



**Resilient Landscapes Fund
Definitions and Map Guide
December 14, 2016**

This document includes definitions of key terms and instructions for developing maps for application to OSI's Resilient Landscapes Fund.

INTRODUCTION

Given the complexity of climate change impacts, land conservationists need strategies to identify sites that will remain relevant to biodiversity conservation. OSI's Resilient Landscapes Initiative recognizes that the physical characteristics of a landscape can buffer an area from the direct effects of a changing climate by offering an array of microclimates that are sufficiently connected. A topographically diverse and connected landscape provides climate options for species and room for ecological processes to operate.

This guide provides OSI's summary of the main concepts used in The Nature Conservancy's (TNC) terrestrial resilience analysis, including the three key elements used in evaluating the relative Resilience of different places: "Geophysical Settings," "Landscape Diversity," (sometimes called "Landscape Complexity") and "Local Connectedness." In addition, it defines the key concept of "Underrepresented Settings."

DEFINITIONS (adapted from [TNC's Resilient Sites for Terrestrial Conservation](#))

Resilience: The degree to which a place can sustain a variety of species and maintain ecological processes despite a changing climate. A highly resilient place offers a better than average combination of Landscape Diversity and Local Connectedness (both defined below). Note that the data does not determine that any site is "resilient" in absolute terms, but rather that some places appear to be more resilient than others. TNC's resilience analysis measures a place's Resilience relative to other similarly situated places. The Resilience score is always relative to other places with the same type of Geophysical Setting (defined below) and in the same ecoregion.

Geophysical Settings: A Geophysical Setting describes two characteristics of a place: (1) its elevation zone; and (2) its dominant geology type. TNC's resilience analysis assigns one of 65 different Geophysical Settings to each place. For example, one type of Geophysical Setting is "low elevation calcareous," sometimes shortened to "L:Calc." Because research indicates that overall biological diversity is dependent upon the availability of quality habitat on a variety of different geology types at different elevations, Geophysical Settings are a critical part of evaluating Resilience. By conserving high quality examples of each Geophysical

Setting, the broad spectrum of biodiversity can be conserved. The terrestrial resilience analysis identifies and directs conservation towards the most resilient examples of each Geophysical Setting. Each place is compared against only those places with the same Geophysical Settings. For example, low elevation calcareous areas are only compared against other low elevation calcareous places and not against high elevation granite.

Landscape Diversity (a.k.a. "Landscape Complexity"): Landscape diversity is a measure of a place's above-ground landform and elevation variety. Landform categories include slopes, cliffs, valleys, coves, and moist flats, as well as the directional orientation of some features. Landscape Complexity creates diverse microclimates that allow species to moderate moisture and temperature locally. Some geology types are by their nature less complex than others because of their rate of or stage in weathering. In order to ensure equal representation of each geology type, Landscape Complexity identifies the most complex examples for each Geophysical Setting, and furthermore compares these examples only against places in the same ecoregion.

Local Connectedness (a.k.a. "Permeability"): Local Connectedness is measure of a place's ability to allow the movement of organisms and the operation of ecological processes. Using road, railroad, and land cover data to identify transitions between natural, semi-natural, and developed areas, the resilience analysis predicts the degree to which these different types of transitions create resistance. Local Connectedness is essential to providing species with access to different nearby microclimates resulting from Landscape Diversity.

Like Landscape Diversity, Complexity is scored relative to Geophysical Settings and ecoregions. Three important aspects of Local Connectedness should be noted: (1) it is not based on the specific needs of any particular species or ecological process, but instead provides a single generalized framework for measuring the "permeability" of a place for species movement and ecosystem function; (2) it measures "connectedness" within a three kilometer (3 km) radius of any given point location, rather than identifying corridors or regional connectivity over a larger area; and (3) the resistance model scores each point location based on all resistance occurring within the 3 km radius, not just the immediately adjacent resistance.

Underrepresented Setting: An Underrepresented Setting is a Geophysical Setting with 1) a relatively low percentage conserved and 2) a relatively high percentage converted out of natural land cover. For instance, over 95% of Very High Elevation Granite/Mafic lands in the region are protected. In contrast, less than 5% of Low Elevation Calcareous lands are protected, while over 50% are developed or converted to agricultural uses. Since conserving high quality habitat in all Geophysical Settings is critical to ensure a broad range of biodiversity, focusing protection on Underrepresented Settings aims to protect the best examples of these "at-risk" settings.

