UTAH SMALL ANIMAL WASTE LAGOONS AND PONDS
for Animal Feeding Operations

For operations under 1,500 animal units
(less than 1,050 dairy cows or 3,750 hogs)

Information Pamphlet

sponsored by

Utah Department of Environmental Quality, Division of Water Quality
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3rd Edition

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PREFACE TO THE THIRD EDITION of *Utah Small Animal Waste Lagoons and Ponds:*

This third edition of *Utah Small Animal Waste Lagoons and Ponds* is written for the use of farmers, ranchers, technical agencies, regulatory agencies, consultants and the public desiring to have animal wastewater impoundments constructed. It addresses the state approval process for small operations using liquid manure handling systems with emphasis on the technical requirements. This process is separate from the federally mandated CAFO permitting program.

Liquid manure handling systems (LMHS) use water to transport manure and usually include structures or impoundments for storing manure. Designs for LMHS must receive approval for construction from the Utah Division of Water Quality. However, the USDA Natural Resources Conservation Service (NRCS) in Utah may approve designs for small operations with less than 1,050 dairy cows or 3,750 hogs. Larger operations are approved only by the Division. These larger operations must receive a Ground Water Permit. Ground Water Permit requirements can be found in the booklet titled: *Ground Water Quality Protection Permitting Information Document.* This and other publications are available at no charge from the Utah Division of Water Quality.

The last page of this edition provides names and telephone numbers to obtain assistance. Feel free to contact these individuals.

INTRODUCTION

The intent of this pamphlet is to help individual farmers and growers know the basic requirements to construct small animal wastewater lagoons, ponds or other liquid manure handling systems. This pamphlet provides brief guidance on design and construction of impoundments such as lagoons and ponds. All details are not covered, but additional sources for help are given. The pamphlet also contains principles which can be used in designing any liquid manure handling system.

The purpose of a lagoon system is to store livestock wastewater and provide treatment to reduce the organic compounds and the nitrogen content of the wastewater. There are advantages and disadvantages to all methods of handling wastewater. You may also consider other waste management alternatives. All liquid manure handling systems need to be evaluated as an important part of an entire farming or ranching operation.

APPROVALS AND PERMITS

An approval or a construction permit for waste lagoon or pond system designs is required from the state prior to construction. The Utah Division of Water Quality (DWQ) issues construction permits for these systems. The USDA Natural Resources Conservation Service (NRCS) in Utah may approve systems serving less than 1,500 animal units (AU), as defined in the table below. Permits are obtained by submitting the necessary construction drawings with pertinent design, construction specifications, operation and maintenance information. This approval and permit process is separate from the federal concentrated animal feeding operation (CAFO) program. Also, you should contact your local county health department to determine if any local construction requirements apply.

ANIMAL UNITS (AU)

One animal unit (AU) is equivalent to one slaughter steer. The following table lists other animals:

Animal Type	Beef Cattle	Swine*	Dairy Cattle	Sheep	Turkeys	Ducks	Hens or Broilers**	Horses
Equivalent to 1,500 Animal Units	1,500	3,750 over 55 pounds each	1,050	15,000	82,500	7,500	45,000	750

*If swine are under 55 pounds, the number of animals is 18,750.
** 150,000 laying hens or broilers that use continuous overflow watering, but dry handle wastes,

Early consultation with agencies is encouraged as you plan your system. Contact NRCS or DWQ for details.

GOVERNMENTAL AGENCIES PROVIDING TECHNICAL ASSISTANCE

Technical assistance may be provided by the Natural Resources Conservation Service (NRCS), Utah State University Extension, consultants and DWQ. The NRCS may provide direct planning, design and field construction inspection assistance on a limited basis. Local NRCS offices exist throughout the state. Your local USU Extension office can provide access to agents, specialists, and information regarding your options in livestock waste management. Information available includes technical advice, building plans, handbooks, fact sheets and management systems. The Utah Department of Agriculture and Food may also provide some assistance.

COST ESTIMATES

Contact the Natural Resources Conservation Service, USU Extension, or your consultant for assistance with cost estimates.

