**Land Uses and Best Management Practices**

## Agriculture

McHenry County's history is deeply rooted in agriculture. With approximately 208,339 acres of farmland, agriculture accounts for about 56% of McHenry County's total land area and continues to be the dominant land use shaping the county's rural character P1. Agriculture also remains a pillar of McHenry County's economy and there are many opportunities for growth, including agritourism, specialty growers and small-scale food processing.

*** Photo of farm and cumulus clouds ***

As an enterprise, farming operates in much the same way a local business or manufacturing operation would. Agricultural producers purchase inputs such as seed, feed, fertilizer, agricultural chemicals, and equipment from local suppliers. The commodities they produce with those inputs are then sold at market. In addition to farming enterprises, several agricultural businesses are located within the County such as seed farms; seed dealers; grain elevators; dairy product processors, sales and distribution; equipment dealers; farmers markets; roadside farm stands; specialty crop sales; and farm chemicals, fuel and supply dealers. These businesses, like all others, fuel McHenry County's economy through property taxes, sales tax, and employment.

The preservation of farmland and local farms are stated goals of the McHenry County 2030 Plan and the McHenry County 2030 and Beyond Plan. The Plans recognize that open space and agriculture are two things that are nearly impossible to restore once they're gone. Preserving these resources requires a concerted effort to limit incompatible development that might encroach from more urbanized areas. In the interest of preserving the county's rural landscape and its environmental, recreational, and agricultural value, the Plans suggest that most new residential growth should occur within municipalities. Concentrating residential development within municipal boundaries is consistent with smart growth strategies discussed elsewhere in this plan and reduces further fragmentation of agricultural parcels. This can also help avoid conflicts about drainage or flooding that often arise where residential development and agricultural land converge.

*** Photo of farmfield in foreground and new subdivision in the background ***

As the agricultural industry continues to evolve and diversify, McHenry County should continue to value agriculture in all of its forms including commodity row crops, animal husbandry, dairy, nurseries, and equestrian farms. Additionally, a growing number of specialty farms and local farmers are finding new markets by selling directly to the consumer through direct sales, farm stands, farmers markets, agritourism, community supported agriculture, and farm-to-table events. The county should continue to support these activities and develop other ways to support local farmers bringing their products to market, such as through a local food distribution hub or food cooperatives. These and other food-system planning recommendations can be found in the McHenry County Local Food Assessment, which was initiated to support a strong sustainable local food system and promote farmland preservation in McHenry County.

*** Photo of Salute grapes-multicolored group ***

According to the 2017 Census of Agriculture, 91% of the county's farmland is in cropland, 2% is in pastureland, 2% is in woodland, and 5% is used for other forms of agriculture. The market value of agricultural products from McHenry County that were sold in 2017 was $163,751,000, with $123,350,000 of that from crops, and $40,402,000 from livestock, poultry and products. The bulk of the farmland in McHenry County is used for commodity row crops with 160,048 acres (or 77% of farmland in McHenry County) planted for corn or soybean P1.

*** Photo of tracked tractor plowing field of bare soil ***

While agriculture is obviously an extremely important and highly regarded land use in McHenry County, many of the farming practices that are commonly used today have negative impacts on water resources. Common farming practices can:

- Degrade soils ability to hold and infiltrate water
- Cause erosion, soil loss, and sedimentation
- Contribute to increased flooding
- Pollute water (groundwater and surface water)
- Reduce groundwater recharge
- Release greenhouse gas emissions.

*** Photo of "storm over farmfield" ***

The impacts to water resources generally begin with the practice of plowing and tilling the soil. This involves turning over the soil to control weeds and prepare the ground for seeding. The tilling process fractures the soils structure and degrades the soils aggregate stability. This compacts and clog's the soils pore spaces, thereby reducing the soils water holding capacity and leaving degraded soils susceptible to erosion and soil loss. The eroded soils are carried downstream leading to sedimentation of the county's waterways. Tilling also kills the living biota in the soil, including beneficial organisms that under natural conditions help distribute nutrients, improve soil structure and increase soils water holding capacity. Tilling leaves the soil bare, exposed, and susceptible to erosion from wind and water for much of the year. Without vegetative cover the cumulative impacts from millions of raindrops, which typically fall at rates of up to 20 miles per hour, dislodges the bare, degraded soil particles and splashes them up to 3-5 feet away P19. The splashed particles then clog soil pores, seal off the soil surface and reduce infiltration. Instead of soaking into the ground, the rainfall collects on the surface and flows overland as stormwater runoff where it can cause further erosion, pollute water and possibly contribute to flooding.

*** Photo of "chocolate milk" runoff flowing off of farmfield ***

Farmers apply nutrients on their fields in the form of chemical fertilizers, animal manure, and bio-solids to provide nitrogen and phosphorus to help their crops grow. Pesticides, including herbicides, insecticides, rodenticides, and fungicides are also applied to fields to protect the crops. However, excess nitrogen, phosphorus and pesticides may be washed into waterways or groundwater if rainfall occurs before plants can fully utilize the chemicals or they can be broken down. Under these circumstances, excess nitrogen, phosphorus or pesticide regularly wash off of farm fields and into waterways during rain events or when snow melts, and can also leach through the soil and into groundwater.

