



United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WASTE SEPARATION FACILITY

CODE 632

(no)

DEFINITION

A filtration or screening device, settling tank, settling basin, or settling channel used to partition solids and/or nutrients from a waste stream.

PURPOSE

This practice is used to accomplish one or more of the following:

- Improve or protect air quality
- Improve or protect water quality
- Improve manure handling methods or serve as a pre- or post-treatment for other processes

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where the waste separation facility will—

- Remove solids from a liquid waste stream as a primary treatment process and facilitate further treatment processes.
- Reduce problems associated with solids accumulation in liquid waste storage or treatment facilities.
- Reduce solids content in a waste stream so liquids and solids can be recycled for other uses.
- Reduce solids content in a waste stream to better facilitate land application of liquids using irrigation techniques.
- Assist with partitioning nutrients in a waste stream to improve handling and application.
- [Assist with sand separation for further uses.](#)

CRITERIA

General Criteria Applicable to All Purposes

Laws and regulations

Plan, design, and construct the waste separation facility to meet all Federal, State, local, and Tribal regulations. Notify landowner and/or contractor of their responsibility to locate all buried utilities in the

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project area, including drainage tile and other structural measures. The landowner is also required to obtain all necessary permits for project installation prior to construction.

Management Assessment

Conduct, document, and incorporate a management assessment into the design. Perform the assessment with the owner/operator to explore options for waste separation components, available resources, and waste characteristics.

The designer shall provide a narrative describing the waste separation facility and how it will be integrated in the waste management system. The narrative shall also include the strategy for utilization, storage, or land spreading of the waste following separation.

Site Assessment

Conduct, document, and incorporate a site assessment into the design. Perform the assessment to determine physical site characteristics that will influence the placement, construction, maintenance, and environmental integrity of a proposed waste separation facility. Include input from the owner/operator. The site assessment shall include:

- Locations and elevations of buildings, roads, lanes, soil test pits, property lines, setbacks, and easements.
- Locations of wells, floodplains, surface waters, springs, wetlands, cultural resources, surface drains, and drain tile.
- Location of utilities.
- Location of sinkholes and other karst features and conduits to groundwater within 1,000 feet of the facility. Features within 1,000 feet of the facility must be further analyzed per WI NRCS Engineering Field Handbook Supplement Chapter 4, Exhibit A to determine if they pose a hazard to the facility or environment.

Safety

Include appropriate safety features in the design to minimize the hazards of the facility. Provide warning signs, fences, ladders, ropes, bars, rails, and other devices, as appropriate, to ensure the safety of humans and livestock. Ensure that proper ventilation and adequate warning signage is provided for waste separation equipment in an enclosed facility or confined area, as necessary, to prevent explosion, poisoning, or asphyxiation.

Carry out all treatment processes in accordance with all safety regulations. Utilize protective clothing when handling potentially harmful chemicals that may be used in the process.

If the facility includes a confined space, configure the confined space in such a way that monitoring for hazardous gases, ventilation, observation of workers in the confined space, and extraction of workers from the confined space are all possible and practicable. Follow provisions of the American Society of Agricultural and Biological Engineers (ASABE) Standard EP 470, Manure Storage Safety.

Location

Position the waste separation facility so the waste stream can be safely routed to and from the facility. Locate facilities outside the 100-year floodplain unless site restrictions require locating it within the floodplain. If located in the floodplain, protect the facility from inundation or damage from a 25-year flood event. Additionally, follow the policy found in the NRCS General Manual (GM) (Title 190), Part 410, Subpart B, Section 410.25, "Flood Plain Management," which may require providing additional protection for structures located within the floodplain. Local zoning regulations may require a higher level of evaluation or protection.

Waste separator selection

Base the type of waste separator, whether mechanical or nonmechanical, on site-specific data for the

waste stream and management conditions. A combination of separation unit processes may be necessary to achieve the desired or required results. NRCS National Engineering Handbook (NEH) (Title 210), Part 637, Chapter 4, "Solid-Liquid Separation Alternatives for Manure Handling and Treatment," provides guidance on different types of solid/liquid separators available. Capture efficiency varies widely for each type of separator depending on the type and consistency of the waste to be treated.

