9. APPENDICES

9.01 Appendix A : Data Source Documentation

Name Date Source		
Political boundaries	2021	NH GRANIT/VCGI
Roads	2021	NH DOT/VCGI
Deeryards	2021	NH GRANIT
Surface water (National Hydrography Plus Dataset)	2018	US Geological Survey
Watershed boundaries (National Hydrography Plus Dataset)	2018	US Geological Survey
Wetlands (National Wetlands Inventory)	2021	US Fish and Wildlife Service
Soils	2021	NRCS SSURGO Database
Rare species and communities	2022	NH Natural Heritage Bureau
Topography and Slopes, LiDAR	2021	NH GRANIT
Vernal Pools	2021	Sunapee Conservation Commission
Prominent Peaks	2021	Sunapee Conservation Commission
Ecoregion	2013	Commission for Environmental Cooperation
Active Farms	2022	Sunapee Conservation Commission
Conserved Land	2022	Town of Sunapee
Current Use Land	2022	Town of Sunapee
Tax Map Parcels	2022	Town of Sunapee
Zoning Districts	2022	Town of Sunapee
Wildlife Habitat Type and Tier (Wildlife Action Plan)	2020	NH Fish and Wildlife Service
National Land Cover Dataset	2001,2011, 2019	Multi-Resolution Land Characteristics (MRLC) consortium
Climate Change Resilience Dataset	2016	The Nature Conservancy
Aquifers	2007	US Geological Survey
Public Water Supplies	2022	NH DES
Wellhead Protection Areas	2022	NH DES
Flood Hazard Areas	2021	Federal Emergency Management Agency
Shoreland Protection area	2020	NH DES
Habitat Blocks	2021	Linking Lands Alliance
Wendell Marsh Wells and Sanitary zone	2015	Town of Sunapee

Data distributed by NH GRANIT, the state's GIS Clearinghouse, are periodically updated, as new data sources become available and conditions on the ground change.

NH GRANIT Data Disclaimer: Digital data in NH GRANIT represents the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of Energy and Planning (OEP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. OEP, CSRC, and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data.

Current Use Category Definitions:

1. Farmland means any cleared land devoted to or capable of agricultural or horticultural use as determined and classified by criteria developed by the NH Commissioner of Agriculture, Markets, and Food and adopted by the Current Use Board.

[redacted]

2. Forest land means any land growing trees as determined and classified by criteria developed by the state forester and adopted by the board. For the purposes of this paragraph, the board shall recognize the cost of responsible land stewardship in the determination of assessment ranges.
3. Forest land with documented stewardship has a lower assessment, to reflect the cost of active stewardship of the land; documentation of a Certified Tree Farm, a Forest Stewardship plan from a licensed forester, or a summary of a Forest Stewardship plan developed privately are sufficient to enroll a parcel in current use as forest land with documented stewardship.
4. Unproductive Land means land, including wetlands, which by its nature is incapable of producing agricultural or forest products due to poor soil or site characteristics, or the location of which renders in inaccessible or impractical to harvest agricultural or forest products, as determined and classified by criteria developed by the board. The board shall develop only one category for all unproductive land, setting its current use value equal to that of the lowest current use value established by the board for any other category. 5. Wetland means those areas of farm, forest and unproductive land that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support and that under normal circumstances.

National Land Cover Database Class Legend Description

Class\ Value Classification Description

Water

11**Open Water**- areas of open water, g
vegetation or soil.

12**Perennial Ice/Snow**- areas character
snow, generally greater than 25% of

Developed

21**Developed, Open Space**- areas with
but mostly vegetation in the form o
for less than 20% of total cover. The
single-family housing units, parks, g
developed settings for recreation, e

22**Developed, Low Intensity**- areas wit
vegetation. Impervious surfaces acc
cover. These areas most commonly

23**Developed, Medium Intensity** -are
and vegetation. Impervious surface
These areas most commonly include

24**Developed High Intensity**-highly dev
in high numbers. Examples include
commercial/industrial. Impervious s
total cover.

Barren

31**Barren Land (Rock/Sand/Clay)** - are
slides, volcanic material, glacial debr
other accumulations of earthen mat
than 15% of total cover.

Forest

41**Deciduous Forest**- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.

42**Evergreen Forest**- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.

43**Mixed Forest**- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.

Shrubland

51**Dwarf Scrub**- Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.

52**Shrub/Scrub**- areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.

Herbaceous

71**Grassland/Herbaceous**- areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

72**Sedge/Herbaceous**- Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.

73**Lichens**- Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.

74**Moss**- Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.

Planted/Cultivated

81**Pasture/Hay**-areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.

82**Cultivated Crops** -areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.

Wetlands

90**Woody Wetlands**- areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

95**Emergent Herbaceous Wetlands**- Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

9.02 Appendix B : Ecoregions

This Appendix contains Ecoregion maps for:

1. Level III and IV for New England
2. Level III for the Continental United States
3. Level I and II for North America

Level III and IV Ecoregions of New England

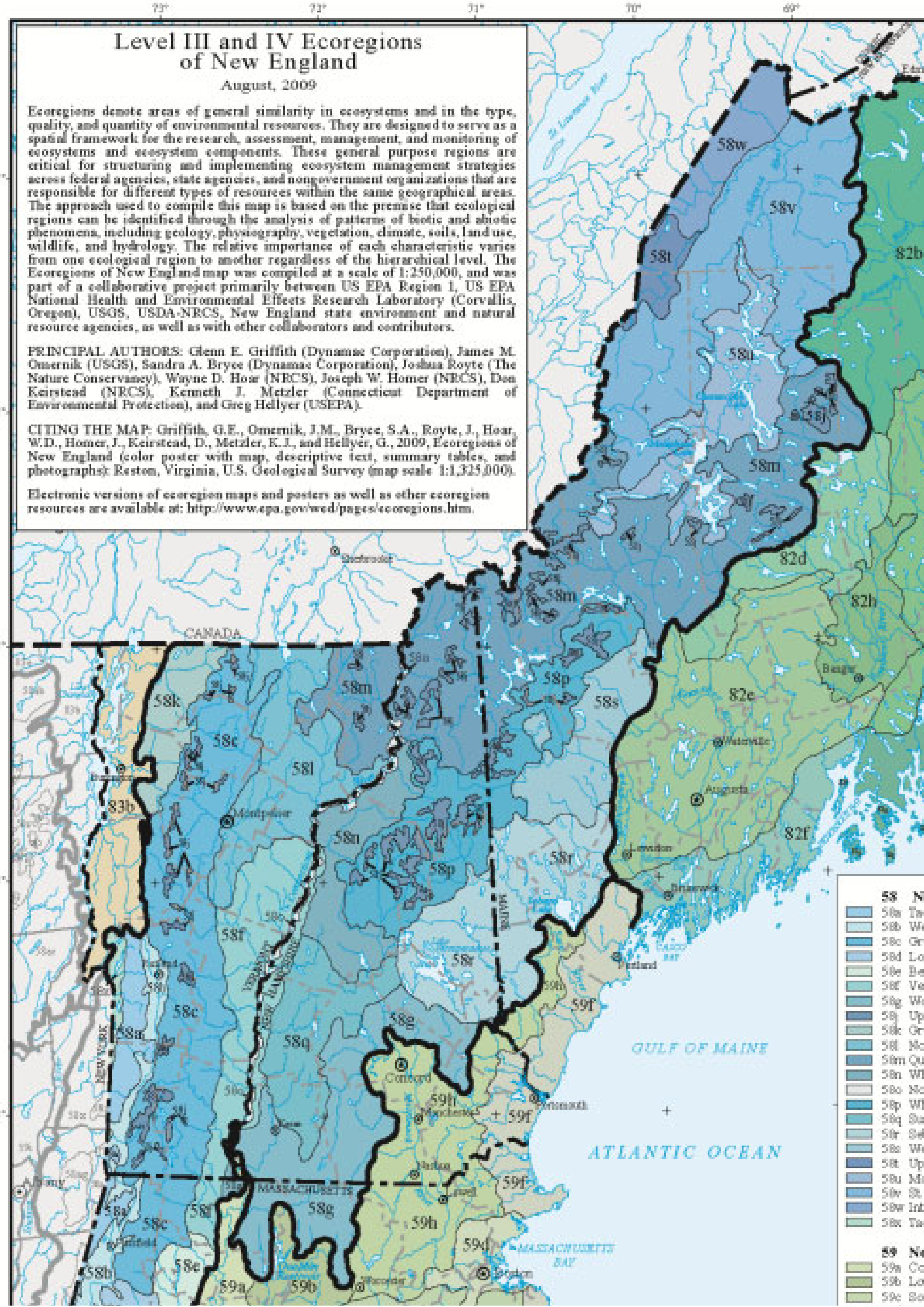
August, 2009

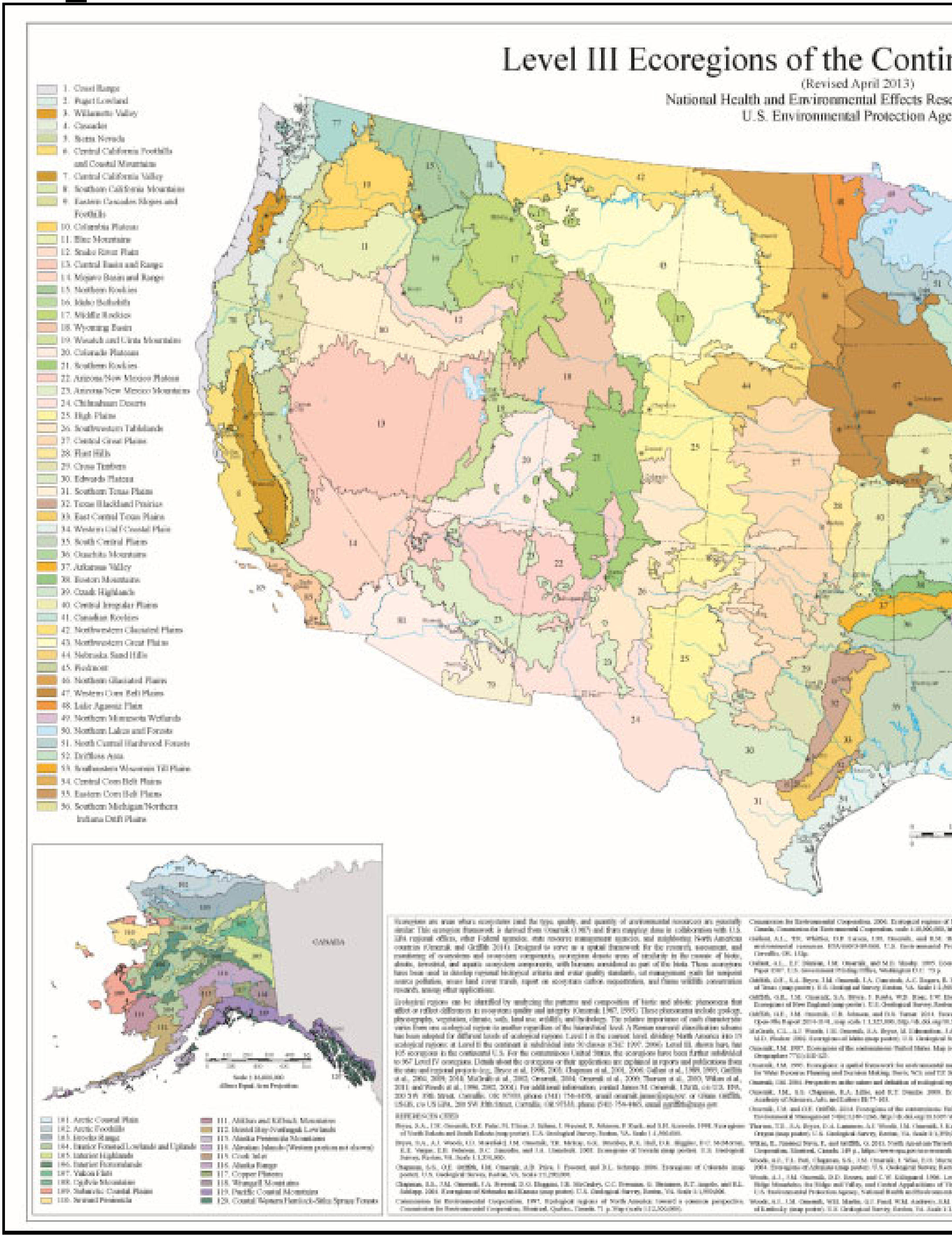
Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. These general purpose regions are critical for structuring and implementing ecosystem management strategies across federal agencies, state agencies, and nongovernment organizations that are responsible for different types of resources within the same geographical areas. The approach used to compile this map is based on the premise that ecological regions can be identified through the analysis of patterns of biotic and abiotic phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecological region to another regardless of the hierarchical level. The Ecoregions of New England map was compiled at a scale of 1:250,000, and was part of a collaborative project primarily between US EPA Region 1, US EPA National Health and Environmental Effects Research Laboratory (Corvallis, Oregon), USGS, USDA-NRCS, New England state environment and natural resource agencies, as well as with other collaborators and contributors.

PRINCIPAL AUTHORS: Glenn E. Griffith (Dynamac Corporation), James M. Omernik (USGS), Sandra A. Bryce (Dynamac Corporation), Joshua Royte (The Nature Conservancy), Wayne D. Hoar (NRCS), Joseph W. Homer (NRCS), Don Keirstead (NRCS), Kenneth J. Metzler (Connecticut Department of Environmental Protection), and Greg Hellyer (USEPA).

CITING THE MAP: Griffith, G.E., Omernik, J.M., Bryce, S.A., Royte, J., Hoar, W.D., Homer, J., Keirstead, D., Metzler, K.J., and Hellyer, G., 2009, Ecoregions of New England (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,325,000).

Electronic versions of ecoregion maps and posters as well as other ecoregion resources are available at: http://www.epa.gov/wed/pages/ecoregions.htm.




Level III Ecoregions of the Contin
(Revised April 2013)
National Health and Environmental Effects Rese
U.S. Environmental Protection Age
1. Coast Range
2. Puget Lowland
3. Willamette Valley
4. Cascades
5. Sierra Nevada
6. Central California Foothills and Coastal Mountains
7. Central California Valley
8. Southern California Mountains
9. Eastern Cascades Slopes and Foothills
10. Columbia Plateau
11. Blue Mountains
12. Snake River Plain
13. Central Basin and Range
14. Mojave Basin and Range
15. Northern Rockies
16. Idaho Batholith
17. Middle Rockies
18. Wyoming Basin
19. Wasatch and Uinta Mountains
20. Colorado Plateaus
21. Southern Rockies
22. Arizona/New Mexico Plateau
23. Arizona/New Mexico Mountains
24. Chihuahuan Deserts
25. High Plains
26. Southwestern Tablelands
27. Central Great Plains
28. Flint Hills
29. Cross Timbers
30. Edwards Plateau
31. Southern Texas Plains
32. Texas Blackland Prairies
33. East Central Texas Plains
34. Western Gulf Coastal Plain
35. South Central Plains
36. Ouachita Mountains
37. Arkansas Valley
38. Boston Mountains
39. Ozark Highlands
40. Central Irregular Plains
41. Canadian Rockies
42. Northwestern Glaciated Plains
43. Northwestern Great Plains
44. Nebraska Sand Hills
45. Piedmont
46. Northern Glaciated Plains
47. Western Corn Belt Plains
48. Lake Agassiz Plain
49. Northern Minnesota Wetlands
50. Northern Lakes and Forests
51. North Central Hardwood Forests
52. Driftless Area
53. Southeastern Wisconsin Till Plains
54. Central Corn Belt Plains
55. Eastern Corn Belt Plains
56. Southern Michigan/Northern Indiana Drift Plains
CANADA
101. Arctic Coastal Plain
102. Arctic Foothills
103. Brooks Range
104. Interior Forested Lowlands and Uplands
105. Interior Highlands
106. Interior Bottomlands
107. Yukon Flats
108. Ogilvie Mountains
109. Subarctic Coastal Plains
110. Seward Peninsula
111. Ahklun and Kilbuck Mountains
112. Bristol Bay-Nushagak Lowlands
113. Alaska Peninsula Mountains
114. Aleutian Islands (Western portion not shown)
115. Cook Inlet
116. Alaska Range
117. Copper Plateau
118. Wrangell Mountains
119. Pacific Coastal Mountains
120. Coastal Western Hemlock-Sitka Spruce Forests
REFERENCES CITED

[redacted]


ARCTIC OCEAN
OCÉANO ÁRTICO
OCÉAN ARCTIQUE
PACIFIC OCEAN
OCÉANO PACÍFICO
OCÉAN PACIFIQUE
ECOLOGICAL REGIONS OF NORTH AMERICA   REGIONES ECOLÓGICAS DE AMÉRICA DEL NORTE   RÉGIONS ÉCOLOGIQUES DE L'AMÉRIQUE DU NORD
Level I   Nivel I   Niveau I
Scale   Escala   Échelle
Lambert Azimuthal Equal Area Projection
Proyección Azimutal de Equiárea de Lambert
Projection Azimutale de Équivalence de Lambert

[redacted]

9.03 Appendix C : Habitat Types & Associated Species

This Appendix contains the habitat summary brochures for the following:

1. Hemlock-Hardwood-Pine Forest
2. Northern Hardwood-Conifer Forests
3. Grasslands
4. Shorelines
5. Headwater Streams
6. Marsh and Shrub Wetlands
7. Natural Community: Montane - subalpine circumneutral cliff 8. Natural Community: Northern hardwood - conifer forest system

Recognizing

Headwater streams are small streams and headwater streams

Some are so small that they

a watershed.

a l e h t f o m e t s y s yr o t a l u c r i c e h t s i kr o w t e n gr a l e h t o t n i n a f t a h t s e i r a l s p a c s a m s e ht n a lt e w d e ts e r o f ts a m s s a tr a t s n a c s m a e r t s r e ta w da e Ht h t o t aterial. the plants growing around surrounding landscape. Topography and geology in cascading mountain streams, varying according ntains streams tend to have large rocks, steep g **Mountain streams** sometimes or always contains water, and which wild the river bottom m eams Valley stre dynamic habitats. certain aquatic invertebrates are well adapted to th and flash floods. Stream salamanders, brook trout, a Mou rough glacially deposite

Spring-fed brooks

ducks, geese, ponds. Wildlife including shrua patchwork of wetland plants They tend to be These str ht wogs maerts llams esehT .sgnirps larutan morf etanigiro dna levarg dnasats a sedivorp retaw looc fo ylppus dnuor-raey riehT ohgnirud rthern waters serving as corridors between them they are too warm reminiscent of The rffies and Warm rock weather. environment for brook trout, particularly

o

n

nts. and provide food and habitat at the source and processes that prevent flooding, maintain water quality, q

Conserving land from development arou

g headwater stream protection into town

flooding and rainfall associated with climate change. undeveloped headwaters may also buffer the predicted nutrie

OQPTTJCMF **keep development** - protecting water quality and preventing flood damage - conservation easements and zoning ordinances will have. **Incorporatin** ommonly recommended for development buffers vary, but a minimum **300 feet away from streams.** Suggested **permanent roads, and driveways at least** 18 F c si t e e f 0 0 3 fo m a e r t s g n o l a t a t i ba h e s l d s w g n i t c e t o r p s r e ff u b n a i r a pi r f o s t i fe n e b e h T . s r o di r r o c ' ht di w r le h t h s w e s a e r c n i s e c a fr u s) e l b a e m r e p (s u o i v r e p n i a t n la ent) can reduce stream water, but pervious pavement (as opposed Natural ground is the best filter for storm on as much of the landscape as possible. t M

trea 4% of their land area in buildings and pavement have developed areas. Watersheds with as little as contamination from stormwater in typical pavem

Avoid the use of fertilizers or pesticides near any s

i. Excess nutrients from fert

s. toxic to aquatic organisms. are species. other and fish kling. levels

s. The UNH Stormwater Center is an excellapplydesigns that filter stormwater into the ground. incl. **Avoid culverts, drains or ditches that discharge storm** l nth e function of streams of all sizes. Before installing any, Properly sized and installed stream crossings are critic storm water management. ort reeb o xfste r timber harvesting, see best management practice re Stream & Wetland Restoration Institute and fosowaNH development, consult the New Hampshire Stream Crossi

s. branches to naturally fall into streams, large trees to maintain stream temperatures, filter run-off, Timber harvesting around headwater and small streams with ore effectively to maintain cold water temperatures and woody ma maintain about 60% of the canopy in a zone as wide as the height of the trees - leave ant **Maintaining dead standing trees, overhanging veg.** When doing forest management work near headwater str riparian buffers of 300 feet or more provide m

Consulting the publications Maintaining downed logs in streams to enhance trout trees to provide moist cover and shade for wildlife

New Hampshire forester before con

Cooperative Extension.

vwaterbodies. Follow established best management practi property. Understand and follow all laws pertaining to r

. Consult a licensed

streams only when the soils are either frozen (winter) or

variations in water rein winter-good in the streams nd oneflies. mayflies. bitats converge. both for water quality and smag streams also have a sects are adapted to headwater streams. A Wide

Stonegy larvae or the rnlong-eared centration of fod long side upla

on both upland and reventing them from do in the smas, itrogen, from a ms also can rainbow smelt, two fish and ers lay their eggs in d water streams for have enough water, to find ager rivers to headwater eding nivers and lakes. e over-run by introduced fish dend sunfish- redfin pickerel, can also provide native fish er, forest birds, and forest edawtaer strea oitavresnoc ybdekoolrevo n noitcetorP dnal erohS evisnet. m.

la deredisnoc netfo era yeh

t e s c i y re n i t n i d es ~ a h t S . a d n oc n g n sa o W p - s e f , r a l sm ae m a la d n a H . n va e sm a b r a t r re e gl h e r n e y l r o r f g n i re ll a n o it s ua r e ta w d a e h e r a ? t n a t r o p m i b d e r u o c s e r a s ffi cult conditions. The group of plants, amphibians, and an temperature makes lesdifficult and fas, and aredry in the summ headwater stream nd the streams as ms are places where forests and streams ge~ of major rivers downstream. impact on the health and integrity ve in the sed rs from the surrounding forest including moths, beetles, and grasshoppers. This, whose larvae live underwater, are found ensities of insects arou d other nitrogen sourceing ensure cleaner water downstream. lso help remove excess nutrients. such ere dhawk. raccoon and ribbon snake if the strea They may also travel over 20 m ses from rout may live year-round in tiny streams the lower reaches of the river. trap sleaves an

Greenfrogs and spring and two-lined ske advantage of the relative safety of hma s ing the summer months. the fail spawning season or.

ondsions of headwater strearridors for wildlsesuch as mink, otter, beever yr ear into small streams to spawhtes s streams. Commonwhte suckers streams are ostermslbe and oftendgeradedhba itats oflagrce can thirve inehdawater streams. bomu introduced species. Natives suhc as dhsrah s c ellslarly those caused by human developm size makes them vulnerable to human not covered by New Hampshire's ComPological value - headwater te w sdl se populations. Runoffced culverts fragment streams, causing ms to dry up. Roads, driveways, and pooater by residential or commercial w a l o s i d n a do o ft e s a e r c n i . s t n a t u ll o p e c u d o r t n i n a c ht o d n a e s e h T . e r u t a r e p m e t m a e r t s n i s m s s i m s i d o t yc n e d n e t e h t y b de d n u o p a e r c e r e m a s e h t d n a m m o c t ' n o d ye h t e c e b d n a , s r e v i r d n a s e k a l r e gr a l f o la e p p ' t a t i ba h t n a t r o p m i e di v y h