*** Photo of Anhydrous Ammonia tank(s) ***

The pesticides can be toxic to humans and aquatic wildlife, can pollute surface water or ground water and have the potential to contaminate drinking water. High levels of nitrogen and phosphorus can cause eutrophication of water bodies. Eutrophication can lead to hypoxia ("dead zones"), causing fish kills and a decrease in aquatic life. Excess nutrients can cause harmful algal blooms (HABs) in freshwater systems, which not only disrupt wildlife but can also produce toxins harmful to humans. As precipitation patterns and storm intensity continue to increase, the levels of nutrients and pollutants washing off fields are also likely to increase.

*** Photo of MCDOT algal bloom next to ag field ***

These excess nutrients not only degrade local water resources but are also having impacts across the country. For instance, the dead zone in the Gulf of Mexico, near the mouth of the Mississippi River, is a hypoxic zone of the ocean that can regularly cover from 6,000-7,000 square miles P2. Without enough oxygen to support marine life, habitats that would normally be teeming with fish have become a massive dead zone as aquatic life either dies or leaves the area. The dead zone in the Gulf of Mexico is primarily caused by nutrient enrichment from the Mississippi River, particularly nitrogen and phosphorous. Most of the excess nutrient input comes from major farming states in the Mississippi River Valley, including Minnesota, Iowa, Illinois, Wisconsin, Missouri, Tennessee, Arkansas, Mississippi, and Louisiana P2. About 67% of nitrogen that enters the Mississippi River north of its confluence with the Ohio River is agricultural in origin (Petrolia & Gowda, 2006), and tile drainage is the major pathway for that pollutant P3.

*** Provide map of the dead zone in the gulf ***

Farms with livestock operations usually involve holding a number of animals in relatively small areas. The animals produce large amounts of manure and urine that are rich in nutrients, including nitrogen and phosphorus, which are potential pollutants. Concentrated livestock on feedlots and overgrazing can expose soils and increase erosion. The more animals, and the larger the operation, the more waste and potential pollution is produced. If not properly managed these pollutants can seep into groundwater or flow offsite to pollute lakes, ponds, rivers, streams, or wetlands and contribute to national nutrient loading problems. Farmers with feedlots can limit discharges by storing and managing facility wastewater and runoff with appropriate waste management systems. Farmers with grazing can adjust grazing intensity, implement rotational grazing, keep livestock out of sensitive areas, provide alternative sources of water and shade, and promote revegetation of ranges, pastures, and riparian zones.

*** Photo of cows facing camera ***

There are numerous methods to manage the nutrients added to farm fields that are designed to reduce or eliminate excess nutrients from moving offsite. These are often referred to as Conservation Practices (CP). The CPs discussed below are classified following a systems approach of Avoiding, Controlling, Trapping (ACT) that was developed by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to address priority natural resource concerns P9. When applicable, the title of the CP is provided below followed by the USDA's CP number in parenthesis:

- Avoidance: Avoidance CPs help producers avoid causing pollution by reducing the amount of nutrients and sediment available in runoff or leaching into water bodies and watersheds. CPs such as cover crops and crop rotation help take up nutrients and stabilize soils to avoid potential runoff and pollution. Crop rotations that include differing crops, such as legumes, can limit or eliminate amounts of chemical fertilizers that need to be applied.

- Controlling: Land treatment CPs that prevent the loss of pollutants include conservation tillage and residue management, which improve infiltration, reduce runoff, and control erosion. Adding CPs such as Cover Crops, will amplify water quality benefits by helping with "Avoiding" as well as "Controlling."
- Trapping: Trapping is the last line of defense against runoff at edge of fields to trap or treat nutrients, sediment, or other pollutants. CPs such as Buffers, Filter Strips, Bioreactors, and a suite of wetland practices to create, enhance, and/or restore wetlands all serve to trap and uptake nutrients before entering water bodies.

*** Sidebar explaining how to use the NRCS electronic Field Office Technical Guide to access information on NRCS Conservation Practices ***

Avoidance Conservation Practices

- Conservation Cover (327) - Conservation cover is establishing and maintaining perennial vegetative cover to protect soil and water resources on lands needing permanent cover that will not be used for forage production. Conservation cover reduces soil erosion and sedimentation, enhances wildlife habitat, and improves water quality. Operation and maintenance of the conservation cover includes mowing to control weeds and maintain vegetative cover. Additional measures may be necessary to control noxious weeds and other invasive species. If wildlife habitat enhancement is a goal, maintenance practices and activities must not disturb cover during the reproductive period for the desired species. To benefit insect food sources for grassland nesting birds, spraying or other control of noxious weeds will be done on a "spot" basis to protect forbs and legumes that benefit native pollinators and other wildlife.
- Cover Crops (340) – Cover crops are grasses, legumes, or forbs that are planted with, or between, annual cash crops to ensure that the soil is covered at all times. The cover crops help restore soil health, protect soils from erosion, build organic matter, improve infiltration and water holding capacity of soil, suppress weeds, help control pests and diseases. Cover crops have also been shown to increase crop yields, break through a plow pan, add organic matter to the soil, improve crop diversity on farms and attract pollinators. There is an increasing body of evidence that growing cover crops increases resilience of agricultural production in the face of erratic and increasingly intensive rainfall, as well as under drought conditions P4. Operation and maintenance of cover crops include: controlling weeds by mowing or by using other pest management techniques, and managing for the efficient use of soil moisture by selecting water-efficient plant species and terminating the cover crop before excessive transpiration. Use of the cover crop as a green manure crop to cycle nutrients will impact when to terminate the cover to match release of nutrient with uptake by following cash crop.
- Livestock or Streambank Fencing (382) - Fencing or constructed barriers to prevent livestock, wildlife, or people from accessing sensitive areas such as streams or lakes. When livestock access water bodies they can damage the shoreline and cause erosion. They can also cause pollution by urinating and defecating in or near the water. By installing fencing to preventing access, streambanks can be stabilized, erosion can be prevented and water quality can be protected. Consider the species of livestock that will need to be excluded when deciding on the type of fencing that will be used. Install fencing as far away from streambank as possible and provide a buffer or filter strip to further protect water quality and prevent erosion. It is recommended that the stream fence have a maintenance gate installed. Woven wire fencing is

