American Society of
Agricultural and Biological Engineers

*An ASABE Meeting Presentation*

*Paper Number: 064170*

# Procedures for Evaluating Un-designed Manure Storage Facilities in New York State

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**Written for presentation at the**
**2006 ASABE Annual International Meeting**
**Sponsored by ASABE**
**Portland Convention Center**
**Portland, Oregon**
**9 - 12 July 2006**

***Abstract.*** *The New York State Concentrated Animal Feeding Operation (CAFO) permit requires that manure storages be designed and built following the Natural Resources Conservation Service (NRCS) NY313 Standard. Because a large number of existing storages were built before the CAFO program inception, it is likely that a large percentage do not meet the NY313 Standard. These storages are categorized as "un-designed".*

*Large CAFOs in New York State (NYS) have until 31 December 2006 to fully implement their CAFO plans; this includes addressing manure storage(s) on their farms that do not meet or have not been assessed and found to substantially meet the NY313 Standard. Similarly, medium CAFOs have until 2009 to fully implement their plan requirements.*

*A recent catastrophic failure of an un-designed earthen storage in NYS has put even more emphasis on this issue. A procedure has been developed to evaluate un-designed storages. The evaluation process takes into account the existing facility, the watershed and location on the landscape, geology and soils, condition of the facility, and test results from soil and water samples. The results of the evaluation can show that the storage facility is good as is, needs continued monitoring, needs to be improved, needs improved maintenance, or needs to be closed.*

**Keywords.** Manure Storage, Engineering Evaluation, CAFO, Standards.

## Introduction

Concentrated Animal Feeding Operations (CAFOs) in NY became regulated in 1996; prior to this time, construction and operation of manure storages was unregulated. The NYS Department of Environmental Conservation (DEC) adopted NY NRCS Standards as the requirement for conservation practices on farms to prevent discharges from the production area from rainfall runoff events up to and including the 25-year 24-hour event and meet the requirements of NY NRCS 312 Waste Management System. Farms that store manure are required to follow NY NRCS Waste Storage Facility Standard NY313.

Although there were a number of discussions during the development of the NYS CAFO permit about the status of existing on-farm manure storages that would be regulated under the Comprehensive Nutrient Management Plan (CNMP) required by the NY312 standard, there was a reluctance to formally address the issue. The reasons for this reluctance included the costs of evaluating existing manure storages, the lack of guidance on how to evaluate them, and the lack of urgency. Under NYS regulations a Professional Engineer registered in NYS would need to perform the evaluation.

On 11 August 2005 an existing un-designed manure storage on a permitted CAFO farm was discovered to have failed catastrophically. Field measurements of the storage after its failure indicated that approximately 11 million gallons of manure escaped from the breeched berm. Although some of the manure was retained in the field below the storage and some was retained in the drainage way to the Black River, a significant volume did reach the river. Over 250,000 fish were reportedly destroyed, water intakes for the City of Watertown were shut down for three days, planned fishing and recreation events were cancelled, and the NYS CAFO permit process was called into question.

One result of this failure was the development of a tool to evaluate un-designed manure storages in NYS. The Conservation Partners in NY, consisting of Department of Agriculture and Markets, State Soil and Water Conservation Committee, NRCS, Soil and Water Conservation Districts and DEC, drafted, reviewed, and adopted as part of the state's Agricultural Environmental Management (AEM) process "An AEM Tool for the Evaluation of Un-designed Waste Storage Facilities". Certified CNMP planners and farmers were reminded that un-designed storages need to be investigated and that this tool would need to be used to help meet the implementation deadline for the CAFO permits.

NYS CAFO permit requires large CAFOs (those with at least 700 mature dairy cows or 1,000 heifers) to have the practices they need to prevent discharges from the production areas on their farms in place by 31 December 2006. The CAFO permit also covers medium CAFOs (those farms with 200 to 699 mature dairy cows or between 300-999 heifers) to have all the practices they need to prevent discharges from the production areas on their farms in place and fully operational by 30 June 2009. There are 145 large CAFOs and 475 medium CAFOs permitted in NY, most of which are dairy operations. Many of these farms have existing manure storages. It is estimated that as many as 80 of the large CAFOs and 200 of the medium CAFOs have un-designed manure storages. Evaluating all of the un-designed manure storages for the large farms is a significant workload. If the un-designed manure storages are found not to substantially comply with NY313, then improvements or alternative storage will need to be made by 31 December 2006 for the farm to stay in compliance. The construction season in NY is challenging after October due to cold temperatures, frozen soils, and often saturated soil conditions. Although there are some professional engineers that are soliciting clients, there is a concern from the farm community that there will not be enough capacity from the engineering community to perform all the needed evaluations in time. In addition, historically farms have not