REFERENCE LITERATURE

Many sources of literature on the subject are available. The NRCS *Agriculture Waste Management Field Handbook* (AWMFH) is a reference on lagoon and pond impoundments. It is written on a technical engineering level. USU Extension has resource materials available including: *Livestock Waste Facilities Hanbook* (MWPS-18), *Illustrated Plans* by Cooperative Extension, and others on the internet at http://aems.aste.usu.edu listed under "books."

TECHNICAL REQUIREMENTS

The majority of lagoon and pond design requirements can be found in the NRCS *Agricultural Waste Management Field Handbook* (AWMFH) latest edition. It is important that impoundments be constructed using sound engineering principles. An adequate supply of water must be available. Subsurface investigation of the site by identifying soil types and the depth to the water table must be done. The depth of one soil exploration must be at least 4-feet below the final elevation of the bottom. The seasonal high water table must be at least 2-feet below the bottom. Structural stability and the proposed lagoon dimensions must be evaluated based on these findings.

Complete plans and specifications must be submitted in order to obtain approval. See the conceptual drawings in this pamphlet. Complete plans for a system would expand these drawings to include the location of all essential impoundment structures, materials, equipment, dimensions and elevations on the plans. A separate text of specifications describing the requirements for materials and installation is usually necessary to amplify the plans.

Perhaps the most environmentally sensitive and sometimes time consuming part of designing an animal waste water impoundment is the design of an acceptable soil liner. Liners are installed to prevent ground water contamination. Synthetic plastic liners have been used with a high degree of success, but are sometimes expensive and difficult to install. Sometimes lagoon sites are located in native soils which are quite impermeable, and further lining is not necessary. However, usually less permeable soils must be hauled to the site and installed as liners, or bentonite is mixed with soils to meet permeability requirements. For large facilities, synthetic liners appear more reliable than clay liners. Additional information on this subject is given later.

Other Technical Requirements:

1. **Lagoon Odor Management**:

Odor Management Parameter	**Physical Separation from other habitation**	**Year-round Operating Depth (Anaerobic Lagoons)**	**Number of Lagoon Cells**	**Volatile Solids Loading Rate for Anaerobic Lagoons**
Required	As required by local ordinances.	6-feet minimum	One	Varies from 4.5 to 5.5# per 1000 cubic feet. See AWMFH.
Recommended*	1,320 feet; also see AWMFH and local siting standards	10-feet minimum	Two, depending on size.	37.5% Minimum Reduction**

*Contact agencies for further information. Usually required for ground water permits. **Mechanical aeration can also help control odors.

2. **Embankments (dikes)**:

Embankment Parameters	Dike Slopes	Top of Dike Width	Materials	Compaction	Rip-Rap Wave Shield
Required	3 Horizontal to 1 Vertical	8-feet	Relatively Impermeable	Compaction Plan or NRCS Supervision	None
Recommended*	Same	Same	Same	90% Standard Proctor	For large lagoons with erodible soils

*Contact agencies for further information. Usually required for ground water permits.

3. **Piping**: Inlet and outlet piping must be specified on the plans. Protection of pipes from freezing and plugging is needed. Protect the liner from erosion. See the concept drawing. Usually piping should discharge above the high water line, but where freezing is expected to cause plugging problems, the pipe could be installed below the expected elevation of the winter ice sheet, as shown on page four.

4. **Miscellaneous**:

(a) A management plan for impoundment operation and maintenance must be submitted with the plans.
(b) A statement of intent to submit a comprehensive nutrient management plan (CNMP) in accordance with CAFO program regulations must be developed with the specifications. A CNMP must be written by NRCS or other qualified specialist. Field application of livestock waste must conform to CNMP requirements.
(c) Impoundment contents shall not be discharged to surface waters. They must be located so they do not contaminate drinking water wells, springs or pipelines. Check with NRCS, local health department or DWQ for guidance.
(d) Saturated manure, such as that immediately removed from solid separation facilities, must not be piled on unprotected surfaces. All drainage from saturated manure must be routed to a lined structure. Drained "non-bleeding" manure may be relocated.
(e) Address safety considerations. This shall include fencing and signing, as necessary.
(f) Thorough compaction of the impoundment subgrade material must be provided. Field testing assistance for this may be provided by testing laboratories or NRCS. See the conceptual drawings on the next page.
(g) A minimum fifeen (15) years sludge storage volume is required for lagoons. This volume varies by animal type. See the NRCS AWMFH for the particular rate of sludge acculumation for each animal type.
(h) Lagoons should be sized to store waste during the nongrowing season, where land application is to be used. This is usually between 120 and 180 days.