For the Resilient Landscapes Fund, OSI has identified 20 Underrepresented Settings. The process OSI used to select these settings is described in Appendix A.

OSI Underrepresented Settings

Elevation Class	Very Low	Low	Mid
Moderately calcareous	x	x	x
Silt/Clay	x	x	x
Calcareous	x	x	
Coastal plain loam over limestone	x	x	
Coastal plain silt and clay over limestone	x	x	
Acidic shale	x	x	
Ultramafic	x	x	
Loam	x	x	
Coastal plain sand over limestone	x		
Mafic	x		

Regional Flow: Regional Flow is a measurement designed to identify potential pathways for directional movements by species at a larger-scale than *Local Connectedness*. Regional Flow data uses models that identify multiple options for movement that could be significant for species range shifts, migrations, or other dispersal patterns in response to climate change. Regional Flow highlights where land use patterns are likely to cause movements to become concentrated because limited surrounding options exist, as well as places where movement is diffuse when many options exist. This measure is useful for identifying the linkage areas important to maintaining permeability across the whole region. Note: At this time OSI is not requiring applicants to use Regional Flow data for application to the Resilient Landscapes Fund.

MAP & DATA GUIDE

Here are step by step instructions for creating the maps that OSI requires for application to the Resilient Landscapes Fund. Applicants are required to prepare and upload six maps, in .pdf form, with their application. Most of these maps will be created with an online mapping tool that does not require GIS or mapping expertise. For questions or concerns about the maps or data, please contact Neil Jordan (njordan@osiny.org).

1. In preparation for using the TNC Resilient Land Mapping Tool put your project boundary shapefile in a .zip folder. Be sure to include all components (.dbf, .shp, .shx, .sbn, .sbx, .prj) in your zipped shapefile.
2. In an internet browser, navigate to <http://maps.tnc.org/resilientland/>
3. Accept the “Project Info and Legal Disclaimers”.
4. In the upper right-hand corner, under “Enter a printout title”, enter your project name and organization name, e.g. “Wild Mountain Pond - My Land Trust”. ”
5. Directly below the title entry box, go to “Upload Zipped SHP” and upload the .zip folder containing your project boundary.
6. Once you push “open”, the viewer will zoom-in to the appropriate scale and will automatically begin the resilience analysis. In the resulting “Resilient Land Summary”, you will see your project’s results, which include Resilience Results and Geophysical Settings. Record these results to include in your application and then press OK. (Note: once you close this window you can re-open it by selecting “Open Last Results” in the “Analyze” section on the right.)
7. **Map 1: Project Location** – In the Visualize section on the right, select “Basemap Only”. Copy the **Focus Areas hyperlink** shown below under “OSI Map Services” and paste it into the box that says “Enter a URL for an ArcGIS Map Service”. Then press “Add Map Service”. This may take a few seconds to load. Once the Focus Areas have loaded, zoom out to an appropriate scale to adequately display your project’s location within the focus area, but not so far that the project isn’t visible.
To save the map, click “Print” in the upper right-hand corner. From the pull-down menu select either portrait or landscape orientation, whichever is appropriate for you project. Click on the “Printout” link to open a .pdf in a new tab. The title should show your project name and organization name. If the framing of your project is acceptable, save the .pdf as “*ProjectName_OrganizationName_Location.pdf*”. If the framing is off, close the .pdf, adjust accordingly within the viewer, and press print again.
8. **Map 2: Resilience** – Zoom in to your project boundary, and select “Resilience” in the “Visualize” section on the right. Set Transparency (slide the button) at about 50%. Make sure your project name and organization name are still in the title box, and then follow the same steps outlined in Map 1 to save your .pdf. Save map as “*ProjectName_OrganizationName_Resilience*”
9. **Map 3: Landscape Diversity** – Maintain the same scale as the Resilience map. Select “Landscape Diversity” in the “Visualize” section on the right, and repeat steps to save .pdf. Save as “*ProjectName_OrganizationName_LandscapeDiversity*”
10. **Map 4: Local Connectedness** – Maintain the same scale as the Diversity map. Select “Local Connectedness” in the “Visualize” section on the right, and repeat steps to save .pdf. Save as “*ProjectName_OrganizationName_LocalConnectedness*”
11. **Map 5: Settings** – Select “Geophysical Setting” in the “Visualize” section on the right. Copy and paste the **Focus Areas with Underrepresented Settings** hyperlink listed below

in the “OSI Map Services” into the “Enter a URL for an ArcGIS Map Service” box, and press “Add Map Service”. This will take a few seconds to load. To view the settings in the area, zoom out slightly from the scale used for maps 3-5, but not as far as map 1. It is important to clearly show any occurrences of Underrepresented Settings on the property. When an appropriate scale is reached, save as *ProjectName_OrganizationName_Settings*”.

