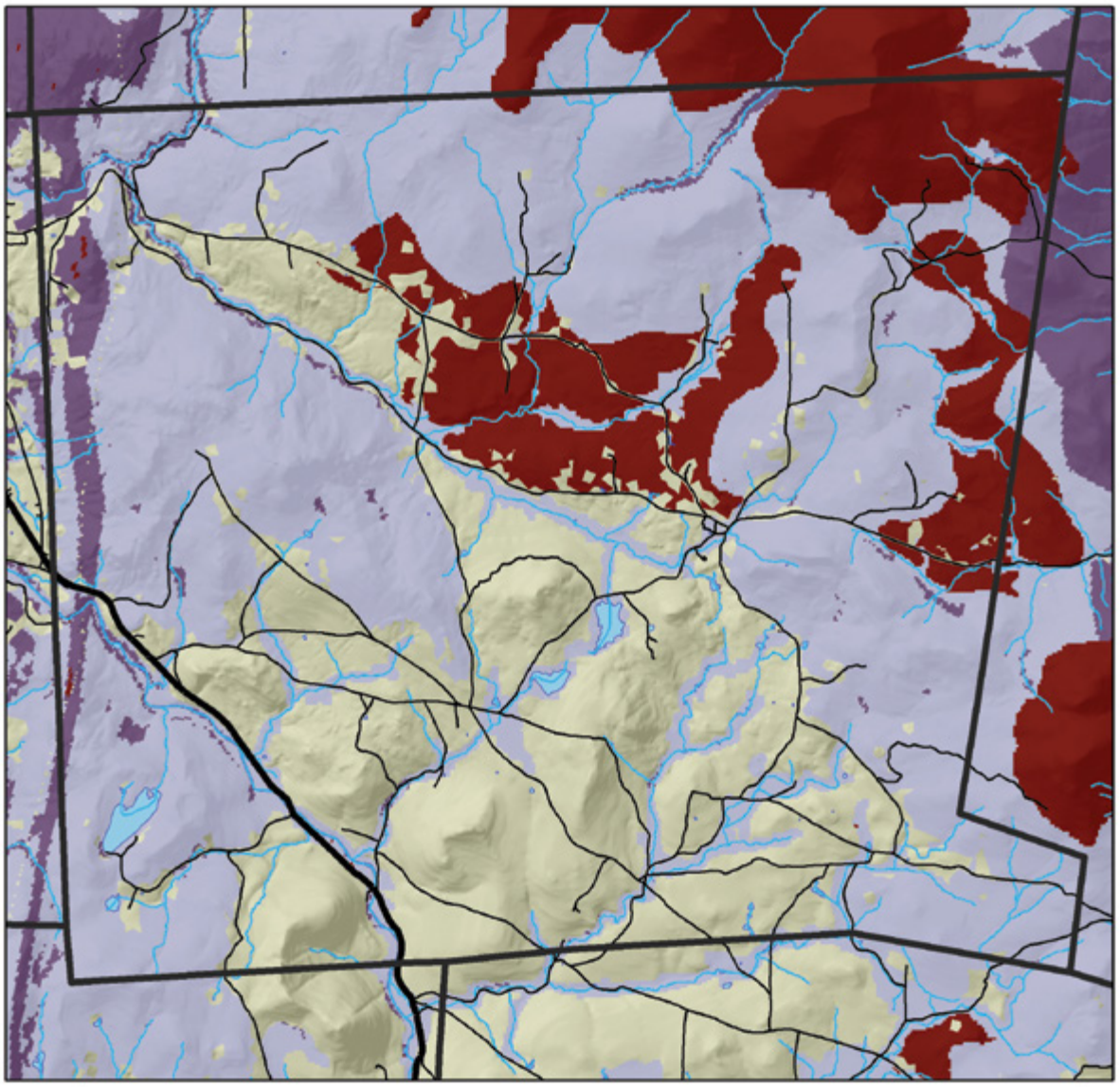
Map 4:
Physical Features



LEGEND

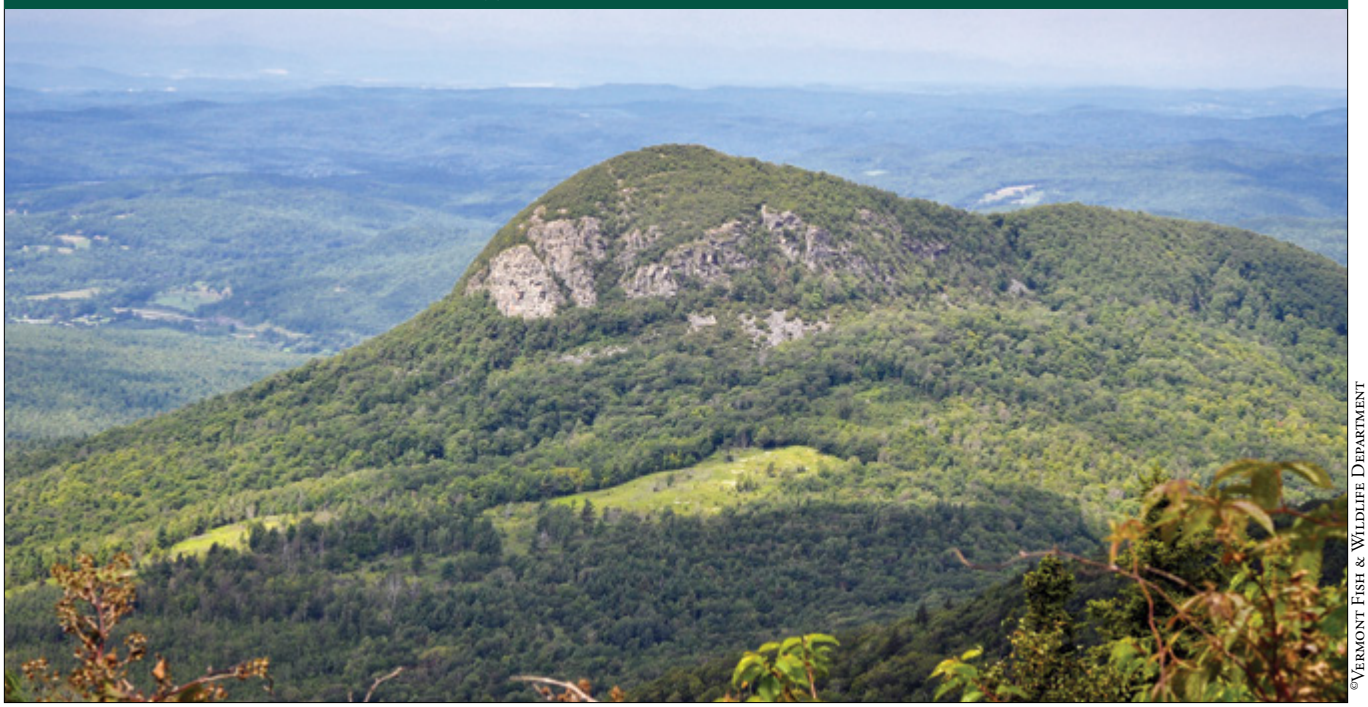
- Town Boundary
- Roads
  - Primary
  - Secondary
- Rivers & Streams
- Lakes & Ponds
- Rare Physical Landscapes
- Representative Physical Landscapes
- Responsibility Physical Landscapes

Data Source:
Vermont Center for Geographic Information
Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
October, 2017

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

Map 4 Physical Features



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This map gives a big-picture view of how physical features are geographically distributed.

Inventory Layers (Described Below)	**Base Layers**	**Additional Online Data**
1. Physical Landscape Diversity	Roads Streams & Rivers Lakes & Ponds Town Boundaries	Biophysical Regions

Physical landscapes, also referred to as enduring features, are the parts of the landscape that resist change. They are hills and valleys, underlying bedrock, and deposits left behind by glaciers or ancient lakes. They remain largely static when natural- or human-induced changes in land cover and wildlife occur, as plants and animals expand or contract their ranges, and even as the climate changes.

