Liquid Manure Storage Area (LMSA) Review Checklist

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| --- | --- | --- | --- |
| Permittee/Site: |       | Engineer: |       |
| County: |       | Twp: |       | Section: |       | ¼ Section: |       |
| **TOTAL** site AU: |       | Reviewer Name: |       | Date Reviewed: |       |

This checklist can be used to review all types of LMSA liners. The checklist is broken up into sections based on the type of liner material. There are also sections that are applicable to all LMSAs and liners. The following three questions will help you determine if the LMSA is in a karst susceptible area, if the LMSA is subject to locational restrictions, or if the LMSA is a limited risk LMSA as these will impact what sections of the checklist are applicable. Please begin using this checklist by answering the following three questions.

**Question 1** - Applicability of Minn. R. 7020.2100 subp 2. A and B (Karst Susceptible Area)

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| 1. Is any part of the facility located within ½ mile of an area where the depth to carbonate bedrock is less than 50 ft. and the uppermost bedrock is carbonate materials or other geologic conditions where soil collapse or sinkhole formation occurs including the New Richmond Sandstone and basal St. Peter Sandstone?
 | YES NO |
| 1. Do karst features exist within 1,000 ft. of the facility (sinkholes, blind valleys, mapped caves, springs, or karst windows) and are geologic conditions near the karst features similar to those of the proposed site?
 | YES NO |

If you answered yes to **EITHER** of the items in Question 1, then the facility is considered to be in a karst susceptible area. The locational restrictions of Minn. R. 7020.2100 subp 2. A and B apply to the LMSA construction unless the LMSA also qualifies for either of the exemptions outlined in Question 2 or 3 below. For easy identification, any checklist component that is only applicable to karst susceptible areas is highlighted in blue. If the facility is not located in a karst susceptible area, you do not need to answer the questions highlighted in blue.

**Question 2** - Applicability of Minn. R. 7020.2100 subp 2. C (Locational Restriction Exemption)

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| --- | --- |
| 1. Is the facility an existing feedlot?
 | YES NO |
| 1. Is construction of a LMSA proposed to correct a pollution hazard?
 | YES NO |
| 1. Will the facility have a capacity of less than 300 AU after any proposed expansion?
 | YES NO |

If you answered yes to **ALL** of the items in Question 2, then the LMSA qualifies for the locational restriction exemption of Minn. R. 7020.2100 subp. 2 C. The review of this LMSA does not need to complete Section 1 of this checklist.

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| **Type of LMSA or LMSA Liner** | **Isolation Distance** |
| Unpermitted/Non-certified (any liner type) | 300 ft. |
| Earthen Liner | 150 ft. |
| Concrete, Synthetic, or Composite Liner | 100 ft. |

Be aware that even though the LMSA is exempt from the well isolation distances of Minn. R. 7020.2005 this does not exempt the LMSA from the requirements of Minn. R. 4725.4450; therefore an isolation distance is still required for water supply wells.

The following chart identifies the required isolation distances of Minn. R. 4725.4450.

Note: Minn. R. 4725.4450, subp.2 requires the distance to double when the well is considered sensitive which is defined as a water-supply well with less than 50 ft. of watertight casing where the casing does not penetrate a confining layer or multiple layers of confining materials with an aggregate thickness of 10 ft. or more.

**Question 3** - Applicability of Minn. R. 7020.2100 subp 1. D and E (Limited Risk LMSA Exemption)

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| --- | --- |
| 1. Is the LMSA constructed entirely of concrete and either
 | YES NO |
| * + 1. Volume less than 5,000 gal. or
		2. Volume less than 20,000 gal. and a separation of 5 ft. to karst susceptible bedrock.
 |  |
| 1. Is the LMSA designed, operated, and maintained as a solids settling area included as part of a NRCS level 4 or 5 vegetative treatment system where both i and ii are true.
 | YES NO |
| * + 1. The manure contaminated runoff is removed in 24 hours and
		2. The floor of the LMSA is either:
			- 1. Concrete, or ;
				2. At least 1 ft. of cohesive soil separated from Karst susceptible bedrock by at least 2 ft. of soils that are not coarser than a sandy loam.
 |  |

