**Introduction**

Soil management encompasses all operations, practices, and treatments used to protect soil and enhance its performance. Every aspect of a farm is related and dependent on its soil, so preventing erosion and improving soil quality should be the highest priority on all farms. Healthy soils are able to infiltrate and store water, cycle nutrients, support high crop yields, trap and degrade pesticides and toxins, suppress pests and weeds, and resist many natural erosive forces. Unfortunately, soil quality and health is relatively fragile and degrades quickly when stressful or destructive farming practices are maintained over a period of time. Degraded, unhealthy soils may exhibit poor soil structure, instability and compaction, less organic matter, reduced water and nutrient cycling, and become highly erosive. In order to achieve crop yield potentials, many farms offset poor soil performance with costly inputs of fertilizer, pesticides, and frequent aggressive tillage practices; resulting in the potential for contaminated runoff and water quality impairments.

**Environmental Concerns**

Soil management is extremely important because farms utilize many acres of the land base. As soil health decreases, runoff concerns increase. Soil erosion from farmland can carry sediments, nutrients, pesticides and potentially pathogens to surface waterbodies, degrading water quality. Concentrations of nutrients, especially nitrogen and phosphorus, can threaten aquatic habitats and contaminate drinking water supplies. Erosion of agricultural lands also contributes to the sedimentation of ditches, culverts, stream channels and shortens the life of ponds, reservoirs, and lakes. Stream corridors and floodplains may become unstable if farms till, crop, or pasture livestock too close to the stream banks; buffering vegetation and root structures are removed. Implementing proper soil management practices may eventually improve soil health and stability, thus decreasing runoff concerns and potentially threats to water quality.

**Potential Economic Benefits**

Soil erosion removes organic matter and topsoil, decreasing soil fertility, tilth, and water holding capacity, resulting in reduced crop growth and inefficient use of crop inputs. Compaction and soil crust layers restrict root growth and seedling emergence. In addition to degrading water quality, sediments from erosion may clog drainage and road ditches, culverts, and water courses leading to maintenance and repair costs and neighbor relation concerns. Farms that develop a Comprehensive Nutrient Management Plan and implement a systems approach to soil conservation will benefit by protecting against erosion and protecting water quality. Crop rotations, strip cropping, conservation tillage, cover crops, water control structures, and vegetative filter strips are just a few examples of good soil management practices. Overall, as soil health improves, all aspects of crop growth and production will improve resulting in profitability.
Summary of Pollution Prevention Practices

- Develop a Conservation Plan to Provide a Multiple Barrier Approach
- Minimize Soil Erosion
  - Adopt appropriate crop rotations.
  - Use conservation tillage practices or reduced tillage practices.
  - Spring tillage, contour tilling and planting, strip cropping, and water control structures.
  - Cover crops, mulches, or crop residues.
  - Managed livestock grazing and access.
- Minimize Soil Compaction.
  - Control equipment access and weight loads.
  - Managed livestock grazing and access.
  - Appropriate crop rotations and cover crops.
- Minimize Soil Contamination.
  - Apply nutrients and other chemicals according to CNMP, regulations, or specifications.
  - Monitor soils with appropriate soil tests.
- Maintain Buffer Zones.
  - Tillage setbacks and permanent vegetative buffers.
  - Restrict equipment and livestock access.
- Use Natural Resources Conservation Service Approved Best Management Practices.
  - Best Management Practices (BMPs) are designed to minimize nutrient and sediment contamination associated with land management practices.

When a soil management structural and/or cultural system is funded by EQIP or the NYS Agricultural Nonpoint Source Abatement and Control Program (ANSACP) a complete system of BMPs meeting NRCS Standards must result.