W y n a M n ir ps w o tt qi n u i v r u s e gr a l l d s w e r t s r e ta w da e H h gi h

z. Eastern brook f accumulating in upriver streams watershed. help Small streams abat. red-should attracts predato insects such as and dragonflies leading to t c e s n i c ti a u qa g n i r u d s m a e r t s r u d e g u f e r l o o c e r t s e g u fe R a t s e ic e p s y n a M . n o i t c u d o r p e r s fi . t n e t t i m r e t n i t a r gi m . s e ic e ps o c l e v a r t s a tc a . s t a b g n i ll e w d n a n o it a l o s i e hT r f e g u f e r a h t i w a d yll e b d e r d n a t s e r o m e h t n i d e ko o lr e v O c e r i e h t e t i ps e D e r a d n a s tr o ffe ll a m s r ie h T . tc A u c it r a p - s t c a p m i w d n u o r g f o e s U a er t s es u a c n ac a l p r o de n gi s e d - n o it a t n e m i d e s s e c a fr u s d e v a p e ki p s e s u a c d n a m o c e r a s ta e r ht s u a c e b s m a e r ts a c it e ht s e a d n a o r p o t s a m s o o t s e r t s r e ta w d a e

. Northern long-ear. **American eel**

. Mink Planash giving the greatest need of conservation — papearhabitats. Species of conservation c snaketail · Caddisflies. Redfin pickerel. Bridle shiner* · Raccoon. Blanding's turtle** · Northern water sn. Banded sunfish

**state-endangered spLouis

Mayfres

Where to get help

ension WdslseS PIf you have information about a wsdlfie species of conservation con

UNH Publications and assistance on forestry and wildlife topics are avai for landowners or your community at 603-271-2461. Contact the UNH Cooperative Ext rative Extension website at: nh Additional publications, contact information, resources, and web vers Forest Resources in each county, Contact information for each ll County 603-447-3834 Hillsborough County 603-641 Belknap County 603-527-5475 Grafton County 603-787 Series are available on the UNH Coope

Stewardship brochures are produced by UNH Cooperative Exten Authorship Coös County 603-788-4961 Cheshire County 603-352-4550 Merrimack County 603-225 Carro me. and Malin this publication was provided by The Sustainable Forestry Initiative. Additioemployer, University of New Hampshire, U.S. Department of Agriculture and The Habitat d cultura Much of the land in New Hampshire is privately owned. These individuals a About the Habitat Stewardship Series Game Department. Written by Matt Carpenter, NH - Fish & Ga ers can play in sustaining Stewardship Series has been created to help landowners and land manage forests, and also our clean water, scenic views, fresh air, natural an e Bureau: King Cover photo: Malin Ely Clyde – UNH Cooperative Extension. Other photos: Photo Credits and sound land stewardship at risk, and to illustrate the role private landown

Michael Marchand - NH Fish and Game; Pam Hunt - NH Audubon; Ben Kimball - NH Natural Heritag

Cooperative Exte

s

uc
n r

ec

no

o
F
s
e
ic
e
c
n
o
it
a
v
r
e
s
n
o
c
fo

pS

the transsional forest ine forest is the most

drier sites. U forests, you'll also sndbeecntaina mix of trees commomlock are most often the d n o (ka o d e r d u n r u bi v d e v a e l- e l pa m - l e z n o r e w o fly a m a da n a C d n a p u n w o r g e v a h t a s i h t f o s e lp m a x e e r a e t ih w , s li o s e li t r e f r o kc o l m e h y b e m i t fs e r o f s ty trees. pocket; many standing dead trees g trees and shrubs emlock or beech in atures such as patches mpshire. Look for uine old-growth cess known a excellent exa Carroll Counties are covere uch of Belknap, Merrimack here are hemlock- f hemlock-hardwood-pine nopy" pine trees (extra-tall-sized cavi h t i w - s t s e r o o r o F k c i r dl e h S - ht r o w m a T n n hs p m a H w e N f o y t i s r e v i n f e n i P- do o w dr a h- kc o l m e . t f e l t a pa m e h t f o s a e r y d s e a r n WMCf UHa g o c e R o l m e h P- do o w shrubs such as wschh white ash (on rich sites ahemlock-hardwood-pine are highly variable and coWhite pine and eastern hHampshire. Considered Hemlock-hard through a propine will be replaced over type of forest habitat. On from abandoned pasture Most white pine stands thiron wood, with starflower or he understory the canopy-layers of youn fo la gre (> 18" diametey hforests with old-growth forests are rare in New Ha succession. Although genhardwoods aHUifCMWforest) make some areas ooks, seeps, and -supra cawod on the ground. Larg growing int

nation of new outbreaks and elies regularly for the presence of Cooper's hawk and bald eagle -rovide habitat for wide-ranging locks (> 1000 acres) of hemlock-ha

(> 81" diametejr which arerized by unique features such rvation and land stewardship efPorests & Lands changepl with idiction. The University of New Hai ich provid lue. spotted salamander. ribbon ear wetlands. streams. ponds. h provides unning areas for bobs d lite. nd as futures nags (standing dea trees d cavity trees'isitcs. suhc as: forets whS old ulba lefor wSd lSe'irch, and pin cherry dnbob cat. Ptaches wood cokc. vation concern regrowing forest. wh gnidulcni sezis eer seert dlo d-tserof eht fo slevel eht no seert g

seert erehw ypo-tuc neegER ot krow, secitcarp tnemeld-llew, ssesal

lse. created ns. including those breeding in ses). The larger the forest openin other key features of, early succe to enhance cover for wsd lse. bussu when the soids and waterbodies. Follow estaoperty. Understand and follow ensed New Hampshire forestb wetlands, or brushy old fields, t openings to ws d yl n o s d n a lt e w r a e n w e tS e di u G m e h r o f b e gr a l g n i v r e s n o C p l s w t n e m p o l e v e d . k w a hs o g n r e ht r o n e r t kc o l m e h kc e hC .

m il e

rds, and other goshawk nests, at *SFBTXJUlfagre pine habitat charact, For both land conse the N.H. Division of most effective perfor prevention and warbler. as such American species of concern tr

Areas of young-forest wood turtle- bt

Forested areas nt

Rocky cliffs which

ib

Canada b alder aspen of

young an adiversity of t many snags an growth character **Areas of mature** are particularly va ats. For mim portant to suppo **and tree species. A. Using forest manag** have fallen or b_ gaps in the can forest floor. _ fallen. decaying growing at all both

...idors-shrub benefits of new forest has for breeding bi brochure in this series stump sprouts-and least 2 acres in size provide a continuous publication ... pine habitat

Always consult aticutsity corr

of trees near wealt n harvest on your prf

and harvest timber

. y e m m u s (yr d

e n i p> do o w dr a h> kc o l m e h e r a ?t n a t r o p m i s t s e r o f d n a d n v ernal pools, marsh habitat, or many smaller and unique habitat types in southern New lock-hardwood pine forests are the habitat that surro ng forest to meet their needs for food, water streams, floodplains, shrublands, grasslands, or peat bogs, shire. Most swdlse that require v or granted given the important supporting role o-breeding. Hemlock-hardwood-pine forests are common-but lso use the surroundi

r. deer. ruffed grouse. chipmunk. ch nuts in these forests (produced by mature oak and beech trees) are play in the ecosystem 'ldn't be taken f white pines in the tree canopy uejay. In turn, raptors such as northern goshawk and Cooper's hawk feed for many species including black bea er and black-throated green warbler. emlock-hardwood-pine provide habitat for forest birds such as scarlet als and find nesting and perching sites in ent. New Hampshire has ledeaf to hemlock-hardwood-pine habitats in New Hampshire is the loss from development thrush, Blackburnian warbl eliminates habitat. affecting the fastest population growth for decades, and it continues to lead to residential and commercial developm aved roads separates wildlife elling wildlife and animals that use forests as corridors between others of forestland. Development permanently n insectoo yll adegl dida s. hbi its migration. increases predation and promotes wildlife-vehicles wetlands. Building and construction of p a s i di gl e d a yl lo o d n a g n u o y ht o b s t e gr a t t a h t a i s A A . e m i t r e v o m e h t g n i l li k . s e e r t k s e l d e e n f o e di s r e d n u e h t n o e c y n a m n i r u c c o s e e r t d s a d e gl di resu lts in fewer hemlocks ore than a few trees at time. lfures (eg.. insecticides) are rn New Hampshire. Preventative tation. Infeste ds such as black-throated green warbler, wildlife such as deer, grouse, fisher, and porcupine, and wil also negatively tical winter cover wilbeles s of-100 years old. They grew back after extensive timber harvesting hemlock-hardwood-pine forests in New Hampshire are the same reeding bir oncern found in these forests are attracted to patches of old or young ent of farms throughout the last century. Many wildlife species forests that contain a diversity of live and dead trees of different larger forest area. Today's forests don't support the same high diversity anagers are less likely to make large openings (e.g. clearcuts). Complicating matters, the public may prefer to view extensive, unbroken as o di e m . t l u s e r a s . s e i c e p s e § l d s w y n a m y b d e r i u q e r s t s e r o f g n u o y e h t o t n i yh

W m e H p p u s m a H d a e h a l s w r ev oc u o hs ye ht e e b d n a s n r o c A do o f t n a t r o p m i l b d n a s l e r r i u qs m m a m ll a m s n o h f o s a e r a e gr a L t i m r e h . r e ga n a t s o f t a tl ba H r h t t s e g gi b e hT s ts e r o f e s e h t fo w d n a l g n E w e N o l n i n o i g e r e ht w d- ts e r o f ht o b a hc u s s t a s ba h n i , s n o i t a lu po p o r n o s n o i s ill o c w kc o l m e H w kc o l m e h e hT m o r f d e c u d o r t n i c o l m e h e r u ta m n a t s b u s yn o t t o c s e f n i n a s la n gi s e ht u o s n i s n w o t s a e m l o r t n o c r o m he conservation coand abandonmage. roughly 80 Many stands of Uniformity affect migrant bavasable for wiin the forest. chirem lock wooly ineffective for

cies of conservat

Where to get help.

Eastern red bat.

Ribbon snake.

Eastern pipistrelle.

Red squirrel.

Cooper's hawk.

technical assistance for landowners or your community, Division at 603-271-2461. Contact the UNH Cooperative Ext. If you have information about a wildlife species ation, resources, and web Forest Resources in each country. Contact information for each UN Publications and assistance on forestry and wildlife topics are

3-6 Belknap County 603-527-5475 Grafton County 603-7 Series are available on the UNH Cooperative Extension website at: Additional publications. contact in form

NH Cooperative Extension Authorship Coös County
603-788-4961
Cheshire County
603-352-4550
Merrimack County
603-2
Carroll County
603-447-3834
Hillsborough County
60

as provided by The Sustainable Forestry Initiative. Add employer. University of New Hampshire, U.S. Department of Agriculture The Habitat Stewardship brochures are produced by U

About the Habitat Stewardship Series Game Department. Written by Malin ElyClyde. this publication w

d in New Hampshire is privately owned. These individua sustainin Stewardship Series has been created to help landowners and land mana forests, and also our clean water, scenic views, fresh air, natural and cultural Much of the lan e – Bugwood.org; M Cover photo: Ben Kimball – NH Nature Heritage Bureau Photo Credits and sound land stewardship at risk. and to illustrate the role private landowners can play in

Scott A. Young © 2010 Ben Kimball – NH Natural Heritage Bureau; Jason Lambert; Ricky Layson Others photos: Robert Anderson – USDA Forest Servic

Cooperative Ex

These brochures are printed on paper

Wood turtle

Blackburnian warble

u
c
o
F
s
e
ic
e
c
n
o
c
n
o
it
a
v
r
e
s
n
o
c
fo

pS

onds, and rivers shoreline ha Recognizing nt from what makes them attracti The qualities that make shorelines attrac Hampshire, but their importance as wsd The shorelines of lakes, p

, lawns, or heavy recreation New Hampshire. High quality shorelines are usual Shorelines with extensive, mature forests along the differe ures become les boulders, and dead trees that have fallen in the wat native aquatic vegetation (plants growing in or und by busdings, roads. docks on or deep water li Underwater vegetation is particularly valuable as coincreases around lakes, ponds or rivers. shoreline habitat. These habitat feat foils. or under the water, such as pondlies, pondweeds, where plants can grow. Look for plants whose foliage lakes and ponds where wave acti s m s a e r a e gr a l s a h t a t i ba h e n i l e r o h s t s e b e hT s a hc u s n o i t a t e g e v r e t a w r e d n u e s r e v i d fo c i t a u q a h t i w d e x i m t r o w r e d d a l b d n a s a t n o o c d n o p w o g shoreline features are found near deep water. shoreline lsy that grow in scattered stands. When these plants such as pickerel weed and ye for great blue and green heron, otter, mink, and habitat becomes a productive hunting ground wetlands, and upland forests. the yellow perch, larger fish such as eastern chain pickerel and

U
E
HS
B
M
E
O
B
T
U
O
B
t
s
d
n
o
p
d
n
a
s
n
o
it
a
u
tc
u
l
f
f
o
s
to
o
r
e
h
t
h
s
s
r
e
n
w
O
.
s
e
n
e
b
ta
h
t
s
e
i
h
s
e
v
i
s
s
n
e
s
ic
e
ps
E
.
s
e
v
a
r
a
l
r
ie
h
t
m
o
r
ie
h
t
e
c
u
d
e
r
dl
u
sr
o
.
e
r
o
h
d
n
a
s
ll
a
d
e
r
a
os
ll
a

c s s e c o r p a w e h t s d u o lc l n a c n r u t n i ya w l A - s t n a t l c n u a l e r o fe b X B N F I U G P F o p l a r u t a n r e da m - n a m hs dr a w e tS e n il e di u G h s r o f p o l e v e d la n o i t id d a

. community partnerships, and financ conservation of these high-value properties healthy lake and river ecosystems, as these a. Conserving land from n'Comprehensive Shoreland Protection Act (seto the development, alteration, or cutting of, Landowners around lakes, ponds and rivers sfunding

property owners. If every shoreline owner m **for protecting and restoring wildlife habitat.** Existing New Hampshire shoreline law sdo help shoreline landowners find the right balap onds and rivers. Two publications by UNH Chabitat, it would have huge benefits for fish.

X F J W O J B U F 3 t - e l bi s s o p s a de br u t s i d n u s a r o o if J X F GJ M E MJ X F HS B M S F IU P E O B T F M HB F T O P P - t - s e n i l e r o h s g n o l a t s e r o f de br u t s i d n u F O X P E E O B EB F E H O J E O B U T F W B F M E O B M

O 0 t - e s l d s w g n i h c r e p M Q D J U B V R B T F F S U O F MM B G F W B F M S F U B X F I U O * t - e s l d s w c i t a u q a r o f t a t i ba h e di v o r p s e k a l y n a m n o n e p p a h s n w o d- w a r d r e t n iW , r e t a w e s e h T .

associations towards management polic destroy the eggs of fish and adult amphibian affect wildlife. Freezing temperatures destroy on docks or to prevent flooding reline habitat and ddisrupt and kill dragonflies as they emerge fr sandy bottoms are especially vulnerable to w. The eroding force of **boat wakes** can destroy lake vegetation. Consider partnering with neighbe done with minimal disturbance of aquatic. installing a dock requires a permit and shoa aware of their effect on sh ear any water body. - and follow. Avoid the use of fertilizers-lime-pesticide number of man-made structures along the sonjoint-ly owned docks to help reduce the ertilizer al substances. Many pesticides and herbicides Protection Act, related to the use of these laws, including the Comprehensive Shorelan herbicides n fertilizers increase algae growth which threatens wildlife and water quality through toxic to aquatic organisms. Excess f

MBOUT BOEEJTQPT recreational equipment for tag-along plants. - **Help stop the spread of invasive aquatic p**causing a drop in oxygen in the water, which from shorelines. can improve the habitat and water quality of

. **Man-made ponds are a poor substitute for** SJWFS 3FN PWF BMM BUH BMPOHQ recommendations for natural

natural vegetation … in or around … important?

St n tseroffo skcolbegra, nosirapmoc yB .seiceps ,seheab'snwal'sknab'seiceps eßl dsw rew dna seirotcaf ot desoppo weN ni sdnopdna sek al sos morfr etaw eht tcetorp eht eto morp , hsslksk tnatu Sop dnop , ekal eht fo eulav eht hsi ro , dnop , ekala ecnO . ekila ta gnitsen rof enil erohs dabru dn tially submerged tree trunks h. and underwater branches as moose or raccoons to disturbance to ducks and rees and shrubs in front of a branches of shoreline trees a d o o w de n w o d - e s l d s w r o f n a s a d e v o m e r yl la u s u s ' t i s a - t s a f - e gr a l g n o l a e s o h t s a h e s l d s w r o f t a t i ba h t n a t r o p m i e

y r

ehabsat and diversity of plants and wsdlge in r mussels burrow in these ns Stagongy larvae, which are in n d snapping turtles. Aquatic windy sds Se that The quality of shoreline habitat may be the s

Why are shorelines im

ive plants die, they deplete the effer less-valuabl of wildlife and undeveloped shorelines surrounded by water body. Lakes, ponds and rivers with the plenty of abundance and variety of w uality protection houses. and heavy boat traffic support far fewer water bodies dominated by docks. stabilized will support the greatest number ore line she plo ht er-point sources'j is the number one threat to water quality in pollution from widespread sources like roads, houses, and cars (s a Ws ater q water, as of which dimine rosion, runoff, pesticides, chemicals, and excess nutrients. These Hampshire. Native shrubs and trees growing along sh it can be difficult to restore its quality. or river for homeowners, boaters, anglers, swimmers, and wildlife growth of aquatic weeds, and muddy the and song sparrows nest in the br Land along shorelines is critical wildlife habitat. Loons need undist Natural vegetation river has been degraded.

vide valuable cover for passing animals and minimize shrubs, and common mergansers use hollows in dead trees. Even the water's edge. Warbling vireos itat for young and adult sunfish the water and food avasable at the shore. loons swimming by. Forested shorelines allow forest animals such home can pro ng spots for painted turtles. Important as it serve as attachment sites for pickerel frog and green frog eggs. Par Dead trees in the water provide hab mpediment to boating and swimming. Some bare shorelines. suc from fallen trees is a rare habitat element on developed shorelines makes excellent sunni breeding grounds such as dragonfly larvae-bluegills and freshwater mussels-moving rivers that are regularly scoured by water and ice-can stslbi ctsh diversif and spawning habitat for many fish. including the state' threatened Coves and shallow areas with aquatic vegetation are used as nurser dtch erons, ducks, mink, raccoons, an in a lake or pond. Young fish, insects, and amphibians living in bridle shiner. A lack of vegetation will ultimately affe ass. pickerel. pike. and creek chubsuckers all forage northern water snakes which all forage along shorelines. predatory shoreline habitats attract hawks. h

, a water and crayfish are abundant in rocky shallows. Lakeshores and aquatic vegetation. Sunfish spawn in circular depressions in shallows, including b

s. FSter-seeding freshwater plants provide cover for aquatic invertebrates such as snaks and drshallow ponds are also the home of musk turtles, painted turtles rotaderp rehto dna hsfiybnopu defnrut.stnalp citauqa ybdeppartstnalp evisavni ybstaerhTi deht netaerht trownaf dna liofilm elbairav sa hcus stnal lse. food sources for many species of wsdlse. When large mats of invas New Hampshire. Invasive plants take over native vegetation and oInvasivep water of oxygen- which also threatens w sd

dle shiner*

Muskrat. Belted kingfisher

Moose. Banded sunfish

Mink. Bank swallow

Great blue heron.