not recommended for use in riparian areas due to potential for flooding damage. Operation and maintenance may include repair of fencing and mowing to keep fencing free of vegetation.

*** include photo of livestock in Nippersink Creek (provide note that fencing will keep livestock out of water) ***

- Nutrient Management (590) - Nutrient management is the management of the application rate, timing, source, and placement of fertilizers, manure, and other soil amendments. The nutrients that have the greatest impact on water quality are nitrogen and phosphorus but Potassium is another necessary nutrient. This methodology follows the 4Rs of nutrient management:

  The **R**ight fertilizer source – Match fertilizer type to crop needs

  At the **R**ight rate- Matches amount of fertilizer type to crop needs

  At the **R**ight time – Makes nutrients available when crops need them

  In the **R**ight place – Keeps nutrients where crops can use them

  Nutrients are only applied when testing shows they are needed and at the appropriate rates based on the testing. The nutrients are applied when plants are best able to absorb the nutrients and with enough time before forecasted storms to prevent the nutrients from being washed away. The nutrients are applied in the optimal location for plants to utilize them accounting for spatial variability within a field.

- Integrated Pest Management (IPM) – IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target species and avoiding harm to non-target organisms. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment including surface water and groundwater. Some IPM approaches include:

  Use knowledge about the pest's habits, life cycle, needs and dislikes

  Use the least toxic methods first, up to and including pesticides

  Monitor the pests' activity and adjust methods over time

  Tolerate harmless pests

  Set a threshold of where an economic harm will be incurred as a trigger to act

  Determine if promoting beneficial insects may help prevent or control pests on crops

Controlling Conservation Practices

Tillage is the agricultural practice of mechanically turning the upper layers of soil on a farm field to prepare the ground for planting, controlling weeds, removing plant residue and loosen compacted soil. Tillage that is deeper and more thorough is classified as primary tillage and tillage that is shallower or more selective is secondary tillage. With conventional tillage practices, only 0% to 15% of the crop residue will typically remain on the farm field after planting P10, leaving the soil uncovered and unprotected for much of the year. The physical turning of the soil also releases carbon dioxide to the

atmosphere P20. The unprotected soils are susceptible to erosion and the loss of nutrients which results in pollution and sedimentation downstream. An increased awareness of soil loss and a growing interest to reduce erosion and pollution have led to more conservation minded tillage practices. A primary goal of conservation oriented tilling is to leave more plant residue, or cover, to protect the soil. Generally speaking, the more vegetative cover that is left on the fields the better protection from rainfall is provided, which results in less erosion and pollution. In many cases the conservation oriented tillage practices have also resulted in reduced operational costs and labor.

- Reduced Tillage – Tillage practices that still employ a full-width tillage system, but uses conservation oriented practices to leave 16 to 30 percent of plant residue after planting P10.
- Conservation Till – Conservation tillage is a broadly defined practice that can include strip till, ridge till and mulch till systems. These techniques leaves at least 30 percent crop residue after planting P10.
- No Till – No till farming is the practice of planting crops without tilling the soil. Instead, the crop seeds are planted directly through the remains of previous crops by planters or drills that cut a narrow V-slot (seed furrow) in the soil, places the seeds in the furrow, and closes the furrow. With no till, at least 60% of plant residue is left on the soil surface after planting, which provides greater protection of soil than other tillage practices P10.