Summary of Regulations

Components that result in a complete system of BMPs meeting NRCS Standards that eliminate a resource concern may be eligible for cost-sharing. Livestock operations that have been designated as a CAFO are required to comply with CAFO regulations. Compliance with local and state laws should be adhered to, including the need for Erosion and Sediment Control practices for appropriate projects; full Stormwater Pollution Prevention Permits (SWPPP) are needed for construction activities (barns, buildings, houses, silos/bunks, stock yards/pens and ponds) disturbing more than one acre and any disturbances over 5 acres: does not include field practices. See the MOU for Implementation of Agricultural Best Management Practices – SPDES General Permit for Stormwater Discharges from Construction Activity (GP-02-01) for details on project permits.

Contact Dig Safely NY before any excavation. If any kind of public funds are to be used, contact New York State Office of Parks, Recreation and Historic Preservation (referred to as SHPO) to determine if the site may contain any artifacts of significant historic value or locations on the National Historic Register and other permits as applicable.

State Regulations—NYS DEC: CAFO Permit
Federal Regulations - EPA: General Information on CAFOs
Is there a current conservation plan in place that addresses soil management? If there is a plan, when was it last updated?

A Comprehensive Nutrient Management Plan (CNMP) and a Whole Farm Plan (WFP) are conservation plans, unique to animal feeding operations, designed to evaluate all aspects of farm production and offer conservation practices that help achieve production and natural resource conservation goals. The soil management plan is just one concentration area of the plan which is focused on resource concerns and Best Management Practices (BMPs) associated with the farm’s cropland. If a (CNMP) or (WFP) has been developed for the farm, is it up to date and being followed? Keeping the plan up to date will incorporate any changes in the farm operation (i.e., changes in crop fields, crop rotations, etc.) and will adequately address new concerns. Some farms (CAFOs) are required by NYS DEC to follow and update their (CNMP) annually.

The 1985 Food Security Act (as amended) required all operators enrolled in a USDA program to have a conservation plan developed by 1990 and fully implemented by 1995 for all fields that were determined to be Highly Erodible Land (HEL). The minimum level of treatment is established through (NRCS) Alternative or Basic Conservation Systems (ACS, BCS) by implementing land management BMPs to control erosion to “economically achievable” Tolerable Soil Loss (T) levels (ACS) or Tolerable Soil Loss (T) levels (BCS). These “basic” plans are not comprehensive and only deal with the erosion control component of a Resource Management System (RMS).

For More Information
NRCS – Comprehensive Nutrient Management Plan
Watershed Agricultural Council – Whole Farm Planning
Food Security Act – Highly Erodible Land Conservation

Is there visible erosion occurring in any fields?

Soil type/characteristics, slope steepness and lengths, precipitation events, concentrated flow paths, crop rotations, and tillage practices are just a few of the many factors contributing to soil erosion levels in a field. Intense storms, prolonged rain events, and snowmelt may saturate soils, limit soil infiltration, and increase water runoff and soil erosion. Compacted soils and surface crusts will also increase water runoff and erosion. Soil erosion removes valuable nutrients from the field and can degrade nearby water sources. Sheet and rill erosion removes soil in thin sheets or within small rivulets less than 1 inch deep. Ephemeral gully erosion is aggressive erosion channels formed by the combination of upslope rills; this type of erosion may be removed by tillage operations, but may reform each year. Classic gully erosion is more aggressive and concentrates water and soil in channels that cannot be controlled through normal tillage practices. Classic gully erosion may remove land from production or hinder equipment and animal movement across a field. The formation of gullies indicates high soil erosion rates, above Tolerable Soil Loss (T) levels. Large contributing watersheds, landscape topography, and concentrated flows should be examined for potential water control BMPs to minimize gully erosion. There are many types of structural and cultural BMPs that address different areas of the landscape, soil health levels, and overall farm management which may significantly decrease soil erosion levels and potentially improve water quality.