5. **Soil Liner Permeability**:

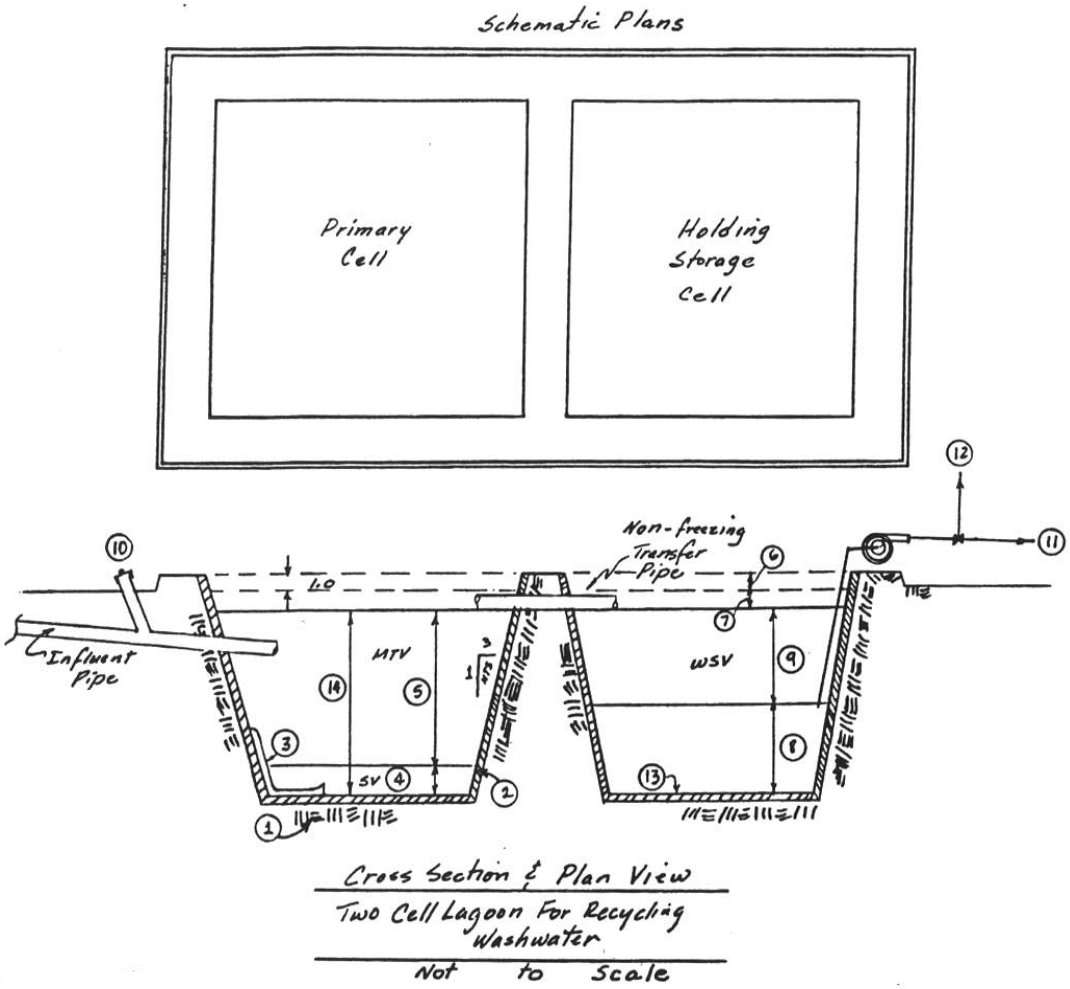
Soil Liner Parameter	Permeability	Thickness	Compaction	Soil Liner Material
Required for wastewater : Full depth ≤ 2-feet Depths > 2-feet	$K \leq 1 \times 10^{-6}$ cm/sec $K \leq 1 \times 10^{-7}$ cm/sec	12-inches minimum	Compaction plan or NRCS supervision is required.	Ensure uniform liner material.
Recommended*	Same	Same	Test to attain minimum 90% compaction at MC = 2 to 3% > optimum MC.	Run periodic sieve analysis & Atterberg limits to insure homogeneous material.