If you answered yes to EITHER of the items in Question 3, then the LMSA is considered a limited risk LMSA. A limited risk LMSA is not subject to the location restrictions of Minn. R. ch. 7020 (Section 1 of the checklist) but is still required to meet the well isolation distances of Minn. R. 4725.4450 (see chart in Question 2).

The following checklist will outline the requirements for plans and specifications for limited risk LMSAs.

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| Limited Risk LMSAs – A LMSA is a limited risk LMSA if you answered “YES” to EITHER a) or b) above. |
| 1. Is there an O&M plan that includes the following?
 | YES NO |
| 1. Routine inspections, repair methods and recordkeeping to document repairs
 |  |
| 1. Operational practices and methods used to monitor the liquid level in the LMSA
 |  |
| 1. Routine inspections of perimeter tile line outlets and inspection manholes
 |  |
| Stop-Sign-13498-large[1] Stop here if you answered “YES” to b) above as this is the only applicable requirement. |
| If you answered “YES” to a) the plans and specs must also include items L-2) to L-10). | N/A |
| 1. All penetrations identified with info on purpose, dimensions, and methods for sealing?
 | YES NO N/A |
| 1. If a precast tank is proposed does it meet the following?
 | YES NO N/A |
| 1. In lieu of requirements L-4) – L-9) below, the manufacturer must certify that it meets the requirements of Minn. R. ch. 7080 for use as sewage tank.
2. The manufacturer must indicate the maximum depth for tank installation
 |  |
| 1. Plans for and location of water stops or joint sealant materials and keyways or reinforcement at all construction joints?
 | YES NO |
| 1. Plans for sealing of all cracks which may extend through concrete liner with appropriate materials? (epoxy injection; routing and joint sealant; stitching)
 | YES NO |
| 1. Floor is at least 5 in. thick and have one of the following:
 | YES NO |
| 1. Fiber reinforcing and specifications on type of fibers and the dosage rate? **OR**
 |  |
| 1. Steel reinforcing based on subgrade drag theory? (Slabs on Grade, ACI-360)
 |  |
| 1. Adequate footings for walls and columns?
 | YES NO |
| 1. 8 in. min. with rebar reinforcement
 |  |
| 1. 10 in. min. with rebar reinforcement if footing not poured continuous with floor
 |  |
| 1. Minimum compressive strength of concrete mix? (typically 3,500 or 4,000)
 | YES NO |
| 1. Provisions for supporting reinforcing steel by appropriate chairs or concrete blocks.
 | YES NO |
| 1. If the soil survey indicates a seasonal water table above the proposed LMSA floor elevation, is there a plan for a perimeter tile that meets the following?
 | YES NO N/A |
| 1. Tile located at least 1 ft. outside the LMSA footing (no more than 7 ft.)
 |  |
| 1. Tile installation depth at least as deep as the bottom of the LMSA floor
 |  |
| 1. A separate drain tile system for each LMSA with access point for sample collection
 |  |
| 1. Access for collection of tile-water samples for each drain tile system
 |  |
| Stop-Sign-13498-large[1] Stop here if the LMSA is a limited risk LMSA – no other sections need to be completed. |

Provided the LMSA which you are evaluating does not qualify for the limited risk LMSA exemption (Question 3) you should use the following portions of this review checklist to evaluate the LMSA. The checklist is broken into sections based upon the type of LMSA liner.

To conduction a complete review of LMSA plans and specs, you should use the checklist as follows:

* Except for those LMSAs that qualify for the exemption outlined in Question 2 (locational restriction exemption), every LMSA plan review must complete Section 1 of the checklist.
* Every LMSA plan review must complete Section 2 of the Checklist.
* Based upon the liner type of the LMSA under review, the appropriate section of the checklist, that matches the type of liner within the LMSA, should then be completed.