12. **Map 6: Conserved Lands Map** - This will be the only map that you will not create within the TNC Resilient Land Mapping Tool. Please provide a map showing your project and all nearby conserved conservation lands. Please indicate the type of conservation ownership.

OSI Map Services

Focus Areas:

http://osiny-arcgis.osiny.org:6080/arcgis/rest/services/Resilience/OSI_Resilience_Focus_Areas/MapServer

Focus Areas with Underrepresented Settings:

http://10.0.0.59:6080/arcgis/rest/services/Resilience/OSI_Resilient_Landscapes_Focus_Areas_and_Underrepresented_Settings/MapServer

APPENDIX A: Resilience Landscape Initiative - Selection of Underrepresented Settings

Overview

OSI’s Resilient Landscape Fund gives preference to places that overlie geophysical settings (geology and elevation classes) that are not well represented in conservation. OSI has updated its selection of underrepresented settings for the eastern US and Canada based on new settings identified in the Nature Conservancy’s (TNC) recently updated [Resilient Sites for Terrestrial Conservation in Eastern North America](#). TNC’s new dataset includes 65 settings, replacing 30 settings spanning 3 elevation classes in the Northeast and 35 settings spanning five elevation classes in the Southeast. This new data improves the mapping of surficial soils, corrects errors in bedrock classifications and normalizes classifications across the southeast and northeast.

As one of the few regional land protection organizations operating across the Eastern U.S. and Southern Canada, OSI is in a strong position to advocate for protection of settings that are underrepresented in all the ecoregions. This document describes OSI’s process for determining underrepresented settings based on 1) relative underrepresentation in conservation, 2) the amount of the setting converted out of natural cover as compared to the amount secured, and 3) the relative biological importance of the settings.

The list of 20 underrepresented settings is listed in Table 3 at the end of this document.

Underrepresentation

Of the 65 settings TNC identified, 12 settings are less than 15% secured in their geology, elevation and across all the ecoregions in which they occur. These settings, listed in Table 1, are the most underrepresented settings in the region.

Table 1: Underrepresented (< 15% secured) for geology, elevation and ecoregion

Elevation Class	Coastal	Very Low	Low	Mid
Calcareous	X	x	x	
Coastal plain loam over limestone		x	x	
Coastal plain silt and clay over limestone		x		
Loam		x		
Moderately calcareous		x	x	X
Silt/Clay		x	x	

Conversion to Securement Ratio

Some geology types may be well represented overall but are underrepresented at specific elevations and are at risk due to high conversion into agriculture and development relative to the amount secured.

To incorporate these settings, we reviewed the conversion to secured ratio (C:S) for all 65 settings (see page 82 of TNC’s *Resilient Sites*). We considered adding any settings where securement was less than 15% and conversion was greater than securement across the region (i.e. ratio greater than 1).

Notably, all the settings listed in Table 1 had a C:S ratio greater than one. Also notable is that very few settings in the Mid, High or Very High elevation classes have high conversion to securement ratios, emphasizing the importance of conservation of Low, Very Low and Coastal settings.

In addition to the settings in Table 1, the following settings are underrepresented **and** had greater conversion than securement:

- All coastal settings except three (silt/clay, coastal plain loam over limestone and coastal plain loam over limestone)
- Acidic granitic at very low elevation
- Acidic sedimentary at very low elevation
- Acidic shale at very low and low elevation

- Coastal plain loam over limestone at very low and low elevation
- Coastal plain sand over limestone at very low elevation
- Coastal plain silt and clay over limestone at very low and low elevation
- Mafic at very low elevation
- Silt/Clay at mid and high elevation (at high elevation the setting includes sand and loam)
- Loam at very low and low elevation
- Ultramafic at very low and low elevation

We removed acidic sedimentary and acidic granitic from consideration because they are the two most common geologies in the east, covering over 75 million acres together, and because the absolute amount of conserved land for this setting is relatively high (over 2 million acres for acidic granitic and over 5 million for acidic sedimentary).

