights in the “Model Inputs” tab, a user may experiment with weighting current ecosystem services more than future ecosystem services using the “Discount Factors” inputs. The table of discount factors is used, but it can be populated using a discount rate using the formula and input in column H.

Discount Factors			Discount Rate: 0%	
	Year	Discount Factor		
Timestep 1	2016	100.0%	2016	100.0%
Timestep 2	2020	100.0%	2020	100.0%
Timestep 3	2040	100.0%	2040	100.0%
Timestep 4	2050	100.0%	2050	100.0%
Timestep 5	2065	100.0%	2065	100.0%
Timestep 6	2075	100.0%	2075	100.0%
Timestep 7	2085	100.0%	2085	100.0%
Timestep 8	2100	100.0%	2100	100.0%
Timestep 9				
Timestep 10				

interpolates within up to 10 timesteps

Example discount rate calculation that can be copied into the discount factors table to the left.

- Below the discount factors is the cost of each adaptation strategy by parcel (optional). These fields allow the user to put a price on each of the adaptation scenarios by parcel depending on land costs, the extent of land predicted converted, marsh-restoration costs, and thin-layer deposition costs, for example.

		Adaptation Strategy Costs (millions of dollars per parcel)				
		No Migration	Migr. Undeveloped	Migr. All Dry	Restore to 1974	Thin Layer Depo.
Cost Details		no cost, existing marsh footprint	purchase undeveloped land or easement when required	purchase developed and undeveloped land when required	marsh restoration costs	thin layer deposition costs
Site 1	Idlewild Inner and Outer	N / A	57.12	67.33	20.66	31.66
Site 2	Alley Creek, Queens	N / A	41.56	50.74	9.87	8.65
Site 3	Lemon Creek, Staten Island	N / A	21.88	25.72	3.93	2.59
Site 4	Pelham Bay Cove	N / A	0.00	5.19	5.78	3.54
Site 5	W.T. Davis	N / A	10.83	13.60	21.25	6.01
Site 6	Udall's Cove, Queens	N / A	51.66	55.32	4.91	2.00
Site 7						
Total Strategy Cost		\$ -	\$ 183.05	\$ 217.88	\$ 66.40	\$ 54.44

- At the bottom of the “Model Inputs tab” is a set of “marsh loss” fields. These fields allow the user to enter the historical marsh loss rates for each parcel. Given low historical SLR rates, these historical marsh loss rates are not assumed to be from sea-level rise related factors. If the user wishes to extrapolate these losses into the future and add them to SLR losses the “assume historical marsh loss rates continue” button may be checked. This would mean that marshes that are rapidly declining would be expected to continue this decline, whereas marshes that have been historically shown to be robust would continue that trend as well (prior to any sea-level-rise related losses)

Assume Historical Marsh Loss Rates Continue (Additive to SLR losses)

Site Name	Historic Pct. Annual Marsh Loss (yr-1)
Site 1 Idlewild Inner and Outer	0.45%
Site 2 Alley Creek, Queens	0.66%
Site 3 Lemon Creek, Staten Island	0.53%
Site 4 Pelham Bay Cove	0.78%
Site 5 W.T. Davis	0.54%
Site 6 Udall's Cove, Queens	1.84%

- After all inputs have been edited, click “Calculate” to start the model calculation (or press <control><shift><R>). Note Excel will stop receiving inputs for a number of seconds, view the lower left of the Excel window to view model-run progress.
- The “Survey **Questions**” tab is provided for reference. It contains a summary of responses from stakeholders regarding the valuation of various ecosystem services.
 - NYSERDA survey information:
https://www.surveymonkey.com/r/NYSERDA_SLAMM_NASSAU and
https://www.surveymonkey.com/r/NYSERDASLAMM_NYC
- The “**Model Outputs**” tab contains a basic summary of aggregated utilities calculated over the simulation period
 - Benefits aggregated over the study period are presented by wetland-benefit type, by site, and by adaptation scenario run.
 - These may be automatically sorted using the “Sort by” pulldown box.