Bald eagle*

pl . Eastern Kingbird . Redfin Pickerel · Eastern chain pickerel · Raccoon · Dragonflies and Damselflies · Painted Turtle e h t e g o t e r e hW n o c n o i t a v r e s n o c f o s e i c e p s e s l d s w a t u o b a n o i t a m r o f n i e v a h u o y t p S e s l d s W n o i s n e t x E e v i t a r e p o o C H N U e h t t c a t n o C - 1 6 4 2 - 1 7 2 - 3 0 6 t a - y t i n u m t Resources in each county. Contact information for each UNH Publications and assistance on forestry and wildlife topics are available for landowners or your com

Series are available on the UNH Cooperative Extension website at: nh Additional publications, contact information, resources, and web verFores

3-225
Carroll County
603-447-3834
Hillsborough County
603-641
Belknap County
603-527-5475
Grafton County
603-787

The Habitat Stewardship brochures are produced by UNH Cooperative Exte Authorship Coos County 603-788-4961 Cheshire County 603-352-4550 Merrimack County 60 ter and Emily Brunkhurst to this publication was provided by The Sustainable Forestry Initiative. Additional employer. University of New Hampshire. U.S. Department of Agricultur ltura Much of the land in New Hampshire is privately owned. These individuals a About the Habitat Stewardship Series Cooperative Extension. and Game Department. Written by Matt Carpen can play in sustaining f Stewardship Series has been created to help landowners and land manage forests, and also our clean water, scenic views, fresh air, natural and cu lsowksi Cover Photo: Ben Kimball – NH Natural Heritage Bureau. Other photo crediPhoto Credits and sound land stewardship at risk. and to illustrate the role private landowners

Dave Menke – USFWS Photo Archive - Department; Ben Kimball – NH Natural Heritage Bureau; Steve Ma

Cooperative Exten

s
s
u
m
d
n
o
p
n
r
e
t

s
a
E

u
c
o
F
s
e
ic
e
e
c
n
o
c
n
o
it
a
v
r
e
s
n
o
c
fo

pS

thern hardwoo Recognizing

r o n a f o s d n a s u o hT s ts e r o f r e ti n o c di s l s h f o s e p o ls 00 5, 1 n e e w t e b a m r a g u s , e r e H r a h c r i b w o ll e y d e r h s w d e x im l t a kc o l m e h fo la b d n a e c u r ps , e l pa m de pi r t S c i p y t e r a s b u r hs fi n o c - do o w dr a h b d n a , r e w o fir a t s x e fs a v r u O . r o o fl p m a H w e N n r e t s e w d n a n r e ht r o n n i s t s e r o f r e s n o c . e g a i l o f fl a f t n a i l s r b d n a s y a l p tanding dead trees (snags) and have patches of large trees in the canopy - young tr The best examples of northern hardwood - conser fwsd flowerdis rn hardwood-conifer fopockets of wetlands, seeps and interspersed patch dead and decaying trees on the ground. Large cavi understory-manys

e
ht
r
o
n
f
o
s
a
e
r
a
e
m
o
s
e
ka
m
-
e
s
l
d
li
w
r
o
f
h
c
ir
tr
o
n
e
r
a
e
r
e
hW
w
e
N
n
i
s
ts
e
r
o
f
-
do
o
w
dr
a
h
n
r
e
ht
r
o
N
ht
i
w
,
e
t
a
t
s
e
h
t
f
o
%02
h
t
f
o
%
0
8
g
n
i
n
i
a
t
n
o
c
,
s
t
s
e
r
o
f
e
s
n
o
c
-
do
o

so Northern hardwoo Mountain in Orange, National Forest, Mou forests include many extensive examples parts of Hslls borough southwestern highla hardw

a
e
r
a
de
da
h
s
e
ht

S

s
e
i
r
e
S
pi
hs
dr
a
w
e
t
S
t

Habitat

NEW HAMPSHIRE WILDLIFE ACTION PLAN

s (> 1000 acres) of northern

Conserving large block – wi-ranging wildlife habitat will provide **development**, goshawk northern and lynx effor stewardship land and conservation land both For future snags (standing dead trees) and den trees for. Large trees (>18' diameter) which are important foh habitat characterized by unique features such as:.

wood turtle, blue-spotted salamander, ribbon snake. **Forested areas near wetlands, streams, ponds, o, Rocky cliffs** which provide sunning areas for bobc dl at least five (5) acres in size wslbened't the most wsfo conservation concern such as American woodcock. Areas of young, regrowing forests, which provide c g and old trees growing at as – a diversity of tree sizes including both – many snags and cavity trees; Areas of **mature forest with characteristics of o**

,fir, pine or hemlock fallen or been cut.~ gaps in the canopy where trees have floor:~ fallen, decaying trees on the forest levels of the forest: you n

tea mi squirrel, porcupine, and white-tailed deer, northern goshawk, great horned owl, red **trees** (conifers). used as winter shelter by. **Pockets of spruce**

Using forest management-work to regenera

great diversity of wsdlsed ependent on northern Afus range of age classes, well-distributed across the lhrubs.. Provide a supply of patches, over time, of young-re

information about how forestry can enhance habitat. the st opening or clearcut. the greater benefit that features of 'early successional' habitats (refer to Shrub lot enhance cover for wsdlse - berry-producing s s are critical for manfields. Create new patches, at least 5 acres in size, near utility cbreeding in surrounding forests. To maximize the benethefore lis **bird-friendly** birds are declining. but most are still common in New throated blue warbler. eastern wood-pewee. and woo. Northern hardwood-conifer forest don't recognize property boundaries. **Discusst** season (Aprs-August). softening edges between habitats and limiting manag Audubon (www.vt.audubon.org) deta ollow all wspert. **Always consult a licensed New Hampshire forester** management projects. **neighboring landowners.** and consider cooperating t. Wsdlse near wetlands only when the soils are either frozen (wi wetlands and waterbodies. Follow established best ma **on your property**. Understand and f pshire's northern hardwood-conifer forests

forests important are northern hardwood-conifer tant ecological refuge for plants and animals. These forests in unfragmented by development and roads, making them an of New Ham r yt r o f g n i d u lc n i , e sl d s w f o s e i c e p s f o s d e r d n u h r o f t a t i ba h e d . s d r i b e e r ht - yt n e v e s d n a s la m m a n o m m o c e fi l d s w n o m m o n o m m o c r u o pe e k pl e h s t tanagers-pileated woodpeckers-s to the wide-ranging mammals and birds. Today-n-providing space for everything from the ood-conifer forest rfo restin New dscape-ies require a forested backdrop within our rapidly ommonplace. If they are to remain common, these bkcears, scare northern hardwood-conse

sting and abandonment of farms the same age, roughly 80-100 years old. They grew cted to patches of old or young trees within last century. Many wildlife species of conservation concern found in nsive timber harve y of live and dead trees of different ages at area. Today's forests don't support the same high diversity of wsdlseodo-conifer forests are attra ess likely to make large openings (e.g. plicating matters, the public may prefer to view extensive, unbroken rforests that contain a diversit of breeding songbirds in the forest birds h will re-grow into the young forests required by many wildlife species. As a result, managers are l ed with the swarms of igrating birds such as eastern woodpewee, black-throated blue warbler, rests are home to the highest concentration sy important blackflies and mosquitoes that are an important food source for young d many others carefully time their arrival to coinc nt Caribbean habitat loss in the birds, southern wintering sites in South America, ing rich and healthy breeding areas for these birds is especia st quarter century. The problem is cumulative - as each new second-home development in northern hardwood-conifer forests s to developme populations. inhibiting migration. increasing predation and gaments the forest into smaller and smaller blocks. eliminating habitat. the la e northern hardwood-conifer forests have been a non-sustainable logging practice where the best trees are cut and ng life collisions on roads. Life rse. High-grading affects wsdlße by removing graded, and are now dominated by low-quality, low-value trees and are left to grow. Som ns woody material on the forest floor'eter trees, which reduces the development of large nut-producing trees, less mature, and less diverse hy cavity trees - and less e

W y n a M a m er o p m i v o r p m o w t o c g n i P e e K w d r a h n r e h t r o N o m m o c e t l d s w t c e s n i t s e t a m s a l b f o s g n i t h g i s c e r a r e h s S d n a c e p s r e d sizes. Compseices as old the elagre for sernorthern hardw throughout the back after ext eHampshire are Many stands of Unifority developing alanand oth tlos Mexico, and the given extensive birds. Maintaining sects (such as wood thrush an Unsed States. M New England fo Refuge for eclarcusts) whicm mature forest. Aan a ti ba H d n a l a it n e di s e R n i d e s a e r c n i s a h r f t n e m p o l e v e d d S w g n i t a r a p e s d S w g n i t o m o r p i d a r g h gi H s i g n i d a r g h gi H e r t y t i la u q r o o p h gi h yl d e t a e p e r - e s n e d s s stewardship guidelines to help mThe wildlife species listed here use northern hardwood-coWildlife found in northern har

large diameter the larger diamarele

squirrel Plan as having the greatest need of conservation--appear habitats. Species of conservation concern--those wildlife species and follow se. Blue-spotted salamander. Mink frog. Black-throated blue warbler. Hoary bat. Black bear. Gray fox. American woodcock. Flying

Where to get the pl. Eastern Wood-Pewee. Red-eyed Vireo. Eastern Red Bat. Purple Finch. Eastern Pipistrelle. Pileated Woodp r landowners or your community-Division at 603-271-2461. Contact the UNH Cooperative Extension if you have information about a wildlife species of conservatio n Forest Resources in each country. Contact information for each Publications and assistance on forestry and wildlife topics are avtechnical assistance fo

-5475 Grafton County 603-787 Stewardship Series are available on the UNH Cooperative Extension website. Additional publications, contact information, resources, an i

16

Cheshire County 603-352-4550

Merrimack County 603-225

Carroll County 603-447-3834

Hillsborough County 603-641

Belknap County 603-527

University of New Hampshire, U.S. Department of Agriculture and The Habitat Stewardship brochures are produced by UNH Cooperative Extension Authorship Coös County 603-788-49

About the Habitat Stewardship Series Game Department. Written by Malin Ely Clyde. this publication was provided by The Sustainable Forestry Initiative. Additio employer.

ater, scenic views-fresh air, natural and cultural Much of the land in New Hampshire is privately owned. These individuals a d to illustrate the role private landowners can play in sustaining tStewardship Series has been created to help landowners and land manage forests. and also our clean w stein - USFWS Photo Archives; Merlin D. Tuttle - Bat Conserva Ben Kimbag - NH Natural Heritage Bureau; Sean Kirwin; Michael Marchand Photo Credits and sound land stewardship at-risk- an

Karen Lauben

Cooperative Exte

s i hs u r h t e gr a l a s e ka m d n a , kc a b n w o r b d n a t s a e r b de y y a l- h o " e e " e ki l s d n u o s t a h t s a c e ki l- e f u g , t u sj t s s e r o f s u o u di c e d , e r u t a m n i t s e n s e hs u r h t ng, partly due to the destruction of forest on the forest floor. Populations of these birds a thick understory, moist sos, and heavy leaf d cliffs and rocky *cat* sustain this species. t' b locks. unfragmented by development. may e i r wintering grounds in Mexico. Providing large clini orests have matured g 60s, bobcat populations have declined in Newrops to sun themselves during the winter. Sinceats use sunny, south-facing ammals. Managing forests for a rat for bobcat prey, including snowshoe hare e is much less dense, young forests to provide pshire, likely because our f teel-colored hawk is a forceful predator in the rn goshawk ase prey and benefl t bobcats-rent age classes (both young and old trees jawlithers small m rels. ts with large trees and an open understory. They — and aggressively defend them — in mature ern hardwood-conifer forests. Goshawks bus d wk ost abundant in patches of young forest, so birds, and ruffed grouse. These prey animals over a large area for rabbits, mice, squir avaiabte'lopment which can disturb nest sites and make val. Goshawk habitats are threatened by human openings are also important to gosha osting in the foliage of their wintering grounds in the southern United ebats migrate to New Hampshire for the summer *ern red baf*less ting behavioes. There are relatively few records of red bats in, mature trees, often near streams or other wates. They spend the day or soor evitercesriehttub,erihspmaHehtoekiL.tserofehtnietacolotflucffidmehtsdniwybdekslebnacstabdernretsae,stabyfotanitseretnig nisaercni eht nevig nrecnoc a ,sen ton od stab der nretsae ,yletanutroF .rewop a ,emordnys eson-etihw ot elbitpecsus ebot ra'stabg

o
s
m
er
a
s
e
r
o
f
i
v
r
u
s
e
v
e
d
y
e
r
p
ts
a
E
s
e
hT
m
o
r
f
e
t
a
tS
e
gr
a
l
i
do
b
w
e
N
ka
m
r
gi
m
i
br
u
t
d
n
lw
e
p
pa
ht
e
l
D
P
,
T
F
JD
F
D
D
O
O
P
P
D
D
O
O
P
P
JJ
UU
B
B
W
W
S
S
F
F
T
T
O
O
P
P
D
D
GG
P
P

EM

F

J

,

MM

B

N

4

H

O

J

HB

O

B

.

Q4

$ "

IT
ES
B
X
F
U
4
U
B
UJ
CB
&
"
"
%
."
8
&
3"
)4
1
"
")

8&
/
S
SF
O
J
T
EO
U
U
"
U
SF
J
N
J
M
JS
UT
F
SS
V
X
T
N
B
JV
RF
C
V
S
E S
P
M
B
JU
T
F
F
[
J
U
BU
F
MM
B
UT
O
BT
J
X
T
J
X
T
S
P
I
J
X
T
T
TF
SF
O
BD

M

B D JS P U T J) H O J T F H O B lD X T S F W B F C E O B T O B D J S F N " F W J U B / Z MM B D J S P U T J) U B U J CB I E O B M T T B S H H O J O J B U O J B N E O B H O J U B F S D B B M F I U EF O S V C ZF I U O F I X

T
E
O
B
MT
T
B
S
H
E
F
U
B
F
S
D
S
F
F
E
E
F
MJ
B
U
F
U
J
I
X
T
B
ID
V
T
T
F
J
D
F
Q
T
F
N
B
H
S
P
G
U
G
B
T
X
P
E
B
F
N
ZT
T
B
S
H
P
U
O
J
X
F
S
H
T
N
B
E
S
F
W
B
F
C

U
I
HJ
M
O
V
T
P

U
E
F
T
P
QY
F
T
B
X
MJ
P
T
E
O
B
O
P
J
T
T
F
S
Q
Q
V
T
F
S
◊
Z S
P
U
T
J
I
U
O
F
D
F
S
F
S
P
N
O
•
S
F
S
B
T
E
O
B
MT
T
B
S
H
U
B
I
U
U
O
B
F
N
T
B
I
T
N
B
E
E
MJ
V
C
D
D
P
F
U
B
U
T
F
I
U
O
J
H
O
J
S
B
F
M
D
M
B
S
V
U
M
V
D
J
S
H
B
G
P

L
B
F
Q
U
B
U
J
CB
I
E
O
B
MT
T
B
S
H
H
O
J
T
P
M
O
F
F
C
T
B
I
E
O
B
MH
O
&
E
O
B
T
EM
F
◊
T
T
F
M
F
F
S
U
T
MJ
P
T
EF
O
J
B
S
E
MM
F
X
S
JF
IU
U
O
F
N
Q
P
M
F
W
F
E
S
P
G
T
F
U
J
T
F
W
J
U
D
B
S
U
U
B
S
F
◊
P
P
T
MB
S
F
S
J
IT
Q
N
B
)
X
F
/
O
J
T
E
O

B
MT
T
B
S
H
U
T
P
N
ZB
E
P
5

I
T
P
U
O
J
LD
B
C
X
P
S
H
M
MJ
X
T
U
B
U
J
CB
I
F
T
F
I
U
F
O
P
MB
UT
F
S
P
G
P
U
J
C
H
O
JU
T
F
O
E
O
B
MT
T
B
S
H
O
J
T
F
O
JM
D
F
%
E F
O
J
MD
F
E
F
W
B
IT
E
O
B
MT
T
B

S
H
O
P
E
O
F
QF
EU
B
IU
T
F
J
D
F
QT
E
S
J
#
O
E
O
B
MT
T
B
S
HU
T
P
.
E
O
B
M
H
O
&
X
F
/
O
J
T
E
S
J
CG
P
Q
V
P
S
HS
F
IU
P
T
O
J
B
U
S
F
D
B
O
B
IU
S
F
MM
B
N
T
T
EM
F
m
O
J
U
T
F
O
U
O
P
X
Z
F
IU
T
O
B
F
N
H
F
W
E
F
S
S
F
G
F
S
Q
F
IU
E
O
B
F
[
J
T
E M
F
m
N

V
N
J
O
J
N
E
F
S
J
V
R
F
S
F
IU
T
E
S
J
C
H
O
J
U
T
F
O
S
E
R
C
A

S
D
N
A
LS
S
A
R
G
R
E
LL
A
M
S
FO
S
D
R
I
*
T
B
S
H
F
T
O
F
E

T
F
S
D
B

L
O
J
MP
C
P
#
T
B
S
H
F
T
O
F
E

T
F
S
D
B

LS
B
M
X
P
EB
F
N
O
S

FUTB&FUJTTSFGFSQ

TFSDB

XPSSBQTIBOOBWB4S

ERCA

SDNALSSARGREGRALFOSDRI

"FUJTTSFGFSQ

TFSDB

XPSSBQTSFGQPITTBS(TOJTFHBSPG

TF

S
D
B

S
F
J
S
S
B
I
O
S
F
IU
S
P
/
F
U
J
T
T
S
F
G
F
S
Q

T
F
S
D
B

S
F
QJ
Q
E
O
B
T
E
O
B
MQ
6
F
J
D
F
QT
E
F
S
F
H
O
B
E
O
F

F
U
B
U
T

T
F
J
D
F
QT
E F
O
F
U
B
F
S
I
U

F
U
B
U
T

O
E
S
J
C
E
O
B
T
F
D
JU
D
B
S
Q
M
B
S
V
U
M
V
D
JS
H"
X
P
E
O
B
M
S
F
IU
P
E
O
B
T
S
F
N
S
B
GG
P
L S
P
X
F
IU
U
V
P
I
UJ
8
H
O
J
X
P
N
G P
H
O
J
N
J
U
F
I
U
S
F
W
F
X
P
)
U
T
F
S
P
G

P
U
U
S
F
W
F
S
S
F
IU
P
E
O
B
T
E
S
J
C
H
O
J
U
T
F
O
E
O
B
MT
T
B
S
HS
P
GU
B
U
J
CB
I
F
H
B
S
P
G
Z
U
J
MB
V
R
I
H
J
I
H
O
J
X
P
S
H
T
S
F
N
S
B
-
F
GJ
M
E
MJ
X
S
P
P
X
U
T
EM
F
m
S
J
F
IU
X
P
N
Z
MM
B
V
T
V
LD
P
U
T
F
W
J
M
S
P
G
G P
F
O
P
U
T
B

F
M
U
"
S
F
N
N
V
T
F
IU
H
O
J
S
V
ET
F
N
J
U
F
F
S
IU
Z B
.
O
F
F
X
U
F
C
T
S
V
D
D
P
Z
MM
B
D
J
Q
ZU
T
H
O
J
X
P
N
F
T
F
IU
I
U
J
X
T
E
O
P
Q
T
F
S
S
P
D
U
B
IU
F
N
J
U
B
Z M
V
"
EJ
N
E
O
B
H
O
J
U
T
F
O
E
O
B
MT
T
B
S
HU
T
P
N
S
P
G
O
P

T
B
F
T
H
O
J
U
T
F
O
F
IU
Z
P
S
U
T
F
E
O
B
D
E
P
J
S
F
Q
T
J
IU
H
O
J
S
V
E
H
O
J
X
P
.
T
E
S
J
C
U
MV
EB
F
T
V
B
D
S
P
T
H
O
J
MH
EF
n
M
MJ
L
T
H
HF
E
O
B
T
U
T
F
O
T
UT
F
O
S
JF
IU
O
P
E
O
B
CB
P
U
T
E
S
JC

H

O

J

[

J

O

H

P

D

F

3
T

U

B

U

J

C C

B
B

I I

E E

O
O

B
B

MM

T
T

T
T

B
B

S
S

HH

O

B

I
U

F
S
P

.

F
S
J

IT
Q

N

B

)

X
F
/
O
J
U
I
HJ
T
F
S
B
S
ZM
H
O
J
T
B
F
S
D
O
J
O
B
F
S
B
T
E
O
B
MT
T
B
S
(
S
J
F
I
U
U
F
F
N
P
U
T
S
F
X
P
ø
E
MJ
X
E
O
B
T
EM
F
ö
G
P
T
B
F
S
B
O
F
Q
P
F
T
F
I
U
F
T
V
F
GJ
M
E
MJ
X
G
P
T
F
J
D
F
QT
G
P
T
F
V
M
B

W U B U J CB I F I U F [J O H P D F S P U O S B F - H O J EF F S C S P S F W P D E P P G S P G T EF F O M B J D F Q T F T F I U F W S F T O P D E O B O J B U O J B N P U P E O B D V P Z U B I X S F W P D T J E E O B T E O B

MT
T
B
S
H
T
U
B
UJ
CB
I
O
P
N
N
P
D
U T
P
N
F
I5
s
O
J
T
U
B
U
J
CB
I
E
O
B
M
T
T
B
S
H
F
S
B
F
S
J
IT
Q
N
B
)
X
F
/
I D
V
T
T
EM
F
m
M
B
S
V
U
M
V
D
J
S
HB
T
F
S
V
U
T
B
Q
T
EM
F
mZ
B
IT
B
F
S
F
)
T
EM
F
m
X
P
MM
B
G
E
O
B
B
G
P
T
U
T
J
T

O
P
D
O
P
J
U
B
U
F
H
F
W
T
F
J
D
F
Q
T
T
T
B
S
HG
P
F
S
V
U
Y
J
N
G P
O
P
JU
B
O
JC
N
P
D
B
S
P
E
O
B
T
F
H
E
F
T
T
F
T
T
B
S
H
T
S
F
X
P
n
E
MJ
X
T
X
P
E
B
F
N
U
F
X
E
O
B
T
O
P
J
U
B
M
M
B
U
T
O
J
Z
S
B
U
J
M
J
N
T
M
M
m
E

O
B
M
E
F
Q
Q
B
D
T
U
S
P
Q
S
J
"
S
B
MJ
N
J
T
U
S
P
Q
Q
V
T
Z
F
IU
G J
U
B
U
J
CB
I
F
GJ
M
E
MJ
X
E
O
B
MT
T
B
S
H
T
B
O
P
J
U
D
O
V
G
P
T
MB
Z
B
N
T
F
J
D
F
Q
T
F
GJ
M
E
MJ
X
E
O
B
MT
T
B
S
H
Z
O
B
N
Z
C
E
F
T
V
P
T
MB
F
S
B
T
E

O
B
M
Q
P
S
$
O
P
J
U
B
U
F
H
F
W
Z
MJ
T
B
F
F
C
Z B
N
Z F
IU
F
D
O
J
T
T
E
O
B
MT
T
B
S
H
M
B
J
U
O
F
U
P
Q
T
B
U
O
B
U
S
P
Q
N
J
P
T
MB
F
S
B
E
O
B
EF
O
P
E
O
B
CB
F
S
B
T
F
D
J
U
D
B
S
Q
H
O
J
N
S
B
G
Q
P
S
D
G J
T
T
B
S
H

X
P
S
H
P
U
E
F
U
S
F
W
O
P
D
U F
F
G
S
V
P
G
S
F
W
P
M
M
B
U
F
C
Z
B
N
T
U
B
U
J
C
B
I
E
O
B
M
T
T
B
S
H
O
J
H
O
J
X
P
S
H
O
P
J
U
B
U
F
H
F
7
T
Z
B
M
Q
U
I
HJ
F
I
O
P
J
U
B
U
F
HF
7
O
P
J
U
B
O
J
C
N
P
D
B
S
P

T F
ID
O
J
O
B
IU
T
T
F
M
U
S
P
IT
F
IU
F
T
V
M
MJ
X
T
F
J
D
F
Q
T
F
GJ
M
E
MJ
X
I
D
J
I
X
H
O
J
O
J
N
S
F
U
F
E
O
J
F
M
P
S
U
O
B
U
S
P
Q
N
J
O
B
O
J
B
U
O
P
D
Z
F
IU
U
B
IU
T
J
T
U
B
U
J
CB
I
E
O
B
MT
T
B
S
H
MM
B
G
P
U
J
B
S
U
O
P

N
N
P
D
"
U
B
U
J
CB
I
T
C
V
S
IT
S
P
T
F
F
S
U
Z
O
B
G J
X
F
G
T
F
T
T
B
S
H
F
W
J
U
B
O
O
P
O
F
S
B
T
E
O
B
M
T
T
B
S
H
O
J
H
O
J
X
P
S
H
T
U
O
B
M
Q
U
T
P
N
Z
B
E
P
5
'
Z
IU
P
N
J
U
F
E
V
MD
O
J
F
T
F
I
5
T
F

T
V
M
B
S
V
U
M
V
D
J
S
H
B
S
P
GT
O
B
N
V
IZ
C
E
F
D
V
E
P
S
U
O
J
F
W
J
U
B
O
P
X
5
T
T
B
S
H
F
Z
S
M
B
J
O
O
F
S
F
Q
E
O
B
T
T
B
S
H
E S
B
I
D
S
P
T
T
B
S
HF
V
M
C
Z
LD
V
U
O
F
.
T
S
F
X
P
n
E
MJ
X
F
W
J
U
B
O
T
B
MM
F

X
T
B
N
F
U
T
F
V
MC
F
MU
U
J
M
E
O
B
N
F
U
T
F
V
MC
H J
C
T
F
T
T
B
S
H
ZB
E
P
U
T
E
O
B
M
T
T
B
S
HS
V
P
O
J
O
P
N
N
P
D
P
T
MB
F
S
B
S
F
U
T
B
E
O
B
E
P
S
O
F
EM
P
HT
B
I D
V
T
T
E
O
B
M
T
T
B
S
H
T
F
S
J
IT
Q
N
B
)
X
F

/
F
S
B
F
S
F
I8
E
O
B
MT
T
B
S
H
F
D
V
E
F
S
P
U
E F
O
J
C
N
P
D
F
W
B
I
O
P
J
T
T
F
D
D
V
T
U
T
F
S
P
G
M
B
S
V
U
B
O
E
O
B
U
O
F
N
Q
P
M
F
W
F
%
U
V
P
CB
Z M
O
P
S
F
W
P
D
Z M
U
O
F
S
S
V
D
T
E
O
B
MT
T
B
S
HU
B
IU
U
O
J
P
Q
F
IU
P
U
F
S
J