Because of the strong influence of the physical landscape on which plants, animals, and natural communities appear and thrive, understanding the physical landscape can help us predict habitat conditions and species presence. Physically diverse landscapes support diverse natural communities and species (Anderson & Ferree, 2010), and thus one way to ensure that biological diversity persists on our landscape is to conserve a variety of physical landscapes.

The background of this map is a representation of elevation in which steep slopes are shaded to produce a "shadow." The effect helps us to visualize the hills and valleys across a landscape. In BioFinder and on other mapping resources, this effect is called hillshade.

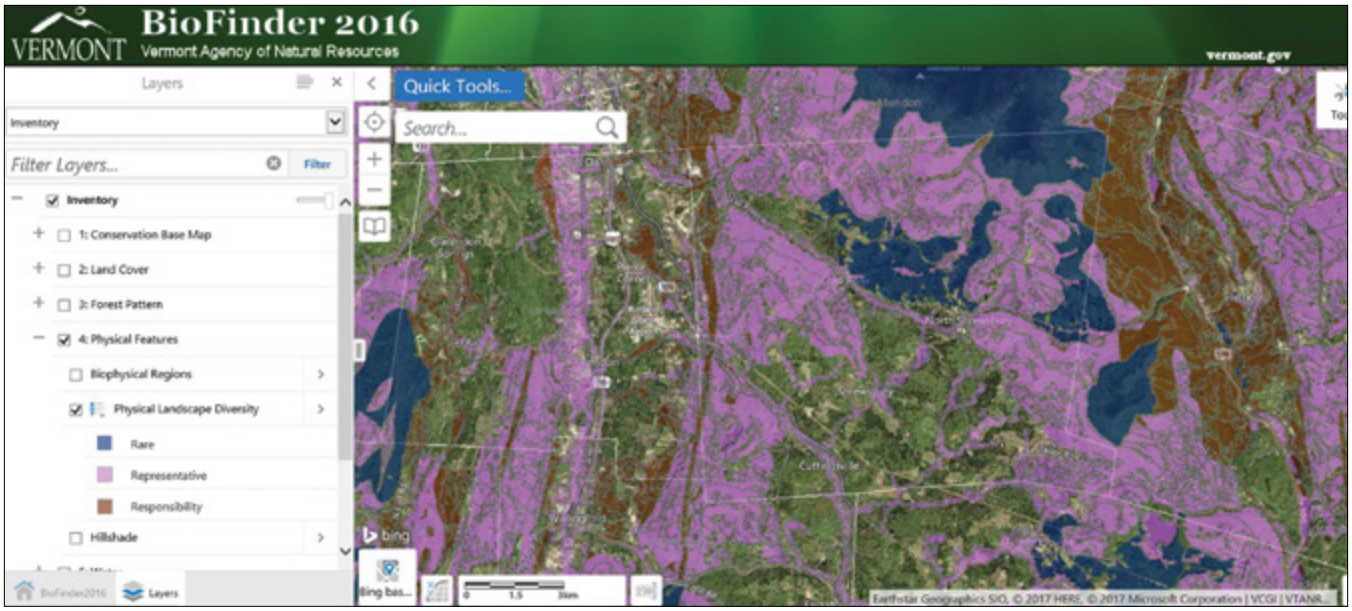
Physical Landscape

What is the Physical Landscape?

The physical landscape includes:

- Bedrock: the rock that underlies everything we see on the surface
- Surficial materials: the gravel, sand, silt, clay, or peat that sit on top of the bedrock
- Topography or Landforms: cliffs, coves, summits, flats, and so forth
- Elevation

Individually, each of the physical attributes above influences the ecological landscape in a particular way. As any gardener or landscaper knows, different plants grow on a shady, north-facing slope than on a



To load Map 4 on BioFinder: Open the **Inventory** theme, then check the box next to **4: Physical Features.** To see all available Map 4 layers, click on the + next to the layer name.

For additional guidance on using BioFinder, please see Getting Started in the introduction to this guide.

sunny hillside that looks south, or in shallow, rocky soils than in deep clay. When these physical attributes are mixed and matched, the resulting patterns can be quite complex. In order to describe the numerous combinations of physical features found across Vermont's landscape, we use Ecological Land Units, or ELUs, results of a computer analysis developed by The Nature Conservancy to standardize the way the physical landscape is described (Ferree & Anderson 2008).

