College of Agriculture, Food and Environment
Biosystems and Agricultural Engineering Extension

COOPERATIVE EXTENSION SERVICE

University of Kentucky – College of Agriculture, Food and Environment

On-Farm Water Quantity Resources Guide

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To assist agricultural producers, a list of water and soil resource practices have been compiled and categorized below, based on their primary purpose.

What is the "best possible use"?

A farm's resources are land, machinery, buildings, structures, and labor. From an efficiency and production standpoint, these resources should be organized into a system of "best possible use." Allocating resources to their best use requires an understanding of options and limits. If we step back and observe, we can see that an agricultural producer's entire business is based on the fact that they have six inches of topsoil and that it rains (adapted quote from unknown source). So, consider water quantity and soil as potentially limiting factors to farming. To this end, every drop of water that falls on the farm should be harvested and utilized to meet crop and livestock requirements. A producer should try to protect, if not build soil and organic matter to increase the water holding capacity of their soils. Soils should be protected from erosion and precipitation by providing vegetative or mulch cover. Animal and vehicle traffic should be controlled and limited to avoid compaction of soil, which inhibits infiltration. This could be accomplished by determining the best locations for driving, feeding, and watering. Biological or mechanical techniques should be developed and implemented to increase infiltration, control flows, slow water movement, filter water, spread water, and treat water. Water surpluses beyond what can be utilized by the farming operation should be allowed to discharge without contamination. This suggests that runoff and captured water might require treatment before discharge or use.

Concentrated flows, drainages, and streams should be protected from livestock to avoid contamination, so that other producers or users can develop water resources without the need and expense of treating water.

To assist agricultural producers, a list of water and soil resource practices have been compiled and categorized below, based on their primary purpose. Producers and resource professionals should use this list as a tool to select and implement water quantity practices to increase crop and livestock production while protecting valuable water resources. This is not an all-inclusive list of practices that can address water quantity, water quality, and soil conservation concerns. There are many other practices that may be considered applicable. The majority of these practices have numbers associated with them. These represent Natural Resources Conservation Service (NRCS) practice standard codes. A description of the practice follows and a hyperlink to the NRCS practice standard is provided. Where applicable, a hyperlink to an extension publication developed by the College of Agriculture, Food, and the Environment is provided.

Protection of the topsoil on a farm is critical for an operation involved in production agriculture. Topsoil holds soil moisture, which is necessary for forage growth and crop production. Soil needs to be protected or covered with vegetation or mulch to prevent erosion and yield losses. Where possible, soil should be built. Where necessary, contaminated soil should be remediated. In any event, the main objective should be to protect soil from rainfall impact and surface water flows. The practices below promote the persistence and maintenance of ground cover or provide an alternative, reinforced surface to reduce erosion.

- Conservation Cover (327)
  - Establishing and maintaining permanent vegetative cover to reduce erosion.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263169.pdf
- Cover Crop (340)
  - Various densely growing plants that are used for ground cover when field is not in cash crop for targeted erosion reduction.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263176.pdf
- Critical Area Planting (342)
  - The establishment of permanent, densely growing vegetation in areas that are known to or expected to experience high rates of erosion due to low ground cover or concentrated flow patterns.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241316.pdf

- Heavy Use Area Protection (561)
  - High traffic areas that are reinforced with soil stabilizing and protection treatments to reduce mud and erosion. Examples include geotextile fabric and rock pads or concrete surfaces.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263184.pdf
  - Fenceline Feeder Systems for Beef Cattle Production and Resources Conservation http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN134/AEN134.pdf
  - Appropriate All Weather Surfaces for Livestock http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN115/AEN115.pdf

Flow Control is the practice of regulating stormwater runoff flow rates. For instance, downspouts and culverts, if not designed properly, can create flows that erode soil and create gullies. Reducing peak flow velocity and volume, with structures and vegetation, can reduce gully erosion and massive losses of soil through erosional processes.