IT Q N B) X F / O J T U B U J CB I S F U B F S H F T P I U T U B U J CB I E O B MT T B S HF HS B M S F W F X P) F Q B D T E O B M S V P G P U O F D S F Q S V P G U T F I HJ IF IU I U J X F S J IT Q N B) X F / O J Z U O V P D Z S F W F O

J U T J Y F M MJ U T F [J T O J T F S D B

O B IU T E O B MT T B S H H O J O J B N F S S V P G P U O F D S F Q

I U J X Z U O V P $ O P U G B S (O J T O P J U B S U O F D O P D G P M F W F M F N P 4 U O F D S F Q

Z
U
O
V
P
$
T
P
P
$
E
O
B
U
O
F
D
S
F
Q
Z
U
O
V
P
$
LD
B
N
J
S
S
F
F
HS
B
M
T
F
S
J
IT
Q
N
B
)
X
F
/
G
P
U
O
F
D
S
F
Q
U
I
HJ
F
U
V
P
C
B
T
U
D
F
U
P
S
Q
O
P
J
U
D
J
S
U
T
F
S
O
P
J
U
B
W
S
F
T
O
P
D
T
U
B
U
J
CB
I
E
O
B

M
T
T
B
S
H

T
E
O
B
MT
T
B
S
H
O
J
E
O
V
P
G
F
GJ
M
E
MJ
8
F
S
F
òJ
E

S
F
W
P
Z
C
E
F
T
V
F
C
M
MJ
X
T
F
[
J
T
MM
B
G
P
T
E
O
B
M
T
T
B
S
(
O
F
Q
F
E
U
B
I
U
T
F
J
D
F
Q
T
G
P
T
F
MQ
N
B
Y
F
F
N
P
T
F
S
B
X
P
MF
#

S
B
F
Z
QJ
IT
ES
B
X
F
U
T
F
I
U
X
P
MM
P
G
E
O
B
T
F
J
D
F
Q
T
F
T
F
I
U
S
P
G
U
V
P
LP
P
M
J
D
F
Q
4
B
F
S
B
S
V
P
Z
O
J
T
U
B
U
J
CB
I
E
O
B
MT
T
B
S
H
F
D
O
B
I
O
F
S
P
O
J
B
U
O
B
M
1
O
P
J
U
D
"
F
GJ
M
E
MJ
8
F
I
U
O
J
EF
öJ
U
O
F
E
J
T
F
J
D

F
Q
T
F
GJ
M
E
MJ
X
F
D
B
GF
Q
Z
U
EM
P
C
O
J
S
B
F
Q
Q
B
O
P
J
U
B
W
S
F
T
O
P
D
L S
B
M
EF
O
S
P
)r
O
S
F
U
UJ
C
O
B
D
JS
F
N
"
r
S
F
JS
S
B
I
O
S
F
IU
S
P
/r
M
F
S
U
T
F
L
O
B
D
JS
F
N
"
r
E
S
B
Q
P
F
M
O
S
F
I
U
S
P
/
r

B
OT
FTPOHPI
OSFUTB&
r

UTFJDFQT
ZFSQ

LS
BM
XPEBF
N
OSFUTB&
r
BOT
OFFSH
IUPPN4
r

XPSSBQT
SFQQPITTBS(
r

F

M U O F S S V D F I U S P , QM F I U F H P U F S F IB O P J U B W S F T O P D G P T F J D F Q T F GJ M E MJ X B U V P C B O P J U B N S P G O J F W B I V P Z G" O F U Y & F W J U B S F Q P P $) / 6 F I U U D B U O P $ U B O

P
J
T
J
W
J
%
Z
U
J
O
V
N
N
P
D
S
V
P
Z
S
P
T
S
F
O
X
P
E
O
B
M
S
P
G
F
D
O
B
U
T
J
T
T
B
M
B
D
J
O
ID
F
U
W
B
F
S
B
T
D
J
Q
P
U
F
GJ
M
E
MJ
X
E
O
B
Z
S
U
T
F
S
P
G
O
P
F
D
O
B
U
T
J
T
T
B
E
O
B
T
O
P
J
U
B
D
J
M
C
V
1
ID
B
F
S
P
G
O
P
J
U
B
N
S
P
G
O
J
U
D
B

U
O
P
$
ZU
O
V
P
D
ID
B
F
O
J
T
F
D
S
V
P
T
F
3
U
T
F
S
P
,
O
J
O
B
T
F
D
S
V
P
T
F
S
O
P
J
U
B
N
S
P
G
O
J
U
D
B
U
O
P
D
T
O
P
J
U
B
D
J
M
CV
Q
MB
O
P
J
U
J
EE
"
X
P
MF
C
P
J
T
O
F
U
Y
&
F
W
J
U
B
S
F
QP
P
$
)
/
6
F
I
U
O
P
F
M
C
B
MJ
B
W
B
F
S
B
T
F
J
S
F
4
QJ
IT
ES
B
X

F
U
4

Z
U
O
V
P
$

O
P
U
G
B
S
(

Z
U
O
V
P
$

Q
B
O
L
M
F
#

Z
U
O
V
P
$

I
H
V
P
S
P
C
T
M
M
J
)

Z
U
O
V
P
$

M
M
P
S
S

B
$

Z
U
O
V
P
$

L
D
B

N
J
S
S
F
.

Z
U
O
V
P
$

F
S
J
I
T
F
I
$

ZU
O
V
P
$
T
P
P
$
Q J
I
T
S
P
IU
V
"
F
U
Y
&

F
W
J
U
B
S
F
Q
P
P
$
)
/
6
Z
C
E
F
D
V
E
P
S
Q

F
S
B

T
F
S
V
ID
P
S

C
QJ
IT
ES
B

X
F
U
4
U
B
U

J
CB
)
F
I5
O
B
F
S
V
U
M
V
D
J
S
H
*
G
P
U
O
F
N
U
S
B
Q
F
%
4
6
F
S
J
IT
Q
N
B
)
X
F
/
G
P
Z
U
J
T
S
F
W
J
O
6
S
F
Z
P
MQ
N
F
P
J
U
J
EE
*
F
W
J
U
B
J
U
J
O
*
Z
S
U
T
F
S
P
,
F
M
CB
O
J
B
U
T
V
4
F
I
5
Z
C
EF
EJ
W
P
S
Q
T
B
X
O
P
J
U
B
D
J
M
CV
Q
T
J
IU
F
E
ZM
$
ZM
&
O
J
MB
.
Z
C
O

F
U
U
J
S
8
U
O
F
N
U
S
B
QF
%
F
N
B
(
T
F
JS
F
4
QJ
IT
ES
B
X
F
U
4
U
B
U
J
CB
)
F
I
U
U
V
P
C"
B
T
MB
V
EJ
W
J
E
O
J
F
T
F
I
5
EF
O
X
P
ZM
F
U
B
W
J
S
Q
T
J
F
S
J
IT
Q
N
B
)
X
F
/
O
J
E
O
B
M
F
I
U
G
P
ID
V
.
M
B
S
V
U
M
V
D
E
O
B
M
B
S
V
U
B
O
S
J
B
IT
F
S
G
T
X
F
J
W
D
J
O
F
D

T

S
F
U
B
X

O
B
F
M
D
S
V
P

P
T
M
B

E
O
B
T
U
T
F
S
P
G
S
F
HB
O
B
N

E
O
B
M
E
O
B

T
S
F
O
X
P
E
O
B
M
QM
F
I
P
U

E
F
U
B
F
S
D

O
F
F
C
T
B
I
T
F
J
S
F
4
QJ
IT
ES
B
X
F
U
4
U

H
O
J
O
J
B
U
T
V
T

O
J

Z
B
M
Q
O
B
D

T
S
F
O
X
P
E
O
B
M
F
U
B
W
J
S
Q
F
M
P
S

F
I
U

F
U
B
S
U
T
V
M
M

J
P
U
E
O
B
L
T
J
S
U
B
QJ
IT
ES
B
X
F
U
T
E
O
B
M
E
O
V
P
T
E
O
B
T
UJ
E
F
S
$
P
UP
It
J
.
&$
)
/
6
LD
B
M
#
O
P
%
T
U
J
E
F
S
D
P
U
P
I
Q
S
F
IU
0
&$
)
/
6
S
S
B
5
U
U
B
.
P
U
P
I
Q
S
F
W
P
$
U
B
1
O
B
N
MM
B
8
MS
B
$
N
P
D
F
S
V
U
B
O
GP
CF
X
F
S
I
B
U
4
F
J
C
CF
%
HS
P
T
F

HB
N
J
S
F
U
T
B
N

F

T
E
O
B
M
T
T
B
S
H
V
P
Z
G
*

F
S
J
IT
Q
N
B
)
X
F
/
O
J
F
P
U
T
S
B
F
Z
F
F
S
IU
Z S
F
W
F
F
D
O
X
F
O
B
F
U
B
F
S
D
P
U
F
W
JT
O
F
QY
F
I
D
JI
X
F
[
JT
O

JT
F
S
D
B
F
U
B
U
T
F
IU
O
J
F
S
B
S
Z M
H
O
J
T
B
F
S
D
T
V
HV
"
S
F
U
G
B
T
EM
F
m
X
P
N
F
V
T
T
J
S F
C
P
U
D
0
U
T
V
HV
"
S
F
U
B
M
O
F
EJ
W
P
S
Q
P
U
E
P
S
O
F
EM
P
H
E
O
B
S
F
U
F
E
V
MD
O
J
F
M
CJ
T
T
P
Q
F
C
Z B
N
T
B
F
S
B
Z
EF
F
X
E
O
B
M
N
S
B
G
MB
O

J
O
P
T
U
D
B
Q
N
J
F
D
V
E
F
S
Q M
F
I
O
B
Z M
V
*
EJ
N
I
H
V
P
S
IU
I U
X

H
S
F
IU
B
F
X
F
M
C
B
JS
B
W
O
P
T
B
F
T
F
U
B
S
P
QS
P
D
O
J
P
U
N
F
IU
S
P
G
U
MV
T
E
S
J
C
H
O
J
U
T
F
O
E
O
B
MT
T
B
S
HF
T
N
B
S
H
P
S
Q
F

S
B
I
T
U
T
P
D
F
U
B
U
T
)
/
6
ZU
O
V
P
D
S
V
P
ZU
D
B
U
S
P
G
4
$3
/
F
D
J
W
S
F
4
O
P
JU
B
W
S
F
T
F
T
F
IU
T
B
T
EM
F
m
GP
F
ME
EJ
N
F
T
E
S
J
C
H
O
J
U
T
F
X F
I
T J
T
T
F
T
T
O
P
F
L
B
U
P
U
H
O
J
M
MJ
X
T
S
F
O
U
I
H
V
P
S
E

F
S
P
N
F
S
B
E
O
B
T
F
D
B
QT
I
U
J
X
T
F
ID
O
V
C
O
J
T
B
H
S
F
U
O
J
X
S
F
U
U
F
C
E
O
B
F
D
S
V
P
T
E
F
W
J
U
B
S
F
Q
P
P
$
)
/
6
E
O
B
4
$3
/
O
P
T
B
F
T
N
S
B
X
U
O
B
MQ
P
U
T
QJ
IT
E
S
P
G
G
T F
O
GJ
M
E
MJ
X
S

P
GU
B
UJ
CB
I
F
M
CB
V
M
B
W
F
EJ
W
P
U
T
B
F
M
U
B
MM
B
GF
IU
O
J
H
O
J
X
P
N
Z
C
E
O
B
U M
V
D
öJ
E
F
S
P
N
I D
V
N
T
J
U
"
T
C
H
O
J
X
P
N
Z
C
E M
F
m
H
O
J
U
T
J
Y
O
B
IU
S
F
U
B
F
S
H
T
E
O
B
MT
T
B
S
HF
HS
B
M
O
O
J
F
S
B
E
O
B
T
F
J
D
F
QT
F
GJ
M
E
MJ
X
G
P

S F T J O B U P O T J O P J U D V E P S Q M B S V U M V D J S W F H O J X P . O P T B F T E S J C H O J EF F S T B T B ID V T T S F X P ⁿ E MJ X H O J S F X P ⁿ H O J X P N S F U B M F S F I X T B F S * T F J ⁿ HS B N T U B U J CB IF H E F T EM F m X

P
MM
B
X
B
S
U
T
H
O
J
D
T
F
V
RJ
O
ID
F
U
H
O
J
X
P
N
P
U
T
O
P
J
U
B
D
Z B
.
O
P
T
B
F
T
H
O
J
EF
F
S
CF
IU
H
O
J
S
V
J
X
T
B
F
S
B
O
J
F
S
P
N
S
P
T
F
ID
O
J
Y
JT
P
U
T
O
P
JU
B
S
U
O
F
D
E J
P
W
B
P
T
U I
HJ
O
U
B
T
EM
F
m
F
IU
O
J
U
T
P
F
S
P
N
S
P
G
U
O
F

N
Q
J
V
R
F
H
O
J
Z
B
I
O
F
/
F
IU
G P
O
P
J
T
J
W
J
%
F
GJ
M
E
MJ
IF
IU
U D
U
B
U
O
F
N
U
S
B
QF
%
F
N
B
(
E
O
P
M
B
T
E
O
B
M
T
T
B
S
H
O
J
S
P
T
B
F
S
B
S
F
U
U
F
H
O
J
X
P
S
HF
IU
H
O
J
S
V
ET
F
S
V
T
T
F
S
Q
Z O
D
IJ
E
U
J
H
O
J
LB
N
T
F
MV
EF
I

D
T
H
O
J
U
UB
EP
N
N
P
D
D
B
P
U
F
MV
EF
I
D
T
E
O
B
F
E
O
B
M
B
S
F
E
F
GG
P
S
F
C
N
V
O
B
F
W
B
I
T
S
O
P
$
F
GJ
M
E
MJ
X
U
mF
O
F
CU
B
IU
T
F
D
JU
D
B
O
P
$
T
F
D
S
V
P
T
F
3
M
B
S
V
UB
/
F
IU
S
P
F
D
T
N
B
S
H
P
S
Q
F
S
B
I
T
U
T
P
D
F
T
F
IU
O
J
H
O
J
X
P

S
HT
F
F
S
U
E
O
B
T
C
V
S
I
T
MM
O
E
O
B
MT
T
B
S
HZ C
E
F
W
J
F
D
S
F
Q
T
B
F
HB
O
B
D
M J
P
T
S
P
P
Q
I
U
J
X
T
B
F
S
B
O
J
T
F
D
O
B
CS
V
U
T
J
E
M
B
D
JS
P
U
T
J
I
D
J
N
JN
F
W
J
U
B
O
E B
F
S
QT
Q M
F
I
P
T
M
B
M
MJ
X
H
O
J
/
F
N
P
4
EM
F
m
B
O
J
U

T
J
Y
F
Z
EB
F
S
MB
U
J
X
T
QJ
I
T
S
F
O
U
S
B
Q
E F
I
T
J
M
C
B
U
T
F
F
W
B
C
MB
V
O
O
B
O
B
O
P
T
EM
F
m
O
S
V
C
P
UT
4
6
F
IU
P
U
F
W
J
U
B
O
F
S
B
I
D
J
I
X
G
P
Z
B
S
H
O
P
T
B
F
T
M
P
P
D
F
W
J
U
B
O
O
P
O
P
U
F
S
P
N
F
S
B
T
F
T
T
B
S
H
O
P
T

B
F
T
N
S
B
8
X
P
E
O
B
M
P
U
T
U
mF
O
F
CF
N
P
T
S
F
ô
P
Z
F
EJ
D
J
CS
F
I
E
O
B
F
N
J
M
S
F
[
J
MJ
U
S
F
G
T
T
F
M
O
J
X
P
S
H
S
F
W
P
D
H
O
J
U
T
F
O
S
F
U
U
F
CS
F
ô
P
P
G
F
M
CB
E
O
F
QF
E
F
S
P
N
B
T U
T
F
O
E
F
I
5
T
X
P
O
T
Z
W
B
F
I
H
O
J
S

V
EO
X
P
E
E
O
V
G
F
S
B
I
T
U
T
P
D
F
M
CJ
T
T
P
Q
E
O
B
F
D
J
S
B
X
F
U4
JM
F
EJ
V
(
P
S
Q
F
[
J
T
Z
O
B
G
P
T
E
O
B
M
T
T
B
S
(
q
N
F
IU
O
J
B
U
O
JB
N
T
EM
F
m
O
X
P
V
S
IT
E
O
B
T
F
F
S
U
F
H
B
S
V
P
D
T
J
E
F
O
B
O
J
B

N
S
P
GS
B
U
D
F
O
G
T
MM
m
E
O
B
M
EF
Q
Q
B
D
T
EM
F
m
S
J
B
E
EF
C
H
O
J
D
V
E
P
S
Q
T
EM
F
m
E
O
B
mJ
EP
N
T
EM
F
m
M
B
S
V
U
M
V
D
J
S
HB
O
*
q
ET
E
S
J
C
H
O
J
EF
F
S
C
E
O
B
MT
T
B
S
H
S
B
C
H
O
J
X
P
N
F
T
J
B
3
q
O
P
D
E
S
J
C
E
O
B
MT
T
B
S
H
P
S
T
E
S
JC
E
O
B
M

T
T
B
S
(
q
LS
B
ES
F
U
GB
H
O
J
X
P
N
P
T
S
B
C
H
O
J
IT
V
n
F
T
6
q
B
U
O
P
D
O
P
JU
B
N
S
P
G
O
J
O
B
I
T
J
,
F
S
J
IT
Q
N
B
)
X
O
J
H
O
J
X
P
N
Z
B
MF
%
q
T
S
F
W
JS
B
N
I
UJ
X
E
F
D
B
G
F
S
B
T
S
F
N
S
B
'q
O
B
M
Q
T
E
O
B
N
F
EU
O
F
N
QJ
V
RF
V
R
J

O
ID
F
U
H
O
J
X
P
N
EF
O
m
F
S
B
F
N
S
B
G
E
F
U
T
F
S
F
U
O
J
S
F
W
F
X
P
)
S
Q
S
P
G
Z
B
Q
Q
MF
I
P
U
F
M
C
B
MJ
B
W
B
oP
O
P
J
T
O
F
U
Y
&
F
W
J
U
B
S
F
QP
P
$
IU
U
V
P
CB
O
P
JU
B
N
S
P
G
O
J
F
S
P
N
B
F
W
P
N
F
S
F
M
CJ
T
T
P
Q
F
S
F
I
8
q
F
S
D
B
F

M
CB
F
T
V
F
IU
F
T
B
F
S
D
F
E
Z
MS
B
M
V
D
J
U
S
B
Q
T
EM
F
m
H
O
J
O
S
V
#
q
E
O
B
T
U
O
F
J
S
U
V
O
MJ
P
T
F
W
P
S
Q
N
J
O
S
V
#
T
U
B
U
J
CB
I
E
O
B
M
T
T
B
S
H
P
U
Z
F
IU
G
J
X
P
MF
C
F
F
T
T
F
T
T
B
S
H
B
I
T
S
F
O
X
P
E
O
B
M
F
S
J
IT
Q
N
B
)
U

O
F
N
U
S
B
QF
E
F
S
m
M
B
D
P
M
S
J
F
IU
T
S
F
U
I
H
m
F
S
m
S
P
G
H
O
J
O
J
B
S
U
T
B
O
B
N
T
F
T
T
B
S
H
O
P
T
B
F
T
N
S
B
IIq
F
W
J
U
B
O
S
F
U
MB
F
M
C
B
J
W
B
F
C
Z B
N
Q
P
S
D
Z B
I
M
B
S
V
U
M
V
D
J
S
HB
O
B
T
B
IIJ
U V
C
I
T
JM
C
B
U
T
F
P
U
U M
V
D
ôJ

E
F
S
J
V
R
F
S
Z F
I
5
F
H
O
F
MM
B
ID
F
IU
P
Z
F
I
U
F
GJ
M
E
MJ
X
S
P
,
U
O
B
S
F
M
P
U
O
B
U
O
F
N
F
W
P
N
S
P
G
O
F
F
X
UF
C
U
B
N
U
O
P
EZ F
IU
F
D
O
J
T
S
F
W
P
D
W
EB
F
EJ
W
P
S
Q
O
B
D
O
P
J
T
O
F
U
Y
&
T
F
T
T
B
S
H
DF
DD
DD
FF
DD

'

T

F

JD

F
O
O

P
P

JJ

UU

B
B

W
W

S
S

F
F

T
T

O
O

P
P

D
D

G G

P
P

Q4

T
F
J
S
F
4
QJ
IT
ES
B
X
F
U
4
U
B
U
J
CB
)
/
"
- 1
/
0*
5
$ "
&
'*
-
%

.*
8
&
3"
)4
1
.
")
8&
/
O
B
I
ID
ø
T
B
U
B
UJ
FU
B
X
U
H O
Q
P
U
TS
PU
X
B
O
J
E O
T
F
JU
O
JU
S
B
QT
E
O
B
I T
S
S
P
T
E
O
P
ET
B
MU
F
QU
D
F
T
QN
E
O
B
M
)
X
F
F
MM
m
JU
V
MM
P
P
S
Q
S
J
B
MU
F
X
B
I
T
S
B
N
F
S
B
U
O
B
U
S
P
Q

N
J
J
S
F
S
B
T
E
O
B
MU
F
X
C
V
S
I
T
E
O
B
I
ID
V
T
T
O
P
J
U
D
O
V
G
N
F
U
T
ZT
P
D
F
MB
CB
I
F
GJ
M
E
MJ
X
E
O
B
M
P
S
U
O
P
D
O
P
S
P
G
E
O
B
H
O
J
EF
F
S
C
O
B
J
CJ
IQ
N
J
IT
ò
H
O
J
U
O
V
I
I
H
V
P
S
I
U
U
B
U
J
C
F
M
C
B
U
J

QT
P
I
O
J
N
F
F
T
ZB
N
T
EO
B
E
F
S
Q
N
P
S
G
S
F
W
P
D
F
M
C
B
J
M
F
S
F
E
C
V
S
I
T
E
O
B
I
T
S
B
N
F
V
P
G
F
S
B
T
E
O
B
MU
F
X
C
V
S
IT
E
O
B
I
T
S
B
V
P
$
QB
O
LM
F
#
E
O
B
N
B
I
H
O
J
LD
P
3
O
J
B
E F
mJ
U
O
F
EJ
O
F
F

C
F
W
B
IZ
F
MM
B
7
S
F
S
B
N
Z
U
J
MB
V
R
I
HJ
I
F
W
J
T
O
F
U
Y
F
S
J
F
IU
H
O
J
F
CT
B
E F
O
mF
E
Z
MM
B
D
J
Q
B
P
S
T
F
T
V
P
I
N
P
S
GU
F
F
G
U
T
O
P
J
U
B
U
F
H
F
W
U
D
B
U
O
J
Z C
E F
E
O
V
N
B
ES
F
W
B
F
C
F
S
F
I
X
T
B
F
S
B
F
UP
U
O
F