***NEED good quality photo or graphic of no till (possibly comparison of tillage practices) ***

- Drainage Water Management (554) - Drainage water management (DWM) is a practice used to control or manipulate the ground water elevation in a drain tile field. Water in a drain tile system is periodically held back within the root zone by adjusting the elevation in the tile system's water control structure. DWM manages the timing and volume of drainage discharges so that drainage water can be available when needed and released at a controlled rate when it is not. With DWM, both water quality improvement and crop production benefits are possible. Water quality benefits are derived by minimizing unnecessary tile drainage and reducing the amount of nitrate that leaves farm fields. DWM systems can also retain water in fields that could be used for crop production later in the season. DWM is not suitable for all sites depending on soil and topography (flat topography most appropriate). Operations and maintenance include removing or adding boards to water control structures throughout the seasons. The following operations schedule was provided by the Blanchard River Demonstration Farms Network P20:

    1. Before tillage, remove riser boards to drop water table levels about 10 days prior to planting fieldwork/operations.
    2. During the growing season, stack riser boards to potentially raise water table high enough to provide capillary water to crop root zone.
    3. Before harvest, if needed, remove boards to lower water table 10 days before Fall fieldwork.
    4. After harvest, install riser boards to potentially raise water table up even further–near ground surface–to hold water and nutrients in the field/soil over winter.
    5. The drain outlet shall be raised prior to and during liquid manure applications to prevent direct leakage of manure from drainage pipes through soil macro pores (cracks, worm holes, root channels).

    *** Include DWM graphic ***

- Grassed Waterways (412) – A grassed waterway is a shaped or graded channel that is established with suitable vegetation to convey surface water at a non-erosive velocity using a broad and shallow cross section to a stable outlet. The grassed waterways are constructed to convey runoff from concentrated flow areas, terraces or diversions where erosion control is needed to prevent erosion and to improve water quality by reducing sediment carried by runoff. When possible, species of vegetation should be selected that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff.

  Grassed waterways can be installed on most fields but are especially effective in controlling gully erosion on steep slopes. Grassed waterways can improve water quality by preventing gully erosion, filtering sediments and pollutants, and providing volume reduction of runoff. A 1992 study found that grassed waterways reduced sediment load by 70%, Phosphorus by 30% and Nitrogen by 25% P5. The grassed waterways must be maintained to make sure they continue to function properly. Operations and maintenance should include making sure the waterways remain properly vegetated, have not developed rills or gulleys in the waterway or along the sides, and have not developed berms on the sides that would prevent water flowing in. Periodic mowing or other controls may also be necessary to prevent the establishment of invasive species. If herbicides are being applied operator must make sure the sprayers are shut off while crossing the waterway. Similarly, if fields are being tilled, lift tillage equipment when crossing the waterway. If damage occurs, re-seed immediately to prevent erosion and more costly repairs.

***NEED good quality photo of grassed waterway ***

- Rotational Grazing (528) – Rotational grazing (also known as prescribed or controlled grazing) refers to managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives. Management of grazing systems can maintain the health of vegetation communities, control forage quality, reduce erosion, improve water quality and watershed function, expand or improve wildlife habitat, and promote economic sustainability. Rotating grazing animals is a management-intensive system of raising livestock on subdivided pastures called paddocks. Livestock are regularly rotated to fresh paddocks at the right time to prevent overgrazing, maintain vegetative cover, optimize vegetation growth, and prevent erosion.

  *** Photo of Terra Vitae Farms livestock ****

  Animal rotations can vary from a simple rotational grazing system (Figure 1) in which animals move or rotate to a fresh paddock every 3-6 days, to an intensive rotational grazing system, frequently referred to as “mob grazing” (Figure 2) in which animals are moved to a fresh paddock as frequently as every 12 hours. A rotation of livestock is frequently followed by a rotation of chickens who break up and spread the manure, eating and digesting insects or other potential pests, which helps to further expedite the breakdown of manure and facilitate uptake of nutrients by vegetation. The frequent movement of animals protects water quality and reduces labor by distributing manure over larger areas where it can aerobically decompose on stable vegetated ground. Fecal coliform and turbidity have been found to be consistently lower at the rotationally grazed sites than at the continuously grazed sites P8. Following the grazing

period, the paddock is rested for a sufficient period of time, so the forage plants remain in a healthy and vigorous condition. As part of operations and maintenance, monitoring data and grazing records should be maintained and referred to on a regular basis to ensure the objectives of the prescribed grazing plan are being, or to make necessary changes in the prescribed grazing plan to meet those objectives.

*** include rotational grazing figures from Agricultural BMP Handbook for Minnesota ***

*** SIDEBAR for Terra Vitae Farms regenerative/restorative grazing ***

- Clean Water Diversion for Open Feedlots –In open feedlots, large amounts of manure are deposited in relatively small areas. Open feedlots, and any animal pens that are exposed to snow and rainfall, will create manure-laden runoff. If there are not provisions to control runoff or if manure management facilities are mismanaged, the open feedlots can be potential sources of pollution. Creating raised berms or grassed waterways to divert clean (manure-free) water around the livestock pens can improve pen conditions and reduce the amount of pen runoff to be handled, stored, and distributed. Rooftop runoff, as well as any runoff water from fields and yards that does not contain manure or feed, should be diverted around animal pens and manure control areas. Providing clean water diversion for open feedlots can improve animal pen conditions, minimize the amount of manure-laden runoff water that needs to be managed, and reduce the potential for pollution. As part of operations and maintenance vegetation on raised berms or flowpaths should be maintained to prevent erosion and the formation of rills or gullies. Repairs should be made immediately.

