Appendix VI – Climate Resilient Conservation and Restoration

Creating landscapes that can withstand extreme weather will take a multilayered approach to ensure increased infiltration, controlled runoff, and restored hydrology throughout all landscapes and new development. Research worldwide has observed that highly altered and degraded lands are more susceptible to climate change impacts[1]. This is particularly true in areas with steep ravines and valleys, where intense rainfall events create extensive opportunity for flood, soil erosion, and more[2]. Protecting existing natural systems and restoring degraded lands is important to create resilient and sustainable landscapes, increase greenhouse gas (GHG) absorption, mitigate climate change, improve socio-economic conditions and to ensure food security[3,4].

Forests

Forests cover approximately 50% of Monroe County's landscape, contributing to regional air quality, erosion control, forest products economy, and wildlife habitat. Forest conservation, restoration, and management offer the most effective, low-cost, nature-based solutions for mitigating climate change[5]. While offering potential contributions to climate change mitigation, forests are also at risk from the impacts of climate change. As such, while part of forest conservation lies in preventing the conversion of forests to other uses, assisting local forests in adapting to climate change is also highly important. This will include measures such as invasive pest management, fire management (including controlled burns), and restocking degraded forests with more native, climate-adapted species (see the Climate Change Field Guide for Southern Wisconsin Forests). To achieve this, landowners would benefit from incentives that "keep forests as forests", such as property tax incentives, investing in carbon markets, and partnerships with resource managers (e.g. US Forest Service, NIACS, NRCS) to implement climate-resilient practices within the forests on their land. Forests also often harbor unique and sensitive habitats such as ephemeral ponds, rookeries, springs and seeps. Protection of these habitats, both within and outside of forests, is crucial for maintaining hydrologic integrity, ecosystem services, biodiversity, and carbon sequestration functions.

Reforestation efforts can aim to restore natural "wild" habitats or be integrated into urban areas and working lands. By using the watershed vulnerability assessments in this report, new and restored forests can be strategically sited on marginal, highly erodible, and high-risk lands in highly vulnerable watersheds. Trees can be integrated into working lands through agro-forestry efforts (see below), and greenspaces in urban and other built areas can provide shade, flood control, and other benefits.

Prairies and Grasslands

Native grasslands of the Midwest region also hold great potential for carbon sequestration, with added benefits for biodiversity, wildlife habitat, and more. As part of photosynthesis, prairie plants pull carbon dioxide from the atmosphere and store it in their stems, leaves and roots. Unlike trees, however, grasslands store most of their carbon underground, in their roots and deep into the soil. Deep root systems deposit carbon into deep soil layers, which is important because the rate of carbon sequestration increases with soil depth (see Minnesota Board of

Water and Soil Resources). This deep root system is what can, in a future climate scenario, potentially make them more reliable "carbon sinks" than forests; because carbon is stored in the soil, it is not released back into the atmosphere when grasslands burn, as it is when trees burn in forest fires[6]. This suggests that **a landscape consisting of forests as well as grasslands will contribute to a diverse "portfolio" of land uses and habitat types that will contribute to a more resilient, adaptable landscape.**

Similarly to forests, the restoration of prairies can also be conducted on a gradient of natural wildlands to integrated working lands and even urban backyards. Large-scale prairie restoration, while potentially costly and effort-intensive, can mitigate carbon, provide wildlife habitat, recreation opportunities, and benefits to pollinators. Alternatively, however, native prairie can be integrated into working lands as prairie (filter) strips and potentially even as income sources in the form of biofuel feedstocks from harvestable buffers (see **Appendix VII**). Native wet prairie plantings can also be used in bioswales, detention basins, and rain gardens in urban and suburban areas.

Waterways and wetlands

Lakes, streams, and wetlands offer many ecosystem services to people, including water quality improvement, flood mitigation, and wildlife protection. Freshwater is essential for all living organisms on Earth, and provides indirect benefits for humans for agriculture, transportation, wildlife and fish habitat, energy production, and more. Protection of freshwater, both in quality and quantity, is essential for human life now and in the future. Monroe County has some of the best conditions in southern Wisconsin to become a trout fishing destination, even as the climate warms. Spring-fed streams help keep water temperatures cool despite rising ambient temperatures, and topographic features help to provide natural shade. Despite this, without purposeful stewardship, many of these cold-water fisheries could be at risk. Because rivers and streams continuously funnel precipitation from the surrounding landscape through the interconnected lakes, rivers, and wetlands, they are sensitive even to distant land-use activities. Non-climate stressors on freshwater systems include activities that change system hydrology (such as dams and diversions), water extraction, pollution and excessive nutrients, and sediment loading. These stressors, coupled with climate change impacts – such as increased flooding leading to increased sedimentation, warming waters precipitating algal blooms, and periodic droughts – can have devastating impacts on local freshwater rivers, streams, and lakes. Protection of rivers and streams will require the reduction of non-climate stressors to improve the natural capacity for these systems to withstand a changing climate.