The model combines the physical attributes listed above with additional factors such as soil types and climatic features to create a visual representation of variation in the physical landscape. For example, the ELUs of the Green Mountains illustrate subtle variations in steep terrain with acidic bedrock and rocky glacial deposits, while the Champlain Valley features combinations of flatter, calcium-rich clay plains.

The Physical Landscape

The physical landscape is like the stage of a theater. While it doesn't change in response to the drama of a play, it does influence the actions of the actors—the plants, animals, and other species that live there.

Because there are several hundred ELUs that appear on the Vermont landscape, maps displaying each ELU unit are impractical. Instead, only the ELUs considered most important for conservation are displayed, divided into *rare*, *responsibility*, and *representative* categories.

Rare Physical Landscapes

Rare physical landscapes are those types least commonly found in Vermont, each covering less than 4.5 percent of the state's land area. Because rare physical landscapes often correspond with the presence of rare species or natural communities, they can be used as a filter for maintaining the state's overall biodiversity. This is particularly important because there are many species about which we know very little (for example, insects, plants, or mosses) and identifying rare physical landscapes can help us to predict where diversity among these unstudied species may occur.

Rare associations include the following:

- Calcareous (Calcium-rich) Metamorphic High Hills/Low Mountains
- Connecticut River Valley (Historic Lake Hitchcock) Sediments
- Enriched Slopes
- Granitic Basins
- Granitic High Hills/Low Mountains

- Granitic Mid-Elevation Hills
- Marine-Lacustrine-Glaciofluvial Coarse Sediments
- Precambrian Plateau
- Upper Mountain Slopes/Mountaintops
- Valley Floor Glacial Lake/Marine Plains
- Vermont Escarpment
- Water-deposited glacial sediments along major riverways

Responsibility Physical Landscapes

Some combinations of physical features are common in Vermont, but rare in the surrounding region or even worldwide. These are called responsibility physical landscapes since we have a "responsibility" to maintain them in our conservation efforts. While individual occurrence of a responsibility physical landscape may not appear particularly special within the local context, including examples of these landscapes in conservation efforts ensures that the species relying on these landscapes can persist at a grander scale.