For More Information
NRCS - Web Soil Survey
Define Area of Interest→Soil Data Explorer→Soil Properties & Qualities→Soil Qualities & Features→Drainage Class
NRCS – Erosion Prediction (RUSLE2)
Cornell University – Cooperative Extension – Agronomy Fact Sheet Series #29 – Soil Texture
Does sediment from crop fields reach a water course? List fields with erosion concerns:

Erosion of agricultural lands contributes to the sedimentation of ditches, culverts, stream channels, and shortens the life of ponds, reservoirs, and lakes. Permanently vegetated buffer zones along field edges, water courses, and other highly sensitive areas may potentially protect water quality by filtering or decreasing the loading of sediments, nutrients, pesticides, and pathogens from cropland runoff.

Tilling and cropping soil too close to water courses removes buffering vegetation and developed root structures; loose soil is exposed and becomes more likely to erode. In addition, fields sloping towards a water course with high erosion levels will most likely transport sediment as well. Excluding livestock access from water courses and establishing a buffer zone will also reduce streambank erosion and contamination risks. Operating farm land without a buffer zone to water courses also degrades wildlife and aquatic habitat along the water course. Decreasing sedimentation and contamination risks can be very difficult when operating cropland in a floodplain or along stream corridor. There are many BMPs that are specifically related to operating agricultural lands in these areas; see reference below for more information.

For More Information
NYS AEM – Tier 2 Worksheet – Stream and Floodplain Management
NYS Conservation Reserve Enhancement Program

What type of tillage practices(s) is used on the farm?

Frequent full-width tillage practices (many equipment passes) disturb 100% of the soil surface and tills deep into the soil profile. Aggressive deep tillage destroys soil structure and incorporates most crop residue, resulting in soil that is highly susceptible to erosion (moldboard plows, chisels, disks and disk harrows, rollers, packers or drags). Mulch tillage practices (several equipment passes), although frequent, disturbs 100% of the soil surface while not tilling deep and inverting residue below the surface. Soil structure is not completely destroyed and surface crop residues protect soil from raindrop impact erosion and slow surface runoff (zone-builders, chisels, disks and disk harrows, rollers, packers or drags). Continuous no-till and strip-till practices (1 or 2 equipment passes) typically disturb less than 40% of the soil surface and leaves zones of the soil profile un-tilled. Soil structure is in “good” health with a protective layer of crop residue; erosion risks are significantly reduced. Within this system, occasional use of other tillage equipment may be necessary to incorporate soil amendments such as manure or compost (fluted/rippled coulters, trash wheels on planter). Reducing tractor speed, tillage depth, tillage frequency, tilling across field slopes, and frost-tilling may also help protect soil structure and improve plant growth while reducing compaction, erosion and potentially contaminated runoff.

For More Information
See all NRCS Residue and Tillage Management BMPs—NRCS eFOTG for NY
**How is crop rotation used on your farm?**

A crop rotation is growing crops in a planned sequence on the same field. Cropland and soil characteristics, erosion concerns, soil health/quality, nutrient balancing, climate, livestock feed demands, cash crop demands, pest, weed, and plant disease regimes, available labor and equipment, agricultural program requirements, and specific watershed or operational regulations are several factors that may influence crop rotations. Hay, small grains, and legumes are examples of crops which provide dense long-term vegetative cover with minimal tillage, thus reducing erosion and runoff concerns. Cover crops planted throughout the rotation may aid in achieving various agronomic and conservation goals as well. Annual row crops such as corn grain/silage, soybeans, and most vegetable crops require significant tillage practices resulting in disturbed and partially bare soils, thus increasing erosion and runoff concerns. Well planned and managed crop rotations should satisfy livestock and other crop demands while also improving soil health, reducing erosion levels, and minimizing cropland runoff concerns.