- Conservation Crop Rotation (328)
  - A rotation of cash crops and cover crops that is planned to maintain ground cover over a field as continuously as possible.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263170.pdf
- Contour Farming (330)
  - Planning field layouts parallel to the contour of hills as opposed to perpendicular to contour lines of hills.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1335263&ext=pdf
- Drainage Water Management (554)
  - A tile drainage management system that is designed to manipulate the level of the water table to a desired depth in the soil profile to achieve specific management goals.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026409.pdf
- Grade Stabilization Structure (410)
  - A cross channel/gully vein of rock or other erosion resistant material that is used to improve stability and reduce the gradient of an eroding channel in an attempt to counteract a migrating headcut and/or repair gully erosion.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263175.pdf
  - Building a Grade Stabilization Structure to Control Erosion http://www2.ca.uky.edu/agcomm/pubs/aen/aen100/aen100.pdf
- Grassed Waterway (412)
  - A densely vegetated channel for the conveyance of water designed to reduce the erosional potential of concentrated flows.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263177.pdf

- Hillside Ditch (423)
  - A bermed channel that flows parallel to the contour of a hillside that is used to divert water to a more desirable location.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs143_025928&ext=pdf
- Roofs and Covers (367)
  - A cover placed over a structure or facility that is designed to protect contents of structure from interaction with rainwater. This practice is especially useful for protecting stockpiled compost, manure, and chemicals from interaction with rainwater.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd340709&ext=pdf
- Roof Runoff Structure (558)
  - Gutters or piping that are mounted to a roof that are designed to channel, divert, and collect rainwater.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263509.pdf
- Stormwater Runoff Control (570)
  - The management of rainwater by means of gutters, pipes, and diversions to manage the quality and quantity of stormwater runoff.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026507.pdf
  - Stormwater BMPs for Confined Livestock Facilities http://www2.ca.uky.edu/agcomm/pubs/aen/aen103/aen103.pdf
- Structure for Water Control (587)
  - A riser installed at the outlet of a drainage system that allows for manipulation of the height of the water table in the soil profile or an open channel.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1335271&ext=pdf
- Variable Rate Nozzles
  - A spray system for applying agrochemicals or water that features an adjustable flow/application rate based on known or assumed parameters of the application environment.
- Vegetated Treatment Area (635)
  - A permanently vegetated area that is intentionally left in tall, densely growing grasses to allow for the filtration of runoff from agricultural facilities.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd340714&ext=pdf
  - Vegetated Filter Strips for Livestock Facilities http://www2.ca.uky.edu/agcomm/pubs/id/id189/id189.pdf

Retention/Detention: Retention is the act of capturing and holding water for later use. Detention is the process of capturing and holding water to provide a slower release of water over a longer time span. Ponds and cisterns are a good examples of detention/retention. These structures also allow for sedimentation of suspended solids and collection of water. They can be further used for the temporary storage of stormwater runoff to allow for metered discharge that reduces peak flow rates.

- Aquaculture Pond (397)
  - An impoundment designed for the production of fish, mollusks, or crustaceans.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026003.pdf
- Dam (402)
  - A cross channel barrier that is designed to detain or retain water for beneficial reuse
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1046852&ext=pdf
- Dike (356)
  - An earthen barrier designed for protection from flood waters and/or the detention or retention of water.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026522.pdf
- Pond (378)
  - An impoundment created for the storage and use of water that is harvested from the landscape.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1255003&ext=pdf
- Riparian Forest Buffer (391)
  - An area of trees adjacent to a waterway that serve as a filter between production areas and waterways. These also provide a considerable habitat value for wildlife.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026098.pdf
  - Riparian Buffers A Livestock Best Management Practice for Protecting Water Quality http://www2.ca.uky.edu/agcomm/pubs/id/id175/id175.pdf
- Sediment Basin (350)
  - A detention basin designed to allow sediment to settle out of water prior to discharge to a downstream waterway.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1254985&ext=pdf

- Spring Development (574)
  - Harvesting water from a spring or other shallow groundwater source for beneficial use.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241321.pdf
  - Alternative Water Source: Developing Springs for Livestock http://www2.ca.uky.edu/agcomm/pubs/aen/aen98/aen98.pdf
- Water and Sediment Control Basin (638)
  - An earthen embankment installed along the contour of a slope that is designed to channel and detain water prior to discharge.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs143_026238&ext=pdf

Filtration/Treatment is the process of slowing down flows or spreading them out over a larger area to increase infiltration rates. Since flows contain nutrients and sediment, the sequestration of stormwater runoff through a field of thick forage, porous media, fibrous root system, or a man-made filter can also build soil and increase vegetative production. These practices reduce the off-farm export of critical resources and potential environmental contaminants.

