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Photo credits: Christian O. Marks

Introduction

Each year, snow melt from the mountains coupled with runoff from spring rains causes the Connecticut River and its tributaries to overflow their banks. These floodwaters inundate farm fields and remnant patches of forest in the floodplain. These unique forests, adjacent to and influenced by the river are known as floodplain forests. Floodplain forests once covered wide stretches along the Connecticut River and its tributaries. Today only a fraction of this floodplain forest remains.

Not only are floodplain forests important to the plants and animals that call this habitat home. Floodplain forests are also natural water-storage areas. During significant floods—and such events can occur any time of the year—water overspreads the flat wetlands and loses velocity, thereby reducing the extent of downstream damage. Floodplain forests also act as a natural filter, trapping sediment, nutrients and pollutants before they reach our rivers and coastal seas, thereby improving water quality.

Clearly New England floodplain forests provide us a wealth of services. Unfortunately, little was known about the physical processes of our rivers such as the timing and duration of inundation and how these processes impact the health of these important forests. Additionally, there had been limited study of their biota. Therefore, the Conservancy's Connecticut River program embarked on a multi-year study to quantify critical values in these physical processes, and to describe priority floodplain sites.

At the conclusion of field work, Conservancy staff from the four basin state field offices and the Eastern Resource Office met and agreed on a map of the 29 most important floodplain sites in the Connecticut River basin (see Table 1 & Figure 1 below), each comprising a cluster of floodplain parcels. These sites were chosen because physical processes such as channel migration and particularly flooding are still adequate to contribute substantially to ecosystem processes and support healthy floodplain communities in these river reaches. During the selection process it was noted that because of the dynamic nature of river channel migration and the extensive clearing of floodplain forests for agriculture all of these floodplains contain a patchwork of cleared areas and remnant patches of young floodplain forest on the lowest floodplain surfaces (typically < 100 years old).

The priority floodplain sites are described in the pages that follow. The descriptions are arranged by river type (size/gradient) and by sub-region^[1] (i.e. climate) within river types. From a floodplain perspective, there are four basic river types: large low gradient rivers, medium low gradient rivers, small low gradient rivers, and high gradient rivers. These river types differ in hydrologic regime and fluvial geomorphology and consequently have different community composition and different dominant physical processes. There are further differences in community composition associated with climatic differences among sub-regions. The site descriptions are preceded by a brief introduction to the ecology of floodplain communities that are characteristic of the river type. In nature, the characteristic communities of a river type are typically arranged along an elevational gradient from bank & bar, to low

^[1] Note that the floodplains of the Connecticut River estuary and more generally the North Atlantic Coast ecoregion were not included in this report on floodplain forests because the strong tidal influence results in marshes rather than floodplain forests. These tidal floodplains are already recognized as ecologically important for their marshes.

floodplain (flooded regularly), to high floodplain (flooded rarely). This site selection attempts to include a complete representation in replicate of this floodplain diversity.

Table 1: Summary of important floodplain areas by sub-region and river type:

Sub-region	Large river	Medium river	Small river	High gradient river
Southern New England (Lower New England Ecoregion)	<ol style="list-style-type: none"> 1. CT River (Middletown, Portland, Cromwell, CT), 2. CT River (Rocky Hill to Hartford, CT), 3. CT River (East Hartford to Windsor, CT), 4. CT River (Northampton, Hadley, Hatfield, MA) 		<ol style="list-style-type: none"> 5. Coginchaug River (Durham, CT), 6. Scantic River (Enfield, East Windsor, CT), 7. Stony and Muddy Brook (Suffield, CT), 8. Bachelor and Stony Brook (South Hadley, MA), 9. Fort River (Amherst, Hadley, MA), 10. Mill River (Whately, MA), 11. Sawmill River (Montague, MA) 	<ol style="list-style-type: none"> 12. Westfield River Branches (Huntington, Chester, MA), 13. Green River (Greenfield, MA)
Mountains & Highlands (Lower New England Ecoregion)	<ol style="list-style-type: none"> 14. CT River (Haverhill NH, Bradford VT, Newbury VT) 	<ol style="list-style-type: none"> 15. Ashuelot River (Swanzey, Keene, NH) 		<ol style="list-style-type: none"> 16. Ashuelot River (Surry, NH)
White and Green Mountains (Northern Appalachians Ecoregion)	<ol style="list-style-type: none"> 17. CT River (Lancaster NH to Brunswick VT) 	<ol style="list-style-type: none"> 18. CT River (Colebrook NH to Canaan VT) 	<ol style="list-style-type: none"> 19. Johns River (Dalton, NH), 20. Passumpsic River (Lyndon, VT), 21. Upper Ammonoosuc River (Stark, NH), 22. Cedar Brook (Milan, NH), 23. Nullhegan River (Ferdinand, VT), 24. Indian and Halls Stream (Pittsburg, NH) 	<ol style="list-style-type: none"> 25. White River (Sharon, Royalton, VT), 26. Third Branch White River (Randolph, Bethel, VT), 27. Wild Ammonoosuc River (Woodstock, NH), 28. Barren & Esker (Ammonoosuc River in Carroll, NH) 29. Moose River (Concord & Victory, VT),

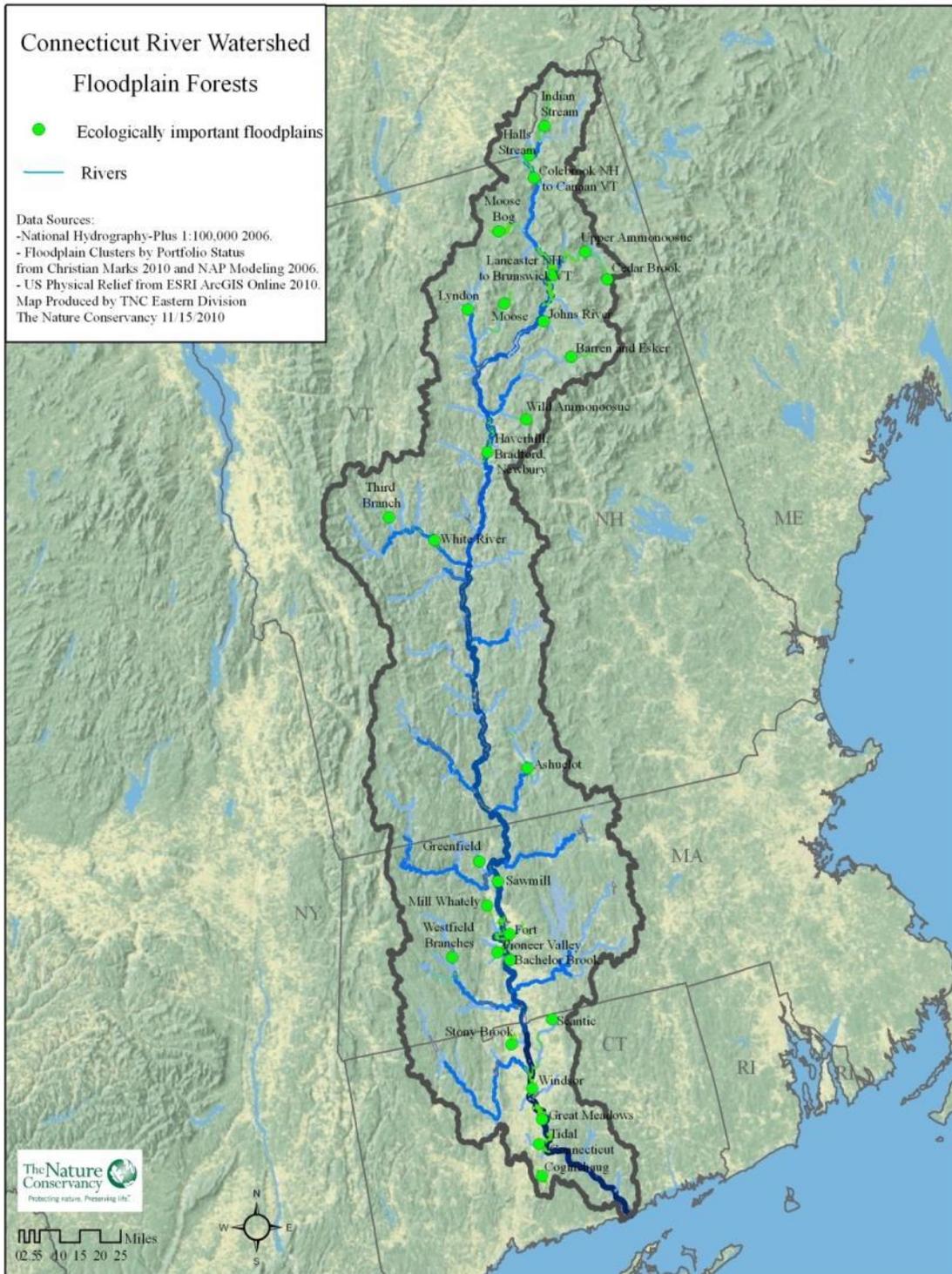


Figure 1: Connecticut River watershed map with locations of ecologically important floodplain forests.

Important floodplain area descriptions by river type and sub-region

Large River Floodplains Overview

Type definition and field recognition: The large river size category is defined as 2,500 to 30,000 km² watersheds. Rivers in this category can be recognized by having a channel large enough for using small motor boats, and muddy low gradient channels.

Locations: The Connecticut River mainstem from the Upper Ammonoosuc River confluence to Long Island Sound.

Ecosystem Function: Large river floodplains contribute disproportionately to ecosystem services because of long duration flooding, and particularly to natural valley flood water storage. Floodplain forests also absorb sediments and pollutants and contribute substantially to the productivity of aquatic food webs. Typically exceptionally rich soils that have been converted to agriculture. Conversion of natural floodplain vegetation to tilled crop land can reverse floodplains from being a sink to becoming a large source of sediments and pollution for aquatic habitats, particularly during floods.

Dominant physical processes: low floodplains flood annually or bi-annually for 10 days or much longer. Stage height differences between low and high water are large (i.e. alternating deep flooding and potentially drought in some summers). Flooding on higher terraces is infrequent (Return Interval ≥ 10 years) but can involve substantial sediment deposition and/or scour in extreme events.

Tree species composition: the **low floodplain** is always dominated by *Acer saccharinum*, but before Dutch-elm-disease, *Ulmus americana* was probably co-dominant on many sites. In the southern part of the CT River, *Fraxinus pensylvanica* is an important late successional species that can be co-dominant with *Acer saccharinum*. In the northern part of the watershed *Fraxinus pensylvanica* is replaced by *Fraxinus nigra*. *Populus deltoides* is an important pioneer species in the southern part of the watershed, and is replaced to some degree by *Populus balsamifera* on the most northern floodplains. *Acer negundo* is an opportunistic species that can join other pioneers on bars as well as occupy gaps left as the *Acer saccharinum* and *Populus deltoides* gradually die off. The role of *Acer negundo* increases in importance in northern areas where there are fewer competing species. *Catalpa speciosa* has become naturalized in floodplain forests in MA & CT as an opportunistic species. *Platanus occidentalis* is generally uncommon on large river floodplains taking advantage of some gaps, but can become locally more abundant where scour is more severe such as at the heads of islands or below waterfalls. Large river back swamps and old oxbows in the southern part of the watershed can have substantial components of *Acer rubrum*, *Ilex verticillata*, *Cephalanthus occidentalis*, *Salix nigra*, *Quercus palustris* and *Quercus bicolor* in addition to the dominant *Acer saccharinum*, while in northern areas they may have conifer swamp species and shrubs like *Alnus incana*. The most consistent characteristic species on **rich higher terraces of the floodplain** is *Tilia americana*, but *Acer saccharum* and *A. nigrum* x *A. saccharum* hybrids are also characteristic, and would likely be the dominant climax species in the absence of clearing for agriculture.

The rich high terrace composition is typically diverse and includes many upland species such as *Pinus strobus*. Within the watershed, *Celtis occidentalis* occurs only on rich mainstem terraces, mostly in NH/VT. These rich mainstem terraces in NH/VT are also more likely to have *Ulmus rubra* than other floodplains. Rich terraces on the lower CT River in southern New England often have abundant *Carya cordiformis*. Other characteristic species of rich terraces are *Juglans nigra* (only in MA), *Juglans cinerea*, *Acer negundo* (in disturbed areas) and *Staphylea trifolia*. Further south than Connecticut, rich high terrace floodplain habitat typically has abundant *Liriodendron tulipifera* and sometimes this species can also be found on rich high floodplain terraces in MA&CT. Within the watershed, the rare *Quercus macrocarpa* is currently only known from one location in Hanover NH, but occurs on other large river floodplains in northeastern North America such as the St. John River in New Brunswick, Canada.

Herb and shrub layer: The herb layer of **low floodplains** is typically dominated by *Matteuccia struthiopteris* and *Laportea canadensis* with some *Boehmeria cylindrica* and *Onoclea sensibilis* or *Pilea fontana* in depressions. Other characteristic species are *Salix nigra*, *Salix eriocephala* and wildflowers as pioneers on bars. In the north, riverbanks are often lined with *Cornus racemosa*. Low floodplains of large rivers have fewer invasive shrubs than other floodplain types because of the deep long duration flooding. There are also few native shrubs except for *Sambucus canadensis* for the same reason. The regionally rare *Arisaema dracontium* is indicative of high quality large river floodplain forest with long duration flooding. **Rich high floodplain terraces** are unfortunately too disturbed to draw conclusions about their natural herb layer composition, but it probably resembles other rich moist forest habitats such as calcareous seeps. Such showy species as *Lilium canadense* can be found here. Higher floodplain terraces have greater abundance of shrubs, both native and invasive (especially if disturbed). In the southern part of the watershed, woody vines such as *Vitis riparia*, *Vitis labrusca*, *Celastrus orbiculatus* and *Toxicodendron radicans* are abundant along forest edges and eroding riverbanks.

Notable wildlife species: The globally rare Puritan tiger beetle (*Cicindela puritana*) requires beach habitat on rapidly growing bars. Beaches are also important for rare dragonflies including *Stylurus amnicola* and *Gromphus fraternus*. While the dragonfly nymphs are emerging on the beach they are vulnerable to rapid increases in flow from ramping up of hydroelectric dam operations or waves from motor boat wakes. In some summers, the beautiful red admiral butterfly (*Vanessa atalanta*) can reach large numbers in the floodplain forest where their caterpillars mature on the abundant *Laportea canadensis*. Bank swallows and belted kingfishers nest in steep eroding banks and are threatened by installation of riprap. Herons, egrets, bald eagles and ospreys use floodplain habitat intensively including for nesting, often in tall cottonwoods on islands. Oxbows and ponded backswamp areas attract cavity nesting ducks for nesting and rearing of their broods. Large numbers of waterfowl, warblers, blackbirds, grackles and other migratory birds use Connecticut River mainstem floodplain forests as an important migration corridor. During flood events fishes from such families as sunfishes and bass (Centrarchidae), catfishes (Ictaluridae), and carps and minnows (Cyprinidae) are known to exploit floodplain habitat on large rivers and the leaf litter swept into the river by the annual spring freshet contributes substantially to aquatic food web productivity.