*Contact agencies for further information. For facilities with ground water permits, synthetic liners appear more reliable than clay liners.

Most impoundments will need to have a synthetic plastic or imported soil liner. Soil liners are the most common. They must be at least 12-inches thick. The appropriate permeability coefficient (K factor), as shown in the table above, is required for lagoon liners. A soil laboratory analysis is required to test for the K factor. A thorough liner compaction must attain a minimum of 90% of standard proctor at two to three percent above optimum moisture content. Unified Soil Classification System (USCS) testing must be done. For facilities with ground water permits, synthetic liners appear more reliable than clay liners. The construction drawings must be accompanied by a description of how compaction will be achieved in construction.

DRAWINGS:

The following conceptual drawings are provided to help a potential anaerobic lagoon system owner understand some of the major theory of design and requirements of construction drawings prior to retaining professional assistance. A two cell lagoon is depicted below. Two cell lagoons are recommended for facilities which recycle washwater, depending on size.



Key to Drawing Numbers

1. Compacted Subgrade.
2. Pre- and post-construction tested soil liner.
3. Splashblocking and rip-rapping required for both lagoon cells.
4. Sludge Storage Volume (SV).
5. Manure Treatment Volume (MTV).
6. Freeboard 1.0 feet minimum.
7. Site specific inflow + precipitation – evaporation depth + 25-year, 24-hour storm. Annual maximum monthly depth.
8. Minimum depth for vegetation and odor control (3-feet plus).
9. Seasonal storage volume (WSV). Usually 120-180 days operating volume.
10. Clean-out for plugged pipe. The discharge should be above high water level or below the seasonal ice sheet.
11. Irrigation discharge.
12. Flush and recycle water.
13. Elevation may be higher than first cell if necessary.
14. Minimum year-round operating depth. 10-feet design goal suggested. 6-feet absolute minimum required (MTV+ SV).

Requirements and Planning Checklist *

1. Evaluate the site and potential methods of waste management.
2. Make or obtain cost estimates.
3. Evaluate if adequate water rights and supply are available to run the proposed operation.
4. If an impoundment or other liquid manure handling system will be used, the requirements apply, and approval from NRCS or DWQ is needed.
5. Calculate the number of animal units for the operation. Consider the number of animals and the time to full buildout.

5A. It is recommended a CAFO permit be applied for 180-days prior to commencing farm operations.

6. If the current operation is 1,500 animal units (AU) or more, then a permit from DWQ is required. These are termed ground water permits. Consider obtaining a DWQ permit now, by judging potential future herd size and other factors.
7. Contact DWQ if a permit is needed. (NRCS and DWQ can both approve systems under 1,500 animal units).
8. Draw a preliminary site sketch and layout.

9. Have a soil and water table investigation done, using a consultant or agencies, as discussed below:
   a. One exploration must be at least 4-feet below the proposed bottom of the impoundment. Additional exploration is recommended.
   b. Log soil types and elevation of the seasonal high water table (SHWT).
   c. Evaluate findings of the investigation. The soil strata must be hydrogeologically stable and the SHWT must be at least 2-feet below the bottom.
   d. Based on the findings of your soil investigation, you may need to adjust your decisions on the type of waste disposal facility, siting, dimensions for the facility, or other items.
   e. Run soil tests to see if native soil is adequate as a liner, or if imported clay or bentonite addition to native soil will be needed to attain a K-factor (permeability) value less than the required permeability (see page three).
   f. Based on cost and the ground water protected, evaluate whether to install a soil liner or a synthetic liner system. For facilities with ground water permits, synthetic liners appear more reliable than clay liners.