Wetlands (also known as marshes, swamps, fens, bogs) are also a critical component of freshwater ecosystems. Wetlands often act as "sponges", absorbing water during times of excess (i.e. flooding) and serving as critical storage of water during drier times. Because of their anoxic wet conditions, wetlands are optimal natural environments for sequestering and storing carbon from the atmosphere[7]. Wetlands furthermore provide critical habitat for many amphibians, birds, and plants. As with forests, avoiding the loss of wetlands (conserving them) tends to be less expensive than wetland restoration[5] and therefore improving surveys, mapping, and conservation of wetlands is a priority for improving landscape resilience.

Restored wetlands, however, are an extremely useful nature-based action for increasing resilience to climate change. Restoration of riverine wetlands (those adjacent to rivers and streams) is especially useful for storing and holding flows, including peak flows, which tend to produce flood damage. Wetland restoration in areas that reconnect streams to their floodplains, restore ditches to natural channels, and help divert and disperse surface flows to reduce flood severity and associated impacts will provide the greatest function and co-benefit opportunity. Coincidentally, marginal agricultural lands (define here) frequently occur in saturated and periodically flooded areas near rivers and streams, therefore presenting an opportunity to restore ecological function while minimally competing with land use for food production (see **Appendix VII**).

Conservation and Restoration on Agricultural Lands

Agriculture is the only major emissions contributing sector that has the ability to shift from a net carbon source to a net carbon sink. Better understanding carbon and greenhouse gas emissions on agricultural lands will help Monroe County contribute to state, federal, and global carbon off-set goals. A strategic approach will help to maintain a strong agricultural economy, with the potential to supplement farmer incomes by generating carbon credits that can be sold in carbon offset markets. The conservation toolbox is full of practices designed to limit soil erosion, reduce and redirect runoff, improve nutrient efficiency, and support more sustainable farming systems. While many practices and conservation programs were intended to meet soil and water quality goals, they are also robust and effective in mitigating and adapting to a changing climate. Re-thinking the landscape through a carbon lens can help reduce the effects of climate change, create resilient landscapes, and meet water quality goals. As such, recommendations are focused on building resilient soils while supporting land use practices that keep water on the land, slow the flow of runoff to streams, and buffer waterways from excess nutrient runoff.

Carbon is also an important element in soil health. Increasing soil organic carbon improves water holding capacity, infiltration rates, soil density, and nutrient availability, better protecting landscapes from rain events, drought, pests and invasive species. Practices that store carbon also have many co-benefits that improve water quality by limiting erosion and filtering nutrients.

Many strategies exist for reaching both soil health and climate change goals on the agricultural landscape. Cover crop techniques are one such example, frequently used in soil health, but with added co-benefits for climate resilience. Cover crops help prevent soil erosion, limit nutrient runoff, reduce soil compaction, increase soil organic matter which raises soil moisture holding capacity, and can even help suppress some pests. Cover crops provide economic benefits by increasing crop yields, out-competing weeds, break disease and insect cycles, host beneficial organisms, attract pollinators, and supply forage. Furthermore, cover crops can help producers cope with excess spring waters through cover crops, which can help dry out wet fields before planting[8]. Increased continuous living cover on agricultural land also helps to reduce the need for fertilizer applications and associated N2O emissions (a greenhouse gas) and increase soil carbon storage. Strategies that reduce disturbance of soil will also contribute to soil health, stability, and carbon storage. Disturbance can be minimized by avoiding or reducing tillage for planting, weed control, or other purposes, and increasing soil cover with mulch and compost can help to conserve soil moisture and reduce soil temperatures[9,10].

Agroforestry and silvopasture techniques also have the potential for enhancing ecosystem resilience to extreme climatic conditions[11], as well as creating economic opportunities on farms. Agroforestry - a system in which trees or shrubs are grown around or among crops or pastureland - produces a wide range of useful and marketable products while contributing to reforestation, soil stabilization, and more. Silvopasture techniques integrate trees into livestock grazing land, in which animal manure all help improve the soil and tree nutrition. Grazing by livestock, meanwhile, controls competing brush species and reduces fire hazard and can result in greater timber yield[12]. Trees in turn create a sheltered microclimate to protect animals from heat – a protection that may become a greater need as the day and nighttime highs increase. By diversifying and expanding farm production to include a wider array of annual crops, perennial fruits or nuts, forage, timber or other forest products, agricultural producers also help ensure their own economic stability by reducing risks of climate change impacts to staple crops and risks related to market fluctuations[9,13](and see USDA Climate Hub Adaptation Resources for Agriculture).

Prairie strips are a conservation practice that integrates “strips” of warm season and cool season grasses as well as native wildflowers into row crop fields. Prairies strips have been observed to deliver enormous soil, water and nutrient benefits while increasing wildlife habitat. Studies from Iowa State University have documented through rigorous research that converting just 10% of a crop field to prairie strips could result in reduction of 95% of the sediment, 90% of the phosphorus and 84% of the nitrogen from overland flow of surface water[14].

Appendix VI References

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