Priority floodplain sites:

Southern New England Plains (Lower New England Ecoregion)

- **Tidal Connecticut River** (Middletown, Portland, Cromwell, CT)
 - Significance: High topographic variation combined with the warmest climate in the watershed results in higher species richness.
 - Current land use: mostly in natural vegetation.
 - Hydrology: flood reliably every spring and for longer durations than rest of mainstem floodplains. These floodplains have a substantial tidal influence that results in marsh on the lowest floodplain surfaces. With sea level rise some of the buttonbush swamps will likely also turn into marsh.
 - Rare species: largest *Cicindela puritana* beetle population in New England, bald eagle's nests; a large heron rookery; *Arisaema dracontium* occurs in the floodplain forests; rare *Salix exigua* occurs on bars; rails and ospreys also occur; possibly rare sedges.
- **Connecticut River - Great Meadows** (Rocky Hill to Hartford, CT)
 - Significance: largest expanse of floodplain in the watershed.
 - Current land use: in northern sections mostly gradual reforestation after agricultural abandonment; in southern sections mostly in intensive agriculture. Significant development such as highway bridges, tank farms and flood dikes has involved installation of hard riprap in northern sections.
 - Hydrology: much of the floodplains flood annually or bi-annually despite modest reductions in flow peaks by upstream flood control dams. The low floodplains have the largest amplitude in flood stages in the watershed by far (regularly 15 to 20 feet difference between annual high and low water level). Flooding may increase in the future with increased runoff from impervious surfaces and sea level rise.
 - Rare species: The coves provide particularly valuable habitat to fish and waterfowl. The floodplain forest has two bald eagle nests; multiple *Arisaema dracontium* populations. The largest heron rookery in the state of CT occurred in the Great Meadows before it was destroyed by the construction of Interstate highway 91. Northern harriers occur in the meadows.
- **Connecticut River - Windsor Islands and Tributary Confluences** (East Hartford to Windsor, CT)
 - Significance: in this section, flow of Connecticut River slows as it encounter the first tidal influence resulting in a broader channel and creating many new bars and islands for floodplain pioneer tree species and potentially for *Cicindela puritana* habitat. The floodplain forest remnants include some of the largest trees anywhere in the watershed.
 - Current land use: islands are in natural floodplain forest vegetation, while mainland floodplains are mostly in agriculture.
 - Hydrology: Low floodplain forest at tributary confluences (Podunk River, Farmington River, and Scantic River) flood frequently, but much of the rest of this large floodplain area is in higher terraces that flood less often and are consequently vulnerable to

invasion by invasive shrubs such as *Euonymus alatus* and *Berberis thunbergii*. Operation of flood control dams has reduced flooding, but only by a modest amount. Flooding may increase in the future with increased runoff from impervious surfaces and sea level rise.

- Rare species: *Arisaema dracontium* populations and rails occur.
- **Connecticut River - Pioneer valley** (Northampton & Hadley, MA)
 - Significance: Remnant floodplain forest patches are some of the largest in the watershed, are of high quality, and contain some of the largest floodplain trees anywhere in the basin. The high floodplain probably has the most fertile soils in the watershed as indicated by species like *Lilium canadensis*, *Staphylea trifolia*, *Celtis occidentalis*, and *Juglans nigra* (a road on high floodplain in Northampton is called Walnut way). This section of river has the largest oxbow in the basin which attracts fish, herons and anglers.
 - Current land use: although large floodplain forest remnants remain much of the floodplains are in agriculture.
 - Hydrology: low floodplain still receives ample long duration flooding annually, although somewhat less than before flood control dam operations began.
 - Rare species: populations of the rare *Arisaema dracontium* occur. The river channel is dynamic in some sections creating recruitment opportunities for floodplain pioneer trees and beach habitat for *Cicindela puritana* and rare dragonflies (e.g. *Stylurus amnicola*, *Gromphus fraternus*). Northern harriers occur in the meadows.

Mountains & Highlands (Lower New England Ecoregion)

- **Connecticut River – Waits River Confluence to Wells & Ammonoosuc River Confluences** (Haverhill NH, Bradford VT, Newbury VT)
 - Significance: several high quality floodplain forest patches remain such as at Bedell Bridge State Park and on Howards Island, NH. Sediments from the Wells River and the Passumpsic River are calcareous and have created high pH soils in some areas, which provides habitat for relatively rare floodplain trees like *Celtis occidentalis* and *Ulmus rubra*. There are some oxbows providing valuable habitat and channel migration is still quite active on this meandering channel.
 - Current land use: most of the floodplains have been converted to row crop agriculture.
 - Hydrology: Less than half of the floodplain areas flood annually or even bi-annually, but almost all of the floodplain area floods during a 10-year recurrence interval flood.
 - Rare species: Low floodplains support the currently most northern population of *Arisaema dracontium*. In the past the rich high terraces may have supported a population of *Quercus macrocarpa*.

White and Green Mountains (Northern Appalachians Ecoregion)

- **Connecticut River – Johns River Confluence to Paul Stream Confluence** (Lancaster NH to Brunswick VT)
 - Significance: perhaps the least altered flood regime anywhere on the mainstem CT River. One of the few mainstem sections with a meandering channel and ample channel migration creating beach habitat and many large oxbows. *Phalaris arundinacea* is the only serious invasive. Although other invasive plant species are present they are uncommon. The floodplain forest patch at the Upper Ammonoosuc River confluence is one of the largest remnants in the watershed.
 - Current land use: floodplains are mostly in hayfields but large floodplain forest remnants occur.
 - Hydrology: extensive floodplain areas flood annually, sometimes multiple times a year.
 - Rare species: Rare plants include *Salix pellita*. There is a heron rookery and osprey nests.

Small River

Type definition and field recognition: small river size category is defined as less than 500 km² watersheds. The small low-gradient river floodplain type can be recognized by having a mud bottom stream channel that is small enough to have logs span the width of the channel and make it impassable for canoes and kayaks during normal flows.

Locations: Coginchaug River, Scantic River, Stony Brook, Bachelor Brook, Fort River, Mill River (Whately & Hatfield), Sawmill River, Mascoma River (provisional), Wells River (provisional), Johns River, Passumpsic River, Upper Ammonoosuc River, Nullhegan River, Halls Stream, Indian Stream.

Ecosystem Function: Small river floodplains contribute to the same ecosystem services as floodplains of large rivers, except quantitatively less so. Small river floodplains potentially present a conservation opportunity because they are too wet for housing development and not as desirable for agriculture as floodplains of larger rivers, as well as having relatively natural flows because of an absence of large (flood control) dams.

Dominant physical processes: Floodplains of the small low gradient river type have high water tables and relatively poor drainage and consequently share many species with swamp and clay plain forests. Flooding may be frequent and prolonged but is not deep. Small river floodplain soils are often relatively poor and acidic in the CT River basin, but there are exceptions such as the Passumpsic River. Channels are often very meandering with many small oxbows, but channel migration rates are too slow and light conditions are too low to allow recruitment of floodplain pioneer tree species.

Tree species composition: Characteristic species are *Acer rubrum* as the dominant with *Quercus palustris* and *Quercus bicolor* as important components in Southern New England. *Carya cordiformis* and *Fraxinus pennsylvanica* in the southern part of the watershed and *Ulmus americana* throughout are also common. *Acer saccharinum* can occur along channel banks and in other areas with longer duration flooding such as stream confluences with larger rivers. In the northern part of the watershed, small river floodplains often have a larger component of *Alnus incana* and potentially include northern conifers like *Abies balsamea*. Due to the small depth of flooding, upland tree species such as *Prunus serotina* can persist on slightly higher elevations within the floodplain. *Carpinus caroliniana*, *Hamamelis virginiana* and in the southern part of the watershed the rare *Nyssa sylvatica* occur in the transition from the floodplain to upland forest. A disjunct population of *Betula nigra*, a pioneer floodplain species typical of acidic drainages, occurs in the small river floodplain forest type in the Merrimack River valley of southeastern NH and northeastern MA. *Populus heterophylla* and *Liquidambar styraciflua* are currently rare species at their northern range extent occurring in forested swamps in southern CT where the dominant tree species are the same as on small river floodplains. Further south, these two tree species are also common in floodplain forests.

Herb and shrub layer: the most common herb layer species are *Onoclea sensibilis* and various sedges. Other fern species (*Athyrium filix-femina*, *Osmunda cinnamomea*, *Thelypteris noveboracensis*) and *Impatiens capensis* can also be prominent. *Cornus amomum* is a common shrub in the southern part of

the watershed and *Alnus incana* is particularly common in the northern part of the watershed. In the southern part of the watershed, *Rosa multiflora* is the most common invasive shrub and *Toxicodendron radicans* is the most common woody vine, whereas in the northern part woody vines and invasive shrubs are uncommon.

Notable wildlife species: Small river floodplains provide good habitat for bird species whose preferred habitats are forested wetlands more generally such as barred owl, American woodcock and red-shouldered hawk. Small river floodplain forests can contain populations of relatively rare reptiles and amphibians such as wood turtle and northern leopard frog.

Priority floodplain sites:

Southern New England Plains (Lower New England Ecoregion)

- **Coginchaug River** (Durham, CT)
 - Significance: The floodplain forest has high species richness associated with the relatively warm climate.
 - Current land use: Most of floodplain has natural vegetation cover including high quality floodplain forest.
 - Hydrology: The floodplain is poorly drained and consequently floods frequently.
 - Rare species: floodplain marsh attracts bitterns, rails and waterfowl.
- **Scantic River** (Enfield, East Windsor, CT)
 - Significance: has a relatively broad floodplain for a river of its size with a high tree species richness including more *Quercus bicolor* than on any other floodplain in the basin.
 - Current land use: most of the floodplain is forested.
 - Hydrology: the floodplain floods, and flooding is likely increasing because of increasing impervious surfaces within the watershed.
 - Rare species: a winding channel with lots of oxbows attracts waterfowl, turtles and frogs.
- **Stony Brook and Muddy Brook** (Suffield, CT)
 - Significance: Stony brook has a relatively broad floodplain for a river of its size and is dominated to a greater degree by *Quercus palustris* than other floodplains in the basin.
 - Current land use: most of the floodplain is forested.
 - Hydrology: The floodplain has poorly drained clay soils that increase wetness. Much of the floodplain floods frequently including during summer rain storms.
 - Rare species: There is also more *Nyssa sylvatica* in the transition from floodplain to hillside forest than on other floodplain sites.
- **Bachelor Brook and Stony Brook** (South Hadley, MA)
 - Significance: Floodplain forest is species rich and in good condition.
 - Current land use: Bachelor Brook is mostly forested, but Stony Brook is only partially forested.

- Hydrology: The Bachelor and Stony Brook floodplains are affected by a backwater effect from the CT River mainstem at the confluences which results in more than usual flooding for rivers of their small size. Beaver activity has created open marshy areas with *Cephalanthus occidentalis*, *Lobelia cardinalis* and other wildflowers.
- Rare species: *Nyssa sylvatica* occurs in the transition from floodplain to hillside forest.
- **Fort River** (Amherst, Hadley, MA)
 - Significance: The Southern branch of the Fort River passes along a rare tract of *Quercus palustris* – *Quercus bicolor* – *Nyssa sylvatica* swamp that is a conservation priority for the state of MA and the Town of Amherst. The Fort River mainstem and adjacent farm fields in Hadley are a conservation priority for the Silvio O. Conte National Wildlife Refuge for protecting grassland bird habitat. The floodplain forests of the Fort River mainstem have high tree species richness.
 - Current land use: The Fort River floodplains are generally more disturbed because of more recent agriculture than on other small rivers that we selected, but a larger portion of riparian parcels has also been protected. The water is still relatively muddy from the few remaining riverbank crop fields in Hadley that lack buffer strips. However the high proportion of land protected in recent years, the reforestation of stream bank buffer strips and the breaching of the only dam on the Fort River mainstem in the first half of the 20th century suggests that an ecological recovery is ongoing.
 - Hydrology: Flooding is less frequent than other small river floodplains probably because the channel has become incised and consequently invasive shrubs are more common particularly *Rosa multiflora*. The Northern branch (Amethyst Brook) is a higher gradient stream where the floodplain forest is dominated by *Platanus occidentalis*, but the mainstem of the Fort River is typical in composition of low gradient small river floodplains.
 - Rare species: no rare floodplain species but several aquatic species including dwarf-wedgemussel and birdle shiner.
- **Mill River** (Whately, MA)
 - Significance: The Mill River floodplain connects to a large protected tract of *Quercus palustris* – *Quercus bicolor* – *Nyssa sylvatica* swamp (Whately Great Swamp WMA), the largest remaining swamp forest in the MA part of the Connecticut River valley. This swamp is near the current northern range limit for *Q. palustris* and *Q. bicolor*.
 - Current land use: until recently agriculture but now largely abandoned.
 - Hydrology: Parts of the floodplain flood regularly, but in other sections the Mill River channel has become incised. Like the Fort River, the Mill River now appears to be experiencing an ecological recovery, although the old mill dam in Hatfield still remains.
 - Rare species: The floodplain includes lots of oxbows and some marsh in part due to intense beaver activity, which provide habitat for several rare species of animals and plants including turtles. The largest population of dwarf-wedgemussel in MA.

- **Sawmill River** (Montague, MA)
 - Significance: There is a large high quality floodplain forest patch at the confluence with the Connecticut River.
 - Current land use: mostly forested.
 - Hydrology: ample flooding on Third Sunderland Island and at the Sawmill River confluence from the mainstem. Flooding decreases upstream and floodplain forest quality declines accordingly.
 - Rare species: bald eagle's nest and *Arisaema dracontium*.

Mountains & Highlands (Lower New England Ecoregion)

- Currently none. The **Mascoma River** (Canaan, NH) has the right stream size and gradient channel as well as a good landscape context, but does not experience sufficient flooding to support flood tolerant species except at Webster WMA, possibly because the channel has become incised.
- The **Wells River** in Wells River, VT is an intriguing possibility because of calcareous parent materials in its watershed but this possibility has not yet been explored.

White and Green Mountains (Northern Appalachians Ecoregion)

- **Johns River** (Dalton, NH)
 - Significance: High water quality in a mostly forested watershed. There are very few invasives and the floodplain is generally very natural.
 - Current land use: natural vegetation except for a railroad line.
 - Hydrology: It has a very meandering channel with lots of oxbows and the floodplain floods annually.
 - Rare species: none observed during TNC field work, but relatively little explored
- **Passumpsic River** (Lyndon, VT)
 - Significance: The floodplain is one of only two rich floodplain sites with large populations of *Acer nigrum x Acer saccharum* hybrids and *Allium tricoccum* in the watershed. One of the few CT River tributary watersheds with substantial amounts of calcareous parent materials.
 - Current land use: mostly converted to agriculture but now changing to other land uses such as athletic fields.
 - Hydrology: The floodplain floods frequently but only briefly and has numerous oxbows.
 - Rare species: *A. nigrum x A. saccharum* hybrids, *Allium tricoccum*, possibly other.
- **Upper Ammonoosuc River** (Stark, NH)
 - Significance: The cold northern climate gives this floodplain forest a unique composition with *Acer saccharinum*, *Alnus incana* and *Abies balsamea* being co-dominant. The channel is meandering with some oxbows. There are few invasives. Several high quality floodplain forest remnants exist and the landscape context contains an exceptionally large portion of protected upland forests.