been willing to pay for professional engineering services; therefore, there is a very limited pool of engineers who have experience serving animal agriculture. The Cornell Cooperative Extension PRO-DAIRY team is scheduling two seminars to provide insights into the evaluation process for engineers who would like to take on this work.

## The Evaluation Process

The following guidance was developed and is posted on the AEM website http://www.agmkt.state.ny.us/SoilWater/AEM/AEM.html for engineers to use. This guidance relies heavily on the engineer's judgment to determine the extent of the evaluation needed. Although there are some advantages in being more prescriptive, because of the wide variety of existing storage conditions and situations it was decided that leaving the degree of investigation up to the individual was best. At the conclusion of the investigation, the engineer would certify, with any caveats, or recommend its closure.

**An AEM Tool For The**
**Evaluation of Un-designed Waste Storage Facilities**

*Reference: NRCS Conservation Practice Standard NY313, Waste Storage Facility*

CAFO permits require an agricultural waste management plan that meets NRCS standards. Some waste storage facilities on farms have not been designed or installed under the direction of a professional engineer or NRCS employee with the appropriate job approval authority. This guide describes the recommended evaluation process to help determine if a waste storage facility that has no design records or no as-built documentation substantially meets the standard. This guide does not apply to new practices installed under a CAFO permit.

## Commonly Associated Practices or Processes

Note: To determine whether a National or New York Conservation Standard applies to this and any other associated practices, check the following website: www.ny.nrcs.usda.gov. Click on the Technical Resources button. Look in the left-hand column for "eFOTG" on the next screen. Under "**Access eFOTG**", click on NY State on the U.S.A. map. Choose the county of interest. Then click on section IV under eFOTG in the left column to look for the Conservation Practice Standards located in Section IV.

**Table A: Commonly Associated Processes or Practices**

| Number | Name | Job/Engineering Sheets |
|---|---|---|
| NY312 | Waste Management System | |
| 342 | Critical Area Planting | |
| 362 | Diversion | NY ENG 22 and 23 |
| 361 | Heavy Use Area Protection | |
| 382 | Fence | |
| 590 | Nutrient Management | |
| 633 | Waste Utilization | |
| 634 | Manure Transfer | |
| NY748 | Record Keeping | |
| 353 | Monitoring Well | |
| NY731 | Well Water Testing | |
| 360 | Closure of Waste Impoundments | |
| 521A - 521D | Pond Sealing or Lining | |

## Other References

Agricultural Waste Management Field Handbook. http://www.ftw.nrcs.usda.gov/awmfh.html

New York Supplements to the Agricultural Waste Management Field Handbook. www.ny.nrcs.usda.gov.

Guideline for Dairy Manure Management from Barn to Storage, NRAES-108, NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, New York, 14853-5701.

Earthen Manure Storage Design Considerations, NRAES-109, NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, NY 14853-5701.

Animal Waste Management Software, AWM. http://www.wcc.nrcs.usda.gov/water/quality/common/wastemgmt/awm.html

Site/operation specific Comprehensive Nutrient Management Plan.

Engineering Field Handbook Chapters 2, Estimating Runoff and Peak Discharges, 4, Elementary Soils Engineering.

Current Soil Survey Data.

Confined Spaces. U.S. Department of Labor – Occupational Safety and Health Administration. http://www.osha.gov/SLTC/confinedspaces/index.html.

NYS Consolidated Laws, Environmental Conservation Title 10, Water Pollution Control, Section 17-0803, SPDES Permits; Application.

Article 17 Environmental Conservation Law, 6NYCRR, Part 750, State Pollution Discharge Elimination System (SPDES). http://www.dec.state.ny.us/website/dow/PhaseII.html

## Cultural Resources

Cultural resource reviews are normally required for all ground disturbing practices, components, or other activities, as per the State Level Agreement between NRCS and the New York State Historic Preservation Officer. Unless modification of the existing storage is needed, this will not be required for the activities covered by this guide.