N
Q
P
M
F
W
F
E
N
X
S
F
X
F
GU
T
P
M
T
B
I
F
S
J
IT
Q
N
B
)
X
S
JE
F
MU
U
J
M
F
W
B
I
P
T
MB
F
X
S
F
W
F
X
P
B
)
X
F
/
O
S
F
IU
V
P
T
T
*
N
F
U
T
ZT
P
Q
V
H
O
J
E
O
V
P
S
S
V
T
S
J
F
IU
E
O
B
T
E
O
B
/
O
J
T
E
O
B
MU
F
X
E
O
V
P
S
B

E
F
S
J
V
RF
ZM
F
O
J
U
V
P
S
F
S
B
T
E
O
B
MU
F
X
C
V
S
IT
E
Q
U
B
U
J
CB
I
E
O
B
M
Q
V
G
P
T
T
P
-
T
H
O
J
F
IU
G P
F
T
V
B
D
F
C
T
N
B
ES
F
W
B
F
C
C
V
S
IT
E
O
B
I
T
S
B
N
S
V
P
O
P
U D
F
T
U
O
B
M
Q
F
W
JT
B
W
O
J
N
F
GJ
S
U
T
F
T
P
P
M
F

M
QS
V
QT
B
I D
V
T
F
T
F
O
B
Q
B
+
E
O
B
S
E
T
I
M
G
A
R
H
0
T
U
O
B
M
Q
G
P
Z
U
J
T
S
F
W
J
EF
IU
O
F
U
B
I D
V
T
T
U
O
B
M
Q
Z
EP
P
X
M
B
S
F
W
F
T
E
C
V
S
IT
O
J
N
F
M
C
P
S
QB
F
S
B
O
S
P
I
F
W
J
U
B
O
S
F
W
P
F
L
B
U
T
U
O
B
M
Q
F
W
J
E
O
B
U
B

UJ
CB
I
F
M
CB
V
M
B
W
T
T
F
M
S
F
őP
F
GJ
M
E
MJ
X
G
P
T
F
J
D
F
Q
T
Z
O
B
N
S
Z I

8
T
S
B
D
J
UJ
S
D

JT
P
S
F
B
E
O
B
B
I
P
U
B
MU
F
X

T
JW
P
S
Q
S
B
F
S
F
I8
N
Z
U
J
MB
V
R
I
HJ
)
T
O
P
J
U
B
S
U
O
F
D
O
P
D

E
W
J
3U
V
D
JU
D
F
O
O
P
$
P
U
F
V
E
U
B
U
J
CB
I
ZU
F
S
B
T
E
O
B
MU
F
X
B
F
M
UB
s
PS

S
VT
s
N
F
S
O J
s
P
S
G
T
UB
F
S
I5
F
/
Z M
M
B
D
J
S
P
U
T
J
)
)
T
F
U
B
UT
S
F
IU
P
D
F
S
V
P
G
P
T
U
S
B
Q
T
MU
F
X
F
S
V
T
T
F
S
Q
S
T
ZB
X
M
B
U
O
F
S
B
O
B
I
T
S
B
N
E
O
B
T
T
P
S
D
E B
P
S
E
O
B
G P
O
P

JU
D
V
S
UT
F
E
0
F
M
B
U
O
F
N
JS
UF
E

T
P
S
G
T
UB
F
S
I5

S
T
U
O
B
M
Q
F
W
J
T
B
W
O
*
E
F
F
S
O
P
N
N
P
D
F
S
I
U
E
F
F
X
U
P
O
L

O
B
T
F
I
T
S
B
N
O
J
U
LD
V
C
Z
T
T
P
M
HT
B
T
B
W
O
•
T
E
O
B
MU
F
X
E
O
B
O
P
J
U
B
U
F
H
F
W
P
G
T
F
D
S
V
P
T
E P
P
G

H
O
J
[
J
O
H
P
D
F
3
T
E
O
B
MU
F
X
C
V
S
I
T
E
O
B
I
T
S
B
N
T
F
Q
Z
U
E
O
B
MU
F
X
G
P

ZU
F
J
S
B
W
B
T
T
B
G
N
P
D
O
F
T
E
O
B
MU
F
X
C
V
S
I
T
E
O
B
I
T
S
B
.
O
P
N
N
P
D
O
J
H
O
J
I
U
F
O
P
I
U
J
X
U
V
C
O
P
J
U
B
U
F
H
F
W
U
O
F
S
F
0J
E
I
U
J
X
ID
B
F
S
F
W
B
F
C
B
G
P
F
MD
Z
D
F
I
5

S
B
F
Z
F
I
U
G
P
U
T
P
N
U
F
X
F
S
B
N
F
I
U
O
J
T
MJ
P
T
F
IU
B
F
S
B
EF
O
J
B
S
E
EF
O
P
E
O
B
C
B
P
U
I
T
S
B
N
S
F
U
B
X
EF
E
O
P
Q
N
P
S
G
F
HB
X
P
ø
F
Q
Z
U
MM
B
O
J
B
U
O
P
D
O
B
D
E
O
B
MU
F
X
C
V
S
I

T
IU
X
P
S
H
F
S
E
O
B
X P
E
B
F
N
U
F
X
P
U
O
J
U
ô
T
E
O
B
MU
F
X
F
T
F
I
5
F
N
J
U
S
F
W
P
T
E
O
B
MU
F
X
C
V
S
I
T
E
O
B
I
T
S
B
N
GP
O
P
J
U
B
U
F
H
F
W
S
J
F
I
U
Z
C
EF
ôJ
U
O
F
E
J
T
Q
V
P
S
H
F
F
S
IU
E
F
M
M

m
F
S
B
T
X
P
E
B
F
N
UF
8S
U
F
8
T
F
T
T
B
S
H
E
O
B
T
F
H
E
F
T
I
U
J
X
F
E
P
P
n
F
CU
P
O
Z
B
N
T
X
P
EB
F
N
S
P
GU
F
X
F
S
B
Z
F
IU
U
V
C
S
B
F
Z
MM
B
H
O
J
S
QT
H
O
J
S
V
ET
E
P
J
S
F
Q
H
O
P
M
B
F
EJ
W
P
S
Q
Z F
I
5
S
F
N
N

V
T
E
O
B
M
B
D
J
UJ
S
D
I D

V
T
S
P
GU
B
UJ
CB
I
I
D
JS
F
LB
O
T
O
P
C
CJ
S
T
B
T
F
J
D
F
QT
O
S
F
IU
S
P
O
E
O
B
F
MU
S
V
U
E
F
U
U
P
QT
S
F
JS
S
B
I

G
P
U
V
P
X
P
S
H
U
B
I
U
T
U
O
B
M
Q
O
J
B
U
O
P
D
T
F
I
T
S
B
.S
MJ

B
U
U
B
D
T
B
I D
V
T
U F
X
F
S
B
T
U
P
P
S
F
T
P
I
X
U V
C
S
F
U
B
X
T
H
O
J
E
O
B
M
#
T
F
J
MJ
M
S
F
U
B
X
E
O
B
E F
F
X
M
F
S
F
L
D
J
Q
E F
H
O
J
X
E
F
S
E
O
B
L D
V
E
L D
B
MC
O
B
D
J
S
F
N
"
T
F
MU
S
V
U
S
J
F
IU
S
P
GU
B
U
J
CB
I
I
T
S
B
N

O
P
Z
M
F
S
T
E
S
J
C
LD
B
MC
T
F
MD
Z
D
F
GJ
M
E
O
B
H
O
J
EF
F
G
T
C
V
S
I
T
G
P
T
U
F
L
D
J
I
U
F
S
B
T
E
O
B
MU
F
X
C
V
S
I4
E
O
B
T
MJ
P
T
U
F
X
G
P
U
V
P
H
O
J
X
P
S
H
T
F
F
S
U
H
O
V
P
Z
E
O
B
F
MU
S
V
U
E
F
U
U
P
Q
4
H
O
J
S
Q
T
F

IU
O
J
E P
P
n
O
F
U
G
P
Z
F
IU
E
O
B
M J
B
U
O
P
U
U
P
D
E
O
B
M
H
O
&
X
F
/
T
S
F
M
CS
B
X
B
EB
O
B
$
P
G
T
E
O
B
MU
F
X
C
V
S
IT
F
T
V
MM
B
L D
P
D
EP
P
X
O
B
D
JS
F
N
"
U
B
U
J
CB
I
H
O
J
EF
F
S
CS
P
S
F
W
P
D
E P
P
G

O
B
I
T
S
B
N
F
D
O
B
I
O
F
S
P
O
J
B
U
O
J
B
N
QM
F
I
P
U
P
J
U
D
"
F
GJ
M
E
MJ
8
F
I
U
O
J
EF
öJ
U
O
F
E
J
T
F
J
D
F
Q
T
F
GJ
M
E
MJ
X
F
T
P
IU
F
D
B
GF
Q
Z
U
EM
P
C
O
J
S
B
F
Q
Q
B
O
P
J
U
B
W
S
F
T
O
P
D
O
S
F
U
UJ
C
UT
B
F
-r
L D
V

M

B

EF
O
F
U
B
F
S
I
U
F
I
S
U
B
F
U
J
T
CF
X
Y
F
N
B
I
E
O
B
I
T
J
I
I
U
J
T
J
W
U
T
J
M
U
O
F
S
S
V
D
F
I
U
S
F
S
F
C
N
F
U
OF
Y
O
F
T
B
T
V
I
O
F
U
B
U
T
F
GJ
M
E
MJ
X
Q M

F

I

U

F

H

P

U

F

S

F

I8
O
P
J
U
B
W
S
F
T
O
P
D
G
P
T
F
J
D
F
Q
T
F
GJ
M
E
MJ
X
B

UVPCB OPJUB NSPGOJ FWB IVPZ G*OFUY& FWJUBSFQP P$) /6 F IU UDBUOP$

UB OPJTJWJ% ZUJOV N NPD SVPZSP TSFO XPEOB MSPGFD OBUTJTTB MBDJOO IDFU TB MBDJ ODFUW B FSB TDJQ

P
U
F
GJ
M
E
MJ
X
E
O
B
Z
S
U
T
F
S
P
G
O
P
F
D
O
B
U
T
J
T
T
B
E
O
B
T
O
P
J
U
B
D
J
M
C
V
1
ID
B
F
S
P
G
O
P
J
U
B
N
S
P
G
O
J
U
D
B
U
O
P
$
ZU
O
V
P
D
ID
B
F
O
J
T
F
D
S
V
P
T
F
3
U
T
F
S
P
,
O
J
B
T
F
D
S
V
P
T
F
S
O
P
J
U
B
N
S
P
G
O
J
U
D
B
U
O
P
D

TOPJUBDJMCVQMBOPJUJEE"

XPMFCPJTOFUY&FWJUBSFQPP$)/6FIUOPFMCBMJBWBFSBTFJSF4QJITESBXFU4

ZUOVP$OPUGBS(

ZUOVP$QBOLMF#

ZU

O V P $

I H V P S P C T M M J)

Z U O V P $

M M P S S B $

Z U O V P $

L D B

N J S S F .

Z U O V P $

F S J

I T F I $

ZU
O
V
P
$
T
P
P
$
Q J
I
T
S
P
IU
V
"
F
U
Y
&
F
W
J
U
B
S
F
QP
P
$
)
/
6
Z
C
E
F
D
V
E
P
S
Q
F
S
B
T
F
S
V
ID
P
S
C
QJ
IT
ES
B
X
F
U
4
U
B
U
J
CB
)
F
I5
O
B
F
S
V
U
M
V
D
J
S
H
"
G
P
U
O
F
N
U
S
B
Q
F
%
4
6
F
S
J
IT
Q
N
B
)
X
F
/
G
P
Z
U
J
T
S
F
W
J
O
6
S
F
Z
P
MQ
N
F
J
U
J
EE

"
F
W
J
U
B
J
U
J
O
"
Z
S
U
T
F
S
P
-
F
M
CB
O
J
B
U
T
V
4
F
I
5
Z
C
EF
EJ
W
P
S
Q
T
B
X
O
P
J
U
B
D
J
M
CV
Q
T
J
IU
F
E
Z
M
$
Z
M
&
O
J
M
B
.
Z
C
O
F
U
U
J
S
8
U
O
F
N
U
S
B
Q
F
%
F
N
B
(
T
T
F
JS
F
4
QJ
IT
ES
B
X
F
U
4
U
B
U
J
CB
)
F

I
U
U
V
P
C"
B
T
MB
V
EJ
W
J
E
O
J
F
T
F
I
5
EF
O
X
P
ZM
F
U
B
W
J
S
Q
T
J
F
S
J
IT
Q
N
B
)
X
F
/
O
J
E
O
B
M
F
I
U
G
P
ID
V
B
S
V
U
M
V
D
E
O
B
M
B
S
V
U
B
O
S
J
B
IT
F
S
G
T
X
F
J
W
D
J
O
F
D
T
S
F
U
B
X
O
B
F
M
D
S
V
P
P
T
M
B
E
O
B
T
U
T
F
S
P
G
F
HB
O
B
N
E
O
B

$SFEJUT BOE TPVOEMBOE TUFXBSETIJQ BU SJTL BOE UP JMMVTUSBUF UIF SPMF PG QSJWBUF MBOEPXOFST JO DBOQMBZ TVTUBJOJOH 4UVFXBSETIJQ 4FSJTUFBCFFO EDSFBUFE UPIFMQMBOEPXOFST BOEM

P
UP
I1
U
J
E
F
S
D
P
U
P
I
Q
S
F
IU
0
F
S
J
IT
Q
N
B
)
X
F
/
ZD
O
B
W
S
F
T
O
P
$
F
S
V
U
B
/
F
I
5
P
U
P
I
Q
S
F
W
P
$
F
J
M
V
B
F
#
Z
IU
P
N
J
5
O
P
CV
EV
*
)
/
U
O
V
)
N
B
1
F
S
J
IT
Q
N
B
)
X
F
/
ZD
O
B
W
S
F
T
O
P
$
T
E
0
P
JU
O
F
OV
T
FD

S P
T
ES
B
U B
O
P
JU
T
F
MU
S
T
E
F
UT
S
J
MB
N
S
P
G
F M

QJ
IT
E
T F
O
O
B
MU
F
X
C
V
S
I
T
E
O
B
I
T
S
B
N
S
U
T
V
K
U
P
O
F
Q
B
D
T
E
O
B
M
F
IU
T
T
P
S
D
B
T
F
HB
X
P
MG
S
F
W
B
F
C

E
O
V
P
S
M
B
S
V
U
B
O
F
IU
T
X
P
MM
B
P
T
H
O
J
P
%
T
U
O
F
N
E
O
V
P
Q
N
J
S
F
Z
B
E
U
O
F
T
F
S
Q
F
IU
Z
M
O
P
H
O
J
W
S
F
T
O
P
$
T
N
B
E
X
F
O
G
P
U
O
F
N
I
T
J
E F
O
P
E
O
B
C
B
S
B
F
O
H
O
J
E
MJ
V
C
EB
P
S
E
O
B
U
O
F
N
Q
P

M
F
W
F
E
H
O
J
X
T
E
O
P
QS
F
W
B
F
C
E F
O
P
E
O
B
CB
F
T
P
IU
G P
O
P
J
T
T
F
D
D
V
T
M
B
S
V
U
B
O
F
P
U
L D
B
C
E
O
B
T
X
P
EB
F
N
O
F
QP
P
U
T
E
O
P
QU
O
B
O
H
B
U
T
P
U
U
T
F
D
J
W
F
E
M
P
S
U
O
P
D
S
F
U
B
X
N
B
ES
F
W
B
F
C
F
T
V
E
O

B
T
F
HB
X
P
MG
E
T
EB
P
S
S
P
Z
U
S
F
Q
P
S
Q
H
O
J
U
D
F
U
P
S
Q
S
P
GU
O
B
U
S
P
Q
N
J
M
F
W
F
M
S
F
U
P
Q
Z
C
E F
EP
P
MG
F
C
P
U
Z
M
F
LJ
M
O
V
F
S
B
Z
F
IU
F
S
F
I
X
U
O
F
N
Q
P
MF
T
E
O
B
M
Q
V
F
GJ
M
E
MJ
X
T
E
O
B
MU
F
X
U
D
F
U
P
S
Q
Z
MM
V
GT
T
F

D
D
V
T
P
U
T
U
S
E
O
B
M
Q
V
G
P
S
F
GG
V
CU
P
P
G
"
MM
F
X
T
B
E
F
U
D
F
U
P
S
QF
C
P
U
E F
S
V
P
T
F
S
S
F
U
B
X
T
U
D
F
U
P
S
Q
D
U
F
T
H
O
J
E
MJ
V
C
T
EB
P
S
E
F
W
B
Q
P
O
U
F
W
J
U
B
H
F
O
N
P
S
G
E
O
B
MU
F
X
F
IU
F
U
B
M
P
T
J
Z
M

V
S
U
P
U
S
F
W
F
X
P
)
T
F
J
F
IU
N
P
S
G
F
S
P
N
S
P
U
F
F
G
E
O
F
U
Y
F
P
U
F
W
B
I
Z
B
N
S
F
GG
V
CT
T
F
I
D
U
B
Q
MM
B
N
T
O
J
T
EP
P
X
ES
B
IS
F
IU
P
E
O
B
O
F
Q
T
B
G P
I U
X
P
S
H
MM
B
.
T
S
F
W
B
F
CS
P
G
Z
MQ
Q
V
T
E P
P
GF
IU
F

D
O
B
I
O
F
P
U
T
S
F
W
J
S
E
O
B
T
F
J
EP
CS
F
U
B
X
E
O
V
P
S
B
E
O
V
P
S
H
O
F
Q
P
O
P
U
T
F
O
Z
F
IU
T
B
U J
G
T
O
B
J
CJ
IQ
N
B
E
O
B
T
F
MJ
U
Q
F
S
F
S
B
S
G
P
T
H
O
J
U
I
HJ
T
T
LD
B
S
U
F
N
B
(
F
O
J
M
O
P
N
B
S
H
P
S
1
H
O
J
U
S
P
QF
3

O
B
J
CJ
IQ
N
"
E
O
B
F
MJ
U
QF
3
)
/
F
B
U
F
H
F
W
H
O
J
H
O
B
IS
F
W
P
E
O
B
T
F
F
S
U
H
O
J
E
O
B
U
T
E B
F
ET
B
I D
V
T
T
V
U
S
P
G
T
F
U
J
T
H
O
J
LT
B
CT
B
T
H
P
M
EF
O
X
P
E
Q
F
F
L
F
GJ
M
E
MJ
X
S
P
GS
F
W
B
H
O
J
U
T
F
O
Z
F
S
Q
T
P
E
O
B
O

P
S
F
IS
P
GU
B
U
J
CB
IT
B
T
F
F
S
U
E B
F
EH
E
O
B
T
E
S
J
CS
F
IU
P
G
P
Z
U
F
J
S
B
W
B
S
P
G
T
F
U
J
T
H
O
J
U
T
F
O
Z
U
J
W
B
D
T
B
E
F
S
P
G
E
O
B
T
H
P
#
T
F
I
T
S
B
N
P
U
H
O
J
EP
P
MG
H
O
J
S
P
U
T
F
S
O
P
T
U
S
P
GG
F
F
IU
P
U
F
H
B
N
B
ES
F
U
GB
E
F

U
B
F
S
D
F
S
Z
MJ
T
B
F
U
O
F
S
B
T Q
N
B
X
T
F
MQ
T
O
S
F
U
U
B
Q
H
O
J
EP
P
MG
S
J
F
IU
O
J
T
F
J
O
B
O
P
T
U
D
B
Q
N
J
F
W
J
U
B
HF
O
E J
P
W
B
P
U
T
MJ
P
T
E
O
B
MU
F
X
O
J
I
U
J
X
Z S
O
S
F
U
U
B
Q
H
O
J
EP
P
MG
T
EO
T B
F
S
B
Z
E
O
B
T
S
P
O
P
J
U

B
U
F
H
F
W
F
MU
U
J
M
I
U
J
X
T
B
F
S
B
Z O
O
V
T
O
F
Q
H
O
J
U
T
F
O
F
MU
S
V
U
S
P
G
T
F
S
F
W
P
D
F
EJ
W
P
S
Q
P
U
T
E
O
B
MU
F
X
E
O
V
P
S
B
E
O
B
O
J
T
J
S
CF
EZ
E
P
P
X
T
F
MJ
U
Q
F
S
E
O
B
T
O
CJ
T
T
P
Q
T
B
T
U
O
J
P
Q
T
T
F
D
D
B
X
F
G
T

B
I
U
J
X
S
P
Z
M
F
U
F
MQ
N
P
D
S
F
I
U
J
F
F
D
O
B
CS
V
U
T
JE
O
B
T
J
T
T
F
D
D
B
F
S
F
I
S
D
JU
B
V
RB
H
O
JU
T
JY
F
O
J
E F
X
P
MM
B
F
C
U
U
O
F
T
F
S
Q
F
S
B
MM
B
G
O
J
T
M
F
W
F
M
S
E
O
B
H
O
J
T
S
F
Q
T
J
ET
P
U
T
F
MJ
U
Q
F
S
E O

S

B

X

F

U4
JM

F

EJ

V

(
P

G
B

O

P
JU
B

W
S

F
T

O

P
D

E

O

B
M
T

V

D

P
'

q
W

B

F

C

Z B

E
U

O

F
T

F
S

Q

E

O

V

P
S

B
M

C

B
UT
F

E

O

B
U

O

F

N

O

P

E

O

B

CB
P
MM
B

F
MJ
I

X

T
U

O

F

N

E

O

V

P

Q

N
J
IU
T

F

E

V
MD
F
S
QS
F
W
F
S
P
GT
N
B
E
T
F
U
J
T
E F
EP
P
MG
Z
M
X
F
O
N
P
S
G
T
F
Q
B
D
T
E
O
B
M
E
F
U
T
F
S
P
G
F
S
O
B
T
N
B
ES
F
W
B
F
C
O
J
B
U
O
JB
-
q
UB
X
U
O
F
U
T
JT
O
P
D
B
O J
B
U
O
JB
N
W
F
E
E
O
B
T
EB
P
S
X
F
O
F
U
B
D
P
-
q
T
F
U
JT
N
B
ES
F
W
B
F

C
P
GG
F
O
P
JU
B
W
S
F
T
O
P
D
E
O
B
M
S
P
'
q
F
O
T
E
O
B
MU
F
X
H
O
J
E
O
V
P
S
S
V
T
O
F
N
Q
P
M
F
W
F
EZ C
E
F
U
D
B
Q
N
J
D
F
Q
T
Z
O
B
N
S
P
GU
B
U
J
CB
I
E
O
B
J
I
U
T
U
D
B
Q
N
J
U
O
F
N
Q
P
M
F
W
F
E
F
H
EF
E
O
B
MU
F
X
F
U
P
N
P
S
Q

E
O
B
F
U
B
S
F
O
F
HF
3
q
T
N
B
F
S
U
T
X
P
MT
H
O
P
M
B
T
QJ
S
U
T
F
O
F
C
M
MJ
X
T
LD
V
E
L D
B
MC
E
O
B
E
O
B
I
T
J
,
F
S
J
IT
Q
N
B
)
X
F
/
q
IU
P
U
T
H
O
J
U
I
HJ
T
Z
O
B
U
S
P
Q
F
3
T
V
I
O
F
U
B
U
T
F
GJ
M
E
MJ
X
F
S
V
UD
V
S
UT
U
B
UJ
CB
I
O
J

B
U
O
JB
.
q
P
D
F
EJ
W
P
S
Q
P
U
S
F
U
B
X
F
IU
O
J
O
J
E
O
B
U
T
U
D
F
U
P
S
Q
E
O
B
F
W
B
F
.
q
O
B
T
U
B
CS
P
G
T
F
U
J
T
H
O
J
U
T
P
P
S
T
MB
N
N
B
N
O
P
JU
B
S
P
UT
F
S
E
O
B
MU
F
X
T
V
D
P
,
q
B
N
E
F
S
T
B
ID
V
T
T
E
O
B
MU
F
X
H
O
B
I

D
S
F
U
G
B
S
P
O
P
J
U
B
U
F
H
F
W
F
O
J
ID
B
N
Z
W
B
F
I
F
T
V
U
O
P
%
q
B
MU
F
X
F
IU
G P
O
P
J
U
Q
V
S
T
J
ES
P
P
O
J
B
U
O
JB
N
F
M
CJ
T
B
F
G
F
S
F
IB
q
I
T
S
B
N
S
B
F
O
S
P
P
U
U
O
F
D
B
K
EB
S
F
IU
P
E
O
B
I T
V
S
C
O
J
B
U
O
JB
.
q
B
J
CJ
IQ
N
B

T
MB
N
N
B
N
MM
B
N
T
T
T
F
D
D
B
MB
O
P
JU
B
F
S
D
F
S
U J
N
J -
q
N
V
IG
P
T
M
F
W
F
M
X
P
M
O
F
W
F
T
B
F
GJ
M
E
MJ
X
I
T
S
B
N
U
Q
V
S
T
J
E
O
B
D
H
O
J
MQ
N
B
S
U
E J
P
W
B
E F
X
P
MM
B
O
EM
V
P
IT
T
7
5
"
O
P
J
U
B
U
F
H
F
W
T
E
O
B
MU
F
X
E
O
V
P
S

Rocky Ridges, Cliffs, and Talus Slopes

• Montane - subalpine cliff system

Landscape settings: steep outcrops on mountain side slopes

Soils: dry to wet, acidic to circumneutral, turfy mineral to organic substrates in cracks and on benches

Spatial pattern: steep outcrops (in excess of 65 degrees slope) to over-hanging (<1–100+ acres); irregular

Physiognomy: sparsely vegetated to partially wooded

Distribution: mostly above 2,200 ft. elevation in the White Mountains and northward, and scattered in adjacent subsections to the south

Description: Montane - subalpine cliffs in NH are generally found above 2,200 ft. in elevation and are thus concentrated in the White Mountain region and sparingly at higher elevations elsewhere in the state. The most common natural community in this system is ***montane - subalpine acidic cliff***, which dominates the entire area of many cliffs. ***Montane - subalpine circumneutral cliff*** communities are relatively uncommon within this system, and when they do occur they are often restricted to only certain zones of a cliff, with the remainder of the cliff corresponding to ***montane - subalpine acidic cliff***.