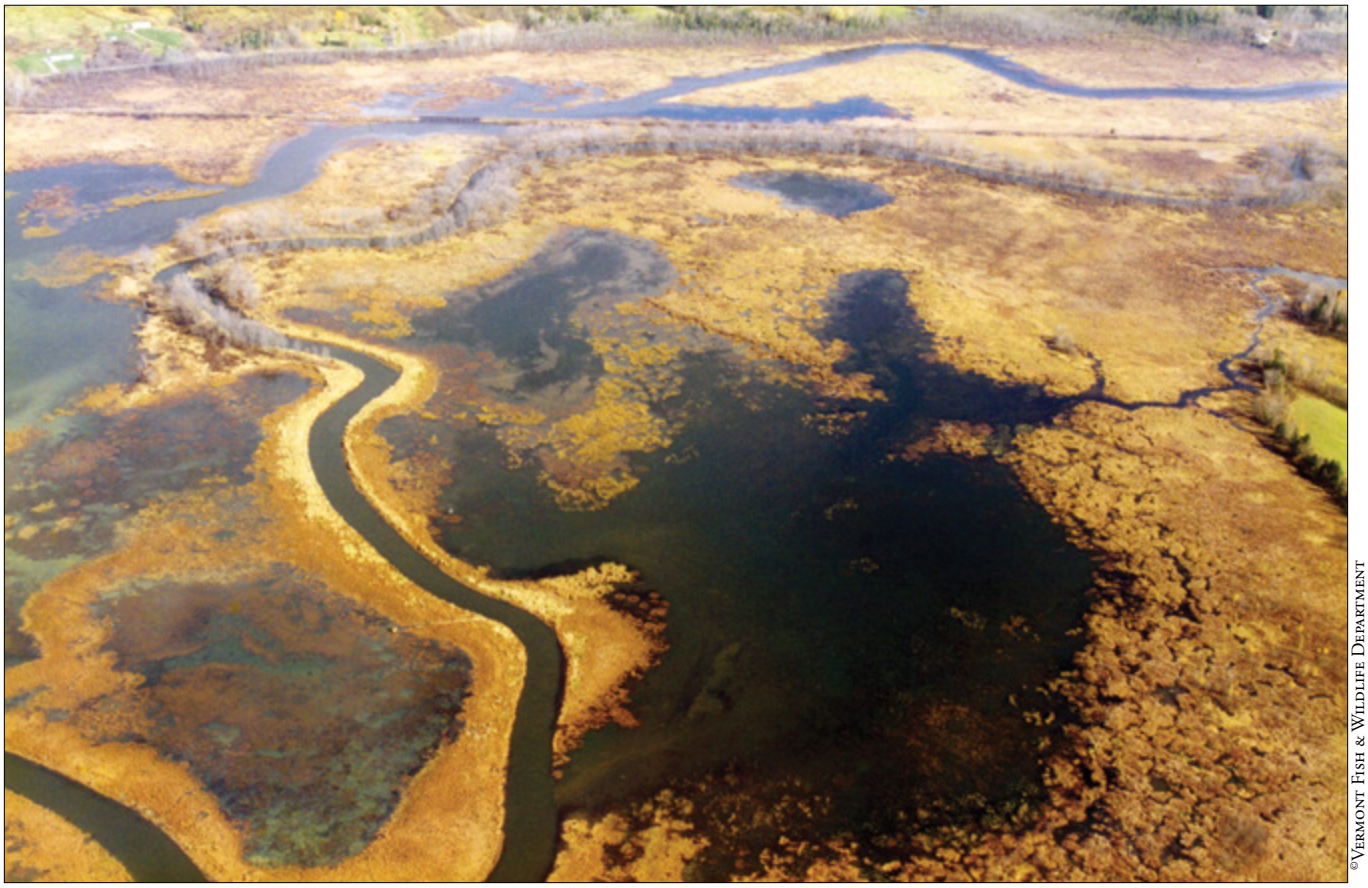
Responsibility physical landscapes include locations with underlying calcium-rich rock, underlying mafic (magnesium- and iron-rich) rock, and cove landforms. While these are fairly common within the state, Vermont has a high responsibility for the conservation of these landscapes regionally.

Representative Physical Landscapes

For each Ecological Land Unit not included on the rare or responsibility lists, high-quality examples were selected throughout the state based on condition and patch size. These are mapped as representative physical landscapes since they "represent" landscapes that include our most common species and natural communities. Common species and natural communities are every bit as important as the rare species conservation efforts often focus on, but without datasets like this, it can be difficult to include their importance on a map.

Physical Landscapes: Significance

In assessing biodiversity within Vermont, we can't inventory every species in every location across the state. Of Vermont's 24,000 to 43,000 species, only 426 are vertebrate animals, and 2,000 are vascular plants (e.g., trees, shrubs, flowering plants, grasses, and so on). We know very little about the remainder, comprising invertebrates, fungi, algae, lichens, mosses, and liverworts. This leaves us unable to accurately quantify



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biodiversity. In the absence of such an inventory, the inclusion of physical features in planning efforts is a way to capture biodiversity. Physical features portray the ecological potential of the landscape.

This idea of ecological potential is especially important given that the distribution of species on today's landscape has been impacted heavily by human land use history. Physical features allow us to see beyond current land cover and land use to instead see where biodiversity would flourish naturally.

Since physically diverse landscapes correspond to diversity in species, conserving wildlife habitat within rare, responsibility, and representative landscapes encourages a diversity of species to flourish. This is particularly true in the face of global climate change. As changes occur over time, plant and animal species adjust their ranges to more climatically suitable conditions. Areas of diversity in the physical landscape will allow for these adjustments to be made more easily, and these areas are likely to continue as the stage for biological diversity even as species composition changes.