- Current land use: Part of the floodplain is in natural vegetation while parts are in old fields.
- Hydrology: relatively unaltered hydrology and flooding is frequent and relatively long for a small river, resulting in more *A. saccharinum* than typical.
- Rare species: none observed during TNC field work, but relatively little explored
- **Cedar Brook** (Upper Ammonoosuc River in Milan, NH)
 - Significance: Small patches of floodplain forests in river bends or stream confluences embedded in much more significant occurrences of other natural riparian communities including fens and conifer swamps. There are few invasives.
 - Current land use: mostly forested including much protected upland forests in watershed
 - Hydrology: hydrology is unaltered, but floodplains that flood frequently are not extensive.
 - Rare species: none observed during TNC field work, but relatively little explored.
- **Nullhegan River** (Ferdinand, VT)
 - Significance: A narrow band of floodplain trees on the channel shelf embedded in much more significant occurrences of other natural riparian communities including bogs and northern conifer swamps. There are few invasives.
 - Current land use: mostly natural vegetation, but part of the higher floodplain appears to be old fields reverting to forest, currently dominated by *Prunus serotina*. The watershed context includes an exceptionally large amount of protected upland forests.
 - Hydrology: hydrology is unaltered, but floodplains that flood frequently are not extensive.
 - Rare species: none observed during TNC field work, but relatively little explored.
- **Indian Stream and Halls Stream** (Pittsburg, NH)
 - Significance: Spring flooding is ample enough to support floodplain forest at the confluences with the mainstem Connecticut River. Further upstream floodplain forests are replaced by other riparian communities that include northern conifer swamps.
 - Current land use: The floodplains at the confluences are mostly in agriculture but the upstream watershed context includes an exceptionally large amount of protected upland forests.
 - Hydrology: These streams have a natural hydrologic regime with a meandering channel.
 - Rare species: none observed during TNC field work, but relatively little explored.

Medium River

Type definition and field recognition: The medium river size category is defined as 500 to 2,500 km² watersheds. The medium river floodplain type can be recognized by a mud-bottom low-gradient river channel that is too shallow for motor boats, yet ideal for canoeing and kayaking (i.e. no log jams across the channel).

Locations: Farmington River (provisional), Ashuelot River, Upper Connecticut River.

Ecosystem Function: contribute to the same ecosystem services as large river floodplains, but in a more moderate amount.

Dominant physical processes: frequent and long duration flooding.

Tree species composition: The medium river floodplain type is intermediate between the small and large river types in terms of physical habitat. Consequently medium river floodplains, like tributary confluences, characteristically combine species from large and small river floodplain types giving them higher species richness, but unlike large and small rivers they do not harbor any species that are unique to them.

Herb and shrub layer: see above comment on tree composition.

Notable wildlife species: numerous oxbows of meandering channels provide ideal habitat for cavity nesting waterfowl, turtles and frogs such as the rare northern leopard frog. Painted turtles appear in much larger numbers on medium low-gradient rivers than on either small or large rivers.

Priority floodplain sites:

Southern New England Plains (Lower New England Ecoregion)

- Currently none, but could change pending flow restoration on the **Farmington River** (Simsbury, CT). In addition to hydrologic alteration by large dams, the Farmington channel has also been straightened in some places.
- The **Deerfield River** in Deerfield, MA also has a medium river floodplain but the channel is too incised except for the section between the Green River confluence and the Route-5 Bridge.

Mountains & Highlands (Lower New England Ecoregion)

- **Ashuelot River South Branch Confluence** (Swanzey, Keene, NH)
 - Significance: The floodplains on the East side of the river mostly have protected mature floodplain forest with some of the largest trees anywhere in the basin. The sluggishly flowing river channel and especially the oxbows attract much wildlife, including waterfowl, kingfishers, herons, frogs and the largest aggregations of turtles sighted during TNC floodplain field work aside from the Farmington River.
 - Current land use: The West side of the river at the South Branch confluence is still in agriculture and privately owned but the more extensive East side is forested and mostly protected.
 - Hydrology: The confluence of the South Branch with the Ashuelot River mainstem still experiences adequate flooding despite upstream flood control dam operations. The hydrology of the South Branch is relatively unaltered by dams. Part of the channel has been straightened. Invasion by glossy buckthorn is a potential concern and may be a symptom of reduced flooding from flood control dams.
 - Rare species: few noted during TNC field work but could potentially include red-shouldered hawk and rare turtles. One individual of *Quercus bicolor* was discovered (in NH, known previously only from the Southeastern part of the state), but it is not clear if this individual is a lone survivor from a formerly larger population or an escapee from cultivation.

White and Green Mountains (Northern Appalachians Ecoregion)

- **Upper Connecticut River** (Colebrook NH to Canaan VT)
 - Significance: Good watershed context with much upland forests protected. There are lots of oxbows that attract waterfowl, especially during migration. Older oxbows are dominated by fens or conifer swamps. There are relatively few invasives.
 - Current land use: Agriculture, except for old oxbows.
 - Hydrology: Extensive floodplain areas flood annually, but flooding is for shorter duration than on large river floodplains. In some sections the channel has been straightened but is now re-establishing a more meandering channel again.
 - Rare species: *Salix pellita*.

High Gradient River

Type definition and field recognition: High gradient river floodplains are defined based on the relatively higher flow energy/velocity as evidenced through the effects of scour and disturbance. High gradient floodplains are recognized by a river channel that has either a cobble or gravel bottom. Re-sprouting multi-trunked trees on the riverbanks that are bent in the downstream direction and that have wounds on the upstream side of the trunk are another identifying characteristic. From the Mascoma River confluence south, these re-sprouted trees are often *Platanus occidentalis*. Two high gradient river floodplain subtypes can be distinguished. The first is a more moderate gradient/energy river where streambeds are gravelly and meandering, while the second is of higher gradient/energy river with a cobble stream bed and a straighter channel. The two types are combined for the Connecticut River basin because both types share the same dominant species and differ mainly in fluvial geomorphology.

Locations: Westfield River, Green River, West River (provisional), Upper Ashuelot River, White River, Third Branch White River, Wild Ammonoosuc River, Ammonoosuc River, Moose River. In addition to occurring on high gradient tributary rivers, this floodplain type can occur at the head of islands and below waterfalls in higher gradient sections of the mainstem Connecticut River such as at Hart Island, NH or below Turners Falls, MA (provisional).

Ecosystem Function: floodplain forest vegetation slows flood waters and reduces soil erosion.

Dominant physical processes: Flooding can be frequent but is typically of short duration in high gradient rivers. The dominant effect of floods is disturbance associated with more extreme events (10-year RI) and/or ice scour.

Tree species composition: Characteristic species include dominance by *Platanus occidentalis* and *Ulmus americana*, with *Salix sericea* and other shrubs along the banks. In northern Vermont, *P. occidentalis* is replaced by *Acer negundo* as the dominant. *Populus deltoides* can also be frequent on the medium gradient rivers with gravel bottoms and meandering channels. These species are good at re-sprouting quickly after damage. Most of the floodplain on high gradient rivers is high terrace, because flow peaks are typically too brief and flow velocities too fast to cause sufficient duration flooding for dominance by these flood tolerant species except at the lowest elevations. The composition of upland tree species on the high terrace depends on the soil fertility and is usually similar to adjacent hill slopes. If soils are more acidic then the high terraces are typically dominated by *Acer rubrum*, upland oaks and possibly *Pinus strobus*. If soils are richer, high terraces are dominated by *Acer saccharum*, sometimes in combination with *A. nigrum* x *A. saccharum* hybrids or *Fraxinus americana*. Like on large rivers, rich terrace tree species may also include *Tilia americana*, *Carya cordiformis*, *Juglans nigra*, *Juglans cinerea*, *Ulmus rubra*, *Liriodendron tulipifera*, and *Acer negundo*.

Herb and shrub layer: Low floodplain areas and riverbanks of high gradient rivers are susceptible to severe invasions of the non-native *Fallopia x bohémica*, which appears to thrive on scour disturbance (possibly because floods break off rhizomes and spread them). The herb layer of the high terrace can also be quite rich with species like *Allium tricoccum*, *Asarum canadense*, and *Trillium erectum*.

Notable wildlife species: High energy banks and rocky ledges especially on northern rivers with ice scour are associated with regionally rare species including cobblestone tiger beetle (*Cicindela marginipenes*), *Astragalus robbinsii* var. *jesupii*, *Prunus pumila* var. *depressa*, *Salix exigua*, *Andropogon gerardii* and other prairie species including many wildflowers.

Priority floodplain sites:

Southern New England Plains (Lower New England Ecoregion)

- **Westfield River Branches** (Huntington, Chester, MA)
 - Significance: Although floodplain areas are small, the watershed context includes mostly forested uplands that are already a conservation priority. The hydrology of the West Branch is unaltered by dams and patches of *Fallopia x bohemica* are relatively small in extent for a high gradient river. Terraces are dominated by *Acer rubrum* and are not particularly rich by floodplain standards.
 - Current land use: The low floodplain forest is in a narrow strip of *Platanus occidentalis* and *Ulmus americana* trees along the riverbank. These narrow strips are buffered by higher terraces and adjacent uplands that are mostly forested.
 - Hydrology: Although flows are unaltered on the West Branch flooding is of short duration and infrequent on most of the floodplain because of the steep valley topography. The mainstem Westfield River has better floodplain development but flooding has been dramatically reduced by flood control dams.
 - Rare species: high energy riverbank species. Probably *Liriodendron tulipifera*, at least historically.
- Pending flow restoration, larger areas of high gradient floodplain may be gained on the **Westfield River mainstem** (Westfield, MA) which include some particularly rich high terrace.
- **Green River** (Greenfield, MA)
 - Significance: One of only two sites where the gradient is moderate enough to combine dominance by high gradient river floodplain species like *Platanus occidentalis* and *Populus deltoides* with a meandering channel and consequently a wide low floodplain. Exceptionally high channel mobility provides ample recruitment sites for pioneer species like *P. deltoides*, *P. occidentalis* and shrub willows. The high floodplain is an exceptional rich terrace with one of two floodplain sites with large populations of *Acer nigrum x Acer saccharum* hybrids and *Allium tricoccum* found during TNC floodplain field work. A mostly forested watershed context results in exceptionally clear water.
 - Current land use: mostly forested but large patches of the floodplain have become heavily invaded by *Fallopia x bohemica*.
 - Hydrology: Flooding is frequent but of relatively short duration on this tributary without significant hydrologic alteration.
 - Rare species: rare sedges, *Acer nigrum*

Mountains & Highlands (Lower New England Ecoregion)

- **Upper Ashuelot River** (Surry, NH)
 - Significance: Only significant floodplain forest dominated by *Platanus occidentalis* in NH, although *P. occidentalis* occur sporadically along the mainstem Connecticut River as far North as the Mascoma River confluence. Upstream watershed context is largely forested.
 - Current land use: Mostly natural vegetation on land protected by US Army Corps of Engineers. Some patches heavily invaded by *Fallopia x bohemica*.
 - Hydrology: Flooding is frequent but of relatively short duration on this tributary without significant hydrologic alteration. The downstream end of the site gets some backwater effect from the Surry Mountain flood control dam.
 - Rare species: *Platanus occidentalis* is rare in NH.
- Pending flow restoration additional high gradient floodplains can be restored on the **West River** (Townshend, VT). Despite dramatic reductions in peak flows, the West River still supports populations of cobble bar species like *Prunus pumila* var. *depressa*, *Andropogon gerardii* and cobblestone tiger beetle (*Cicindela marginipenes*).
- Pending flow restoration additional high gradient floodplains can be restored on the **mainstem Connecticut River** (Sumner Falls & Hart Island in Plainfield, NH or below Turners Falls and Holyoke Falls in MA)

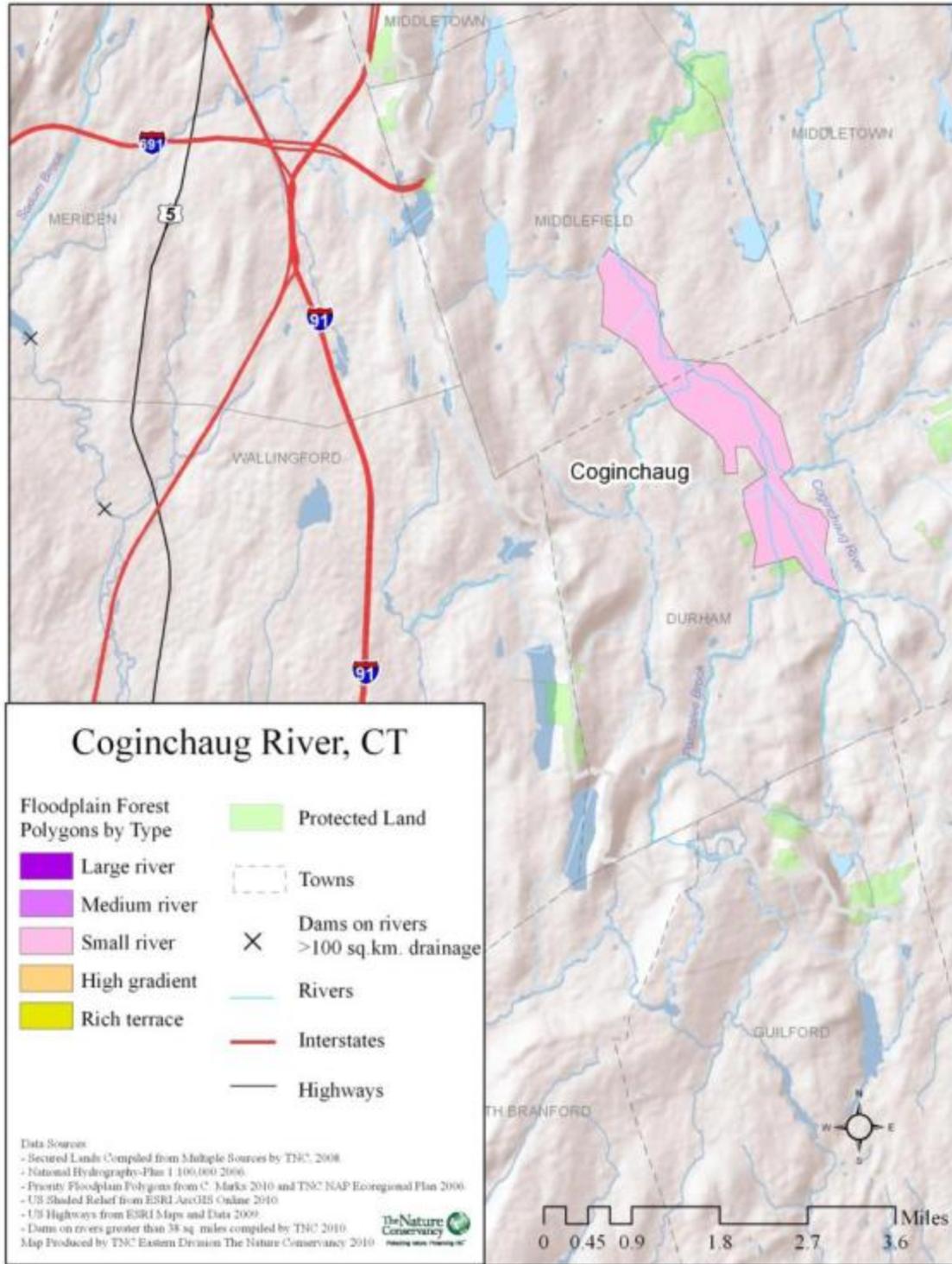
White and Green Mountains (Northern Appalachians Ecoregion)