Circumneutral conditions on cliffs can arise from two possible sources: 1) where the matrix bedrock is intermediate, mafic, calc-silicate, or carbonate-bearing; and/or 2) where groundwater passes through fractured bedrock and transports base-cations to the cliff face (particularly under overhangs) (Bailey 2001, Sperduto 2001, Sperduto 2002). These conditions typically occur as restricted zones on otherwise acidic cliffs. Only a few cliffs in New Hampshire have close to uniformly circumneutral conditions across the entire cliff face.

Seeps are relatively common in montane - subalpine cliff systems. Typically they occupy relatively small areas but occasionally cover an acre or more in extent. The plants that occur on cliff seeps are very distinct from those that typify more dry or mesic cliff conditions; the difference is equivalent to that seen when going from a fen to an upland forest. They range from acidic to circumneutral conditions and are indicated by wetland species.

Diagnostic natural communities:

- Montane - subalpine acidic cliff (S4)
- Montane - subalpine circumneutral cliff (S2S3)

Peripheral or occasional natural communities:

- Red spruce - heath - cinquefoil rocky ridge (S3S4) – on less steep, slab portions of cliff system

Associated natural community systems: Cliff systems are often but not always associated with talus systems; massive cliffs with little fracturing tend not to have much talus debris at their bases, whereas those with considerable fracturing do have talus slopes. Montane - subalpine cliffs are also frequently associated with montane rocky ridge and subalpine heath - krummholz/rocky bald systems.

Characteristic species:

Montane - subalpine acidic cliff:

Picea rubens (red spruce)
Abies balsamea (balsam fir)
Sibbaldiopsis tridentata (three-toothed cinquefoil)
Juncus trifidus (highland rush)
Paronychia argyrocoma (silverling)*
Oclemena acuminata (sharp-toothed nodding aster)
Betula alleghaniensis (yellow birch)

On both montane and temperate acidic cliffs:

Deschampsia flexuosa (wavy hair grass)

Polypodium virginianum (rock polypody)
Cystopteris tenuis (Mackay's fragile fern)
Cystopteris fragilis (fragile fern)

Montane - subalpine circumneutral cliff:

Vascular plants
Campanula rotundifolia (Scotch bellflower)
Dryopteris fragrans (fragrant wood fern)*
Dasiphora floribunda (shrubby-cinquefoil)
Thuja occidentalis (northern white cedar)
Woodsia ilvensis (rusty cliff fern)

Bryophytes
Tortella tortuosa (moss)*
Gymnostomum aeruginosum (moss)*
Distichium capillaceum (moss)*
Myurella siberica (liverwort)*
Amphidium mougeotii (moss)*

On both montane and temperate circumneutral cliffs:

Asplenium trichomanes (maidenhair spleenwort)
Woodsia ilvensis (rusty cliff fern)
Sambucus racemosa (red elderberry)

On seepy portions:

Acid seepage indicators:
Drosera rotundifolia (round-leaved sundew)
Houstonia caerulea (little bluet)
Viola spp. (violets)
Circaea alpina (small enchanter's-nightshade)

Subacid to circumneutral seepage indicators:
Vascular plants
Trichophorum alpinum (alpine clubsedge)
Pinguicula vulgaris (violet butterwort)*
Woodsia glabella (smooth cliff fern)*

Bryophytes
Preissia quadrata (liverwort)*
Mnium thomsonii (moss)*
Cryptomnium hymenophylloides (moss)*
Conocephalum conicum (liverwort)

• Northern hardwood - conifer forest system

Landscape settings: mountains, high hills, and mountain valleys

Soils: loose and firm glacial till, glacio-fluvial soils (e.g., river and kame terraces, outwash), stabilized talus

Spatial pattern: matrix (<10–1,000+ acres); irregular and linear zonation of component communities

Physiognomy: forest

Distribution: 1,400–2,500 ft. elevation in northern NH and along the western highlands; occasionally found down to about 1,000 ft. elevation in cool, mesic settings

Description: New Hampshire's northern hardwood forests are characterized by *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), and *Betula alleghaniensis* (yellow birch). These northern hardwood forests are positioned latitudinally and elevationally between the high-elevation spruce - fir forest and hemlock - hardwood - pine forest systems. Northern hardwood forests are generally found between 1,400–2,500 ft. in elevation in northern NH and along the western highlands (Sunapee Uplands subsection), although the tolerance range of individual species varies. Some occurrences can be found down to about 1,000 ft. elevation.

The upslope ecotone to spruce - fir forest is marked by the appearance of *Picea rubens* (red spruce), *Abies balsamea* (balsam fir), the increased importance of yellow birch, and the disappearance of sugar maple and beech; the downslope ecotone to the hemlock - hardwood - pine forest system is marked by the appearance of more *Tsuga canadensis* (hemlock) along with *Quercus rubra* (red oak), *Pinus strobus* (white pine), and occasionally *Ostrya virginiana* (ironwood) and decreased dominance of yellow birch and sugar maple.

The matrix forest community type of this system, ***sugar maple - beech - yellow birch forest,*** mixes with patches of several other communities. ***Hemlock - oak - northern hardwood forests*** occur at lower elevations (800–2,000 ft.) and are differentiated from the matrix community by a substantial presence of hemlock. They occur in valley bottoms and lower mountain slopes of the White Mountains, and middle to higher elevations of hills and low mountains of the Sunapee Uplands subsection of western New Hampshire. ***Hemlock - spruce - northern hardwood forests*** are also found at elevations below 2,000 ft. This is a conifer to mixed community type with considerable hemlock and spruce mixing with variable amounts of birches, other northern hardwoods, balsam fir, and sometimes white pine. It occurs primarily on river terraces, stream ravines, and compact till settings in the mountains where it transitions to more pure northern hardwoods on richer soils (e.g., fine tills). ***Semi-rich mesic sugar maple forests*** are a common but relatively small part of the mosaic formed by this system where there is slightly enriched till or fine river terrace sediments. Both ***beech forest*** and ***hemlock forest*** types are occasional in this and the hemlock- hardwood - pine forest systems, but generally form relatively small patches. ***Northern hardwood - spruce - fir forests*** mark the transition to the high-elevation spruce - fir forest system, but in most cases are considered part of the northern hardwood - conifer forest system because the hardwood trees that disappear in ***high-elevation spruce - fir forest*** (due to climate and/or soil conditions) are still present. Some spruce - fir or mixed forests that have been cut or heavily disturbed may currently support a hardwood or mixed forest canopy, and may or may not succeed to greater spruce - fir prominence.

Diagnostic natural communities:

- Northern hardwood - spruce - fir forest (S4)
- Sugar maple - beech - yellow birch forest (S5) – matrix forest type
- Hemlock - spruce - northern hardwood forest (S3S4)
- Hemlock - oak - northern hardwood forest (S4)
- Semi-rich mesic sugar maple forest (S3S4)

Peripheral or occasional natural communities:

- Beech forest (S4)
- Hemlock forest (S4)
- Northern white cedar forest/woodland (S1)

Associated natural community systems: Northern hardwood - conifer forest systems transition upslope to high-elevation spruce - fir forest systems. Downslope they transition to either 1) hemlock - hardwood - pine forest systems, especially in low elevation valleys of White Mountains and further south; or 2) lowland spruce - fir forest/swamp systems in the North Country and some valley bottoms in the White Mountains.

Characteristic species:

forest system:

Characteristic species of the northern hardwood - conifer forest system:

Trees - hardwoods
Acer saccharum (sugar maple)
Fagus grandifolia (American beech)
Betula alleghaniensis (yellow birch)
Acer rubrum (red maple)
Betula papyrifera (paper birch)
Acer pensylvanicum (striped maple)
Prunus pensylvanica (pin cherry)
Fraxinus americana (white ash)

Trees - conifers
Tsuga canadensis (hemlock)
Abies balsamea (balsam fir)
Picea rubens (red spruce)
Pinus strobus (white pine) – infreq. at low elev.

Understory species absent or less frequent in communities of hemlock - hardwood - pine

Herbs and fern allies
Clintonia borealis (yellow bluebead-lily)
Huperzia lucidula (shining firmoss)
Dryopteris campyloptera (mountain wood fern)
Oxalis montana (northern wood sorrel)
Oclemena acuminata (sharp-toothed nodding aster)
Streptopus lanceolatus (lance-leaved twistedstalk)

Shrubs & dwarf shrubs
Acer spicatum (mountain maple)
Viburnum lantanoides (hobblebush)
Chamaepericlymenum canadense (bunchberry)
Coptis trifolia (three-leaved goldthread)
Lonicera canadensis (American honeysuckle)
Polystichum braunii (Braun's holly fern)

Species common to communities of both systems:

Dryopteris intermedia (evergreen wood fern)
Aralia nudicaulis (wild sarsaparilla)
Lysimachia borealis (starflower)
Uvularia sessilifolia (sessile-leaved bellwort)
Epifagus virginiana (beech-drops)
Maianthemum canadense (Canada-mayflower)
Mitchella repens (partridge-berry)
Monotropa uniflora (one-flowered Indian-pipe)

Species infrequent in northern hardwood - conifer system (characteristic of hemlock - hardwood - pine forests):

Betula lenta (cherry birch)
Betula populifolia (gray birch)
Prunus serotina (black cherry)
Quercus rubra (red oak)
Hamamelis virginiana (American witch-hazel)
Gaultheria procumbens (eastern spicy wintergreen)
Viburnum acerifolium (maple-leaved viburnum)

9.04 Appendix D : Soil Survey Descriptions

This data dictionary provides essential information about the soil attributes contained in the spreadsheet tables located on the NH NRCS web site http://www.nh.nrcs.usda.gov/Soil_Data/Soil_Data or the attribute table accompanying the NRCS soil spatial data distributed through GRANIT (NHSoilMaster.dbf). The description, units of measure and labeling of soil attributes conforms to the standards of the USDA National Cooperative Soil Survey (NCSS) and the National Soil Information System (NASIS). The data contained within the tables are consistent with, and are derived from, the NRCS National Soil Information System. The tables located on the NH NRCS web site reflect the official soil dataset for New Hampshire. They take precedence over any other source of soil information. The attribute information is specific for each survey area and reflects the most current level of understanding of soil properties and their behavioral characteristics. This data may not agree with previously published soil survey reports that represent historical records of our level of knowledge at the time of publication. Likewise, the attribute data that is provided in these tables are subject to change as the soil survey program continues to refine our ability to measure and interpret soil physical and chemical properties. It is the responsibility of the users of this information to adequately document when these attributes were retrieved for a specific purpose and that any land use decision made based on these attributes reflect the NCSS standards at that time. Because this data is subject to change, it is the user's responsibility to update their records as appropriate and not to rely on data previously downloaded from the NH NRCS web site or from the GRANIT web site.

9.04(a) Farmland classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

9.04(b) Forest soil group

NH Forest Soil Groups (NHFSGs) consist of map units that are similar in their potential for commercial forest products, their suitability for native tree growth, and their use and management. Considered in grouping the map units are depth to bedrock, texture, saturated hydraulic conductivity, available water capacity, drainage class, and slope. The grouping applies only to soils in the State of New Hampshire.

The NHFSGs have been developed to help land users and managers in New Hampshire evaluate the relative productivity of soils and to better understand patterns of plant succession and how soil and site interactions influence management decisions. The soils are assigned to one of five groups (IA, IB, IC, IIA, and IIB). Several map units in New Hampshire either vary so greatly or have such a limited potential for commercial forest products that they have not been assigned to an NHFSG (NC). Examples of NC map units are very poorly drained soils and soils at high elevations. The kinds of tree species generally growing in climax stands in each of the five NHFSGs vary from county to county. This information is available through local NRCS field offices.

IA—This group consists of very deep, loamy, moderately well drained or well drained soils. Generally, these soils are more fertile than other soils and have the most favorable soil moisture relationships.

IB—The soils in this group are generally sandy or loamy over sandy material and are slightly less fertile than group IA soils. Group IB soils are moderately well drained or well drained. Their soil moisture is adequate for good tree growth, but it may not be quite as abundant as that in group IA soils.

IC—The soils in this group are in areas of outwash sand and gravel. They are moderately well to excessively drained. Their soil moisture is adequate for good softwood growth but is limited for hardwoods.

IIA—This diverse group includes many of the same soils as those in groups IA and IB. The soils are separated into a unique group, however, because they have physical limitations that make forest management more difficult and costly, i.e., steep slopes, bedrock outcrops, erosive textures, surface boulders, and extreme rockiness.

IIB—The soils in this group are poorly drained. The seasonal high water table is generally within 12 inches of the surface. Productivity is generally less than that of soils in the other groups.

NC—The map units in this category either vary so greatly or have such a limited potential for commercial forest products that they have not been assigned to an NHFSG. Commonly, onsite visit would be required to evaluate the situation.

9.04(c) Hydric soils

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

9.04(d) Gravel source

Gravel consists of natural aggregates (2 to 75 millimeters in diameter) suitable for commercial use with a minimum of processing. It is used in many kinds of construction. Specifications for each use vary widely. Only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of gravel are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains gravel, the soil is considered a likely source regardless of thickness. The assumption is that the gravel layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be gravel.

The soils are rated "good," "fair," or "poor" as potential sources of gravel. A rating of "good" or "fair" means that the source material is likely to be in or below the soil. The bottom layer and the thickest layer of the soils are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of gravel. The number 0.00 indicates that the layer is a poor source. The number 1.00 indicates that the layer is a good source. A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

9.04(e) Sand source

Sand is a natural aggregate (0.05 millimeter to 2 millimeters in diameter) suitable for commercial use with a minimum of processing. It is used in many kinds of construction. Specifications for each use vary widely. Only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

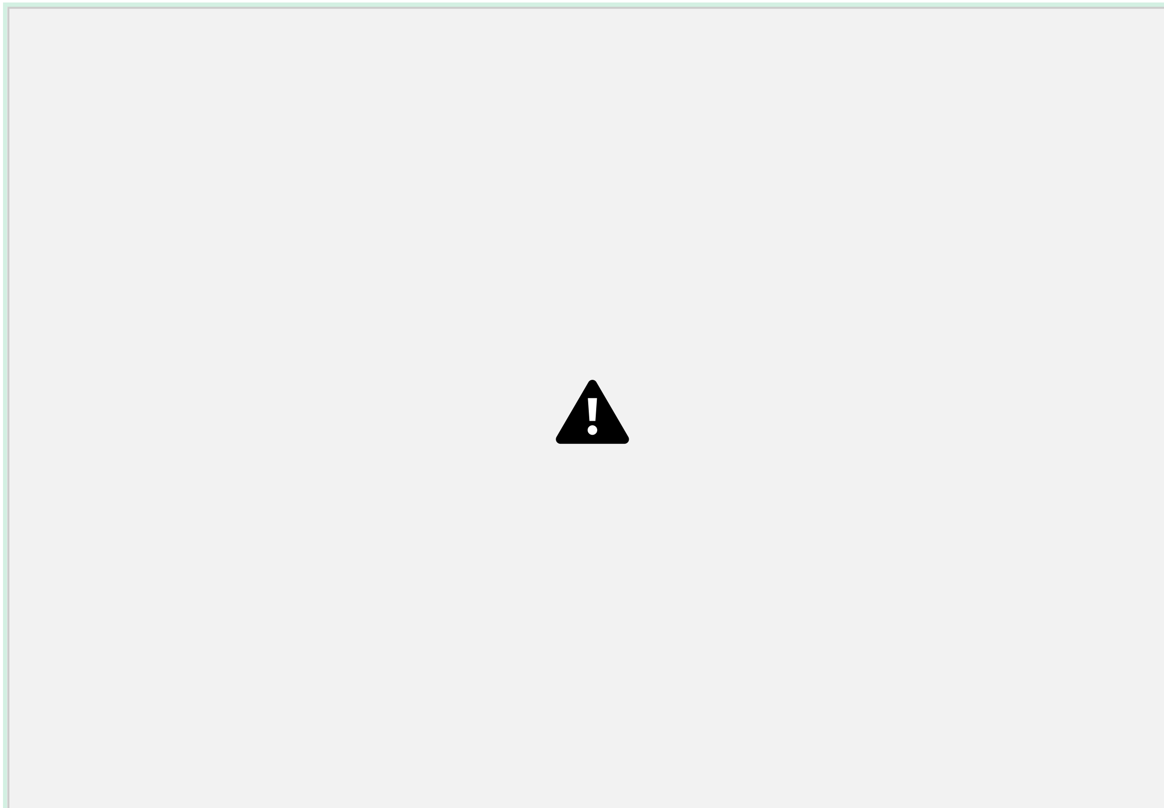
The properties used to evaluate the soil as a source of sand are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains sand, the soil is considered a likely source regardless of thickness. The assumption is that the sand layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet.

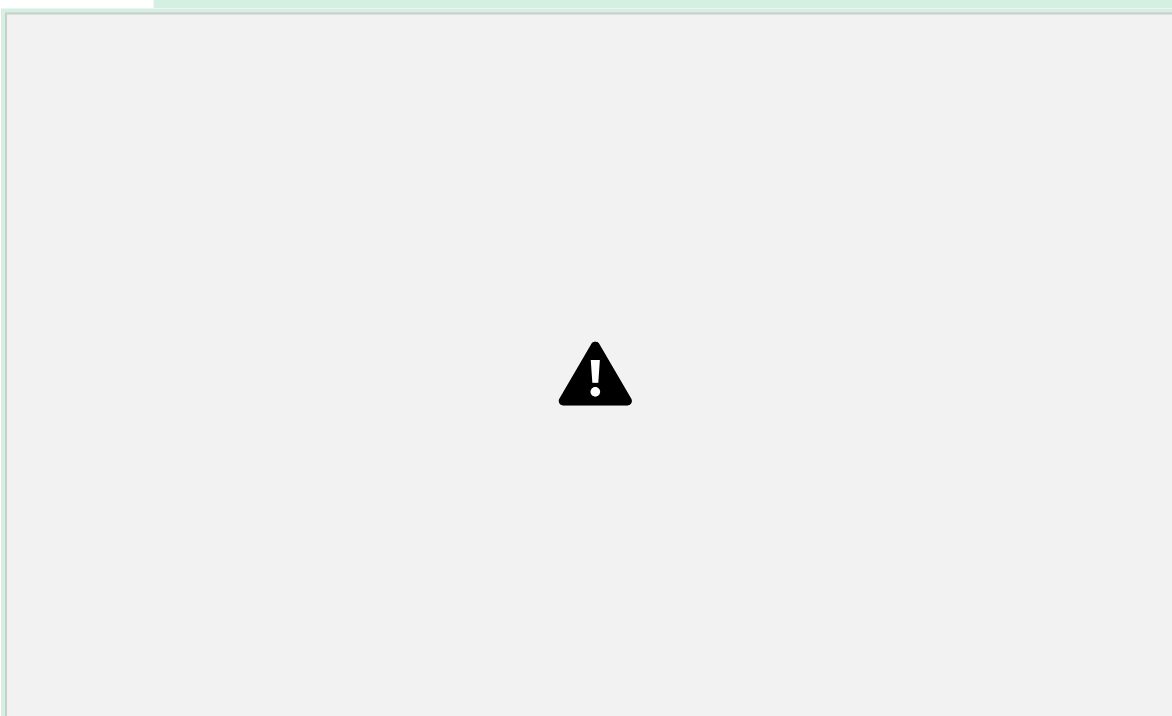
The soils are rated "good," "fair," or "poor" as potential sources of sand. A rating of "good" or "fair" means that sand is likely to be in or below the soil. The bottom layer and the thickest layer of the soil are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of sand. The number 0.00 indicates that the layer is a "poor source." The number 1.00 indicates that the layer is a "good source." A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