Physical Landscapes: Map Interpretation

This Physical Landscape Diversity map can be very useful at a statewide or multi-state scale where a high degree of accuracy is unnecessary. When viewing physical landscapes within a single town, they should be interpreted with caution. This dataset is mapped as a grid, with each box of the grid representing a 30m x 30m area. At this scale, the boundaries between two ELU types cannot be considered highly geographically accurate. However, the physical landscapes map can be used as an initial bird's eye view to help in thinking about the local landscape in a new way when determining conservation strategies.

On the printed maps associated with this guide, physical landscapes are mapped only as rare, responsibility, or representative. On BioFinder, a user can identify each ecological land unit individually.

Physical Landscapes: Planning Considerations

In many locations, mapped physical features overlap with other important components, such as forests and waterways. In these cases, the importance of the physical landscape can strengthen the prioritization of these other features in conservation work.

However, some areas highlighted as important physical landscapes are quite different from those outlined on other maps in this guide. This is because other layers tend to reflect current landscape condition, where habitat exists now. Rare and responsibility

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physical landscapes are often places where diversity in habitat types could exist in the future, alongside the places where we currently find biodiversity. When planning with climate change in mind, we need to remember that the species we're now familiar with are likely to shift their ranges or be affected by a new host of stressors such as disease or drought. Meanwhile, new species will be establishing themselves in the region—not only trees and large animals that we can study easily, but also microorganisms in the soil, fungi, insects, etc. While we can't predict the exact composition of species that will be living in our communities, this map suggests some areas that together will provide the setting necessary to maintain a rich diversity of plant and animal species.

When planning, one way to look at the Physical Landscape Diversity map is therefore to see how current conservation lands are distributed across physical landscape types. If some significant physical features are underrepresented, consider prioritizing them in future conservation efforts.

At its core, this map provides a lens for erasing current land use patterns to allow you to think about the ecological potential of the land. If your community is interested in restoration or land conservation efforts, or in planning for a changing climate, you may find this map particularly enticing.

You might also try the following strategies for conserving important physical landscapes:

Conservation Goal	Conservation Strategies for Important Physical Landscapes	
	Nonregulatory Strategies	*Regulatory Strategies*
Include physical landscapes in conservation efforts	Compare maps of physical landscape diversity to conserved lands. Prioritize under-represented features in conservation efforts.	When feasible, locate building envelopes outside these areas.
	Encourage residents to conserve their land.	
	Encourage residents to enroll in Current Use (or local tax stabilization program).	
	Conduct planning efforts so as to avoid development in these areas.	
Protect habitat blocks or waterways that include important physical landscapes	See Map 3, Layer #3, and Map 5, Layer #2.	

For additional information, see *Conserving Vermont's Natural Heritage*.