- Constructed Wetland (656)
  - A man-made wetland that is designed to detain water, increase sedimentation, and transform chemical compounds to more desirable forms prior to discharge into the environment.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_025770.pdf
- Contour Buffer Strips (332)
  - Strips of dense, permanent herbaceous vegetation that run parallel to the contour of a slope that are used to intercept and filter runoff from uplands and between contour farmed strips.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs143_026249&ext=pdf
- Denitrifying Bioreactor (605)
  - A bed of organic material that is used to reduce nitrate concentration in shallow groundwater through the process of denitrification.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd340747&ext=pdf
- Field Border (386)
  - Strips of permanent vegetation that are established around the edges of fields to intercept and filter overland flow of nutrients and agrochemicals.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241318.pdf

- Filter Strip (393)
  - A linear patch of dense, herbaceous vegetation that is used to intercept runoff.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241319.pdf
- Saturated Buffer (604)
  - A system to allow for surface water to infiltrate into a buffer area to reduce overland flow and nutrient export from fields.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1051806&ext=pdf

Infiltration The vertical movement of stormwater through the soil profile is what is necessary for productivity and recharging groundwater resources. Increasing infiltration allows the soil to act as a biofilter that slows the flow of water and provides nutrients to plants. Compaction of the soil is the exact opposite of what we want. Therefore, proper site selection and planning of roads, feeding areas, etc. needs to be well thought out. The practices listed below are concepts that producers should consider.

- Deep Tillage (324)
  - Tillage below the normal depth that is used to break up restrictive layers, encourage infiltration, and reduce compaction by physically manipulating soil characteristics.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241314.pdf
- Diversion (362)
  - A bermed channel that flows parallel to the contour of a hillside that is used to divert water to a more desirable location.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1254995&ext=pdf
- Infiltration Basins
  - A pond that is designed to promote the infiltration of water into the ground in order to recharge shallow groundwater and reduce overland flow.
- Mulching (484)
  - The use of plant material to protect the soil surface and increase moisture holding capacity.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1335267&ext=pdf
- Stripcropping (585)
  - Planning a rotation of crops and inter-planted cover crops to provide soil cover and reduce erosion.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1335270&ext=pdf

- Terrace (600)
  - Creating earthen embankments along the contour lines of hills to create arable contoured fields on slopes that would traditionally pose major erosion risks.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263187.pdf
- Residue and Tillage Management, no-till (329)
  - Utilizing crop residue as a resource and eliminating tillage to improve soil health and reduce erosion.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1249901.pdf
- Residue and Tillage Management, reduced till (345)
  - Utilizing crop residue as a resource and minimizing tillage to improve soil health and reduce erosion.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1251402.pdf

Conservation The management of water is critical for agricultural operations. Producers should focus on controlling flows, infiltration, filtration, treatment, and detention/retention, just to name a few. Conservation practices serve to build soils and reduce off farm transport of nutrients, pathogens, and soil. These practices build resilient operations that are better prepared to deal with periodic drought and surplus water situations.

- Nutrient Management (590)
  - Agronomic allocation of all sources of nutrient on farm from source identification to application and utilization in the field. This includes manures and inorganic fertilizers, alike. The critical components of nutrient management planning are utilizing the right rate, source, timing, and location of fertilizer applications to suit crop needs without over applying nutrients.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046896.pdf
  - Kentucky Nutrient Management Planning Guidelines (KyNMP) http://www2.ca.uky.edu/agcomm/pubs/ID/ID211/ID211.pdf
  - Nutrient Management Concepts for Livestock Producers http://www2.ca.uky.edu/agcomm/pubs/aen/aen113/aen113.pdf
- Conservation Plan
  - Help provided through NRCS technical assistance that addresses on-farm resource concerns through an integrated best management practice implementation plan. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/cp/
- Forest Stewardship Plan
  - A forest management plan that addresses forestry related resource concerns by identifying potential solutions through best management practice implementation. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_002400.pdf

- Agricultural Water Quality Plan
  - A document that details current management practices and water resource concerns on a farm and identifies best management practices that can be implemented to reduce the rick for degradation of waterways. https://www.uky.edu/bae/awqp

Infrastructure Development is an overlooked piece of production agriculture. In order to have efficiency, materials, machines, water, and other resources need to be handled and distributed effectively. Investing in infrastructure helps to improve efficiency and fosters more thoughtful use of natural resources. Developing an integrated infrastructure management plan lends itself to improving all aspects of an agricultural operation.