  *** Include photo of feedlot diversion from Iowa State Extension ***

Trapping Conservation Practices

- Filter Strips (393) - Filter strips are borders of grass or other permanent vegetation that are used to reduce the velocity of water, allowing suspended solids to settle out, runoff or soluble pollutants to infiltrate, pollutants to be absorbed on soil and plant surfaces, and soluble pollutants to be taken up by plants. These strips of vegetation are typically placed between pasture or cropland and environmentally sensitive areas such as , lakes, streams, ponds, wetlands or drainageways to protect water quality and prevent erosion. The filters strips are also very effective in treating animal waste and can be located along pastures, feedlots, and winter feeding areas to reduce water pollution. Filter strips can reduce nitrogen (to 77%), phosphorus (to 94%) and organic matter (to 96%) in animal waste runoff P17. The filter strips typically need to be mowed to promote dense vegetative growth and control the establishment of weeds.

  *** *** NEED quality photo of filter strips ***

  Filters strips can also serve as important buffers to prevent erosion along a waterway. With perennial vegetation slowing down the velocity of runoff, the potential for erosion and scouring is reduced and the potential for infiltration is increased.

  *** Photo of river with crops up to edge of eroded banks and a graphic showing Filter Strip***

- Dentrifying (woodchip) Bioreactor (605) - Bioreactors are practices that utilize a carbon source, commonly woodchips, to support the removal of nitrate-nitrogen from subsurface agricultural tile drainage. They remove nitrate by the process of denitrification. Under anaerobic conditions, bacteria use carbon from the woodchips in their conversion of nitrate to nitrogen (N) gas. Advantages of denitrification beds are relatively high rates of nitrate removal, small footprints, minimal maintenance during the design life, and low installation costs.

  *** NEED photo of bioreactor ***

  Woodchip bioreactors typically consist of an excavated trench, approximately 5 feet to 25 feet wide, by dozens of feet long, and about 4.5 feet deep that is filled with woodchips. The trench is designed to connect with a drain tile on the high end of the trench and an outlet on the low end of the trench. Water from the drain tile flows through the bioreactor. Microorganisms on the wood chips consume the nitrates in the water and expel it as nitrogen gas. Woodchip bioreactors typically reduce average annual nitrate loadings in the range of 35% to 50% P7. The maintenance may include moving stop log levels a few times a year and the woodchips will likely need to be replaced after about 15 years P21.

- Constructed (Treatment) Wetlands (656) - Constructed wetlands, sometimes called treatment wetlands, are man-made ecosystems engineered to simulate the water-cleansing process of natural wetlands. The constructed wetlands are planted with native wetland vegetation and designed to hold sufficient amounts of water to support wetland hydrology. For agricultural purposes, constructed wetlands (656) are used to filter wastewater, contaminated runoff, and sub-surface drainage from cropland, feedlots, aquaculture operations, and agricultural processing facilities. The constructed wetland can be designed to be part of a wastewater treatment system where the outflow will be recycled for use in land applications; to capture and store seasonal surface and subsurface runoff from upstream for use when it is needed; or to improve the quality of stormwater runoff by filtering and reducing nutrients, sediment or other pollutants. Case studies in Maryland, Illinois, and Iowa indicate wetlands can remove 68% of nitrate-nitrogen and 43% of phosphorus can be retained from drainage water P18.

  *** NEED photo of constructed agricultural wetland (or non-ag constructed wetland) ***

  The vegetation installed should consist of native species suitable for the soils and hydrology. On-going operations and maintenance includes managing the hydrologic control structure to maintain appropriate hydrology and control of non-native or invasive vegetation. The design must allow the constructed wetlands to be drained completely for maintenance. Constructed wetlands should not be constructed in existing wetland should located to avoid impacting existing wetland. While wildlife may utilize them, the main goal of the constructed wetlands (656) is for water treatment which tends to limit the diversity of vegetation and wildlife. If wildlife habit is the primary goal, Wetland Restoration (657) or Constructed Wetlands (658) would be more appropriate standards to follow.

*** Sidebar – “The nation that destroys its soil destroys itself” Franklin D. Roosevelt P11 ****

*McHenry County farmers, along with the agencies and organizations that support them, should take a leadership role in adopting no till, cover crops, and other conservation practices that restore soil health in order to protect water resources, make farms in the county more resilient to extreme weather, and improve profitability.*

There are a number of conservation practices that can be implemented on farms to protect water resources in McHenry County. The conservation practices can help stabilize soil, prevent erosion, keep nutrients in the soil and on the farm property, and reduce the need to apply additional nutrients or chemicals. The right practice should be employed based on the farming activity and the potential threat to water resources. There are agencies and organizations that can provide both technical and financial assistance to properly, and profitably, implement the conservation practices.

Improving the health of soil is one of the most important steps that can be made to better manage water resources, improve water quality, increase farm profitability, and preserve agriculture in the county. Since only living things can be healthy, it helps to understand that healthy soil is a living ecosystem teeming with billions of bacteria, fungi, and other microbes that work together to sustain plants, animals and people. Soil is an ecosystem that when properly managed can provide nutrients for plant growth, absorb and hold rainwater for use during dryer periods, filter and buffer potential pollutants from leaving fields, provide a solid foundation for agricultural production, and provide a diverse habitat for soil microbes to flourish and keep the ecosystem running smoothly.