Separation efficiency

Base the volume or percentage of solids separated on estimates of daily waste water production, if applicable, and the total solids capture efficiency for the type of separation device selected. Where manufacturer information or local data concerning total solids capture efficiencies are not available for the type of waste separation device selected, the efficiencies in 210-NEH-637-4 can be used to estimate the amount of separated material that will be generated, [see Table 1. Efficiencies in Table 1 can be used independently or in tandem.](#)

Table 1

Solid/Liquid Separators	Total Solids Capture Efficiency
Static Inclined Screen	10-20%
Vibratory Screen	15-30%
Rotating Screen	20-40%
Centrifuge	20-45%
Screw or Roller Press	30-50%
Settling Basin	40-65%
Weeping Wall	50-85%
Sand Settling Lanes	50-70%
Mechanical Sand Separator	50-95%

Chemical amendments

Chemical amendments, such as metal salts and polymers, can be used to treat manure to enhance the separation process. The addition of chemicals to the liquid waste stream for improving total solids capture efficiencies must be in accordance with manufacturer's guidelines and requirements.

Storage or treatment of separated solids

Provide adequate storage for separated solids unless they are transported directly from the separator to the final utilization location. Base the design for solid storage on the requirements in NRCS Conservation Practice Standard (CPS) Waste Storage Facility (Code 313).

Design treatment facilities in accordance with the appropriate practice standard for the treatment process, such as NRCS CPS Composting Facility (Code 317) or other needed practice standards.

Utilization of separated wastes

Separated solids or liquids may be further treated, recycled in the waste management system, or land applied. Where land application of separated solids or liquids is used, meet the criteria in NRCS WI CPS Nutrient Management (Code 590).

Discharges

Capture any discharge or runoff from the waste separation facility, the temporary solid or sand storage area, or associated appurtenances in a waste storage or treatment structure.

Conveyance system

Design waste transfer components in accordance with requirements of NRCS CPS Waste Transfer (Code 634).

Outlets

Provide adequate outlet capacity for the waste separation facility to safely convey the design load to a storage or utilization location.

Outlets may include pipelines, perforated or slotted pipe risers, porous plank walls or dams, or screened walls. Provide at least 10 percent open area for screening used to separate solids at the outlet of settling basins.

Increase the inflow capacity of perforated riser pipes by 50% over the design flow to account for plugging. Control basin outflow using an orifice plate set at the elevation of the basin bottom.

Compute average flow rate through the basin outlet by assuming a headwater depth of 0.7 times the basin liquid depth.

Use emergency overflow appurtenances, such as notched weirs, or pipe bypasses to control flows exceeding design capacity. For separation facilities exposed to precipitation, design emergency overflow appurtenances to pass and contain the contaminated runoff from the drainage area of the facility for a 25- year 24-hour storm frequency plus the normal waste stream discharge.

Mechanical separators Additional Criteria for Mechanical Separators – Screens, Presses, Filtration Methods

Manufactured separators are separators such as screen separators, centrifuges, hydrocyclones, and presses (screw or belt type).

Performance

The performance of mechanical separators is generally reported for a given throughput or flow rate and solids concentration. If different flow rates are required, obtain separator efficiencies from the manufacturer. Where manufacturer information or local data is not available, use efficiencies in Table 1.

Flow rate and velocity

Follow manufacturer's recommendations for the design flow rate and liquid waste stream velocity for filtration and screening devices.

Structural design

Follow manufacturer's recommendations for the structural and foundation components for all supports, foundations, footings, etc.

For proper functioning of mechanical separation equipment, environmental conditions may require roofing and/or building enclosure. Design roofs for enclosures in accordance with the requirements of NRCS CPS Roofs and Covers (Code 367).

Settling basins Additional Criteria for Settling Basins

Construct the settling basin with a durable liner such as concrete, geosynthetic material, compacted soil, or geomembrane liner that is adequate to support cleanout equipment.

Earthen settling basins shall meet the criteria contained in NRCS WI CPS Waste Storage Facility (Code 313), Table 1 or NRCS WI CPS Pond Sealing or Lining – Compacted Soil Treatment (Code 520), Table 1.

Concrete settling basins shall meet the criteria contained in NRCS WI CPS Pond Sealing or Lining – Concrete (Code 522), Table 2.

The design loadings and quality of materials for walls shall be in accordance with the NRCS WI CPS Waste Storage Facility (Code 313).

Construct the side slopes of earthen embankments no steeper than 2 horizontal to 1 vertical (2:1). For earthen embankments greater than 3 feet in height, construct the side slopes no steeper than 3:1 on the outside and 2:1 on the inside of the embankment.

Additional fill for embankment settlement shall be a minimum of 5% of the fill height measured at the centerline.

Do not use the settling basin to store manure scraped from feedlots or other areas. Additional solid storage should be used for scraped manure. If needed, leachate from solid storage area may be directed to the settling basin.

Base the minimum volume of the settling basin on a hydraulic retention time of at least 30 minutes.

Velocity

Do not exceed 1.5 feet per second liquid waste stream flow velocity through settling basins.

Depth

Provide sufficient depth for solid and liquid storage and for the depth of influent flow. Include a minimum of 1 foot freeboard.