## Permits and Notifications

All permits, easements, and rights-of-way are the responsibility of the landowner. "Dig Safely NY" (formerly the Underground Facilities Protection Organization, or UFPO) and non-member local utilities will be contacted according to the time required before construction to mark all applicable facilities in the construction area. This is the responsibility of the excavator.

Identification and the location of all other farmstead underground or overhead facilities is the responsibility of the landowner.

Ground disturbing activities of less than one (1) acre do not need an Erosion and Sediment Control Plan or corresponding permit. Also, a permit is not needed if the project meets the criteria of the Management Practices in conformance with the SPDES General Permit for storm water discharges from construction activity; GP-02-01 signed September 2003.

An Erosion and Sediment Control plan may be needed if modifications to the storage facility are required.

## Inventory and Evaluation

Working from the current CNMP (all waste storage facilities must have and be part of a CNMP) and in consultation with the CNMP Planner and the producer, the licensed professional engineer will do the following:

- Evaluate the type of farming operation, waste management and runoff handling system, and the producer management level.
- Determine the type of animals, herd size, average animal weight, average weight gain/milk production (if applicable), source, quantity and consistency of waste stored, bedding material, and volume of waste water (including any silage leachate, milkhouse wastewater, and other contaminated water or liquids that will be directed into the structure). See if they are accurately accounted for in the Comprehensive Nutrient Management Plan.
- Evaluate the existing storage site location for feasibility, giving consideration to manure transfer systems for the loading and unloading. Give consideration to existing buildings, future expansion, access routes, traffic patterns, drainage, utilities, equipment capabilities, safety, neighbors, possible odor problems, siting, and appearances. Utilize current soil survey information to evaluate map units and potential inclusions for project compatibility on the site.
- Evaluate other appurtenances of the waste storage facility such as manure transfer components, piping, drainage features, soil erosion control features, runoff control practices, push off walls, access ramps, safety features, fencing, etc.
- Determine the waste storage volume needed using the storage period from the unloading and spreading schedule from the CNMP. Also determine the length, width, depth and actual storage volume capacity of the existing structure. Use design procedure contained in NRCS Practice Guideline Waste Storage Structure - 313.
- Evaluate the watershed and specific site using professional judgment to determine the potential risk to the environment. Based on risk potential, the investigation can be adjusted for thoroughness. Information on well depths and locations, aquifers, bedrock location and condition, surface water sources and flow patterns could be pertinent to an investigation. Review soil survey information on the soils permeability and suitability for a waste storage facility. Other waste storage facilities and/or ponds in the area may give insight to the potential for seepage from the waste storage facility being evaluated.
- Collect design and construction data. Determine when the storage was built, and who the contractor was. Determine what types of construction equipment and methods were used. Determine the site conditions during construction and the types of soils encountered. Determine that the side slopes are appropriate and stable, and that there are not any signs of sliding, cracking, or poor maintenance. Determine if the dike top width is adequate. Determine the history of use for the storage. Determine if the embankment meets the criteria of the Waste Storage Facility Standard.
- Evaluate the ground water. Historic water quality data from nearby wells may contain important information. Determine the nitrate ($NO_3$-N) levels and bacteria counts in the nearby wells. Determine if there is other evidence that the waste storage facility is leaking. If the evaluation confirms that there is leakage, or the probability thereof, a geologic site investigation shall be conducted by a qualified individual to determine the extent of the leakage, and if the soils are suitable for an earthen waste storage facility.

- Based on this initial inventory and evaluation determine the need for additional investigations.

## Geologic Investigation

**Electromagnetic Induction (EMI).** Meters may be used to obtain preliminary estimates of site conditions. These devices are non invasive, are easily transported by one individual (EM-31), or in some cases two individuals (EM-34), and when placed on the ground surface can penetrate soil to theoretical depths of up to 30 meters (~100 feet). Electromagnetic Induction surveys, when properly interpreted, help to identify "areas of less or more concern", and assist in planning more detailed subsurface investigations. These areas can be evaluated later by digging test pits, or by installing monitoring wells to monitor seepage.