- Access Control (472)
  - The exclusion of people, livestock, vehicle, or equipment from a specific area for a management purpose.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs143_026262&ext=pdf
- Access Road (560)
  - A developed path of travel for traversing a farmstead.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263183.pdf
- Animal Trails and Walkways (575)
  - Reinforced paths that are designed for heavy traffic from animals, people, or ATVs.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1264120&ext=pdf
- Composting Facility (317)
  - A structure designed to facilitate the aerobic microbial breakdown of organic material to a nutrient rich soil amendment. Composting can also be used as a means for disposal of livestock mortalities.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026122.pdf
  - On-Farm Disposal of Animal Mortalities http://www2.ca.uky.edu/agcomm/pubs/id/id167/id167.pdf
  - On-Farm Composting of Animal Mortalities http://www2.ca.uky.edu/agcomm/pubs/id/id166/id166.pdf
- Controlled Traffic Farming (334)
  - Limiting the travel of heavy farm equipment to designated paths to reduce the extent of compaction in fields.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd340739&ext=pdf

- Dry Hydrant (432)
  - A water hydrant that draws water by means of suction (no pressure required).
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046853.pdf
- Farmstead Energy Improvement (374)
  - Auditing the current status of a farm's energy demands and implementing newer, more efficient technologies to address deficiencies.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046854.pdf
- Lighting System Improvement (670)
  - The replacement of outdated lighting systems.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1144488.pdf
- Livestock Shelter Structure (576)
  - Permanent or portable shade or shelter that can be utilized by livestock. These structures are useful not only for protecting livestock, but also for luring them away from forested riparian areas where they would traditionally seek shelter.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241322.pdf
  - Farmstead Planning: Old Farm Buildings Repurposed for Better Farming: How to Develop a Complex
  - http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN131/AEN131.pdf
- Irrigation Land Leveling (464)
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs143_026412&ext=pdf
- Irrigation Pipeline (430)
  - A water pipeline and associated components for use in irrigation.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046882.pdf
- Irrigation Reservoir (436)
  - A pond or small lake with the specific purpose of use as an irrigation water source.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046883.pdf
- Irrigation System, Microirrigation (441)
  - An irrigation system that is designed for small, efficient applications of water to crops to improve the overall efficiency of irrigation.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd340699&ext=pdf
- Irrigation System, Surface and Subsurface (443)
  - A comprehensive irrigation system designed to address above and below ground irrigation practices and improve efficiency.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs143_025957&ext=pdf
- Irrigation Water Management (449)
  - The process of fine tuning an irrigation system to optimize water use efficiency.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263179.pdf

- Pond Sealing and Lining (520, 521, 522)
  - A compacted clay, geomembrane, geosynthetic, or concrete liner that is utilized to reduce seepage and volume loss from ponds.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1051808&ext=pdf
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1335268&ext=pdf
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1051810&ext=pdf
- Sprinkler System (442)
  - A water application system that consists of nozzles and pipeline operating under pressure.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd340701&ext=pdf
- Tailwater Recovery (447)
  - The recovery of irrigation water from tile drainage systems or irrigation/rainfall runoff from surface conveyances and subsequent recycling of that water into the irrigation system.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263178.pdf
- Tree/Shrub Establishment (612)
  - The planting of woody plants for ground cover and erosion control.
  - https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1255192&ext=pdf
- Water Harvesting Catchment (636)
  - A collection and storage structure for harvested water.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_025733.pdf
  - Rainwater Harvesting for Livestock Production Systems http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN135/AEN135.pdf
- Watering Facility (614)
  - A developed area that provides livestock with an alternative water source to traditional surface water resources.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263189.pdf
  - Tire Tanks for Watering Livestock http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN133/AEN133.pdf
  - Providing water for Beef Cattle in Rotational Grazing Systems http://www2.ca.uky.edu/agcomm/pubs/ID/ID236/ID236.pdf
  - How to Develop a Farming Complex http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN131/AEN131.pdf
- Water Well (642)
  - A drilled, dug, driven, bored, or jetted hole that is installed into an aquifer to produce usable volumes of water.
  - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263191.pdf