We also removed coastal settings from the list because sea level rise requires the coastal region to be evaluated with different parameters than those incorporated into the terrestrial resilience analysis and datasets.

The other settings were added due to the high amounts of conversion.

Biological Importance

Some geology types have a greater capacity to support higher numbers of rare and/or common species due to their fertility or unique traits. TNC's previously published analysis of species richness and rarity for eastern settings indicates that calcareous, sand and silt/loam support the greatest numbers of species (see Anderson and Ferree, 2010 [here](#)). Ultramafic and shale also create unique habitat conditions that support rare species.

Final Settings

Based on the amount of the setting that has been secured, the ratio of conversion to securement, and biological relevance of the settings, OSI selected the settings in Table 2 as the 20 underrepresented settings for use in the Resilient Landscapes Protection Fund.

Table 2: Final Underrepresented Settings

Elevation Class	Very Low	Low	Mid
Moderately calcareous	x	x	x
Silt/Clay	x	x	x
Calcareous	x	x	
Coastal plain loam over limestone	x	x	
Coastal plain silt and clay over limestone	x	x	
Acidic shale	x	x	
Ultramafic	x	x	
Loam	x	x	
Coastal plain sand over limestone	x		
Mafic	x		

Note that when evaluating projects, OSI will also consider the relative representation of settings within the ecoregion that the project occurs.

When we compared this new group of settings against OSI’s previous underrepresented settings for both the Southeast and the Northeast (see Table 3 below) we dropped out several settings we had previously considered unrepresented, a few of which warrant explanation.

- Based on improved geology data, TNC reclassified significant portions of mid elevation shale as mid elevation calcareous. As a result, the relative securement of mid elevation shale went up while the relative securement of mid elevation moderately calcareous went down, resulting in mid elevation shale being removed from the underrepresented settings.
- Low elevation sand is a biologically important setting that was underrepresented in the northeast. It is no longer considered underrepresented in this analysis because it is 40% protected across the east.
- Calcareous (or limestone) is a high priority for conservation due to its underrepresentation, high level of conversion to development and agriculture, and ability to support greater biological diversity than other settings. Mid elevation calcareous was a priority in OSI’s funds previously. On examination, mid elevation calcareous is only underrepresented in four of the nine ecoregions in which it occurs with total protection of 19% across the East.

NORTHEAST, May 2013		How it changes
Tier 1 – Underrepresented, at-risk and biologically critical settings		
	Low elevation calcareous	Included
	Mid elevation calcareous	Included
	Low elevation fine	Included as "silt/clay"
	Low elevation coarse	Excluded; 40% secured across the east
Tier 2 – Moderately underrepresented and at-risk settings		
	Low elevation calcareous	Included
	Low elevation mafic	Included
	Mid elevation moderate calcareous	Included
	Mid elevation shale	Excluded; mid shale reclassified as mid mod calc
	High elevation calcareous /moderate calcareous	Excluded; 20% secured across the east
SOUTHEAST, May 2015		
Tier 1: Underrepresented and highest biological significance		
	Low elevation Calcareous	Included
	Mid elevation Calcareous	Excluded; 19% secured across the east
Tier 2: Underrepresented		
	Low elevation Moderately Calcareous	Included
	Mid elevation Moderately Calcareous	Included
	Low elevation Surficial Sediment - Mountain	Excluded; no longer a setting
	Mid elevation Surficial Sediment - Mountain	Excluded; no longer a setting
	Low elevation Mafic	Included
	Mid elevation Mafic	Excluded; 58% secured in the east
	Low elevation Ultramafic	Included
	Mid elevation Ultramafic	Excluded; 48% secured across the east
	Low elevation Fine	Included as "silt/clay"
	Low elevation Fine/Lime	Included for very low only
	Low elevation Sedimentary - Coastal Plain	Included as "loam"
	Low elevation Loam/Lime	Included
	Low elevation Granite	Excluded; 23% secured across east
	Low elevation Shale	Included

Table 3: Summary of changes to previous underrepresented settings in the Northeast and Southeast