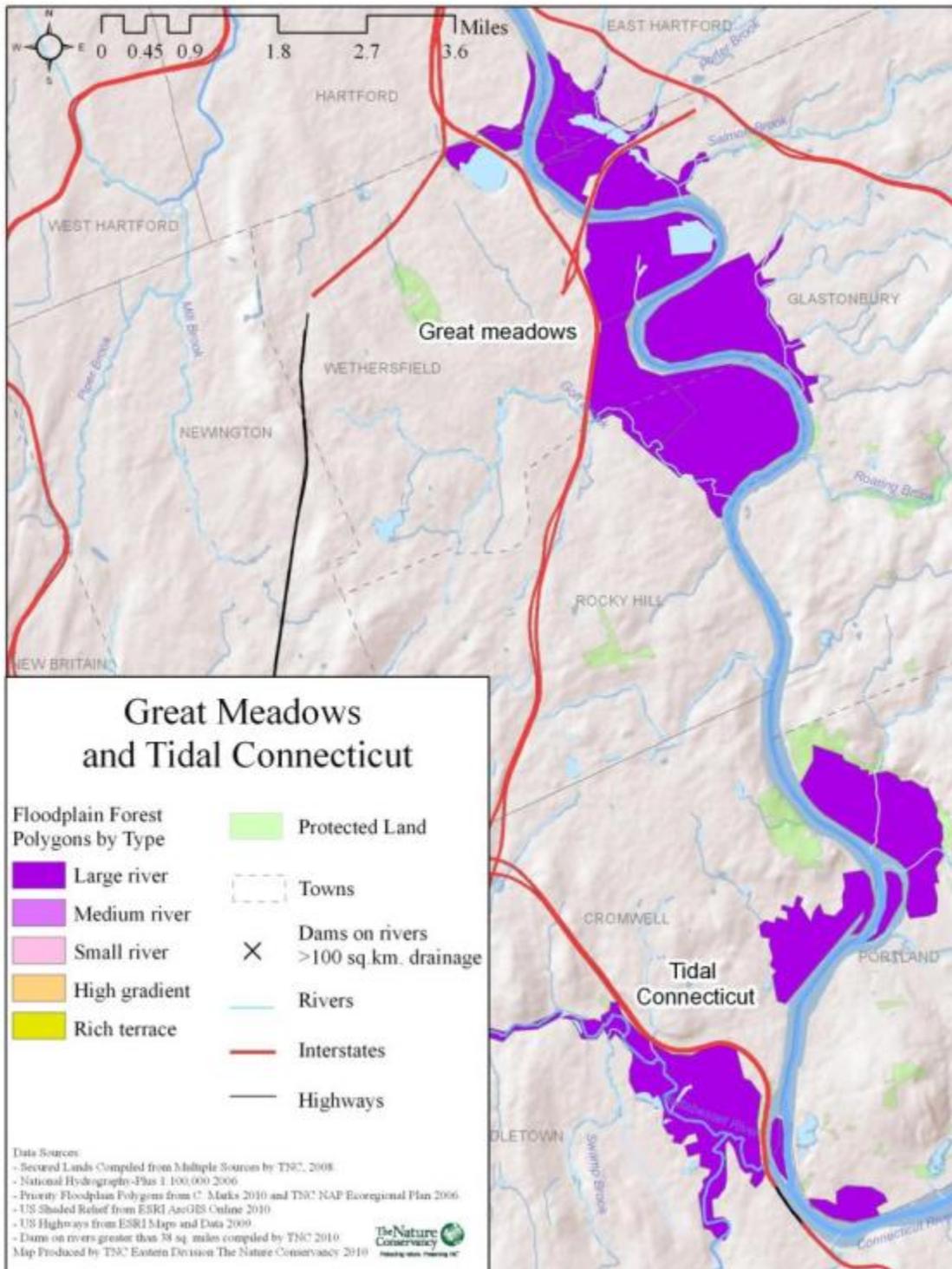
- **White River** (Sharon, Royalton, VT)
 - Significance: The White River stands out in having large ice scour shelves on the riverbank that are dominated by otherwise regionally rare prairie species including many wildflowers. The calcareous parent materials in the White River watershed have created the highest pH soils on any floodplains in the CT River basin.
 - Current land use: Relatively recent and widespread clearing of natural floodplain vegetation for agriculture.
 - Hydrology: The White River is exceptional in being the largest tributary without any large dams on it. Flooding is brief and affects only a narrow part of the floodplain in most years, but flows are of high energy and typically coincide with ice break-up creating the largest areas of ice scour shelf habitat in the Connecticut River basin.
 - Rare species: High channel mobility has created numerous bars and islands creating habitat for shrub species such as the rare *Salix exigua*. High energy cobble shores provide habitat for rare cobblestone tiger beetles (*Cicindela marginipenes*).
- **Third Branch White River** (Randolph, Bethel, VT)
 - Significance: One of only two sites where the gradient is moderate enough to combine dominance by high gradient river floodplain species like *Acer negundo* and *Populus deltoides* with a meandering channel and consequently a wide floodplain. Exceptionally high channel mobility provides recruitment sites for pioneer species like *P. deltoides* as

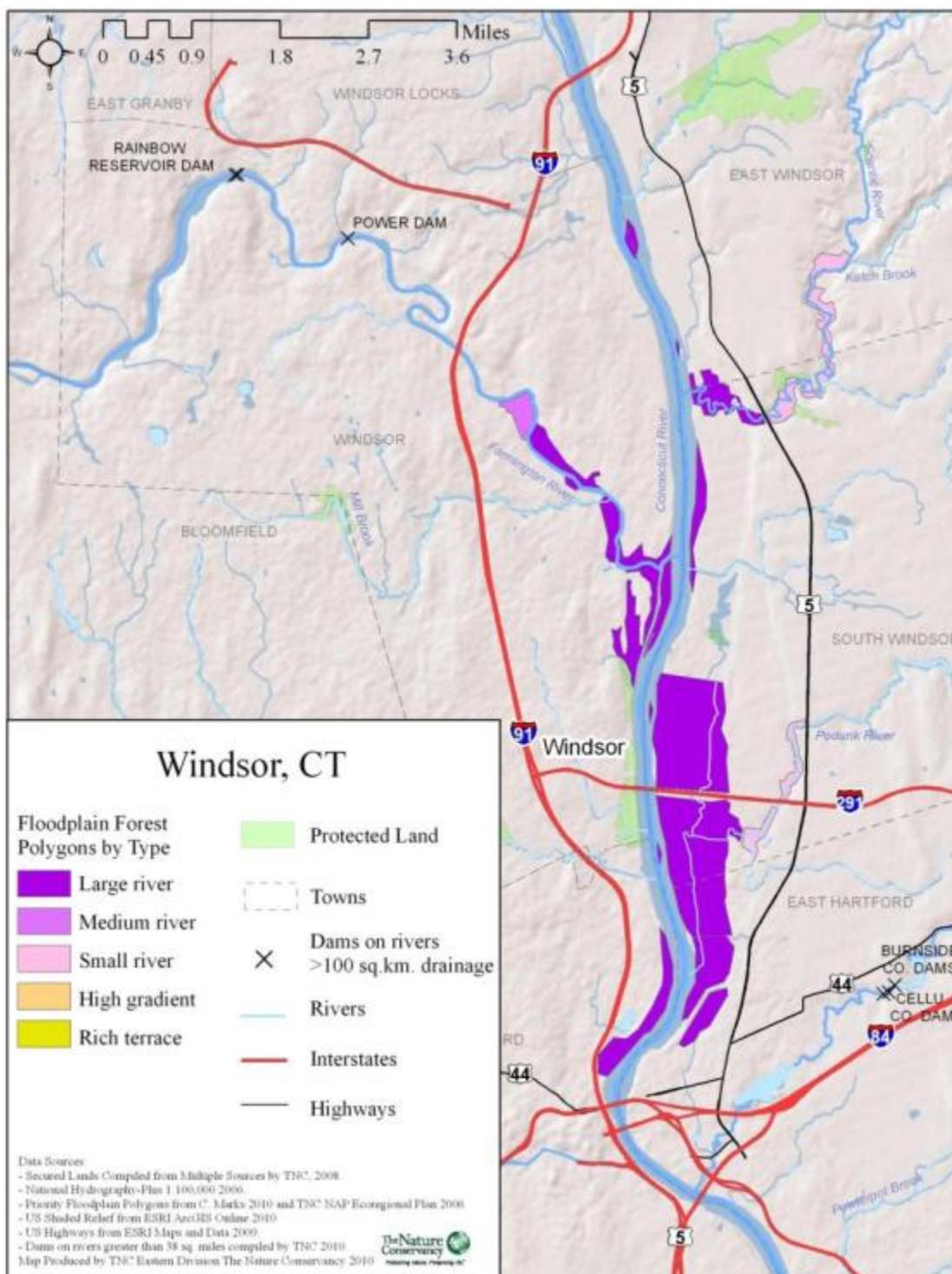
well as steep eroding banks for bank swallow and kingfisher nests. One of the few Connecticut River sub-watersheds where soils are high pH because of calcareous parent materials.

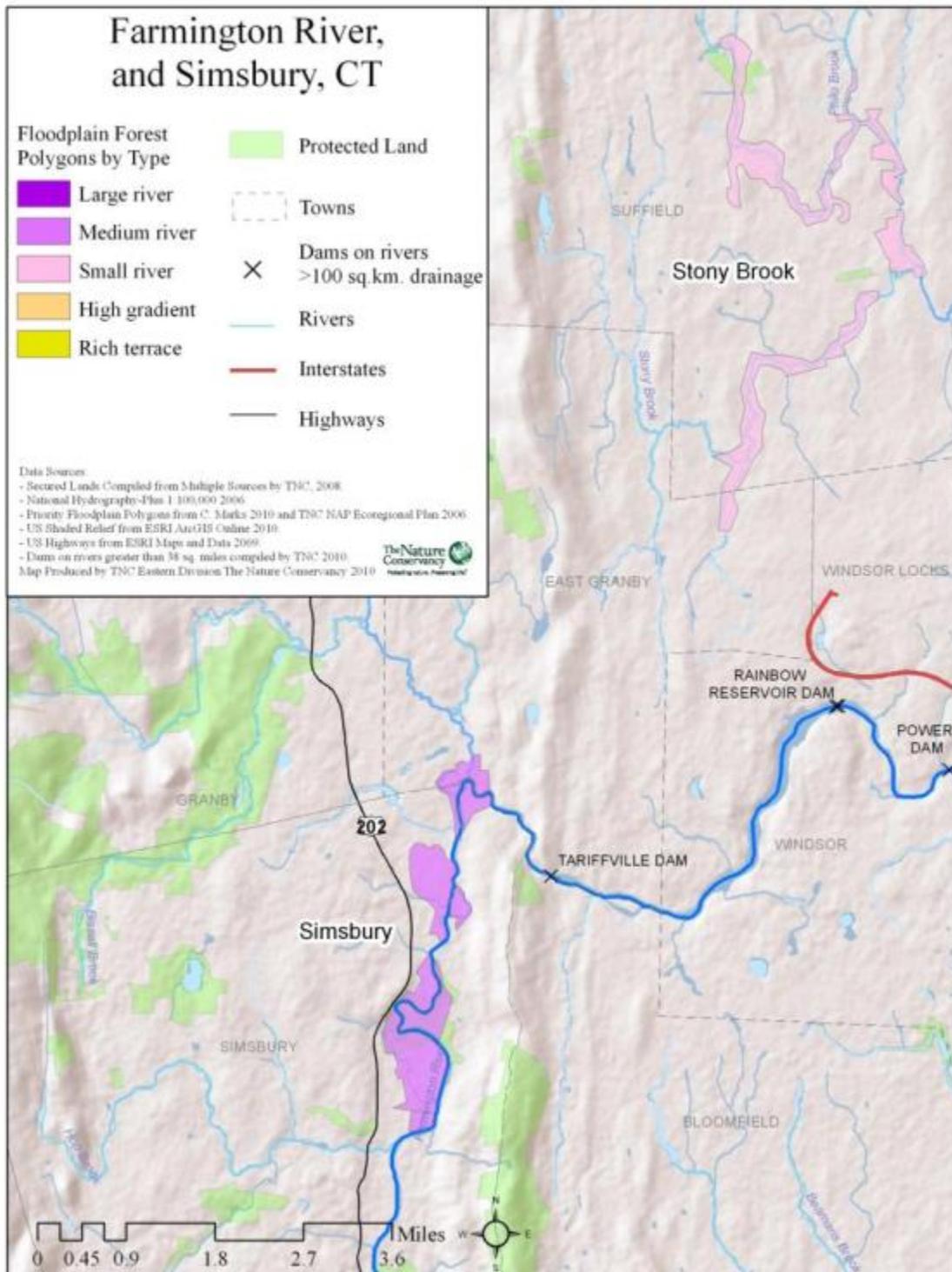
- Current land use: The high terrace has rich calcareous soils and is dominated by *Acer saccharum* and relatively little disturbed compared with rich terrace forest elsewhere. Large patches of the low floodplain have become heavily invaded by *Fallopia x bohemica*.
- Hydrology: Despite having a hydrology that is relatively unaltered, flooding is of short duration.
- Rare species: none observed during TNC field work, but relatively little explored.
- **Wild Ammonoosuc River** (Woodstock, NH)
 - Significance: Only narrow bands of floodplain trees occur along the riverbank, but they are buffered by forested high floodplains and mountain slopes, which are part of the White Mountain National Forest.
 - Current land use: forest
 - Hydrology: Despite a hydrology that is relatively unaltered, flooding is of short duration.
 - Rare species: relatively little explored; possibly rare species of ice scour shelves.
- **Barren & Esker** (Ammonoosuc River in Carroll, NH)
 - Significance: Only narrow bands of floodplain trees occur along the riverbank, but they are buffered by forested high floodplains and mountain slopes, part of the White Mountain National Forest. In places significant channel mobility creates open habitat for pioneers.
 - Current land use: forest
 - Hydrology: Despite a hydrology that is relatively unaltered, flooding is of short duration.
 - Rare species: relatively little explored; possibly rare species of ice scour shelves.
- **Moose River** (Concord & Victory, VT)
 - Significance: Includes a mix of meandering gravelly sections mostly in Victory Basin WMA and higher gradient sections with a more braided cobble bottom channel. Significant channel mobility creates bar habitat for recruitment of floodplain pioneer species including abundant wildflowers. The upstream watershed context is mostly forested and large areas are protected. Victory Basin WMA has relatively few invasives.
 - Current land use: natural vegetation upstream and more hayfields downstream.
 - Hydrology: Despite a hydrology that is relatively unaltered, flooding is of short duration and mainly affects bars and banks.
 - Rare species: relatively little explored; streamside prairie habitat on bars in braided sections downstream of the WMA is maintained by ice scour and may include rare species.