*** NEED photo(s) of healthy soil or photos comparing healthy vs unhealthy ***

Soil health improves as the level of organic matter increases, which in turn helps rebuild the soil structure and porosity, and creating better habitat for the soil organisms. A soils capacity to absorb water and promote infiltration is directly related to the soils health including soil structure and porosity. Managing soil health is largely a matter of building organic carbon and maintaining suitable habitat for soil organisms. This can be accomplished by following five general principles for soil health:

1. **Minimize soil disturbance** – Soil disturbance can occur in different forms including:

   **Physical disturbance** such as tillage that is destructive to soil microbes, results in bare, exposed, and unprotected soils with diminished soil structure that is prone to erosion.

   **Chemical disturbance** such as over application of nutrients or pesticides that can result in disruption of the food web between fungi, other microorganisms, and plant roots.

   **Biological disturbance** such as overgrazing that results in reduced root mass, increased runoff and limits plants ability to harvest CO2 and sunlight.

2. **Increase plant diversity** – Having a diversity of plant species produces a variety of carbohydrates that can support a diversity of soil microorganisms in the soil. The diverse soil organisms help provide nutrients and water to plants as well as help fend off diseases and pests.

3. **Maintain continual rooted/live plants in the soil** - Living plants maintain a rhizosphere, an area of concentrated microbial activity close to the root. Since living roots provide the easiest source of food for soil microbes, growing long-season crops or a cover crop following a short-season crop, can maintain food resources for the foundation species of the soil food web.

4. **Keep soil covered to maintain soil armor** - Soil cover intercepts rain and protects soil from erosion, conserves moisture, warms soil in winter/reduces temperature in summer, suppresses weed growth, and provides habitat for members of the soil food web.
5. **Carefully timed livestock integration** – Animals, plants and soils have maintained a synergistic relationship over geologic time. Integrated crop-livestock operations can result in many soil health benefits. Livestock manure adds organic matter to the soil. Livestock can be added to a cropping system by allowing them to graze a cover crop or by rotating fields to perennial forage crops. The deep rooted forage crops or cover crops improve soil structure while helping to keep nutrients on the farm.

Properly implementing these principles to improve soil health should include the use of no-till practices and cover crops. As previously discussed, instead of turning the soil and leaving it bare, no-till practices leave at least 60% of the previous crops roots and stubble in place. The stubble intercepts rain, protects the soil from erosion, and promotes infiltration. The seed of the next crop is simply drilled into the soil through the stubble. Over time, continuous no-till improves the balance of nutrients and soil organisms, increases soil particle aggregation and makes it easier for plants to establish roots and to retain moisture so water can be available for crops in late summer. Additionally, there is a reduction in greenhouse gas emissions since CO2 that would have been released during tilling remains in the soil. Because the farmer does not need to plow the fields, no-till requires less labor and lowers operational costs from reduced fuel use and wear on machinery.

*** NEED photo of stubble on no-till field ***

No-till practices and cover crops provide many benefits, but adopting both can help the transition from conventional-till to no-till. In many cases, corn yields can drop slightly for five to seven years when converting from conventional-till to no-till practices. This is because tillage briefly injects oxygen into the soil that stimulates bacteria and microbes to decompose organic residues and release nutrients. These are short-term gains though, because continuous tillage breaks down and reduces organic matter causing soil productivity to decline over time. On the other hand, after seven to nine years of continuous no-till, fields will produce higher yields than conventionally tilled fields because the soil health improves, microbes and soil fauna return, and nutrients are restored. Adding cover crops provides the ability to jump-start no-till, potentially eliminating any yield decrease to corn and helping farmers adapt faster to a continuous no-till system P22.

*** Photo comparing cover crop field with field of bare soil ***

Cover crops are crops of specific plant species that are grown primarily for the benefit of the soil rather than to provide a crop yield. Cover crops are usually planted to help maintain live roots and soil cover between rotations of cash crops. Their function is to stop erosion, cut down on weeds, improve water quality, and enrich the soil health. The biomass below and above ground provide sources of nutrients and carbon to feed microbes and other soil organisms which in turn build organic matter in the soil. As the organic matter increases the soil structure and porosity improves which increase the soils ability to store and infiltrate water. The persistent cover helps to protect soil from rainfall and erosion while also suppressing weeds. The increased diversity of plant species help increase the diversity of organisms in the soil that help distribute water and nutrients as well as control diseases and pests. The use of cover crops can provide many benefits including:

- Protect Farms from Flood and Drought – The cover crops increase the soils ability to absorb and infiltrate water reducing flood damage and allowing farmers to return to fields quicker after flooding. The healthier soils and cover crops help to conserve water and reduce moisture stress during periods of drought.
- Saves Time – Not having to till and reducing applications of fertilizer and herbicide can result in less time in the field.
- Cut Fertilizer Costs – Many cover crops contribute nitrogen to the soil or are able to scavenge and mine soil nutrients. Legume cover crops convert nitrogen gas in the atmosphere into soil nitrogen that crops can use thereby reducing the need to purchase and apply additional fertilizer. Less fertilizer saves money and protects water quality.
- Reduce the Need for Herbicide and Other Pesticides – Cover crops suppress weeds and reduce damage by diseases, insects and nematodes. Cover crops accomplish this by smothering weeds or outcompeting them for water and nutrients; blocking light or altering light frequencies that shade out weeds; providing root exudates or compounds that provide natural herbicidal effects. This protects water quality and reduces operating costs.
- Improve Crop Yields by Enhancing Soil Health – Quick growing cover crops hold soil in place and protects soil from wind, rain, and erosion and speeds up infiltration of excess surface water. The cover crops improve soil health by building soil fertility, structure and tilth which relieves compaction and accelerates root growth. The addition of organic matter encourages beneficial microbial life and enhances nutrient cycling.
- Protect Water Quality – Cover crops reduce the need to apply nutrients and chemicals thereby reducing the potential for pollution. By preventing erosion and runoff, cover crops reduce nonpoint pollution caused by sediments, nutrients and agricultural chemicals. Additionally, cover crops can take up excess nutrients and prevent leaching to groundwater.
- Help Safeguard Personal Health – By reducing reliance on agrichemicals cover crops help protect the health of farm families, neighbors and workers.

There are a wide range of cover crop species that can be used to match the timing of crop rotation, the season, and soil types in McHenry County. Many of the cover crop species have deep roots that help increase the soils capacity to hold water and promote infiltration. Since some species provide high levels of nitrogen the need for adding chemical fertilizer is reduced or eliminated, thereby reducing the potential for water pollution. Other species are effective at taking up excess nutrients and preventing them from leaching into groundwater. Farmers will select species of cover crops to meet their needs and goals. They may also plant multiple species at the same time, sometimes referred to as a "cover crop cocktail" to provide a wider variety of benefits. The use of cover crop cocktails provides the added benefit of increasing species diversity which increases the diversity of soil organisms and improves the health of the soil. In the most general terms, cover crops can be thought of as warm and cool season grasses or warm and cool season broadleaf species.

Legumes that produce a substantial amount of growth, such as hairy vetch and crimson clover, may supply over 100 pounds of nitrogen per acre to the next crop. Legumes such as field peas, bigflower vetch, and red clover usually supply only 30 to 80 pounds of available nitrogen. Crops grown on fields after legumes can utilize at least 30 to 60 percent of the nitrogen the legume produced. Fertilizer applications of nitrogen can be reduced accordingly P12. Legumes also provide other benefits, including attracting beneficial insects, helping control erosion, and adding organic matter to soils.

Commonly used grass cover crops include the annual cereals (rye, wheat, barley, oats), annual or perennial forage grasses such as ryegrass, and warm-season grasses such as sorghum–sudan grass hybrids. Grass species can also be useful for scavenging nutrients, especially nitrogen, left over from previous crops. They tend to have extensive root systems, and can establish rapidly to help reduce erosion. In addition, they can produce large amounts of residue that can help add organic matter to the soil. Because of their extensive cover, grasses are also effective at suppressing the germination and growth of weeds.

Buckwheat is a summer annual that is easily killed by frost, grows well on low-fertility soils, and completes its life cycle quickly. It can grow more than two feet tall in the first month after planting making it useful to suppress weeds. It may also suppress root pathogens. Although its seeds do not disperse widely, buckwheat can reseed itself and become a weed so it may need to be mowed before seeds develop.

Several plants in the Brassica family are used as cover crops including mustard, rapeseed, and forage radish. The Brassicas are increasingly used as winter or rotational cover crops in vegetable and specialty crop production. Canola can grow well under the moist and cool conditions of late fall, when other kinds of plants are going dormant for winter. Forage radish can be particularly useful because of its fast growth in late summer and fall, which allows significant uptake of nutrients. The radish develops a large taproot, approximately one to two inches in diameter and a foot or more deep. The radish taproot can break through compacted layers of soil, improving infiltration and allowing deeper rooting by the next crop. Forage radish will winterkill and decompose by spring, but it leaves the soil in friable condition, improves soil aeration, and enhances the soils ability to store and infiltrate rainfall.

*** NEED Photo of radishes, and/or the holes they provide ***

Although cover crops can benefit water quality by reducing or eliminating the need for additional applications of fertilizer or pesticide for weed control, the cover crops do need to die back to provide organic matter for the soil and to prepare the field for planting the next crop. If the cover crop is not one that dies in winter (winterkill) then it will need to be terminated. Some crops can be terminated using a “roller-crimper” to knock the vegetation over and cut the stems. However, depending on the cover crop and the farmer’s practices, herbicide may be used to terminate (burn off) the cover crop. Care must be taken to only apply what is needed to terminate the crop while minimizing disturbance of the soil, and the soil organisms. In either case the organic material is available to build organic material in the soil.

*** NEED photo of tractor rolling-crimping cover crops ***

Implementation of no-till and cover crops on agricultural fields throughout McHenry County can help to reduce flooding, erosion, nutrient loss and pesticides in runoff. Additionally, these practices will help make farms more resilient to the increased precipitation, storm intensity, temperatures and drought that is expected. By building organic matter and improving soil health these practices will also help ensure agricultural opportunities are available for future generations.