~~Base the minimum volume of the settling basin on a hydraulic retention time of at least 30 minutes.~~

Bottom width

Base the minimum bottom width for the settling basin on the cleanout equipment used, but not less than 4 feet.

Access

Establish the minimum top width of earthen embankments for settling basins at 15 feet when equipment access is needed for cleanout. Where access to the settling basin is not required for cleanout, base the minimum top width on the equipment used to construct the embankment or berm, but not less than 4 feet.

~~Construct the side slopes of earthen embankments no steeper than 2 horizontal to 1 vertical (2:1). For earthen embankments greater than 3 feet in height, construct the side slopes no steeper than 3:1 on the outside and 2:1 on the inside of the embankment.~~

Design access ramps to allow entry into the basin for cleanout by normal loading equipment at no steeper than 10:1. Steeper access ramps are acceptable where special surfacing of the ramp is provided for traction purposes and the equipment used can accommodate the increased slope, but no steeper than 4:1.

Settling basins receiving lot runoff

Settling basins used with or without screening to remove solids from process-generated liquid waste streams (i.e., flush water from covered freestall barns or milking parlor waste water) that include significant external drainage fall into this category.

Size the settling basin to flood-route the peak discharge from a 25-year frequency, 24-hour duration storm rainfall. Direct discharge to a storage area or vegetated treatment area.

Use a minimum runoff curve numbers of 90 for unpaved lots and 95 for paved lots.

Use flood routing procedures contained in TR-55, Chapter 6, or NRCS National Engineering Handbook (NEH), Part 650, Engineering Field Manual, Chapter 11.

Flow rate

Base the minimum design flow rate for a settling basin that receives lot runoff on the normal liquid waste stream from the operation plus the peak runoff from the 10-year 1-hour storm from the drainage area of the basin.

Volume

Base the design volume for settling basins receiving lot runoff on the total depth needed for liquid and solids storage and the minimum surface area required for the basin. Where no specific information is available on sludge accumulation rates from lot surfaces, use 0.05 cubic feet per square foot of surface area per month for unpaved lots and 0.01 cubic feet per square foot of surface area per month for paved lots. Increase these values by 50 percent if lots are steep (greater than 2%) or poorly maintained. The minimum solids accumulation storage period is 1 month.

Settling basins that exclude lot runoff

Settling basins used with or without screening to remove solids from process generated liquid waste streams (i.e., flush water from covered freestall barns or milking parlor waste water) and do not receive significant external drainage fall into this category.

Flow rate

Design the capacity for a settling basin that excludes lot runoff on the normal liquid waste stream from the operation.

Volume

Base the design volume for settling basins that exclude lot runoff on the volume needed to provide solids storage for a specified treatment period plus temporary liquid storage necessary during dewatering. Use a minimum temporary liquid storage based on the volume of the liquid waste stream for 1 day.

Sand separation and reuse

Separation processes that remove sand from water and organic material fall into this category.

Dilution

Provide adequate dilution water for sand-laden manure to keep organic solids in suspension for proper sand separation. Use a minimum water to sand-laden manure dilution ratio of 2:1 (volume basis).

Capacity

Design the system to provide adequate capacity to handle the required manure and sand loadings.

Sand storage

Provide storage of separated sand to allow additional time for liquid to drain from the sand. Collect the drainage and route it back into the waste handling stream.

Nonmechanical sand separation and reuse

Sand separation techniques that rely on the velocity of the waste stream to settle out sand fall into this category.

Velocity

Design the waste stream velocity between 1 and 2 feet per second. Base the flow velocity on the site-specific sand gradation curve.

Include a transition area between flush system or waste transfer system and the sand lane that will lower the velocity to the design waste stream velocity that will allow the sand to settle out. Size sand lane outlets large enough to prevent flow constriction that will cause excessive settling of organic solids.

Volume

Provide a minimum settling area storage volume based on the maximum time between cleanouts. Design the bottom width to be compatible with the removal equipment, but not less than 8 feet.

Hydraulic retention time

Design the hydraulic retention time of at least 3 minutes and not more than 5 minutes. Make adjustments using the site-specific sand gradation curve.

CONSIDERATIONS

General Considerations

Location

When locating waste separation facilities, consider elevation and distance from the source of material to be separated and the location of long-term liquid and solid waste storage facilities. Take advantage of gravity flow wherever possible. Other considerations for locating waste separation facilities include vehicle access, proximity to wells, wind direction, neighboring dwellings, proximity of streams and floodplains, required setback distances, and visibility.