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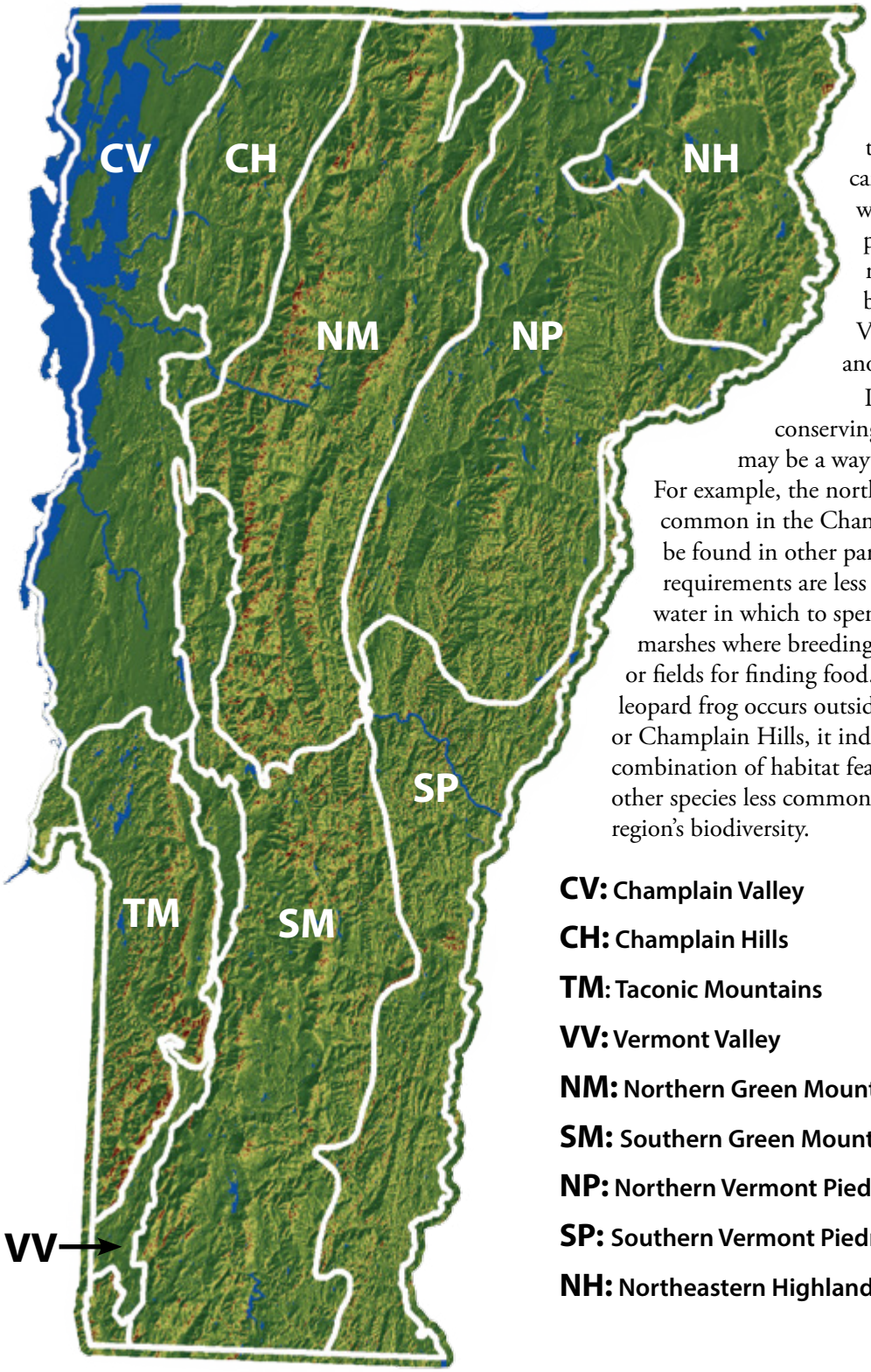
Additional Online Data

Biophysical Regions

In the Physical Landscape Diversity map described above, landscapes are broken into specific component pieces. However, we can also lump them into much more general categories, called biophysical regions, to divide the entire state into areas with like physical features.

Each of these regions share similarities in climate, bedrock, geologic history (glacial deposits, flooding, and so on), topography, land-use history, and hydrology (water flow patterns). When conducting planning efforts (especially at a statewide or regional scale), these biophysical regions can be used as a lens through which to assess conservation priorities, because what may be common in one biophysical region of Vermont may be rare in another.

In the area in which it is rare, conserving habitat for that species may be a way to preserve biodiversity. For example, the northern leopard frog is quite common in the Champlain Valley. While it can be found in other parts of the state, its habitat requirements are less widespread: permanent water in which to spend the winter, floodplains or marshes where breeding occurs, and wet meadows or fields for finding food. When the northern leopard frog occurs outside the Champlain Valley or Champlain Hills, it indicates the presence of a combination of habitat features that may support other species less common in the region, adding to the region's biodiversity.