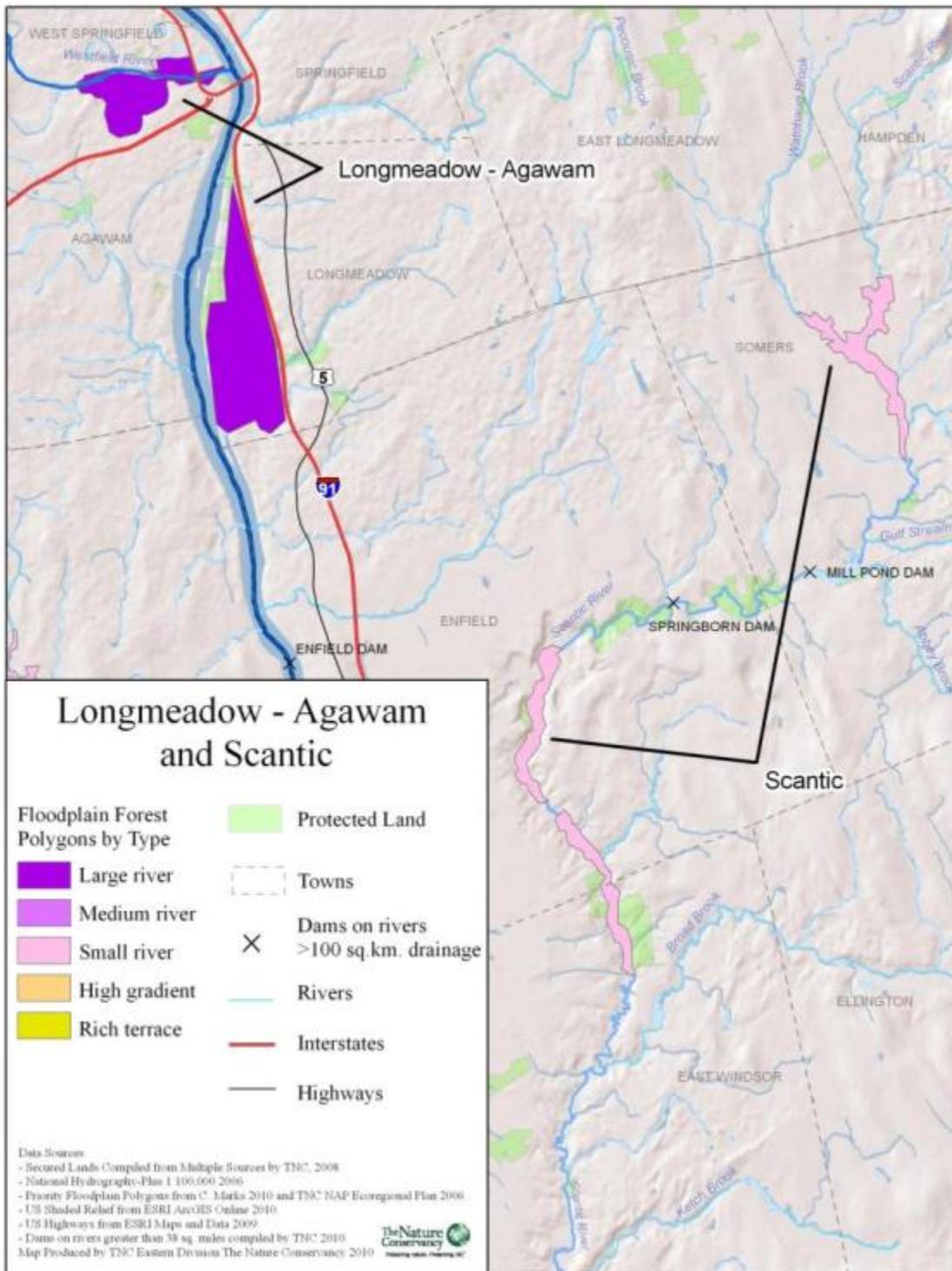
Appendix 1: Connecticut River priority floodplain site maps from South to North