Outlets

Where excessive clogging of perforated pipe or slotted outlet structures is anticipated, consider adding additional features to increase the screened surface area. A picket fence box, wood slotted wall, or framed structure with No. 9 expanded metal screen are all alternatives.

Biosecurity

Consider how waste separation facilities and the disposal of waste products will affect the biosecurity for the farm and neighboring areas.

Weeping walls

To maximize drainage and solid-liquid separation, install weeping walls around the entire perimeter of the waste to be treated and maintain drainage paths to and through the walls. Consider waste particle size, particle size distribution, and length of flow paths when selecting screen opening size and spacing. Ensure drainage is transferred to a liquid storage facility.

Sand bedding

When sand bedding is reused, select uniformly sized sand to improve separation efficiency.

Solid/solid separation

When separating poultry litter into fine and coarse fractions, a higher percentage of the nutrients are partitioned with the fine fraction. The coarse material, consisting mostly of shavings and feathers, has a lower nutrient content and can be reused as bedding or as an energy source.

Visual screening

Consider using vegetative screens or other methods to shield waste separation facilities from public view for aesthetics.

Precipitation

Rainfall on the solids storage areas associated with waste separation facilities can result in increased waste water discharge into the long-term storage facility. Consider covering solids storage facilities in high precipitation areas.

Sand system abrasion resistance

Where sand is a major component of the liquid waste stream, consider the use of abrasion-resistant waste transfer piping and pumps to increase the useful life and reduce frequency of repairs.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. As a minimum, the plans and specifications will include—

- Plan view of the waste separation facility showing the entire waste management system, including waste production facilities, waste collection points, waste transfer pipelines, waste treatment, storage facilities, and related appurtenances.
- Location of all inflow and discharge structures with a description of materials, sizing, profiles, and critical elevations.
- Detail drawings for all components to be constructed.
- Details of support systems for manufactured waste separation devices.
- Fencing and signage as appropriate for safety purposes.
- Written specifications describing installation requirements and operating characteristics, such as design flow, volume, and/or retention time.

OPERATION AND MAINTENANCE

Develop and review an operation and maintenance (O&M) plan with the owner and operator prior to constructing the waste separation facility. Ensure that the O&M plan is consistent with the purposes of the waste separation device chosen, its intended life, safety requirements, and the criteria for its design. As a minimum, include—

- A description of the normal operation of the facility, safety issues, and normal maintenance items to ensure that the owner and operator understand the level of O&M required for the separator to operate as intended.
- Operation instructions for any manufactured waste separation devices.
- Alternative operation procedures in the event of equipment failure or other emergency.
- Daily and/or periodic inspection of—
 - Separation device and support structure.
 - Screens and outlets.
 - Remaining capacity in storage facilities.
- If a manufactured waste separation device is installed, the manufacturer shall provide a warranty that describes the design life of the device and the warranty coverage.

REFERENCES

- Burns, R.T. and L.B. Moody. 2003. Development of a Standard Method for Testing Mechanical Manure Solids Separators. American Society of Agricultural Engineers – CIGR Meeting Paper No. 034131. American Society of Agricultural and Biological Engineers. St. Joseph, MI.
- Ford, M. and R. Fleming. 2002. Mechanical Solid-Liquid Separation of Livestock Manure Literature Review. Ridgetown College – University of Guelph, Ridgetown. Ontario, Canada.
- Manure Management System Series – Outdoor Air Quality. 2002. MidWest Plan Services Handbook 18, Section 3. MidWest Plan Service, Iowa State University. Ames, IA.
- Mukhtar, S., J.M. Sweeten, and B.W. Auvermann. 1999. Solid-Liquid Separation of Animal Manure and Wastewater. Texas A&M AgriLife Extension Service. College Station, TX.
- Livestock and Poultry Environmental Learning Community. 2019. “Solid-Liquid Manure Separation.” Accessed May 20, 2021. <https://lpec.org/solid-liquid-manure-separation/>

- 332 USDA NRCS. 2019. National Engineering Handbook (Title 210), Part 637, Chapter 4, Solid-Liquid
333 Separation Alternatives for Manure Handling and Treatment. Washington, D.C.
334 <https://directives.sc.egov.usda.gov/>
- 335 USDA NRCS. 2012. National Engineering Handbook (Title 210), Part 651, Agricultural Waste
336 Management Field Handbook. Washington, D.C. <https://directives.sc.egov.usda.gov/>
- 337 USDA – NRCS, Wisconsin Field Office Technical Guide, Section IV, Conservation Practice Standards.
- 338 USDA – NRCS, National Engineering Handbook. Part 650, Engineering Field Handbook.
- 339 USDA – NRCS, Technical Release 55 (TR-55). Urban Hydrology for Small Watersheds.

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