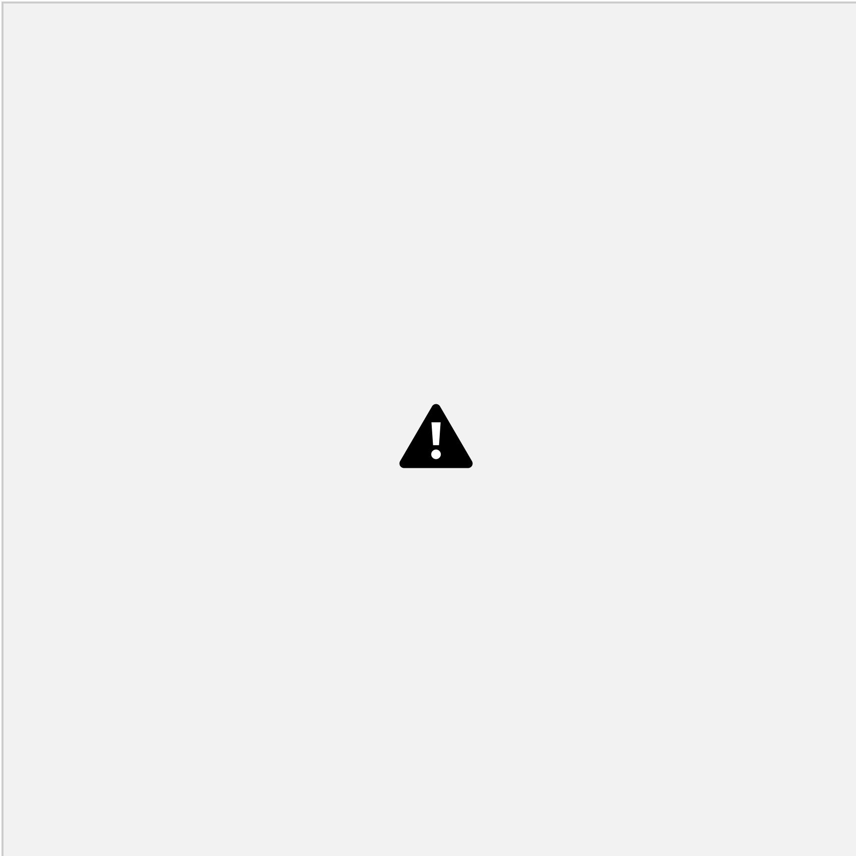
The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

9.05 Appendix E : Renewable Energy



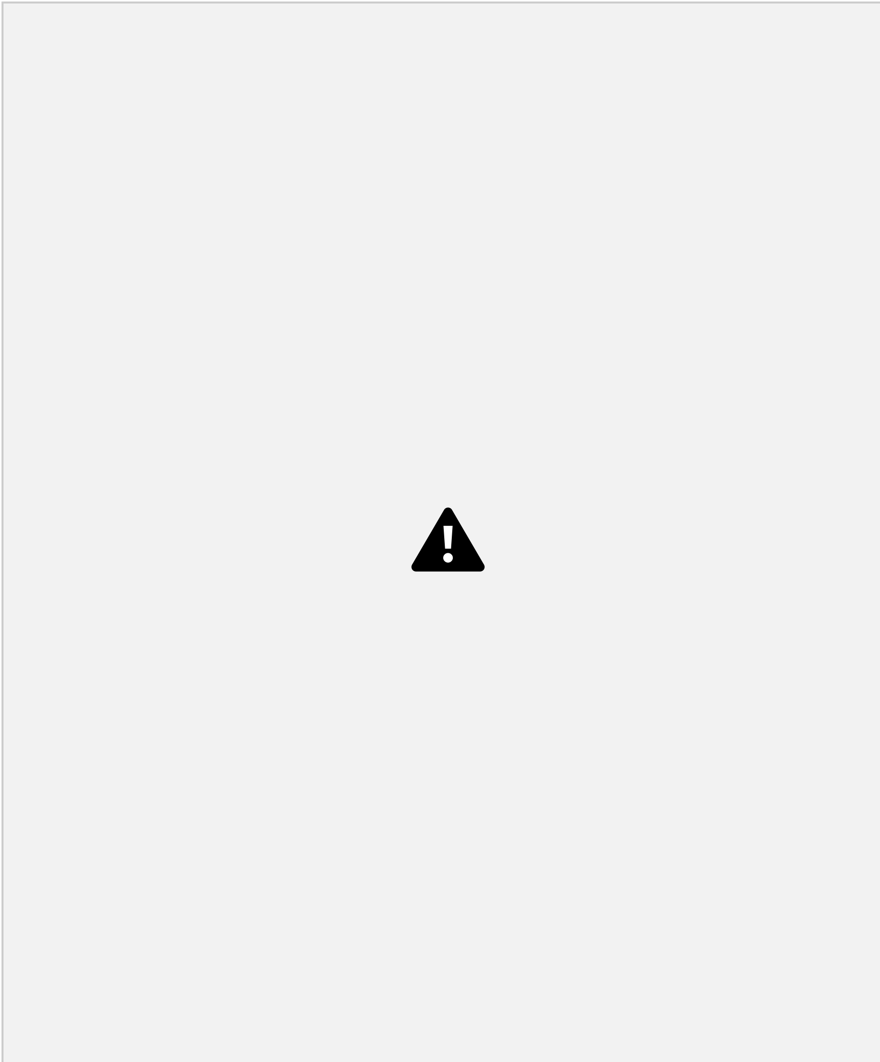




Source: Oak Ridge National Laboratory 2013

Hydropower Potential from New Stream-Reach Development for New England Region Dataset Overview. This dataset provides hydropower potential data (high-energy intensity stream-reaches and new potential areas for hydropower development) and environmental attributes in stream segments that do not currently have hydroelectric facilities in the New England Region 1 HUC. The data is aggregated to HUC10 watersheds.

Wind Power Sources: National Renewable Energy Laboratory and AWS Truepower.



This map shows the predicted mean annual wind speeds at a 30-m height, presented at a spatial resolution of 2 kilometers that is interpolated to a finer scale. Areas with good exposure to prevailing winds and annual average wind speeds around 4 meters per second and greater at a 30-m height are generally considered to have a suitable wind resource for small wind projects. Small wind turbines are typically installed between 15 and 40 m high. Given the technological advancements in the wind industry, locations with lower wind speeds that may not have been suitable for wind development in the past may be suitable today or in the future. The average wind speeds indicated on this map are model derived estimates that may not represent the true wind resource at any given location. Small terrain features, vegetation, buildings, and atmospheric effects may cause the wind speed to depart from the map estimates. Consumers should seek expert advice for siting wind turbines and estimating their energy production.

This resource map shows estimates of wind power density at 50 m above the ground and depicts the resource that could be used for community-scale wind development using wind turbines at 50-60-m hub heights. As a renewable resource, wind was classified according to wind power classes, which were based on wind speed frequency distributions and air density. These classes ranged from Class 1 (the lowest) to Class 7 (the highest). In general, at a 50-m height, wind power Class 4 or higher could have been useful for generating wind power with turbines in the 250-kW to 750-kW rating. Given the advances in technology, resources below Class 4 may now be suitable for the new midsize wind turbines. In recognition of these continuing advancements in wind energy technologies and the ability for the current generation of wind turbines to extract cost competitive wind energy from lower wind speeds the Energy Department has moved away from the wind power classification system and now reports wind speeds only.

9.06(a) Geological

(i) Mine, Quarried, Natural Rock Features

1. Indians Cave: Located on Keyser Hill

Indians' Cave is a natural cave formed by broken granite at the surface of the hill that have shifted to create this natural cave that forms the basis of a local legend from the 1860s or earlier. Legend has a native American man and woman sheltering at the cave after small pox wiped out their tribe, but they were also infected and died together in the cave. The cave first known as Hedgehog Den was renamed by a group of excursionists in 1878 who paid a local stone cutter to carve the name and date into the stone at the cave entrance.

2. Bears' Den: Located in Simpson Reserve

Bear's Den is a natural group of huge glacial erratic boulders that form a cave near Red Water Brook, accessed today by a hiking trail.

3. Pulcifer Rock: off Caldwell Lane

Pulcifer Rock is a glacial erratic, like the nearby Bear's Den rock cluster. It is consistently referenced in all the old deeds for the land within the triangle formed by Hells Corner Road, Rte 103-B (Edgemont Road) and Caldwell Lane.

4. Twin Willow Mica Mine: Located on Mica Mine Hill north of Trow Hill Road

Sunapee's only commercial mica mine was located at a deposit discovered in the early 1880s by John L. George (1839-1919) a local farmer and amateur mineralogist. Mine operations began in 1895 by men from Lempster when large pieces of mica were worth about 1/10 the price of gold. In 1896 mining rights were purchased by the Boston Mica Company that extracted mica from the spring to fall until about 1905.

5. Samuel Bailey Granite Quarry: Located off south side of Rolling Rock Road

Samuel Bailey (1792-1892) was Sunapee's early and best-known quarryman who operated a granite quarry from the 1830s into the 1860s at this location quarrying natural fissured surface rock with hand tools, first establishing Sunapee's long quarry history.

6. Boyce & Bailey Granite Quarry: Located off Burkehaven Hill Road

In 1884 Samuel Bailey (1792-1892) sold the rights to his 2nd major quarry, north of Rolling Rock Road to his grandson Murvin Bailey and neighbor Arland Boyce. This was Sunapee's largest quarry that produced a fine grain granite called Light Sunapee and Dark Sunapee, well suited for monuments and building use. The industry was aided by the arrival of the railroad in 1877. Blocks from this quarry were purportedly used for the Library of Congress building in Washington D.C. This quarry remained active until about 1910.

7. Stocker Granite Quarry: Located off Edgemont Road

This quarry is located on land that was once Samuel Bailey's land, now owned by William Stocker. He and his family quarry, cut, shape and polish granite for a variety of uses since the 1980s to present day.

9.06(b) Historic

(i) Burial Grounds & Burial Structures

1. Colby Burial Ground: Located on Stagecoach Road

Established in 1801 as the town's official burial ground on land of Joshua Gage, surrounded by a stone wall. Burials include several Revolutionary War veterans. This cemetery continues to be in use today.

2. Old Eastman Burial Ground: Located on North Road

Established in 1801 as the town's official burial ground on land of Elijah

Eastman. 3. Cooper-Young Burial Ground: Located off Stagecoach Road

Established about 1808 on land of Cornelius Young, who was the first burial, and contains several Revolutionary War veteran graves. About _ were buried there, all lived in the local area of this cemetery, with the last in 1925.

4. Lower Village Burial Ground & Granite Tomb: located at Lower Main Street

Established about 1815 on land of Nathanial Perkins, where the North Meeting House was built in 1832. In 1868 the town had a granite holding tomb constructed at this cemetery. 1950 was the last burial here.

5. South Sunapee Cemetery: Located on Harding Hill Road

Established about 1822 on land owned by Thomas Pike, where the South Meeting House was built in 1833. Families from south Sunapee are buried here. This cemetery continues to be used today.

6. George's Mills Village Cemetery: Located on Main Street

Established in 1865 by Elbridge G. Chase (1815-1895) for residents of George's Mills. Graves are unusually laid-out to orient North-South with burials facing Lake Sunapee. This cemetery continues to be in use today.

7. Crowther Chapel & Burial Ground: Located on Stagecoach Road

Built in 1936 by Mary and Samuel Crowther on their property after the death of their young son John. This small stone chapel with a Tiffany window, is a quiet, reflective place in the forest on land once owned by Joshua Gage. The Crowther family graves are nearby. The Chapel is open Sundays in the summer to the public.

(ii) Early Settlement Roads & Stone Culverts / Bridges

1. Mill Road (stone culverts) laid-out 1769, at Webb Home Farm Forest, in use as Angell Brook Rd, Trask Brook Rd, Cross Rd, Brook Rd
2. Thurber Road, laid-out in 1772, in use as Stagecoach Rd, Winn Rd, North Rd to Springfield 3. Whipple Road to Croydon, laid-out in 1773, in use as Ryder Corner Rd
4. North Road, laid-out 1786, in use as Prospect Hill Rd, part of Otter Hill Rd 5. County Road, laid-out 1786, in use as Bradford Rd
6. Goshen Road, laid-out 1789, in use as Nutting Rd
7. Abandoned sections of the Georges Mills Road

(iii) Sugar River Railroad

1. Railroad bed built 1870-71 from Newbury to Newport; discontinued 1955.

2. Granite block trestle 1871, off Paradise Rd
3. Wendell Depot 1872, 52 Depot Rd (see buildings)

(iv) Stone Structures

1. Sugar River Railroad granite trestle

Built in 1870 with granite blocks provided by Augustus Trask and George Paul, probably from Samuel Bailey's granite quarry off Rolling Rock Road for the Sugar River Railroad formed in 1865 to build the section of track and stations between Bradford and Claremont. The line later became part of the concord & Claremont Railroad and then the B&M Railroad. Rail traffic began over the trestle in 1872 and continued to 1955.

(v) Stone Dams

1. Sugar River granite block dam: Located on River Road

Built circa1836 by the Sunapee Company, a consortium of businessmen, it is the oldest surviving dam on the Sugar River in Sunapee. Several mills on both sides of the river were powered by water held by this dam. The damaged top section was rebuilt.

2. Sugar River gristmill, tannery & pulp mill dam: Located by Hames Park, Main Street

First built in 1797 by millwright John Chase Jr for a mill pond to power a grist and sawmill, This dam was also used by a leather tannery and excelsior mill from the 1860s to 1890s. In 1888 the dam was refurbished for use by the new wood pulp mill and in 1925, refurbished again for use by the Lake Sunapee Power Company's new hydroelectric station penstock. Portions of this dam still exist.

3. Sugar River excelsior mill dam: Located north of Town Hall, Edgemont Road

The boulder dam was built in 1888 by Wm. Clinton Stocker of Sunapee for a new excelsior mill after selling is old mill to the wood pulp company. The excelsior mill operated until about 1898. In 1895 the Sunapee Electric Light Company, of Clinton Stocker and his nephew Arthur Stocker, located a turbine at the excelsior mill powered by water in the mill pond at this dam, and installed the first village street and house lighting.

4. Sugar River Smithville dam: Located off Abbott court

Boulder dam built in 1854 by John B. Smith (1818-1884) arguably Sunapee's most important machinist, inventor and industrialist, who founded Smith Machine Company in the lower village on the bank of the Sugar River where he built a wood shop, machine shop, and forge where his patented wooden clothes pin machines were manufactured for sale across the country. His mills burned down in 1871 but he rebuilt and in 1874 had perfected a grinding technique to make a perfect two-piece achromatic lens, then the standard for telescopes. John had become interested in astronomy and was one of very few men in America who had achieved this. John produced about 5 telescopes in Sunapee, quite an achievement. One telescope was 60" long, 4" diameter with a power from 80 to 400 diameters. His telescopes were purchased by the Cambridge Observatory and Grand Prairie College.

5. Sugar River George Sawmill Canal: Located off Lower Main St.

About 1840 Elijah George 2nd and his sons began construction of canal, about 370-ft long, averaging 6-ft deep and totalling about 644,000 cu ft of soil and rock dug and moved by hand on the south side of the Sugar River to flow water to a grist and sawmill that they built located south of the Lower Main Street bridge. The canal remained in use until 1887. It remains as a land form with stone walls and the remains of pulleys and shafts from the mill.

6. Sugar River Trow Sawmill dam: Located off Lower Main St

The second Willis Trow sawmill in the Lower Village, its dam and canal race were built in 1895 at the south side of the Sugar River. After damage to the dam from the Great Hurricane of 1938, a diesel engine provided power to run the mill instead of water power. The canal was filled in, but the portions of the stone dam remain. This sawmill continues to be operated by the 4^{th} generation, Jeffrey Trow in 2022, a 127-year family history on this site. The Trow Sawmill is the last operating wood products mill in Sunapee.

7. Sugar River dam at Wendell Marsh

About 1800, Abiathar Young (1753-1827) built a dam that created Wendell Marsh to operate a sawmill at the south end of today's marsh. Operation of the sawmill continued after his death by his 4 sons until 1832 when the land was sold out of the family. In 1923 the Abiathar Young water flow rights and dam site were sold to Francis Murphy, who represented the newly formed Lake Sunapee Power Company. A new dam was built near the site of the old dam and nearly 1-mile of 6-ft diameter wooden penstock was built to power a 750-HP hydro-electric turbine located near Wendell Depot. This dam and hydro-electric facility operated until 1952. The dam remained in place and in 2014 was rebuilt to modern standards by the NH Fish and Game Department to maintain water levels in Wendell Marsh, a wildlife refuge.

8. Otter Pond dam at Otter Brook

In the late 1780s John Harvey built a mill at Otter Pond, sold to Ichabod Hearsee in 1791, and sold again in 1805 to miller Daniel George. The dam at Otter Pond has been maintained to this day. Daniel George and his descendants operated grist and sawmills on Otter Brook that flows from this dam into the 1890s. The village of Georges Mills was named for Daniel George.

9. Ledge Pond Brook dams

The stone dams on Ledge Pond Brook were built about 1810 by Caleb Mudgett and about 1840, probably by Wells Davis to create two mill ponds on Ledge Pond Brook for the operation of a sawmill on the brook at the north side of Perkins Pond Road. In 1849 the sawmill was owned by James Trow, who built a third dam at Ledge Pond. From James, 5 generations of the Trow family have operated sawmills in Sunapee and continue to do so in 2022. These stone dams exist in 2022 and two are protected in the MacWilliams Lot, conserved by Ausbon Sargent. The sawmill operated from about 1810 to the 1880s.

10. Angell Brook sawmill dam

This stone dam powered a sawmill, built bout 1795, by Joseph Chase on Angell Brook at the north side of Bradford Road. It was one of two sawmills in south Sunapee and the only dam remnants in this part of town to survive today.

(vi) Stone Walls

1. Range & Lot line stone walls (see stone wall mapper)
2. Farm yard & pasture stone walls
3. Granite bank walls at roads: High Street 1890, Central St 1948
4. Granite bank walls at river: Hames Works at High Street 1890, Main St at Rte.11 1909 5. Granite bank walls at lake: Sunapee Harbor 1890

(vii) Cellar holes and barn foundations

1. Wm McBritton house site at Webb Home Farm Forest
2. E. Young-Eleaser Sischo house site at Webb Home Farm Forest
3. Nathaniel Perkins house site c1800 at 279 Youngs Hill Rd
4. Joshua Freeto house site 1829, at Wendell Marsh
5. Francis Pingree c1794, Trow Hill Road
6. Sam Cilley-Josiah Conant farm house c1800, Dodge Pasture Rd 7.

Theodore Davis farm house & barns c1828, Dodge Pasture Rd 8.
James Eastman farm house c1834 Maurer Rd
9. Robert Emerson farm house c1800, Dodge Pasture Rd 10.
David Perrin - Noyes farm house c1810, Dodge Pasture Rd 11. No.
6 Schoolhouse 1817 site of 741 North Rd
12. Joseph Pillsbury farm house c1795 off Main St Geo Mills 13. Jacob
Evans-John Bartlett farm house & barn c1780, site of 800 North Rd

(viii) <u>Significant Buildings</u>

	Circa year	Description	Location		Circa year	Description
	1780	Benjamin George	101 Bradford Rd		1892	Loon Island Lighthouse

		farm house			rebuilt 1960	
	1780	Woodward farm house	Bradford Road		1909 rebuilt 19802	Burkehaven Lighthouse
	1780s	Esek Young -John Angell farm house	45 Angell Brook Rd		1859	Methodist Church parsona
	1789	Whittier Perkins farm house	175 North Road		1871	Methodist Church
	1790	William Gage farm house	324 Stagecoach Rd		1897	Methodist Church
	1790s	Abiathar Young farm hou			1898	St. James Episcopal Church
	1791 rebuilt 1881	Stephen Lang farm house	3 Messer Rd		1860	No. 5 Schoolhouse
	1790s	Daniel Moses - Merrill farm house & barns	144 Route 11		1867	No. 8 Schoolhouse
	1790 altered 1931	Joshua Gage farm house & barns	258 Stagecoach Rd		1870	No. 7 Schoolhouse
	1794	Abijah Emerson farm house	526 North Road		1877	No. 2 Schoolhouse
	1795	Ichabod Heasee farm house	1279 Route 11		1877	No. 3 Schoolhouse
	1796	Esquire Woodward farm house	Keyes Road off Trow Hill Rd		1893	No. 1 Schoolhouse
	1798	Philbrick Huntoon farm house	77 Burkehaven Hill Rd		1815	Dane house general store
	1798	Samuel George farm ho			1826	Conant - Russell Store
	1800	Job Clapp farm house	110 Brook Rd		1835	Cutting tavern house
	1800	James Young farm house	34 Stagecoach Rd		1843	Marble General Store
	1800	Enoch Perkins farm house	140 Perkins Pond Rd		1850	Gardner Tavern
	1800	Perkins farm house	140 Perkins Pond Rd		1851	Josiah Turner's general sto

	Circa year	Description	Location		Circa year	Description
	1800	Francis Smith farm house	511 North Road		1855	Hopkins Wallet Shop hous
	1800	Samuel Patch farm house & barn	962 Route 11		1857	Tin Shop
	1800	Hadley Muzzey farm house	1007 Main St Georges Mills		1870	Knowlton Block – IOOF Ha
	1802	Joseph Chase farm house	47 Harding Hill Rd		1872	Wendell Depot
	1804	Thomas Pike farm house	28 Bradford Rd		1889	Hame Works Office
	1805	Trask-Paul farm house	9 Youngs Hill Rd		1890	Flanders Livery-Museum
	1805	Enoch Harvey farm house	171 Burkehaven Hill Rd		1890	Harbor Hotel Livery
	1806	James Atwood farm hous			1792	Philip Huntoon Stone Hous
	1808	Asahel Dickinson farm house	66 Hells Corner Rd		1800	Jonathan Worster house
	1808	Joshua Bartlett farm hou			1800	Moses Muzzey house
	1809	John Currier farm house	26 Caldwell Lane		1800	Stone House
	1810	Caleb Whitaker farm hou			1823	Nathan Burpee - Russell ho
	1810	Jonathan Crowell farm house	143 Bradford Rd		1832	John Colby house
	1810	Cornelius Young farm house & barn	207 Stagecoach Road		1840	Moses Muzzey house
	1810	Samuel Gardner farm house	24 Fairway Drive		1844	Jesse Wilson house
	1812	Amos Rowell-Levi Colby farm house	172 Sleeper Rd		1845	Amos George house
	1812	Moses Eastman farm house	247 Prospect Hill Rd		1851	William Stevens house
	1815	Clapp farm house	59 Cross Rd		1854	John B. Smith house
	1815	Abiathar Young Jr farm house	164 Lower Main St		1876	Robert C. Osgood cottage, Island, oldest surving lake

	1820s	Samuel Bailey farm barn	154 Edgemont Rd		1880	Pleasant Home - Conrad M
	1821	Ichabod Eastman farm house	12 Ryder Corner Rd		1906	Billy B Van estate house ar

	e Circa year	Description	Location		e Circa year	Description
	1822	Abial Cooper farm house	28 Old Granliden Rd		1830s	Ryder farm house
	1824	William Trow farm house	16 Trow Hill Road		1832	Hackett farm house
	1825	Ira Hurd farm house	270 Nutting Rd		1832	Abial Cooper farm house
	1825	William Trow farm house	915 Route 11		1832	John Balch farm house
	1825	Eliakim Putney farm house & barn	37 Meadow Brook Rd		1832	John Gardner farm house
	1825	Jacob Stickney farm house	60 Wayland Rd off Prospect Hill Rd		1835	Daniel George Jr. farm hou
	1825	Elbridge Chase farm house & barns	79 Prospect Hill Rd		1840s	Gideon Angell farm barn
	1828	Francis Pingree farm house	Woodham Springs Route 11		1840	Gardner farm barn
	1830s	Elijah George farm barn	325 North Rd		1840s	Welcome Angell farm hous
	1830	Oliver Young farm house	66 Stagecoach Rd		1847	Elias Abbott farm house