For More Information
NRCS – Conservation Crop Rotation (328) Standard

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**What is the minimum level of crop residue cover during the rotation?**

Crop residue is any plant material left on the soil surface after harvest. Protective crop residue layers decrease rainfall erosion, decrease water runoff velocities, conserve soil moisture, regulate surface soil temperature, slowly recycle nutrients back to soil for plant uptake, improve soil organic matter content, and support beneficial organisms. Crop types, rotations, and tillage practices will dictate crop residue cover levels during the growing season and after harvest. Hay/grass, small grains, soybeans, and corn grain are examples of high residue crops; low residue crops include corn for silage and many vegetable crops. Estimate the crop residue level percentage by stretching a line, with 50 marks on it, diagonally across the crop rows. Count how many of the 50 present marks are directly over residues; multiply the number of marks by 2 to find the percentage of residue. Residue values may fluctuate throughout the crop rotation.

For More Information
See all NRCS Residue and Tillage Management BMPs: NRCS eFOTG for NY

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**How are cover crops managed on an average year?**

Cropland erosion potential and runoff concerns is highest on bare soils, sloped land, and fields with poor soil structure; spring snowmelt, spring/fall heavy rain events, and saturated soil profiles increase erosion potential and runoff concerns as well. Cover crops, including grasses, legumes, forbs, and other species are supplemental crops grown within the crop rotation for seasonal cover and other conservation purposes. There are many types of cover crops; however some species exhibit special characteristics that make them favorable for specific climates, applications, and management styles. In general, cover crops serve to: reduce wind and water erosion, increase soil organic matter content, capture/redistribute nutrients in soil profile, promote biological nitrogen fixation, suppress weeds, provide supplemental forage, manage soil moisture, and minimize soil compaction.

For More Information
NRCS – Cover Crop (340) Standard
Cornell University – Cover Crop Decision Tool
How does your farm manage soil organic matter?
Soil structure and overall health is enhanced by friable, “sticky”, and porous organic matter which improves water and nutrient absorption and holding capacity. Nutrient rich organic matter provides food and habitat for beneficial microorganisms which aid in pest/disease control while also degrading pesticides and toxins. Soils rich in organic matter (aggregates) are less susceptible to compaction, erosion, and contaminating runoff. Farms may correctly manage and benefit from soil organic matter by regular additions of manure/compost, crop rotations with high residue and/or perennial crops, cover crops, and reduced or less aggressive tillage practices.

For More Information
Cornell University – Cooperative Extension – Agronomy Fact Sheet Series #41 – Soil Organic Matter

Are there existing soil and/or water control practices in place in the farm fields (e.g., diversions, WASCOB, waterways, terraces, strip cropping, and buffers)? If yes, complete table on page 7.
Identify any existing soil and/or water control practices in the farm fields and document their locations. Determine when they were installed and if they are still functioning as designed or intended.

For More Information
NRCS – Structure for Water Control (587) Standard
Cornell Cooperative Extension – Agronomy Fact Sheet Series #58 – Subsurface (Tile) Drainage BMPs

Are there subsurface drainage concerns on the farm?
Poorly drained soils can be identified by mottles or grayish patches of soil within the rooting depth of crop plants (top 3-4 feet), standing water or extreme saturation after rain events, and consistently poor crop growth. Soils that are poorly drained and consistently saturated or wet can limit crop growth, delay or inhibit equipment access/operation, increase soil compaction, and potentially increase surface and ground water contamination risks. Minimize or eliminate the application of manure, fertilizers, and pesticides to poorly drained soils to avoid water contamination risks.
Consult a qualified professional or engineer when designing and installing drainage tiles to decrease field wetness. Water collected and discharged through drainage tiles may potentially transport nutrients, pesticides, and/or pathogens leaching through the saturated root zone. Minimizing water contamination from water control outlets is discussed below.