**Soil Test Pits.** If the waste storage facility can be emptied and there is access to the bottom, test pits can be dug to determine the condition of the existing soil lining. The dike can be evaluated in a similar manner. Exercise caution to properly dig and backfill the test pits to prevent this investigation from causing leaks. Test pits can be dug outside the waste storage facility both uphill and downhill. Consideration should be given to soil permeability, stability, foundation, seepage, and location of water table and bedrock. Conditions on the site will determine how many test pits to dig, where to dig them, and how deep to go. If seepage is suspected, testing should be done for ammonia ($NH_3$-N), nitrate ($NO_3$-N), and bacteria.

**Soil Sampling.** Representative soil samples should be collected and tested by a certified soils laboratory using the most current **ASTM** testing procedures. Grain size distribution, Atterberg limits, and permeability tests should be performed on all samples. Soil should be classified according to the Unified Soil Classification System (USCS) and tested for permeability at the compactive effort of the in situ soil density condition. In the event that the soil tests or permeability test results are unsuitable, consideration should be given to selecting an alternative waste storage facility site, an alternative waste storage facility type, or the employment of a liner.

**Seepage Determinations.** Where appropriate, direct seepage calculations may be performed using sensitive water level measurements, and a mass balance based on inputs minus outputs. Evaporation and precipitation and any influent need to be measured accurately. These results should be compared to estimated rates.

## Conclusions/Recommendations

**Monitoring System.** It may be necessary to install a monitoring well(s) or system to check for future seepage if the site is sensitive environmentally and the soils are marginal. Shallow wells that are sampled on a regular basis may be appropriate. There may also be tools like the electromagnetic induction (EMI) survey that can be used to map areas of higher nutrients leaving a waste storage facility without installing and monitoring wells.

*Reference: NRCS Conservation Practice Standard 353, Monitoring Well*
*Reference: NRCS Conservation Practice (Interim) Standard NY731, Well Water Testing*

**Liner Installation.** The waste storage facility may need to be lined if the evidence shows that there is a problem, or the potential of a problem, on a sensitive site where risks need to be reduced. An earthen lining with suitable soils placed according to detailed engineering specifications may be used. A geo-synthetic flexible membrane lining that is designed for the site that meets the manufacturer's specifications may be another alternative.

*Reference: NRCS Conservation Practice Standards, 521A - 521D*
*Pond Sealing or Lining - Flexible Membrane - 521A*
*Pond Sealing or Lining – Soil Dispersant - 521B*
*Pond Sealing or Lining – Bentonite Sealant – 521C*
*Pond Sealing or Lining – Compacted Clay Treatment – 521D*

**Closure.** The investigation may show that the un-designed waste storage facility is a hazard to the environment and there is no feasible way to prevent it from being a potential pollution problem. Emptying the waste storage facility and filling it in or breaching the dike may be needed to prevent it from being a safety or environmental hazard.

*Reference: NRCS Conservation Practice Standard 360, Closure of Waste Impoundments*

## Final Documentation Requirements

An as-built documentation package will be developed for each un-designed manure storage facility that is evaluated using this guide. The as-built package will, as a minimum, include the following:

1. MANAGEMENT ASSESSMENT. The management assessment shall include but not be limited to the following:
    a. Documentation showing that the current storage system meets the producer's objectives.
    b. Documentation showing the storage system meets the needs of the current farming operation, including waste production, storage and application requirements. Maintenance history of the storage facility shall also be included.

Documentation describing the best management practices being implemented to ensure storage safety; maximum operating levels are maintained and not exceeded; and the storage facility itself is maintained to current operating standards as part of the CNMP.

    c. Documentation describing the existing contingency plan for when the maximum operating levels are reached and exceeded as part of the CNMP.
    d. Document any monitoring and leakage collection systems that are currently implemented for the storage system.

2. SITE ASSESSMENT. The site assessment shall include, but not be limited to, the following:
    a. Plan map showing locations of buildings, barnyards, roads, lanes, soil test pits (if applicable), property lines, setbacks, easements, wells, floodplains, surface waters, surface drains, drain tiles, utilities, cultural resources, and wetlands as part of the CNMP.
    b. Documentation showing soil survey information, soil test results, any test pit or soil boring logs, and soil permeability will be checked if available. This documentation shall include soil layers described with respect to texture using the Unified Soil Classification System (USCS).
    c. Documentation describing any saturation indicators including volume of flow and elevation. Ground water maps and well construction logs shall be included when available.
    d. Documentation describing locations, dimensions, and elevations of any sinkholes and other karst features near the facility.

e. Documentation showing that the waste facility is not located in a flood prone area.

f. Local well test information should be included if testing and/or monitoring has been performed as part of the CNMP.