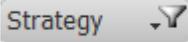
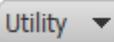
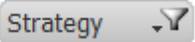
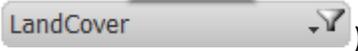
Sort By ▼

- Wetland-service benefits are unitless but can be compared across sites and across adaptation strategies. However, these are relative benefits and therefore cannot be compared from one spreadsheet implementation to the next (Nassau County SLAMM runs vs. NYC for example)
- To the right of the table of benefits are columns showing incremental benefits and costs

Site number	Site Name	Adaptation Scenario	Incremental Benefit	Cost of Strategy (millions)	Cost per Unit Benefit	Benefit per unit cost
Site 1	Idlewild Inner and Outer	Migr. Undeveloped	900.31	57.12	0.06	15.76
Site 2	Alley Creek, Queens	Migr. Undeveloped	1214.86	41.56	0.03	29.23
Site 3	Lemon Creek, Staten Island	Migr. Undeveloped	346.23	21.88	0.06	15.83
Site 4	Pelham Bay Cove	Migr. Undeveloped	616.94	0.00	0.00	N / A
Site 5	W.T. Davis	Migr. Undeveloped	956.59	10.83	0.01	88.35

The incremental benefit column shows how much the adaptation strategy has improved predicted wetland benefits against the “no-action” scenario (the “no-action” scenario is often labeled “no migration”). When this is combined with the cost of the adaptation strategy, the cost per unit benefit and benefit per unit cost may be calculated. Generally a user would be most interested in the adaptation strategy that provides the highest benefit per unit cost.

- The “**Ecosystem Benefits**” tab contains additional pre-made charts that can be used to examine model results.
 - Most of these tables have editable fields that allows the user to customize the graphic.

For example a field that says:  will allow you to click on the icon on the right and select one of the adaptation strategies and change the graph accordingly.
 - “**Components of Each Site’s Utility**” shows the components of utility for each site in a stacked bar chart. ((Note: you can select which strategy is being examined using the “Strategy” pull-down box at the top of the chart. You can also edit which utilities are shown and which sites using the other pull down boxes marked with  .)
 - “**Utility by Site over Time**” shows how the ecosystem utilities of each site change over time given SLR effects, historical marsh loss, and the selected discount rate. (The default is to show the sum of all utilities. However, the specific utility being displayed may be edited along with the strategy at the upper left :  )
 - “**Utility at one Site by Strategy over Time**” shows how the ecosystem utilities of one site across all adaptation strategies modeled. (The site being displayed and the utilities included may be edited at the upper left)
 - “**Expected Value Land-Cover Summary**” shows the predicted quantity of each wetland at each parcel over the simulation period. (Note: select which site and strategy you are viewing using the pulldown box at the top left.) The land cover selection originally shows only wetland types, but dry lands and open water may be selected using the land-cover pull down box at the right of the graph: )
- The “**Adaptation Strategy Benefits**” tab contains results showing the benefits and incremental benefits of each adaptation strategy.
 - “**Comparative Incremental Benefits of Adaptation Strategies**” shows the predicted incremental benefit of each adaptation strategy broken down by site. This gives the

user an idea of the impact of each adaptation strategy against the others as well as the site-specific differences in adaptation strategy.

- **“Incremental Benefits” pie chart** shows a pie chart of the incremental benefits of one adaptation strategy by site. So the relative benefit to each site of each adaptation strategy may be displayed. The adaptation scenario chosen may be modified using the pull-down box at the upper left: 
- **“Current Utility vs. 2100 Utility”** is an interesting bar chart that displays the current wetland benefits as a black bar for each site followed by a set of predictions for 2100. The second bar shows the no-action scenario predicted utility in the year 2100. The following bars show incremental benefits provided by adding multiple adaptation strategies to the previous bar. For example, the third bar shows the benefit of undeveloped-dry-land migration and the fourth shows migration to all dry land. The fifth shows dry land migration as well as thin layer deposition. The final bar shows all adaptation strategies combined including restoring marshes to their 1974 footprint. The take home message: in some cases additive adaptation strategies will allow a marsh to retain its current utility by 2100 and in other cases they may not.
- **“Estimated Wetland Benefits per Unit Cost” chart** shows the wetland benefits each adaptation strategy by site as a function of that adaptation strategy cost for that site. Higher bars indicate that a particular adaptation strategy is predicted to be more cost effective at a particular site than lower bars.
- **The Utility Tabs**
 - These tabs describe the relationship between modeled wetland types and land covers or land-cover metrics produced by the model. They are editable for a more advanced user and guidance on editing them will be available soon.
 - (Note to advanced users -- the magnitude of the utility value does not matter—each of these are “relative utilities” and are then normalized by the model based on the ecosystem relative ranks. Therefore an ecosystem “relative rank” for one ecosystem service that is twice as large as another means that the maximum utility for the first ecosystem service will be twice as high as the maximum utility for the second.)
- **Other tabs to the right**
 - These tabs contain the raw model results and some intermediate inputs and are generally for the more advanced user only.