*The County, Natural Resource Conservation Service, Farm Bureau, McHenry County College, other organizations should coordinate to provide training, education, or other support to help farmers implement no-till, cover crop, and other conservation practices that protect water resources.*

Since conservation practices such as no-till and cover crops may include new operations or applications that are not currently standard practices in the region, additional education, training and effort will likely be required to help farmers adapt to conservation practices. To help reduce obstacles for successful implementation, organizations and institutions should collaborate to obtain grants or other funding sources to assist farmers, provide training and education, create opportunities for experienced guest farmers to share experience, and provide other forms of support.

*** NEED photo of training on farmland or famer education program ***

*Residents, businesses, and institutions in McHenry County should support farms that produce food locally and sustainably to enhance food security, maintain the county's agricultural heritage, and protect water resources.*

In the early 1900's approximately 40 percent of Americans lived on farms, compared to 1 percent in 2000, and much of the food consumed in the U.S. was grown locally P23. Since few foods were processed or packaged, much of the food typically travelled less than a day to market. Communities understanding of the quality of foods were based largely on direct contact with the farmers. After World War II, the U.S. food system shifted from local to national or even global food sources. With improvements in transportation, food production developed regional or global specialization and perishable items could be shipped across the globe at affordable prices. Over the past several decades U.S. imports of food continued to grow. According to the U.S. Food and Drug administration, the U.S. now imports about 15 percent of its overall food supply P13.

In recent years, developments in the mainstream food system have been accompanied by growth in local food systems and evidence suggests there is significant demand for locally produced foods P14. Local food markets account for a relatively small but growing share of agricultural sales in the U.S. and McHenry County. As referenced in the County's 2030 Plan, 2030 and Beyond Plan, and the Local Food Assessment (LFA) Report, McHenry County is committed to local food production and agritourism. The LFA Report (P15) evaluated the local food market, identified potential barriers to its development, and made specific recommendations on how to improve the local food system. Following the report's recommendations the County has made changes to policy to remove barriers and encourage growth in the local food systems. The County should continue to implement changes and work with others to raise awareness and create better opportunities for local growers, producers and consumers to support each other.

*** Photo of Farmers market ***

Local foods tend to taste better than imported because they can be grown for flavor rather than durability. Access to local food can lead to healthier diets because if the food tastes better people are more likely to eat it. Local farms are able to offer greater variety of food, such as heirloom vegetables or specialized breeds, than the conventional mass produced options typically found in stores. Supporting local food helps the local economy by providing revenue to the farmer, by keeping the revenue in the local economy, and providing increased employment opportunities. Local food production, marketing and distribution can also drive entrepreneurial culture in a community leading to increased development of small businesses P16.

*** Photo of Terra Vitae Farms ***

*The County, municipalities, businesses, organizations and institutions should promote agritourism and ecotourism by highlighting its local food and sustainable farms; the scenic vistas and rural charm, and vast natural areas, to market McHenry County as a healthy destination for visitors to play, eat and explore.*

With its abundant natural open space, rural charm and close proximity to densely populated urban areas, McHenry County offers unique opportunities for visitors to enjoy the outdoors, scenic vistas, local food, and recreation that can only be experienced in a more rural, agricultural environment. By consistently promoting its healthy environment, sustainable farming practices, and local food production McHenry County can be widely recognized as a healthy destination for visitors to come play, eat and explore.

*** Photos of Sustainability Tour/Salute Vinyard ***

P1 2017 Census of Agriculture
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Illinois/cp17111.pdf
P2 https://serc.carleton.edu/microbelife/topics/deadzone/index.html
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P5 Schueler, T. R. | 1992. Design of Stormwater Wetland Systems, Metropolitan Washington Council of Governments, Washington, D.C., 133.
P6 https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/home/?cid=nrcs143_023568
P7 https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/cp/ncps/ Conservation Practice Standard 605 - Denitrifying Bioreactor Fact sheet (PDF, 2.09 MB)
P8 Sovell, L. A., Vondracek, B., Frost, J. A., & Mumford, K. G. | 2000. Impacts of Rotational Grazing and Riparian Buffers on Physicochemical and Biological Characteristics of Southeastern Minnesota, USA, *Streams. Environ. Manage., 26*, 629–641.
P9 https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1187023.pdf
P10 https://www.galesburg.com/news/20171016/conservation-tillage-trends-for-illinois-and-knox-county
P11 https://www.riceswcd.org/roosevelt-urges-states-to-create-conservation-districts/
P12 https://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition/Text-Version/Benefits-of-Cover-Crops
P13 https://www.fda.gov/food/importing-food-products-united-states/fda-strategy-safety-imported-food
P14 https://www.ers.usda.gov/webdocs/publications/46393/7054_err97_1_.pdf?v=0
P15 County Land, County Food: McHenry County Local Food Assessment Technical Report and Recommendations, Openlands and the McHenry County Agricultural Conservation Easement and Farmland Protection Commission (ACE)
P16 https://cefs.ncsu.edu/wp-content/uploads/research-based-support-for-local-food-systems.pdf
P17 https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ks/newsroom/features/?cid=nrcs142p2_033528
P18 http://www.jswconline.org/content/55/3/303.short
P 19 https://crops.extension.iastate.edu/encyclopedia/how-reduce-potential-soil-erosion-early-spring
P20 https://www.esrl.noaa.gov/gmd/icdc7/proceedings/abstracts/reicoskyLU373.pdf
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