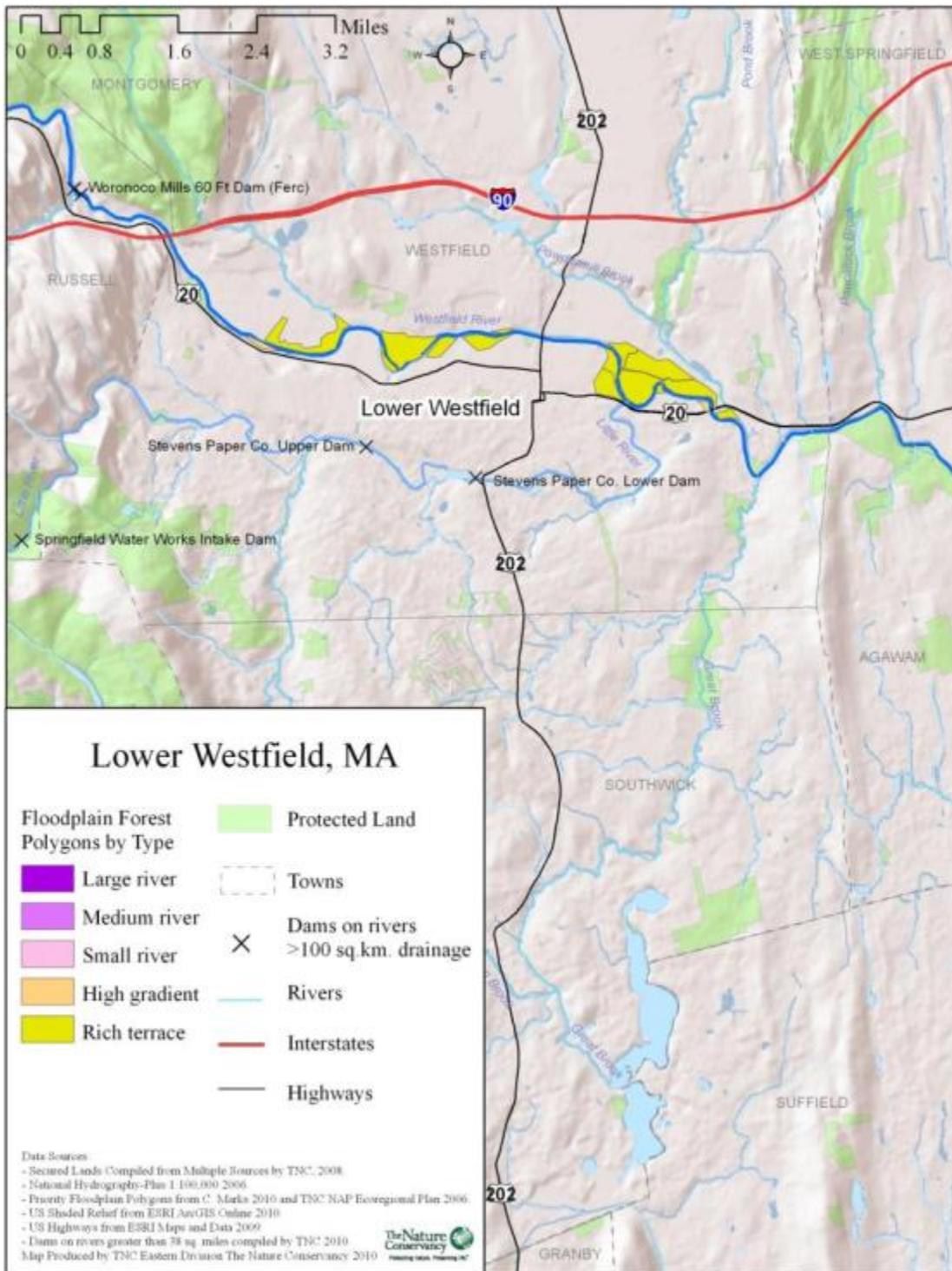


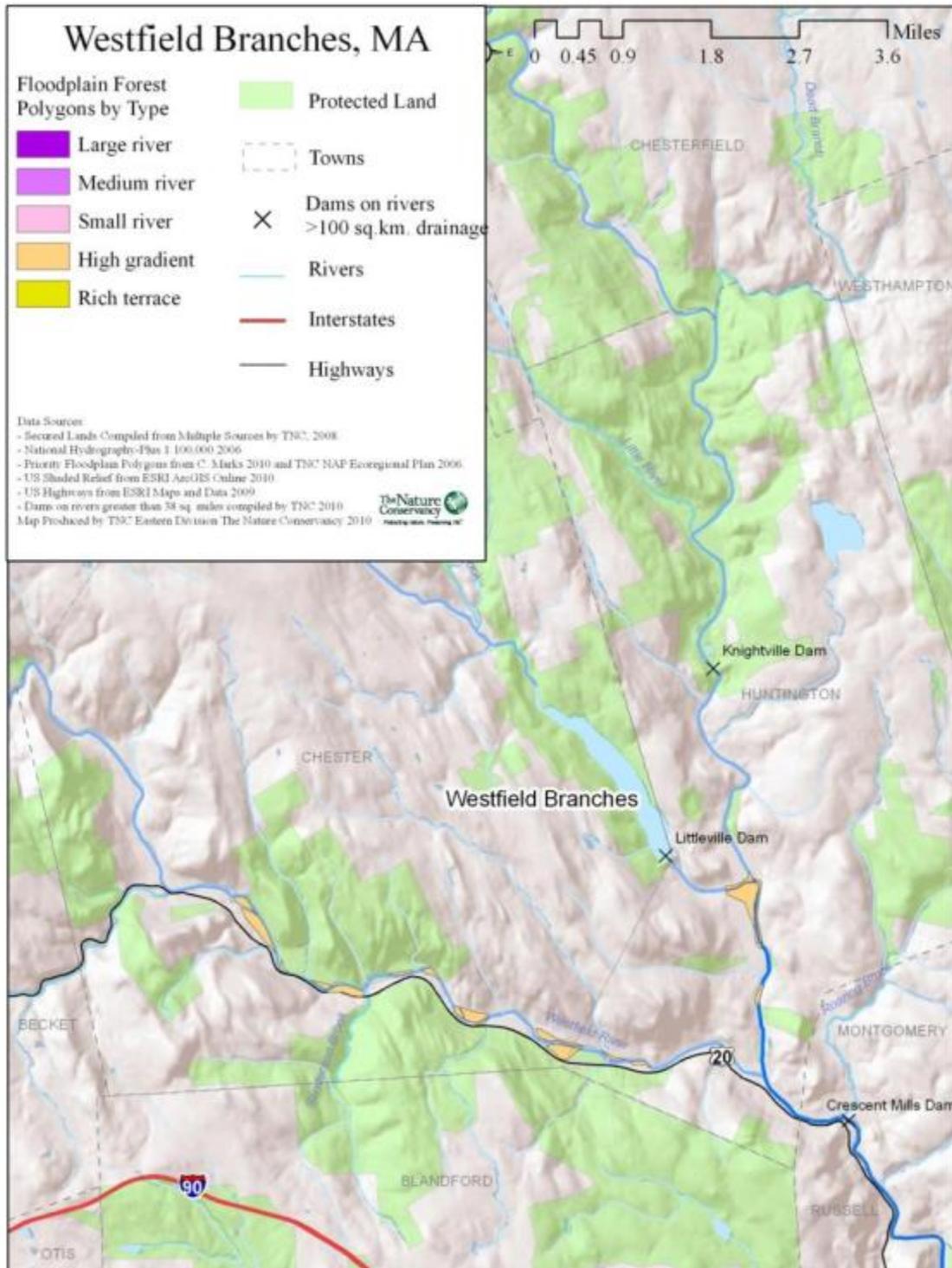


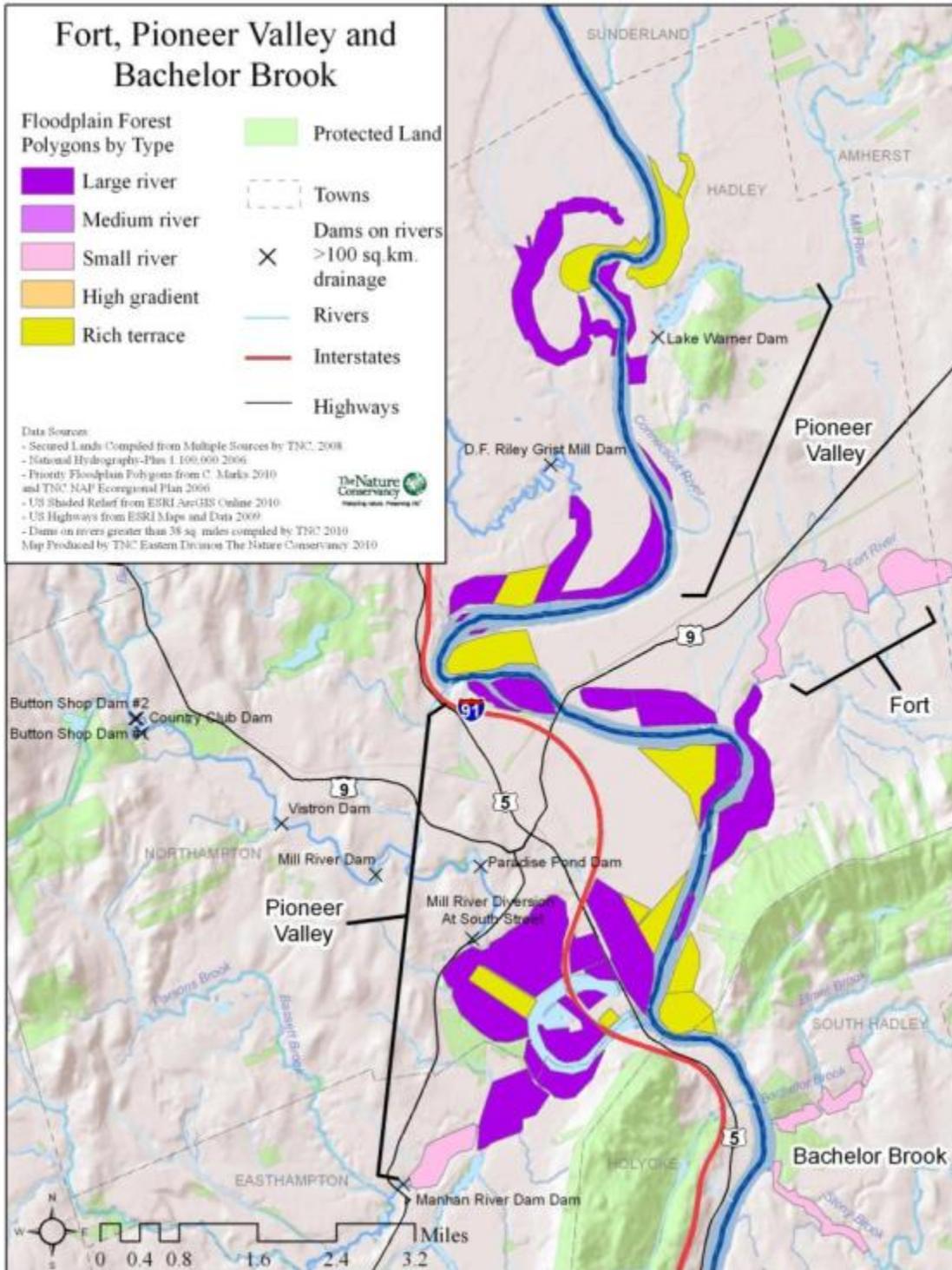


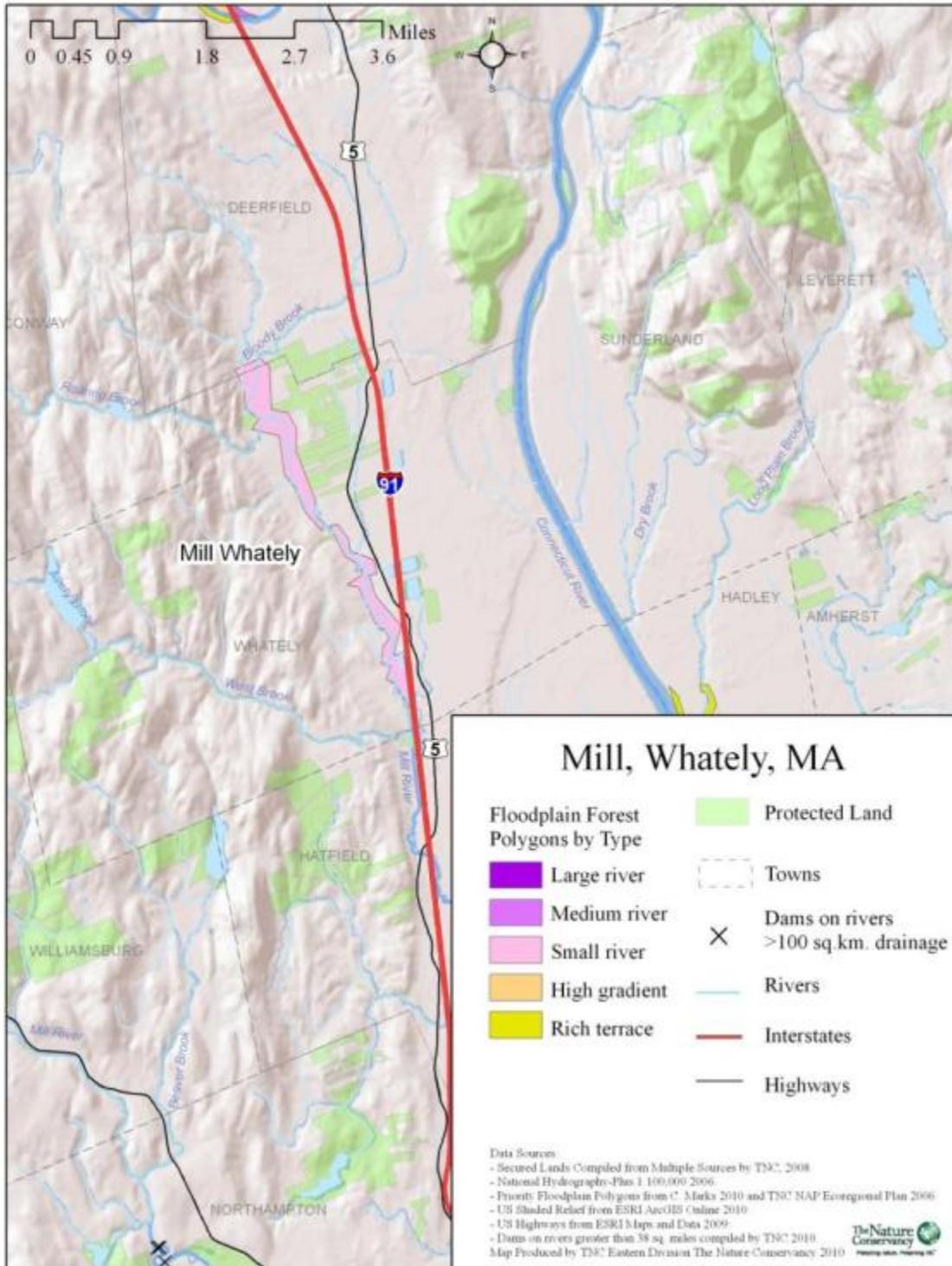


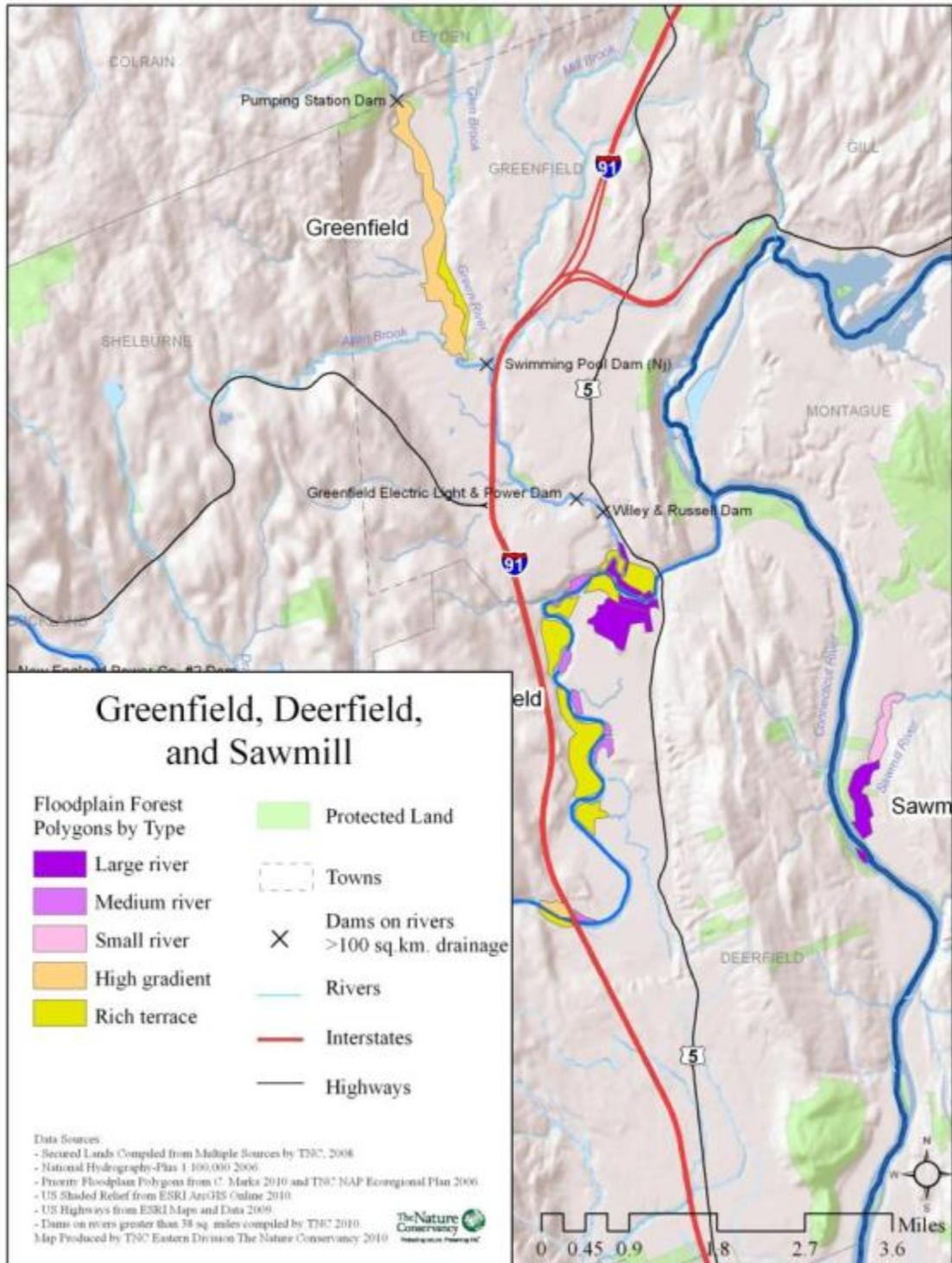


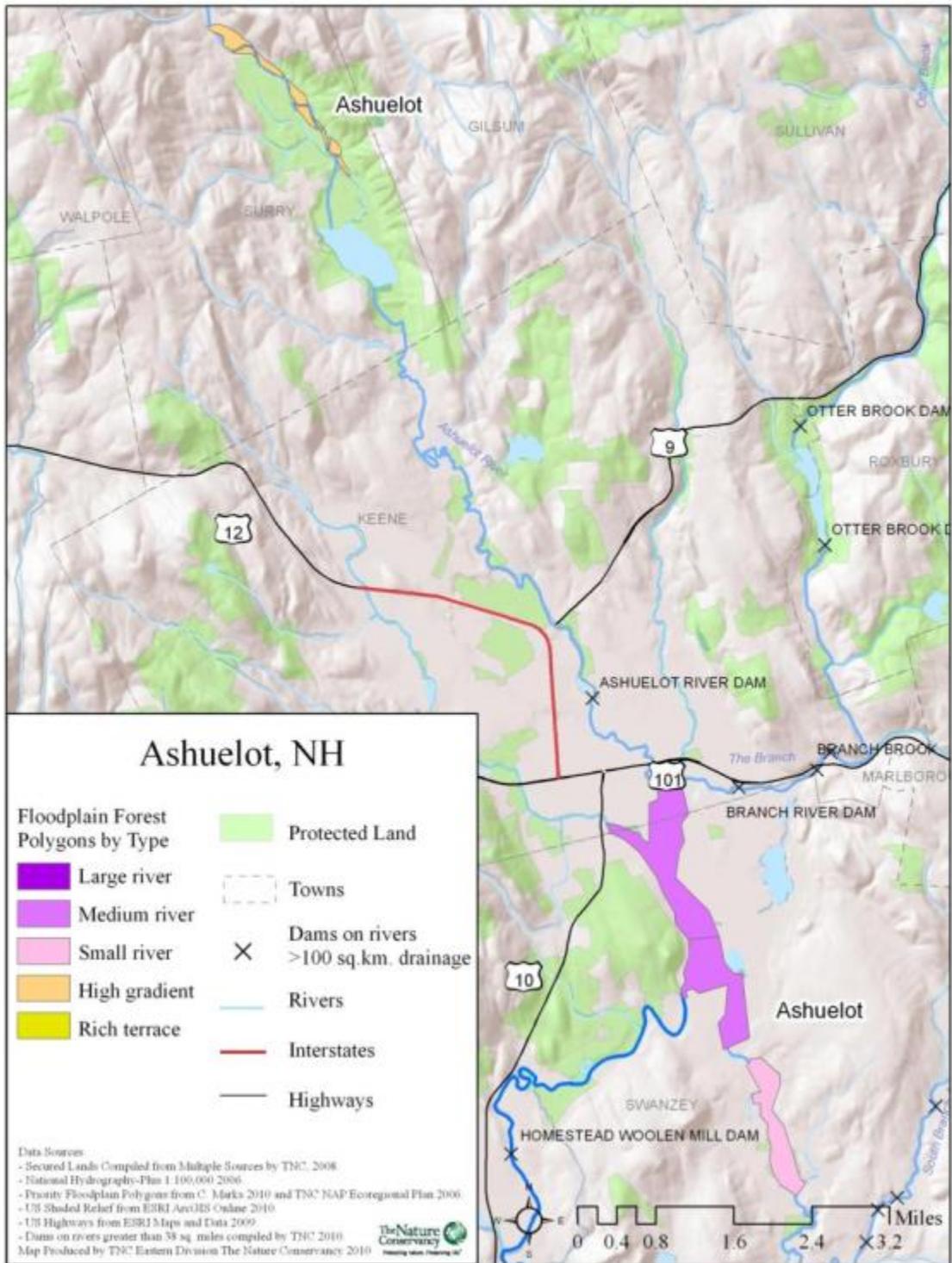


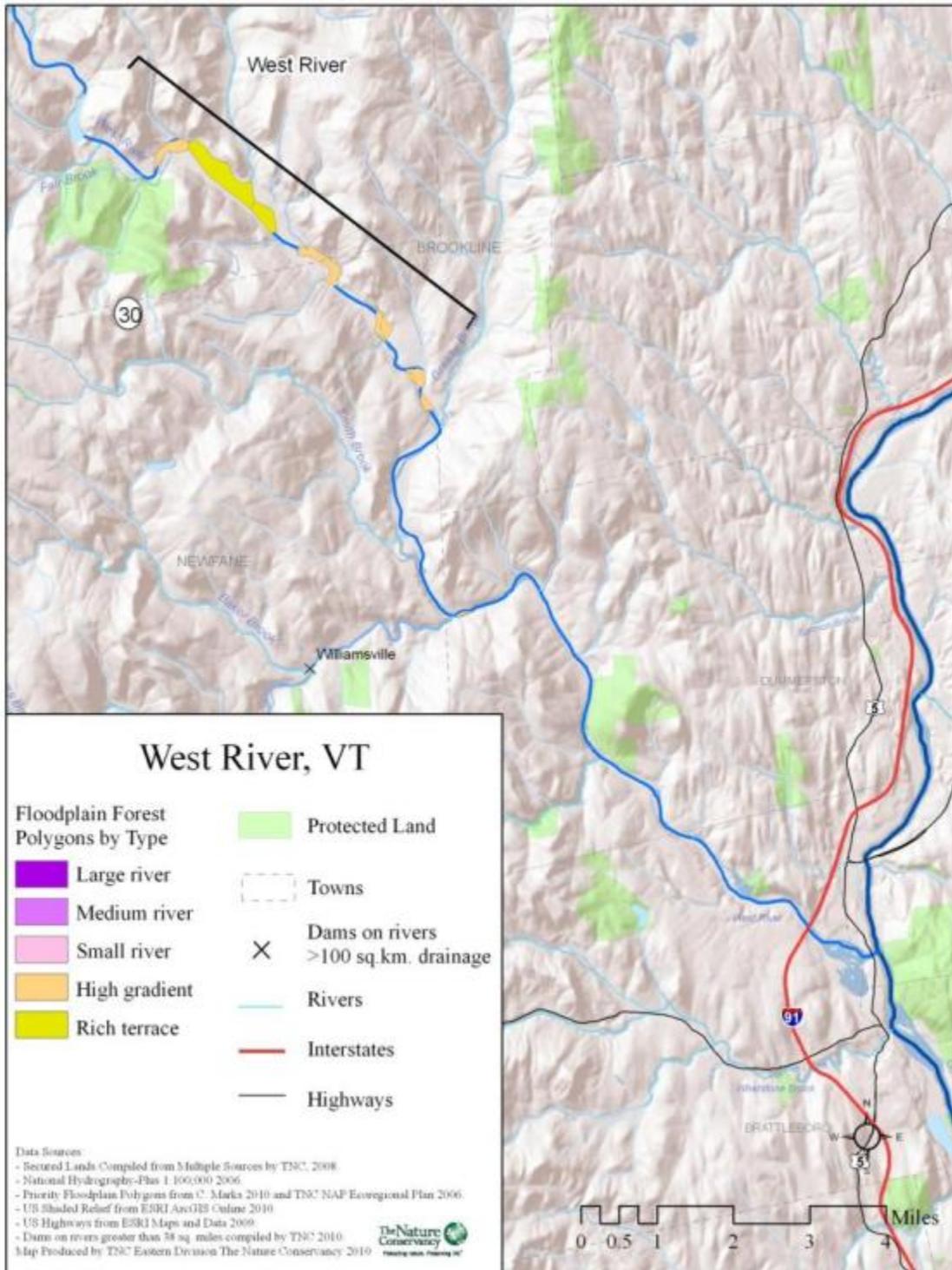


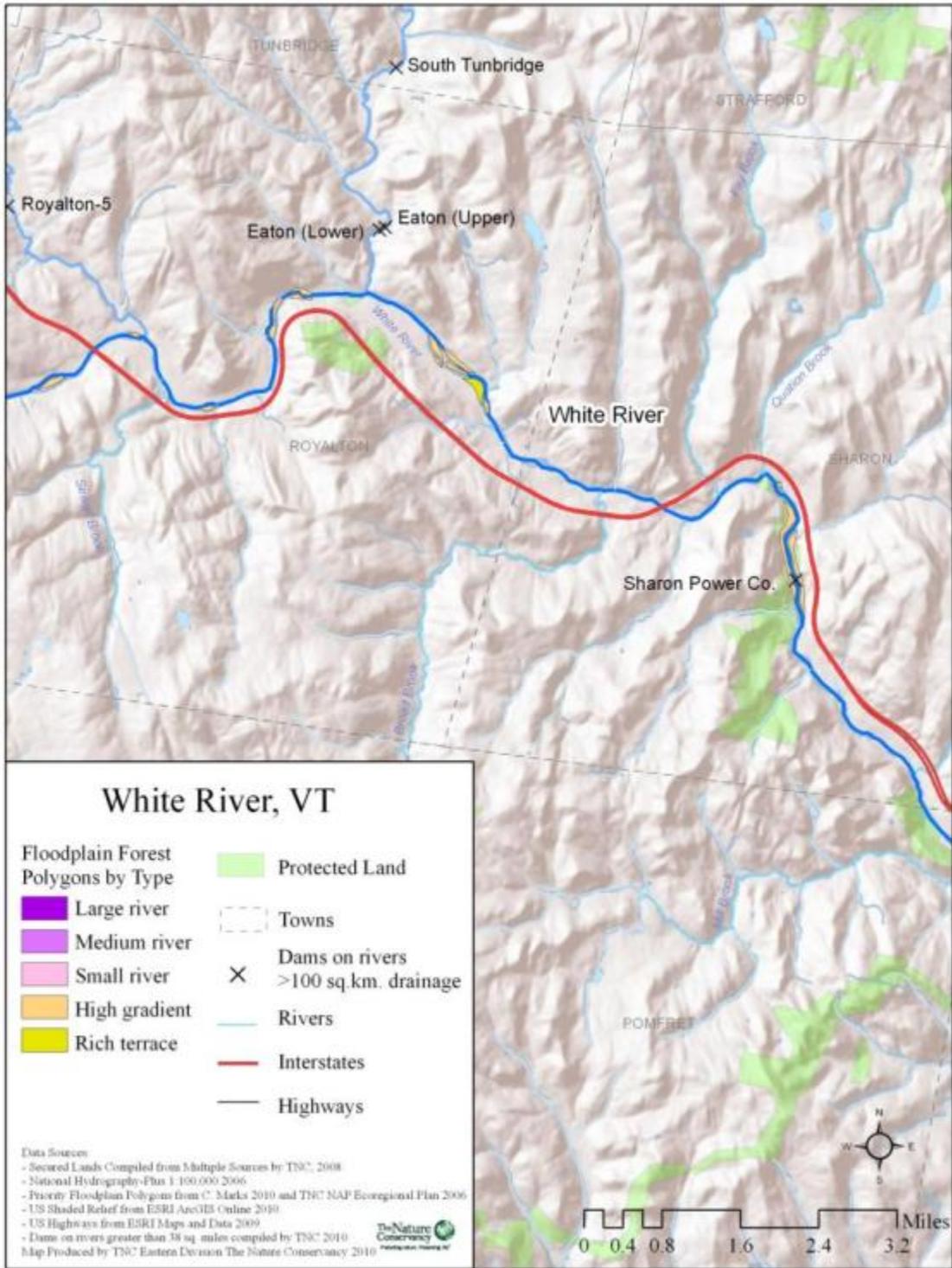


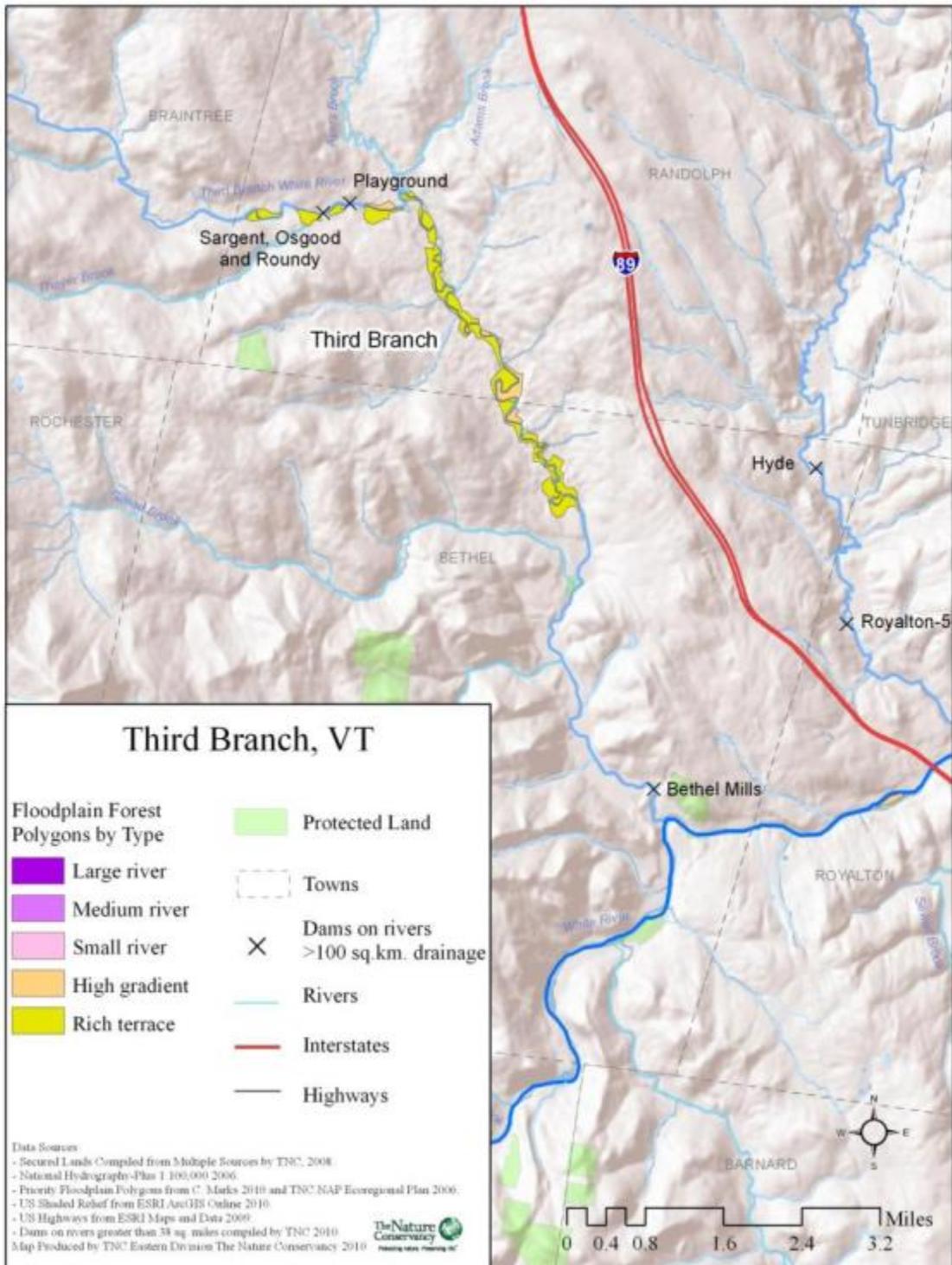


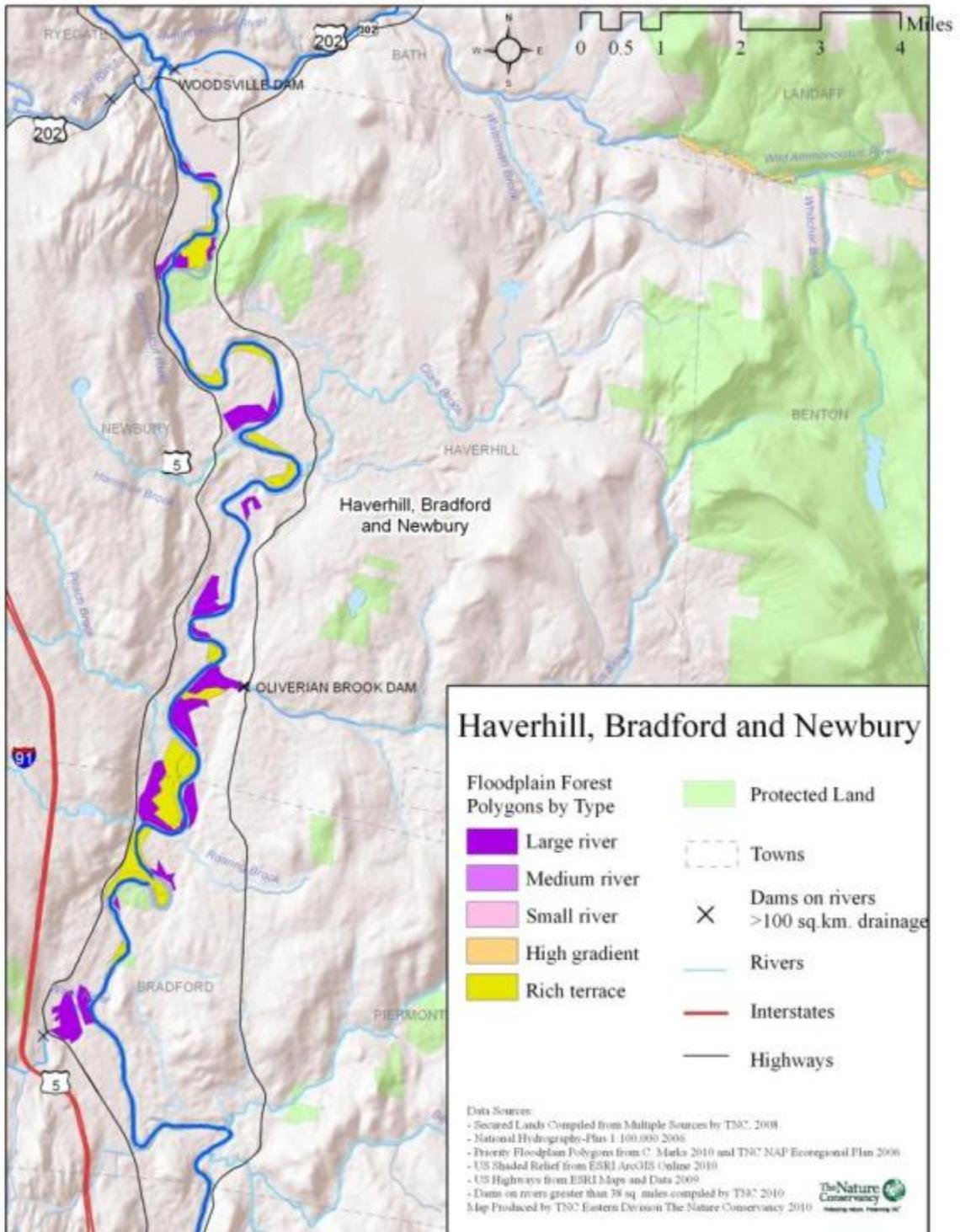


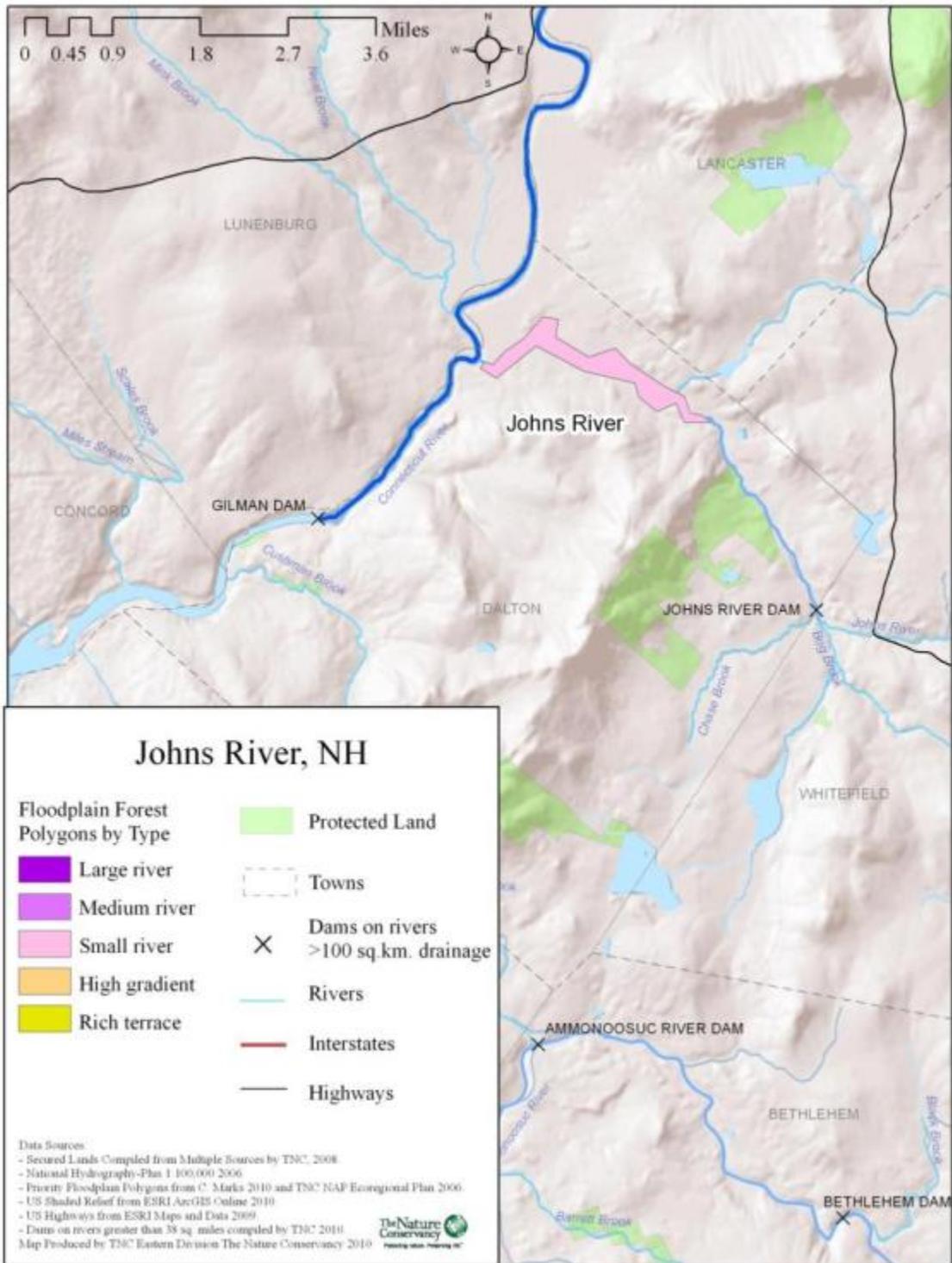


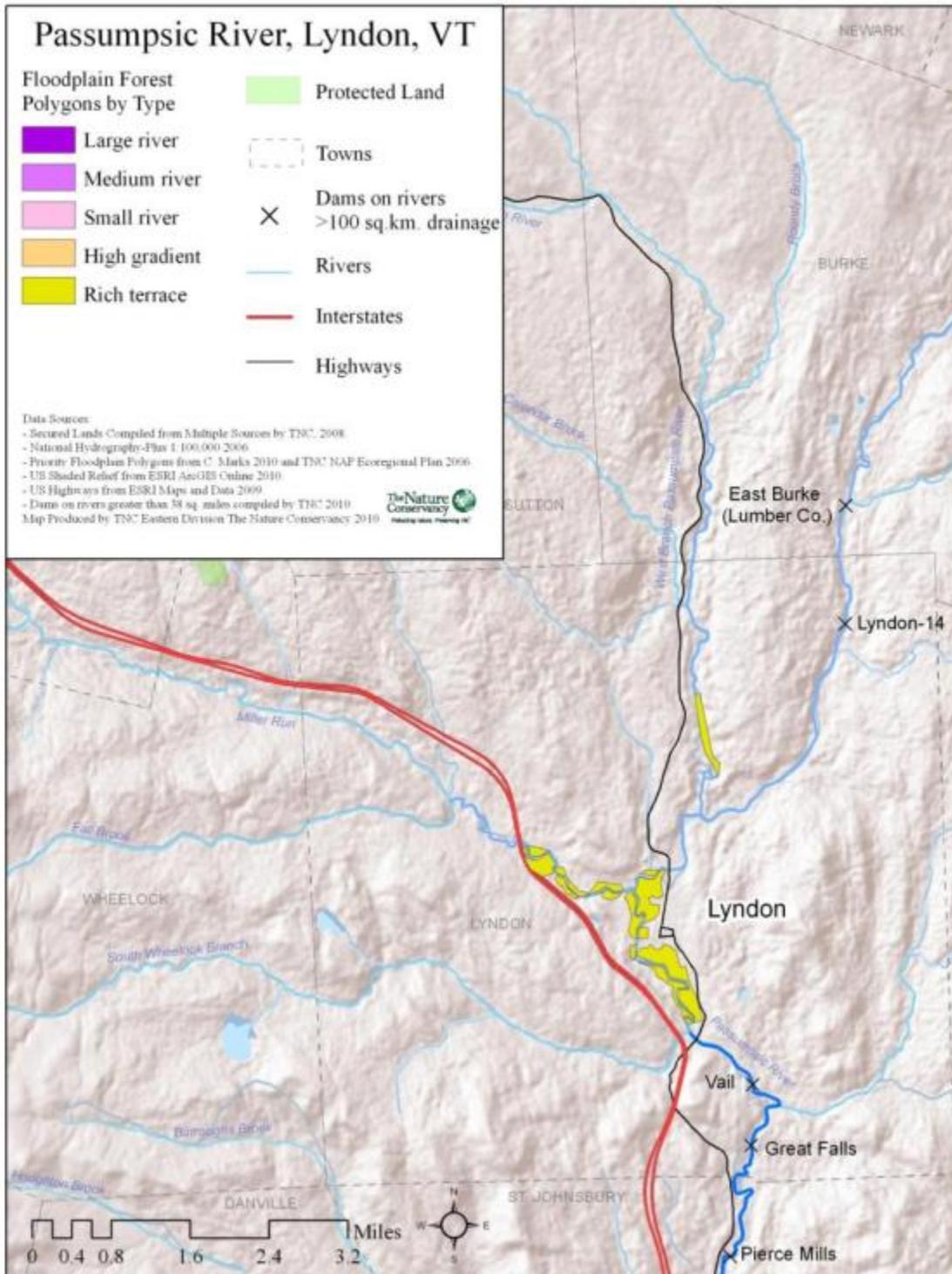


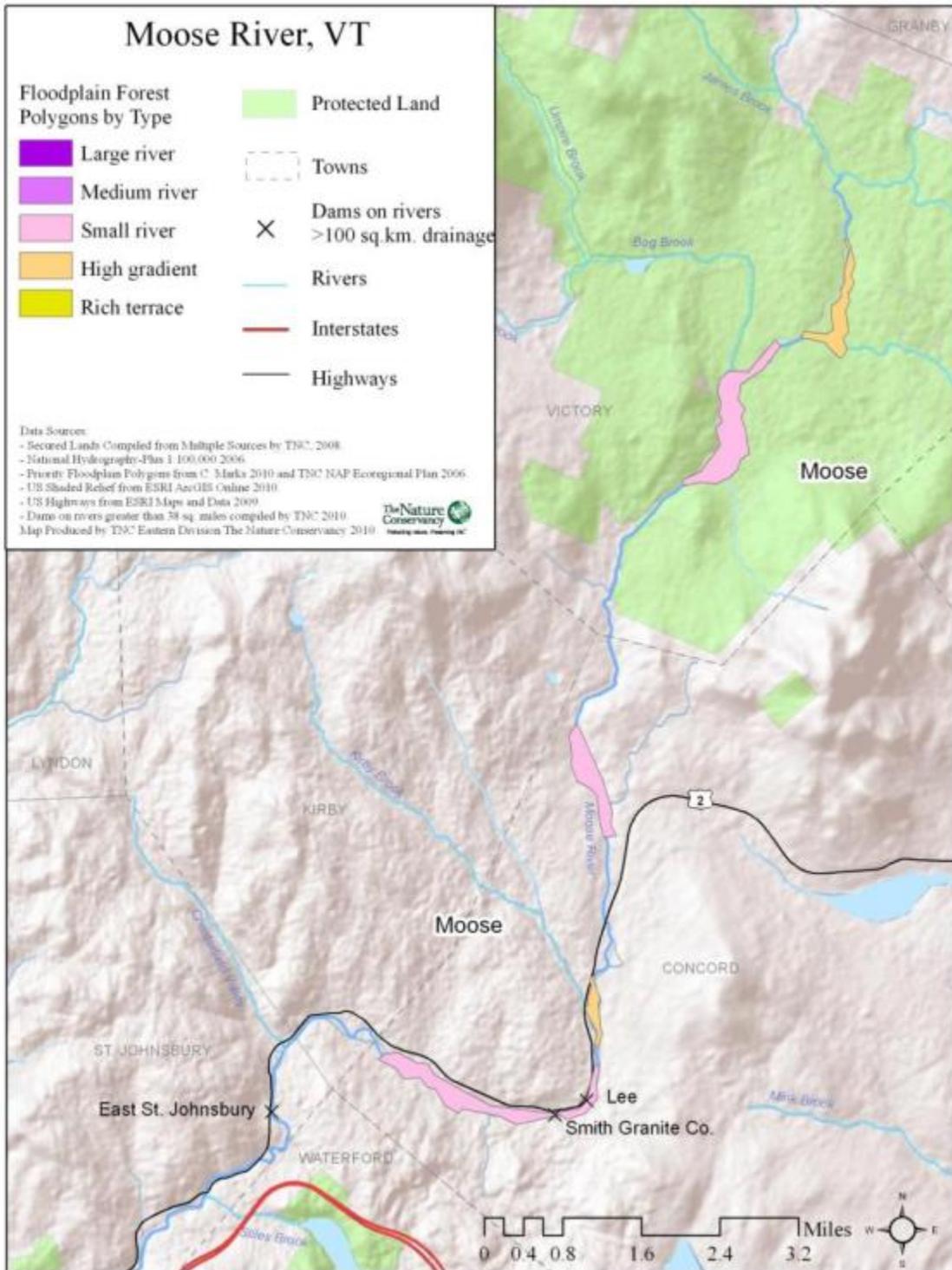


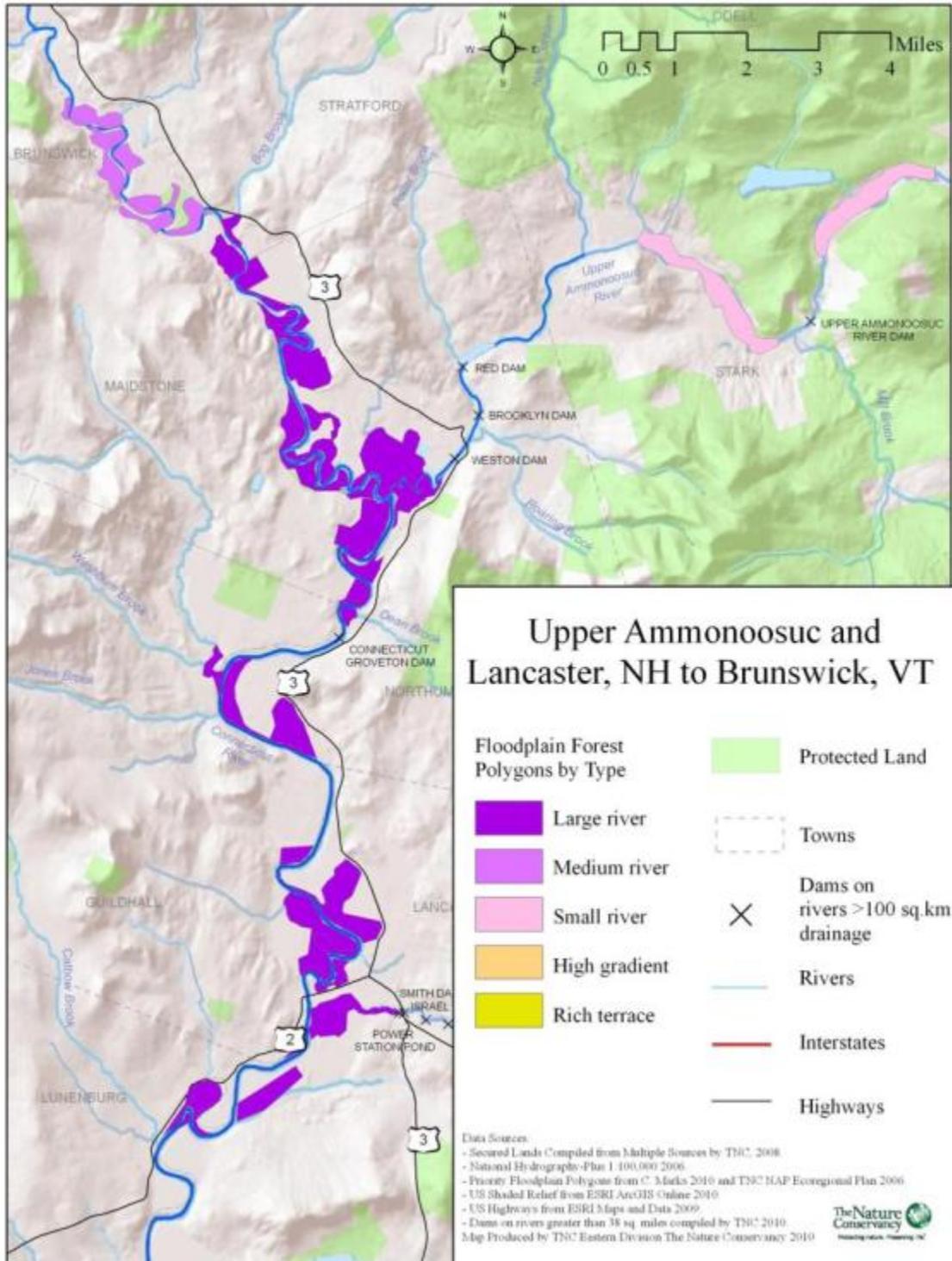


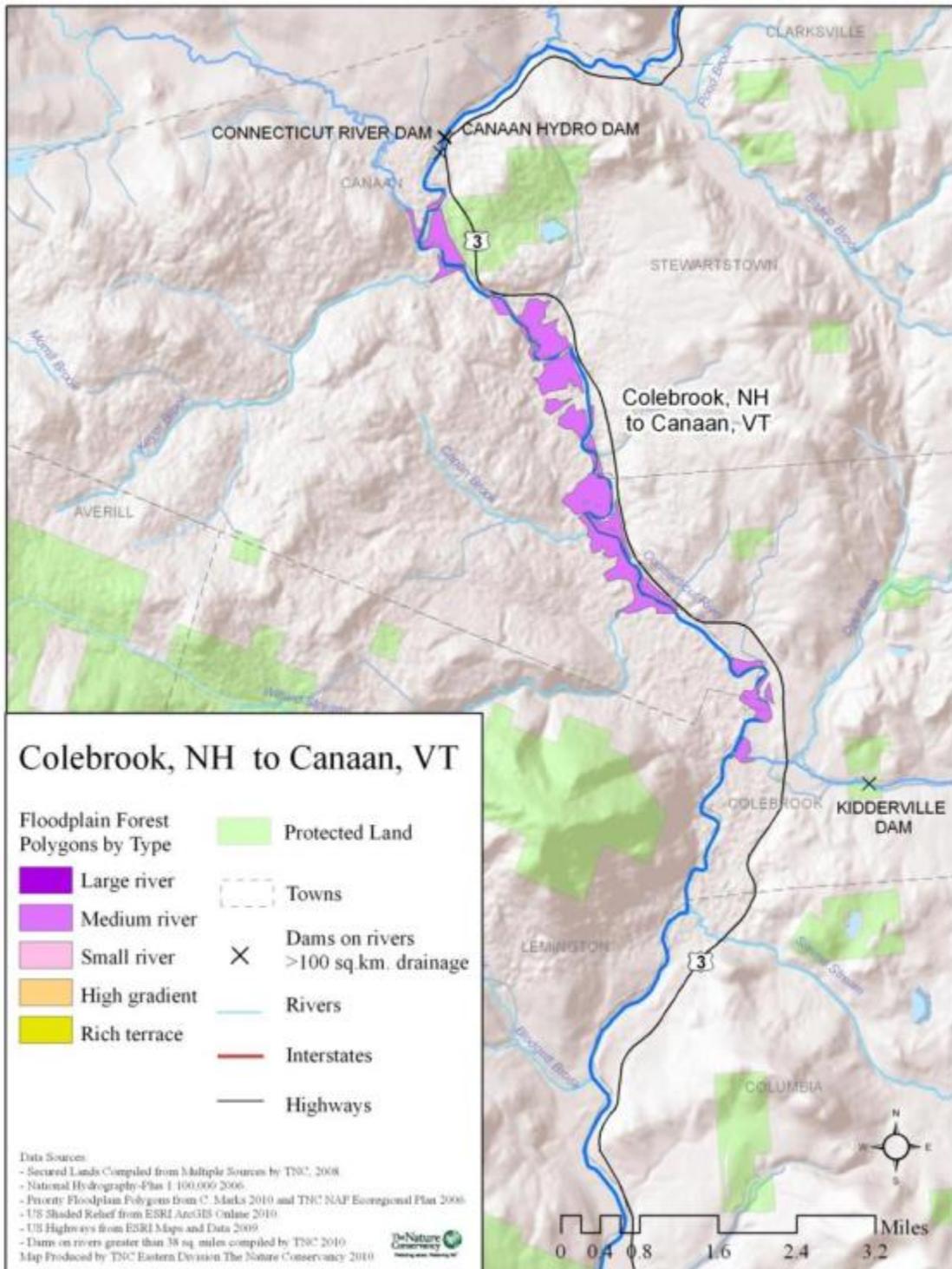












Appendix 2: List of common and Latin plant species names

Abies balsamea – balsam fir

Acer negundo – boxelder

Acer nigrum – black maple

Acer rubrum – red maple

Acer saccharinum – silver maple

Acer saccharum – sugar maple

Allium tricoccum – wild leek

Alnus incana – speckled alder

Andropogon gerardii – big bluestem

Arisaema dracontium – green dragon

Asarum canadense – wild ginger