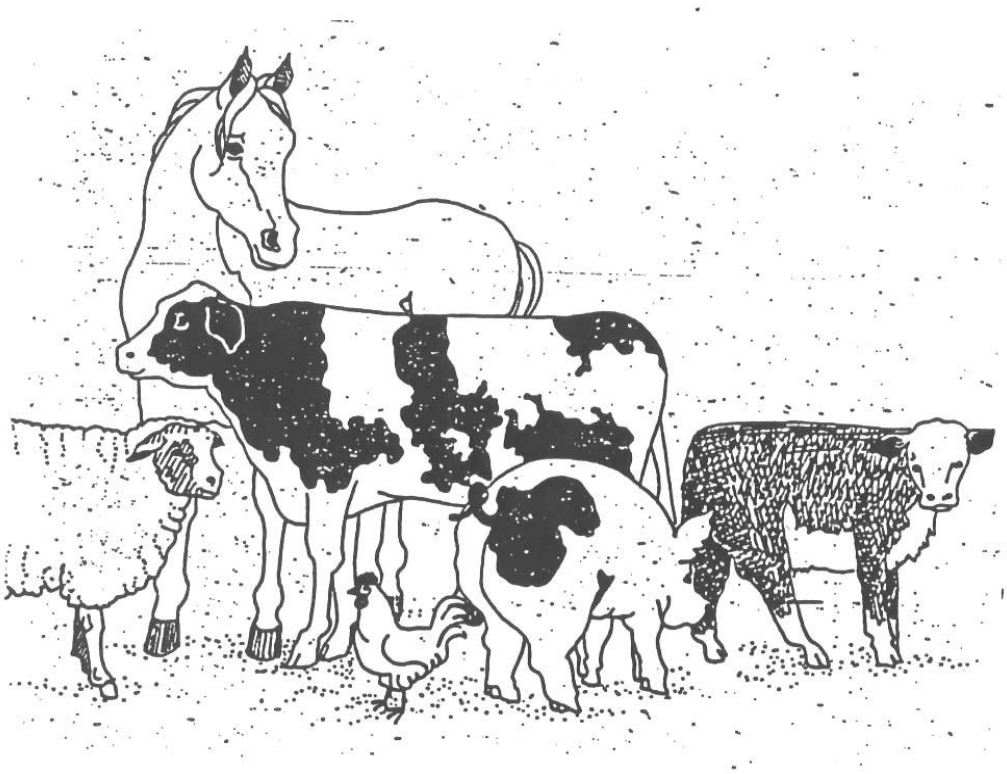
10. Locate and dimension the system, to include the requirements from the AWMFH and this pamphlet, for odor control, embankments, piping, liner permeability, etc.
11. Make draft plans and specifications for the system expanding on the concept drawing in the pamphlet.
    a. This should include the location of all essential structures, materials, equipment, dimensions, and elevations.
    b. The specifications should describe the materials and installation requirements needed to complete the plans successfully.
    c. Update the cost estimate to the current draft plans and review financial issues.
12. If land application of waste nutrients is necessary, the nutrient management plan must conform to comprehensive nutrient management plan (CNMP)requirements.
13. Have your draft plans and specifications reviewed and signed by yourself and NRCS or your consultant prior to submittal for approval.
14. The agency will review the plans and ask for adjustments to the design, or will issue an approval letter or permit to you. Ground water permits require a 30-day public notice prior to permit issuance (for operations ≥ 1,500 AU).

15. After approval notify your agency contact of the date you begin construction.
16. Normally, the agency will do some periodic inspection during construction.
17. Notify the agency of completion of construction, and request final inspection and certification.
18. Receive final approval of completed construction prior to discharging water into the system.
19. Make a set of as-built plans for a record, for you and the agency.

* Contact NRCS, USU Extension, your consultant, company sponsor, or DWQ for additional help.

Telephone Numbers for Information on this Subject:

USDA Natural Resources Conservation Service (NRCS) in Utah:
Salt Lake City office (801) 524-4550 (Messrs. Neil Pellmann or Kerry Goodrich), or contact your local NRCS field office.
USU Extension: Logan office (435) 797-3396 (Dr. John Harrison).
Division of Water Quality: Salt Lake City office (801) 538-6067 (Mr. Dave Rupp).



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