9.06(c) Recreation

(i) Hiking & snowmobile trails

1. Ledge Pond Town Forest trails
2. MacWilliams Conservation Land trails
3. Class 6 - Dodge Pasture Rd, laid-out 1810, abandoned in 1930s.
4. Dewey Woods Town Forest 1928, hiking trails 2007 & 2011
5. Garnet Hill Park 1948, hiking trails 2011
6. Wendell Marsh Town Forest trails
7. Harbor River Walk 1997
8. Tilton Park aka Ski Tow Hill, 1938, Sun-Ragged-Kearsarge Greenway Trail 9. Frank Simpson Reserve 2004, Sun-Ragged-Kearsarge Greenway Trails 10. Webb Harrison lot trail 2006
11. Webb Home Farm Forest trails 1972
12. Abandoned railroad bed trail
13. Webb-Dane Lot trail 2006

(ii) Parks

1. Sunapee Harbor Park 1971, Bandstand 1996, Main St.
2. Sunapee Harbor Town Wharf 1944, Main St.
3. Coffin Park 1966, Harbor River Walk 1997, Fitness equipment 2020, Edgemont Rd 4. Tilton Park aka Ski Tow Hill 1938, Playground at Edgemont Rd
5. Hames Park 1998, 42 Main St
6. Osborne Reflecting Pool 1966, at High St bridge
7. Veterans' Park 1948, ball field, 567 Route 11
8. Dewey Beach 1936, Garnet St
9. Dewey Woods Ball Field 1973 & 1990
10. Georges Mills Beach & Town Wharf 1938, Cooper St

(iii) Water Body Access

1. Sunapee Harbor town wharf and boat launch 1944, 83 Main St

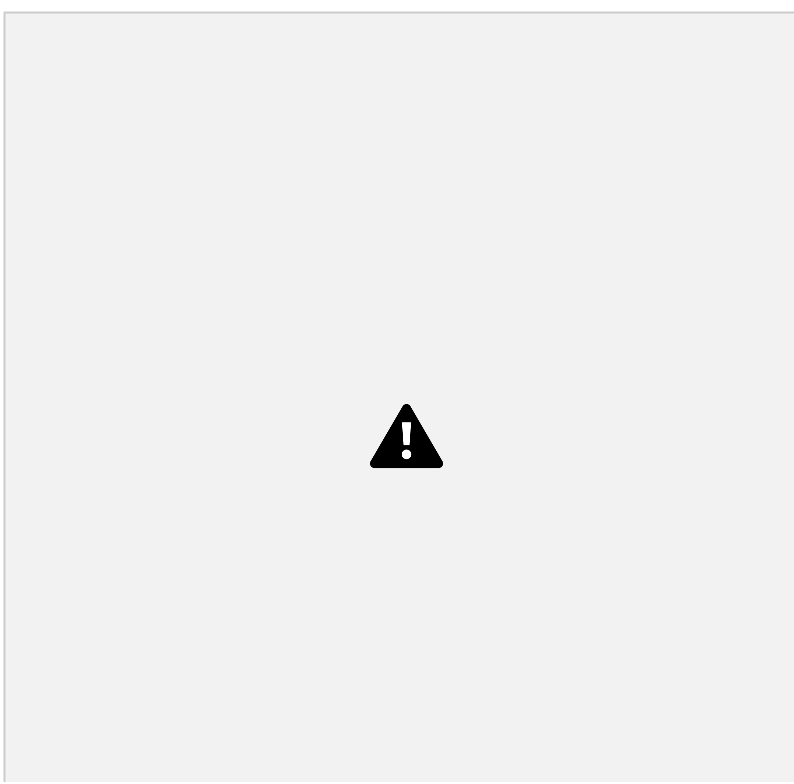
2. Georges Mill town wharf and boat launch, Cooper St
3. Dewey Beach, 1936 Garnet St
4. Perkins Pond boat launch, Perkins Pond Rd
5. Ledge Pond, off Meadow Brook Rd
6. Sugar River at River Road
7. Sugar River at Coffin Park
8. Sugar River at Wendell Marsh

(iv) Scenic Vistas and Viewpoints

1. View to Corbin Park from Burkehaven Hill Road
2. View to Mt Sunapee from North Rd, Trow Hill Road
3. View of Sugar River from River Road
4. View to Mt Sunapee from Trask Brook Road
5. Views of Lake Sunapee from Harbor & Beaches
6. Note: Lake Sunapee Scenic & Cultural Byway: 103-B / Rte 101 / Rte 11 / Sun Harbor

9.07 Appendix G : Conservation Plan Process

At the regular meeting of the Sunapee Conservation Commission on November 11, 2022, project consultant (Upper Valley Lake Sunapee Regional Planning Commission) facilitated a prioritization exercise. Commission members were asked to provide their priority focus areas, focus topics, and specific actions for the conservation plan. Members were provided with Town maps and results of the co-occurrence analysis to inform their choices. The consultant than facilitated discussion with opportunity for members to describe their choices and for consensus on how similar items were grouped together. Once priorities were understood, members were asked to select those focus areas and focus topics of highest priority. Members who were not in attendance at the meeting shared their highest priorities via email based on those chosen during the meeting. This process resulted in the following:



Focus topics. Each heading indicates a group of priorities and discussion topics, further described under each bullet. The numerical value next to each heading reflects the number of SCC members who voted for this topic

as a high
priority.

- 5 - Water / sewer infrastructure
  - where expansion might occur
  - advance development where infrastructure available to reduce impact on natural resources
- 5 - Planning and zoning collaboration
  - Advance enforcement through available staffing
  - Reduce variance and increase predictability
  - Consider appropriate enforcement and use of fines
  - Increase lot size in rural residential
  - Ensure changes in planning/zoning include consultation with SCC and consideration of conservation values
- 4 - Protect resiliency zones
  - Protect resilient areas
  - Wetlands protection
- 4 - Protect drinking water sources
  - Municipal water source protection
  - Zoning protection for future wells
  - Protection of aquifers
- 3 - Invasives management
  - Unsure where to start, not much information available outside of the efforts by LSPA
  - Keep scenic vista sight lines clear from invasive species disturbance.
  - Flip side is to advance native plants and species.
- 3 - Preserve farmland and important farmland soils
- 2 - Advance natural settings recreation
  - Support existing and new places

Focus areas. Each heading indicates a group of priority areas, further described under each bullet. The numerical value next to each heading reflects the number of SCC members who voted for this topic as a high priority.

- 5 - South Sunapee south of Rte. 103 (connection to large Mt Sunapee tracts) o Concern for use of NH Highway garage at high co-occurrence area along Nutty Rd o Discussion of opportunity to connect with Q2C corridor just south
- 5 – Wellhead and drinking water supply protections
  - Wendell Marsh Well head protection area
  - Shoreland along Lake Sunapee protections, particular concern for homes not connected to public systems and septic that may fail, impacting WQ
  - Wellhead protection areas over all
- 5 - Red Water Creek to Mud Pond including Blueberry Mt southeast corner of town •

4 - Identify preferred area for development and no development
• 4 - Ledge Pond / northwest corner of town (highest rated area on the draft co-occurrence map) •
1 - Lower Sugar River

Specific actions. Each item listed below was identified as a specific action the SCC could take as part of the Conservation Plan. These items were not prioritized.

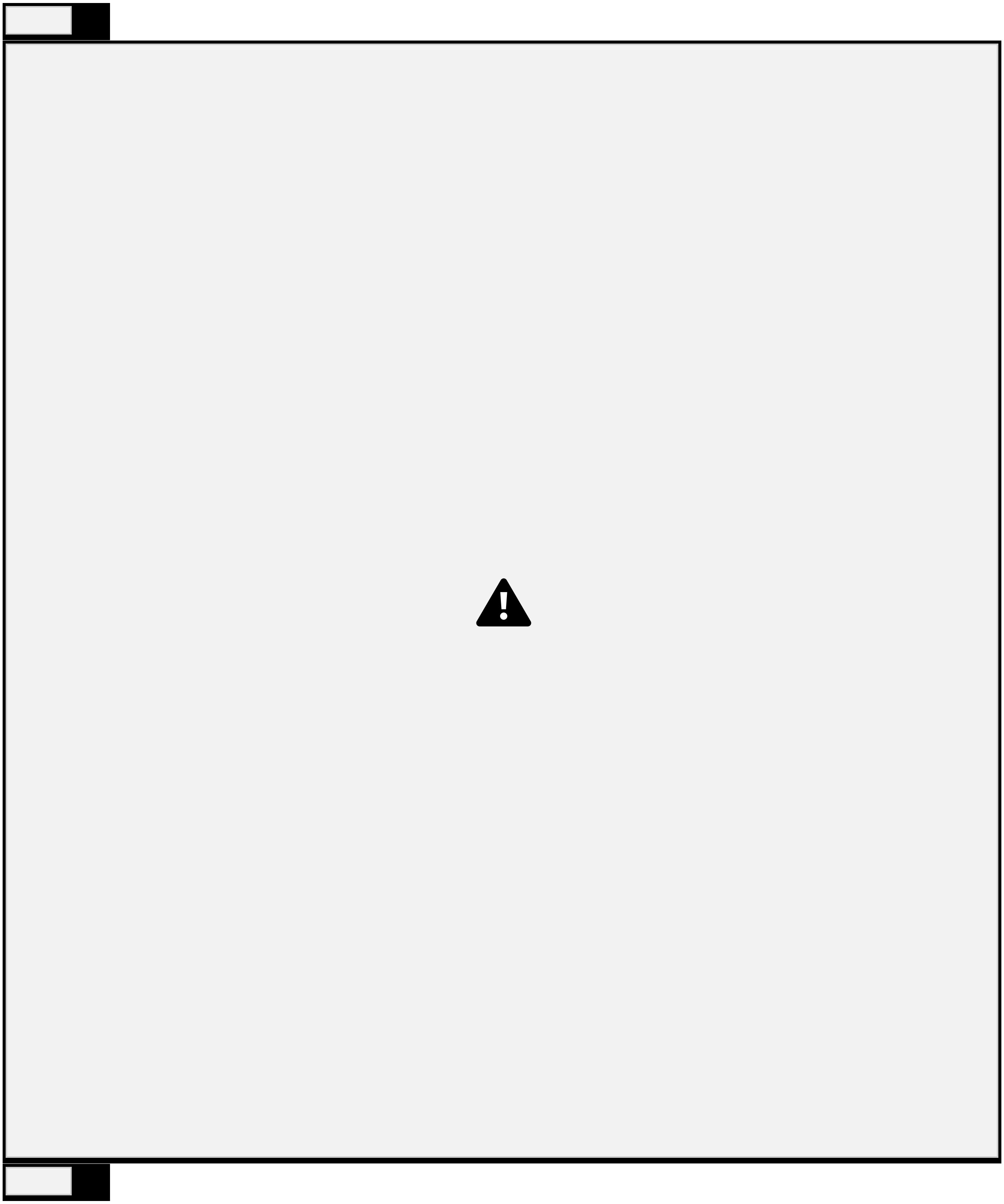
• Continue protecting large and small high value conservation lands
• Protecting large undeveloped land tracts
• Identify prime wetlands
• Zoning protection now for future municipal wells
• Enforcing existing regulations
• Integrating NRI into planning board decision making
• Protecting wildlife corridors
• No variances
• What can be done to further protect NW Sunapee?

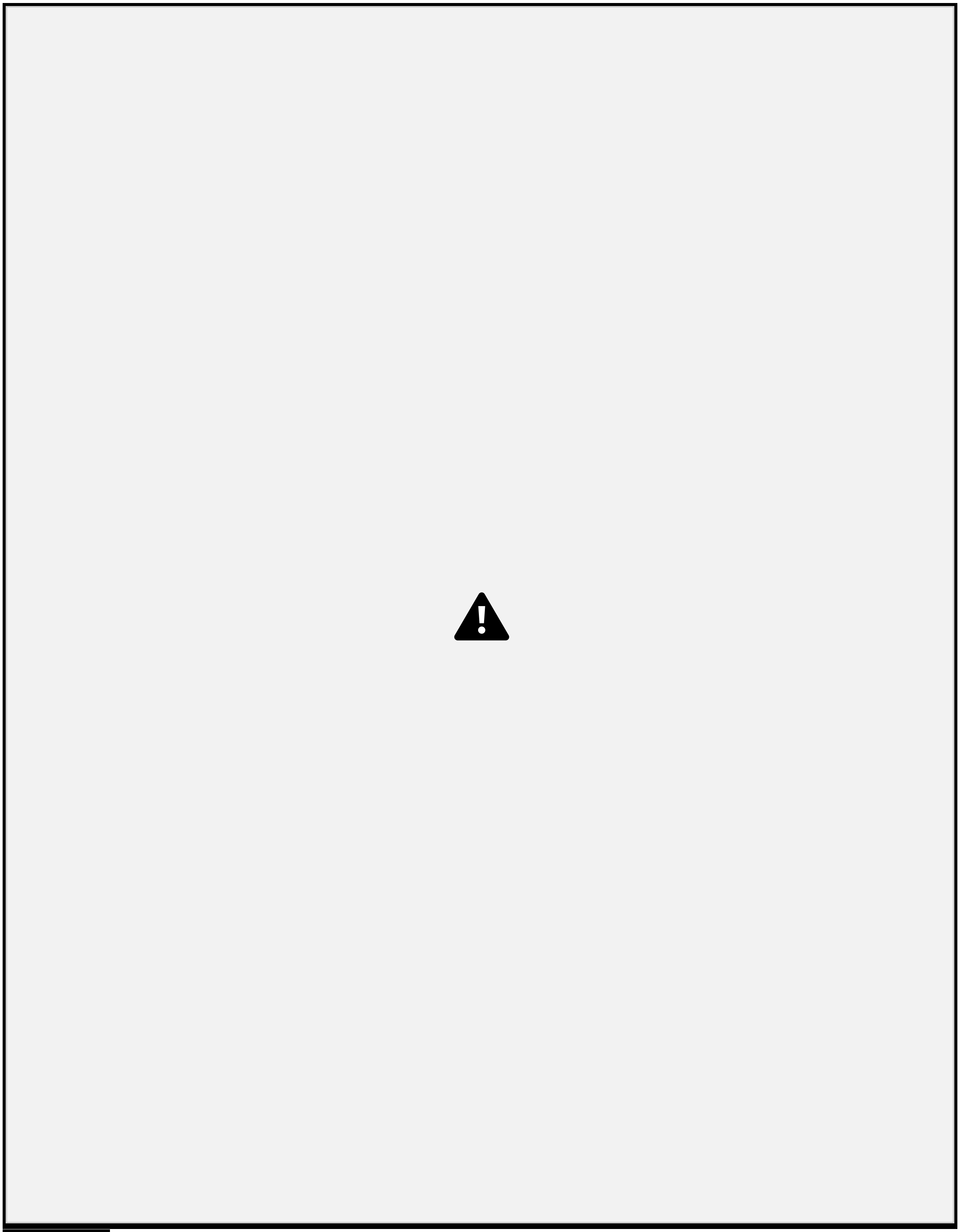
Interviews. To inform the Conservation Plan, project consultant performed a series of interviews with the following individuals.

• Town Water and Sewer Department, Aaron Cartier.
• Town Recreation Department, Steve Bourque.
• Town Highway Department, Scott Hazelton.
• Town Planning and Zoning Department, Scott Hazelton and Michael Marquise. •
Lake Sunapee Protective Association, Geoff Lizotte.

9.08 Appendix H : Additional Resources

This Appendix contains the following information:
1. Private Well water testing & exceedance rates in Sunapee (2006-2020) 2.
Quabbin to Cardigan Partnership, 2018 Regional Plan
3. Lake Sunapee Scenic and Cultural Byway brochure
4. Lake Sunapee Ice-Out dates according to the Sunapee Historical Society





9.09 Appendix I: Bibliography

Anderson, M.G., A. Barnett, M. Clark, C. Ferree, A. Olivero Sheldon, J. Prince. 2016. Resilient Sites for Terrestrial Conservation in Eastern North America. The Nature Conservancy, Eastern Conservation Science.

Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.

Anderson, M.G., M. Clark, and A. Olivero Sheldon. 2014. Estimating Climate Resilience for Conservation across Geophysical Settings. Conservation Biology 28 (4) 1523-1739. http://dx.doi.org/10.1111/cobi.12272

Ardizone, Katherine A. and Mark A. Wyckoff, FAICP. FILLING THE GAPS: Environmental Protection Options for Local Governments, 2nd Ed. Michigan Department of Natural Resources and Environment, Coastal Management Program with financial assistance from the National Oceanic and Atmospheric Administration, authorized by the Coastal Zone Management Act of 1972. December 2010.

Auger, P. & J. McIntyre. 1991. Revised 2001 by A. J. Lindley Stone. *Natural Resources Inventories: A Guide for New Hampshire Communities and Conservation Groups*. Durham, NH: University of New Hampshire Cooperative Extension.

Centers for Disease Control and Prevention (CDC). 2022, June 1. Harmful Algal Bloom (HAB)-Associated Illness. Available online at https://www.cdc.gov/habs/

Connecticut River Joint Commissions. “A Homeowner s Guide to Water Quality Protection.” 2018, https://crjc.org/wp-content/uploads/2018/10/homeguide-07162018R.pdf.

Flavelle, Christopher, et al. “New Data Reveals Hidden Flood Risk Across America.” *The New York Times*, The New York Times, 29 June 2020, https://www.nytimes.com/interactive/2020/06/29/climate/hidden flood-risk-maps.html.

Jay, A., D.R. Reidmiller, C.W. Avery, D. Barrie, B.J. DeAngelo, A. Dave, M. Dzaugis, M. Kolian, K.L.M. Lewis, K. Reeves, and D. Winner, 2018: Overview. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 33–71. doi: 10.7930/NCA4.2018.CH1

Lake Sunapee Protective Association (LSPA). 2016. Water Quality Trends and Concerns. Available online at: https://www.lakesunapee.org/trends-concerns

Lemcke-Stampone, Mary D.; Wake, Cameron P.; and Burakowski, Elizabeth, "New Hampshire Climate Assessment 2021" (2022). The Sustainability Institute. 71.

Moore, R.B., Johnson, C.D., and Douglas, E. M. 1994. Geohydrology and water quality of stratified-drift aquifers in the lower Connecticut River basin, southwestern New Hampshire: U.S. Geological Survey Water-Resources Investigations Report 92-4013. Denver, CO: United States Geological Survey Earth Science Information Center.

Murphy, J. and L. Anderson, 2019. Responsible Wind Power and Wildlife. Washington, DC: National Wildlife Federation.

National Wildlife Federation. 2013. *Wildlife in a Warming World*. Available online at: https://www.nwf.org/~/media/PDFs/Global-Warming/Reports/NWF_Wildlife-Warming World_Report_web.pdf

New Hampshire Bureau of Economic and Labor Market Information. 2008. *Community Profiles.* Available online at: http://www.nh.gov/nhes/elmi/communpro.htm.

New Hampshire Department of Environmental Services (NHDES). 2021. Status Report on the Occurrence of Per- and Polyfluoroalkyl Substance (PFAs) Contamination in New Hampshire. Concord, NH: New Hampshire Department of Environmental Services.

New Hampshire Department of Environmental Services (NHDES). 2021. New Hampshire Fish Consumption Guidelines. Available online at https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/ard-ehp-25.pdf

New Hampshire Department of Environmental Services (NHDES). 2021. Cyanobacteria Sightings Reported - Gloeotrichia. Available online at https://www.des.nh.gov/news-and-media/cyanobacteria sightings-reported-gloeotrichia

New Hampshire Department of Environmental Services (NHDES). 2022. New Hampshire Watershed Report Cards built from the 2020/2022, 305(b)/303(d), HUC 12: Newport Tributaries. Available online at https://www4.des.state.nh.us/onestoppub/SWQA/010801060405_2020.pdf

New Hampshire Department of Environmental Services (NHDES). 2022. New Hampshire Watershed Report Cards built from the 2020/2022, 305(b)/303(d), HUC 12: Sunapee Lake. Available online at https://www4.des.state.nh.us/onestoppub/SWQA/010801060405_2020.pdf

New Hampshire Department of Environmental Services. 2008. *DES List of Fourth Order and Higher Streams (Publication WD-08-9)*. Available online at http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm.

New Hampshire Department of Environmental Services. 2008. *DES List of Public Water Supplies*. Available online at http://www2.des.state.nh.us/OneStop/.

New Hampshire Department of Environmental Services. 2008. *Official List of Public Waters*. Available online at http://www2.des.state.nh.us/OneStop/.

New Hampshire Department of Natural and Cultural Resources Division of Forests and Lands. 2020. *New Hampshire Forest Action Plan*. Available online at: https://www.nh.gov/nhdfl/documents/nh stateforestactionplan_2020.pdf

New Hampshire Department of Revenue Administration. 2021 (reports generated annually). *Current Use Reports*. Available online at: https://www.revenue.nh.gov/mun-prop/property/equalization 2019/documents/current-use-alpha.pdf.

New Hampshire Fish and Game Department. 2015. *Wildlife Action Plan*. Concord, NH: New Hampshire Fish and Game Department.

New Hampshire Natural Heritage Bureau. 2008. *Rare Plants, Rare Animals and Exemplary Natural Communities in New Hampshire Towns* (an online resource, regularly updated). Concord, NH: Department of Resources and Economic Development.

New Hampshire Office of Energy and Planning. 2022. *OEP Population Projections*. Available Online at: https://www.nh.gov/osi/data-center/population-projections.htm.

Omernik, J.M., and G.E. Griffith. 2014. Ecoregions of the conterminous United States: evolution of a hierarchical spatial framework. Environmental Management 54(6):1249-1266, http://dx.doi.org/10.1007/s00267-014-0364-1.

Simpson M.H., Stack L.J., Gruber J., Wood R., Crosslin T., Lawson C., Roseen R., Smith J. 2012. Stormwater drainage system vulnerability, capacity, and cost: Response to climate change and population growth. Final project report: Sectoral Applications Research Program FY2009, Climate Program Office, National Oceanic and Atmospheric Administration

Society for the Protection of New Hampshire Forests and The Nature Conservancy NH Field Office. 2005. *New Hampshire's Changing Landscape 2005*. Concord, NH: Society for the Protection of New Hampshire Forests.

Sperduto, D. D. & W. F. Nichols. 2004. *Natural Communities of New Hampshire*. Concord, NH: New Hampshire Natural Heritage Bureau and The Nature Conservancy.

United States Department of Agriculture Natural Resources Conservation Service. 1999. *Soil Survey of Sullivan County Area, New Hampshire*. Available online at: http://nh.nrcs.usda.gov/Soil_Data/index.html.

Wake, Cameron P.; Burakowski, Elizabeth A.; Wilkinson, Peter; Hayhoe, Katharine; Stoner, Anne; Keeley, C.; and LaBranche, Julie, "Climate Change in Southern New Hampshire: Past, Present and Future" (2014). The Sustainability Institute. 2. https://scholars.unh.edu/sustainability/2