3. CONSTRUCTION ASSESSMENT. The construction assessment shall include, but not be limited to, the following:

   a. Documentation stating when the facility was built including the time of year construction was performed.

   b. Document if known the contractor and type of equipment used during construction.

   c. Document if known the materials (liners, imported material, etc.) used for construction.

   d. Documentation showing the results of any engineering or geological inspections performed. These inspections could address slope stability, dike top width, and any indications of failure past or present.

4. CERTIFICATION LETTER. The person performing the evaluation shall provide a letter certifying the waste storage facility based on the information included in this package. The following statement, including recommendations and signature, must be included with the certification letter:

   It is my professional opinion that the structure substantially meets NRCS Standard 313 with the following exceptions"..... (if any).

   a. Monitoring Requirements..... (if any)

   b. Reconstruction Requirements.....(if any)

   c. Additional Operation and Management Requirements.....(if any)

   a. Closure action.....(if needed)

   The letter should also include the certifying qualifications (P.E.) obtained for performing this evaluation.

## Operation and Maintenance

Facilities, structures, and practices must be operated and maintained to ensure proper function and longevity. Periodic follow-up with the landowner is essential to ensure that all operation and maintenance (O&M) requirements are understood and followed.

***Discussion:***

The effort to complete each evaluation will be highly variable since each structure is unique. Cost estimates to perform an evaluation of an un-designed storage ranges from $500 for some to upwards of $20,000 for other structures. The remediation required will range from nothing required to storage closure (following NRCS standard 360) and the replacement with a concrete or metal storage structure. Closure costs could exceed $50,000 for some sites and large storage structures can cost more than $300,000. This is a significant expense even for the largest farms.

Because this guidance is not prescriptive, some farms may have a difficult time choosing an engineer. The farms will want to control costs yet adequately evaluate their existing storage. Comparing the costs and evaluations with their neighbors will not be that meaningful since each site's evaluation may be quite different. Advice on choosing a professional engineer should be given to the farms by their CAFO planner. The CAFO planner with a number of farm clients will be in a good position to see how the engineers compare over a variety of sites.

To complete the estimated 80 evaluations by the end of 2006 is certainly possible. Soil permeability laboratory tests may take a month or two to be completed. Surveys of the existing storages may best be done as the storages are emptied in the Spring and the Fall. Ten engineers accomplishing 8 evaluations each is in the capacity of the agricultural engineering profession in NYS. However correcting deficiencies, closing, and/or replacing storages within the time frame may be a problem. The construction season often ends in early November in NYS. This may leave some large farms out of compliance with their CAFO permit.

## Conclusions

An established procedure to evaluate un-designed manure storage facilities is needed to assist producers as they decide how or if they can continue to use these manure storage structures and be in full compliance with their CAFO permit. Evaluating these storages will help the farmer make appropriate economic decisions when implementing a CNMP. This process should also protect the environment from inadvertent failure and /or excessive leakage.

Planning, designing, constructing and documenting that a waste storage facility meets NRCS standards is preferred over trying to evaluate it after the fact. All new large and medium CAFO facilities must follow the NRCS NY 313 Standard when designing and constructing new storage facilities. All new storages built on existing CAFOs must also follow the NRCS 313 Standard when constructing a new manure storage structure.

Methods to evaluate existing manure storages quickly, confidently and cheaply are needed.

Farmers, agencies, governments, citizens, and engineers need to be aware of the possible risks from un-designed manure storages and have methods to ensure that the existing manure storages do not pose a threat to the health and safety of the public or a danger to the environment.

## References


Agricultural Waste Management Field Handbook. http://www.ftw.nrcs.usda.gov/awmfh.html

New York Supplements to the Agricultural Waste Management Field Handbook. www.ny.nrcs.usda.gov.

Guideline for Dairy Manure Management from Barn to Storage, NRAES-108, NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, New York, 14853-5701.

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Article 17 Environmental Conservation Law, 6NYCRR, Part 750, State Pollution Discharge Elimination System (SPDES).

http://www.dec.state.ny.us/website/dow/PhaseII.html