CV: Champlain Valley

CH: Champlain Hills

TM: Taconic Mountains

VV: Vermont Valley

NM: Northern Green Mountains

SM: Southern Green Mountains

NP: Northern Vermont Piedmont

SP: Southern Vermont Piedmont

NH: Northeastern Highlands

Vermont's nine biophysical regions are:

- **Northeastern Highlands**
  Granite bedrock dominates this cool region, which is characterized by large wetlands, remote mountains, and lakes and ponds. Spruce and fir dominate both lowlands and high elevations, while northern hardwood forests cover the mid-elevations.
- **Northern Vermont Piedmont**
  Calcium-rich soils combine with a cool climate to support mixed forests and northern white cedar swamps, fens, and other interesting natural communities in this region. The uplands have fine agricultural soils, but a short growing season.
- **Southern Vermont Piedmont**
  Calcium-rich soils and rolling hills make this a good place for agriculture. The climate is average for Vermont, except in the extreme southeast where it is quite warm. Northern hardwoods and red oak dominate the vegetation.
- **Southern Green Mountains**
  A broad plateau is dotted with a few dominant peaks. Climate is cool and rainfall is relatively high. Northern hardwoods, spruce, and fir dominate, and there are a number of small lakes and ponds.
- **Northern Green Mountains**
  This area has a cool climate and high elevations. Northern hardwoods dominate the sideslopes, whereas high elevations have spruce and fir as well as alpine meadow communities.
- **Champlain Valley**
  This region of Vermont has a warm climate and abundant fertile farmland. The Champlain Valley contains both northern hardwood forest and various species of oaks and hickory. It has some of the state's most significant natural diversity and the state's most densely populated areas.
- **Champlain Hills**
  This region consists of the hills and footslopes located between the Champlain Valley and the Green Mountains. Soils are primarily derived from glacial till and are shallower and rockier than in the Champlain Valley. There is some agriculture, but not nearly to the extent of the valley below. Northern hardwood forests dominate the region, dotted with softwood and mixed stands, dry oak communities, and wetlands.
- **Taconic Mountains**
  The slate belt of Vermont, the Taconics are dramatic wooded hills dominated by sugar maple, beech, and yellow birch forests. Dry oak and hickory forests are found on the lower elevation knolls, while spruce and fir occur at the highest elevations.
- **Vermont Valley**
  The Marble Valley has marble and limestone with glacial deposits on the valley walls, abundant springs, and wetlands.

Some communities may find it useful to visit this map on BioFinder to see where the boundaries of these regions fall geographically. If your community contains sections of different biophysical regions, you may find it useful to frame your planning efforts within the context of each region, even if it divides your town. For example, the regional ecological needs of the Champlain Valley and the Northern Green Mountains are somewhat different. A town spanning the boundary between these two regions may want to consider strategies for the two areas separately, keeping in mind that boundaries are approximate. The map was intended to describe landscape characteristics at a state scale; there is no way to identify an exact boundary line between any two regions.

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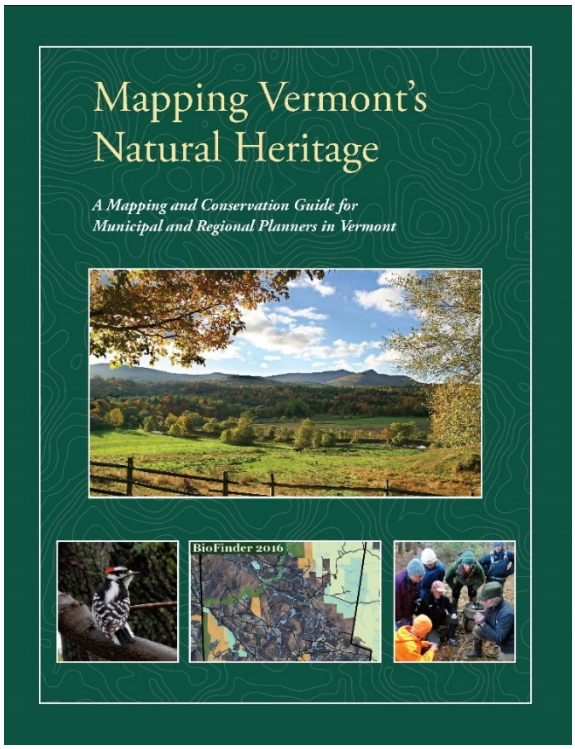
Mapping Vermont's Natural Heritage

This is one chapter of a larger publication called *Mapping Vermont's Natural Heritage: A Mapping and Conservation Guide for Municipal and Regional Planners in Vermont*. Please visit https://anr.vermont.gov/node/986 for additional information or to see the entire guide.



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