For More Information
NRCS – Subsurface Drain (606) Standard
Cornell Cooperative Extension – Agronomy Fact Sheet Series #58 – Subsurface (Tile) Drainage BMPs

Are the location and/or stability of any water control outlet, surface or subsurface, a concern?
If subsurface drains, field tiles, underground outlets, or road culverts are out letting into a watercourse or causing significant erosion it is important to know where and what they are draining. They may be potentially transporting excessive nutrients, sediment, pathogens, and other contaminants to water sources. Visual inspections of the outlets during rainfall events and after spreading manure on fields is one way to determine potential contaminate sources and transport pathways. To reduce the potential for surface water degradation, prevent water control drains from emptying directly into streams or ditches; direct potentially contaminated water into a storage area or vegetated area. In addition, poorly located water control outlets that are contributing to erosion in active cropland, around access roads, other infrastructure, or sensitive areas should be re-located and properly controlled.
Are you satisfied with crop yields on an average year?
If not, soil degrading management practices discussed in this Tier 2 worksheet may be contributing to poor soil health, and consequently, low crop yields. Developing a (CNMP) may identify structural and/or cultural BMPs that might significantly improve soil conditions and crop yields.

For More Information
NYS AEM – Tier 2 Worksheet – Nutrient Management: Manure and Fertilizer:

How is soil compaction managed on the farm?
Compacted soils exhibit the following negative characteristics: reduced water infiltration, poor aeration, restricted root growth and seedling emergence, decreased soil moisture, poor crop yields, increased erosion, increased water runoff, and increased nutrient losses. Managing compaction may be difficult; however the benefits of healthy soil, crop yield increases, and decreased runoff concerns are worth the effort. Control all equipment and livestock access through fields; sacrifice compaction in one small area versus the whole field (i.e., designated access roads or routes for equipment, animal trails/laneways for heavy travelled livestock areas). Keep equipment and livestock off of wet/saturated soils. Reduce equipment loads (i.e., spreader tank size and manure volume) to minimize weights, or utilize equipment with more or wider tires to disperse concentrations of load weights. Develop crop rotations with high crop residue levels and consistent cover crops. Finally, adopt tillage practices with minimal/shallow soil profile disturbance, requires less equipment passes, and leave a percentage of crop residue on the soil surface.

Do you know the level of soil organic matter content in farm fields? Has the Cornell Soil Health Test been used to manage soils? If no, would the farm be interested in more information?
A Cornell Soil Health Test Report provides information on soil health status and identifies specific constraints. This information, combined with an understanding of the farming operation and the field's management history, is then used to choose specific management practices to address these constraints and maintain better soil health.

For More Information
Cornell University – Soil Health Test and Management Planning:
Is wind erosion a concern on the farm?
Soil and organic matter that has been pulverized by aggressive tillage practices into fine particles are light weight and easily transported by air. Wind erosion degrades soil productivity in the field while potentially causing downwind air quality issues, especially in populated areas. Soil covers in the form of crop plants, cover crops, mulches, or crop residues can protect soils from wind. Healthy soils with good aggregate structure are affected less by wind erosion. In addition, establishing herbaceous wind barriers/windbreaks may aid in protecting soils from wind erosion.

For More Information
NRCS – Herbaceous Wind Barriers (603) Standard

Does erosion occur from irrigation runoff? (Farms that answer yes should complete the irrigation water management worksheet)

For More Information
NYS AEM – Tier 2 Worksheet – Irrigation Water Management

SUMMARY
AEM Tier 2 Assessments document environmental stewardship and establish benchmark conditions on the farm. They also identify resource concerns and areas of opportunity. The AEM Tier 2 worksheets also help to further establish baseline data that can be used to prioritize issues for Tier 3 planning.

Tier 2 Assessments should be completed on-site with the farmer. When the initial assessment is completed, appropriate feedback in the form of an AEM Tier 2 Worksheet Summary should be provided to the farmer. The summary should include an overall level of concern for the worksheet, explanation of the overall ranking, a list and description of items of greatest concern, as well as, documentation of what is being done well and what areas need improvement. After the evaluation is complete, the farm should be given a ranking which will determine their priority to advance to the AEM Tier 3 planning phase. Appropriate ranking categories that could be used are: High, Medium, or Low Priority. A ranking procedure that has been approved by your local AEM Team should be used to make the ranking determinations.