Astragalus robbinsii var. *jesupii* – jessups milk vetch

Athyrium filix-femina – lady fern

Betula nigra – river birch

Boehmeria cylindrica – smallspike false nettle

Carpinus caroliniana – American hornbeam

Carya cordiformis – bitternut hickory

Catalpa speciosa – northern catalpa

Celastrus orbiculatus – oriental bittersweet

Celtis occidentalis – northern hackberry

Cephalanthus occidentalis – buttonbush

Cornus amomum – silky dogwood
Cornus racemosa – grey dogwood
Fallopia x bohemica – Japanese knotweed
Fraxinus nigra – black ash
Fraxinus pensylvanica – green ash
Hamamelis virginiana – witch hazel
Ilex verticillata – common winterberry
Impatiens capensis – jewelweed
Juglans cinerea – butternut
Juglans nigra – black walnut
Laportea canadensis – wood nettle
Lilium canadense – Canada lily
Liquidambar styraciflua – sweetgum
Liriodendron tulipifera – tulip tree
Lobelia cardinalis – cardinal flower
Matteuccia struthiopteris – ostrich fern
Nyssa sylvatica – black gum
Onoclea sensibilis – sensitive fern
Osmunda cinnamomea – cinnamon fern
Phalaris arundinacea – reed canary grass
Pilea fontana – lesser clearweed
Pinus strobus – eastern white pine
Platanus occidentalis – American sycamore
Populus balsamifera – balsam poplar
Populus deltoides – eastern cottonwood

Populus heterophylla – swamp cottonwood

Prunus pumila var. *depressa* – low sand cherry

Prunus serotina – black cherry

Quercus bicolor – swamp white oak

Quercus macrocarpa – bur oak

Quercus palustris – pin oak

Rosa multiflora – multiflora rose

Rudbeckia laciniata – cutleaf coneflower

Salix eriocephala – diamond willow

Salix exigua – narrowleaf willow

Salix nigra – black willow

Salix pellita – satiny willow

Salix sericea – silky willow

Sambucus canadensis – American black elderberry

Staphylea trifolia – American bladdernut

Thelypteris noveboracensis – New York fern

Tilia americana – American basswood

Toxicodendron radicans – poison ivy

Trillium erectum – red trillium

Ulmus americana – American elm

Ulmus rubra – slippery elm

Vitis labrusca – fox grape

Vitis riparia – river grape