For Example: A review of an earthen lined LMSA would need to complete Section 1, Section 2, and

Section 4 of the checklist. The remainder of the checklist is not applicable.

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| 1. Locational Restrictions (ALL LMSAs, except those that answered “YES” to Question 2)
 |
| * 1. Are the following **shoreland** restrictions met?
 | YES NO |
| 1. If there are no existing animal housing or manure storage areas at the proposed facility, no construction is allowed.
 |  |
| 1. If site has 1,000 AU or more after construction, a LMSA cannot be constructed within the shoreland area. A LMSA can be constructed outside of the shoreland area.
 |  |
| 1. If site has less than 1,000 AU after construction, the LMSA may not be constructed closer to high water mark than any other animal housing or manure storage area on the site.
 |  |
| * 1. Are the following **floodplain** restrictions met?
 | YES NO |
| 1. LMSA construction or expansion is prohibited when any part of the facility is within a floodplain.
 |  |
| * 1. Are the following **Karst** restrictions met?
 | YES NO |
| 1. LMSA construction or expansion is prohibited within 300 ft. of a sinkhole.
 |  |
| 1. The volume of a LMSA is limited to 250,000 gal. when 4 or more sinkholes exist within 1,000 ft. of the proposed LMSA location.
 |  |
| * 1. Are the following **private well** restrictions met?
 | YES NO |
| 1. Concrete, synthetic, or composite lined LMSA construction or expansion is prohibited within 100 ft. of a well.
 |  |
| 1. Earthen lined LMSA construction or expansion is prohibited within 150 ft. of a well.
 |  |
| 1. If the well is considered sensitive - less than 50 ft. of watertight casing where the casing does not penetrate a confining layer or multiple layers of confining materials with an aggregate thickness of 10 ft. or more then:
 |  |
| 1. Concrete, synthetic, or composite lined LMSA construction or expansion is prohibited within 200 ft. of the well.
 |  |
| 1. Earthen lined LMSA construction or expansion is prohibited within 300 ft. of the well.
 |  |
| * 1. Are the following **public well** restrictions met?
 | YES NO |
| Construction or expansion of a LMSA is prohibited within 1000 ft. of a community well or other wells serving a public or private school or licensed child care center, unless **ALL** of the following are met:1. MDH has approved a drinking water supply management area for the well
2. The LMSA is not within the drinking water supply management area
3. The LMSA is not within 200 ft. of the well.
4. The well is not considered vulnerable (Minn. R. 4720.5550, subp. 2)
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| 1. Requirements for all types of liners (this section is required for all types of LMSAs)
 |
| * 1. P.E. licensed in MN or NRCS staff with approval authority signature on plans?

(Not required if constructed entirely of concrete and volume less than 20,000 gal) | YES NO N/A |
| * 1. Information to indicate that the plans and specifications are for the site whose permit application is under review?
 | YES NO |
| 1. Owner Name, Address, County, Township, Section, ¼ Section
 |  |
| * 1. Plan for a preconstruction conference which includes the design engineer, inspector, owner and contractor(s)?
 | YES NO |
| * 1. If the facility is in a karst susceptible area, has a karst feature survey been completed?
1. The survey must comply with and be documented on the forms provided as Attachment A.
 | YES NO N/A |
| * 1. If the LMSA is located within a MDH approved drinking water supply management area (DWSMA), has the following information been included with the plans?
 | YES NO N/A |
| 1. Location of feedlot, manure storage areas, and land app. sites on map of DWSMA
 |  |
| 1. Copy of the vulnerability assessment of the DWSMA
 |  |
| 1. Description of vulnerability for manure storage and land app. from assessment
 |  |
| 1. Copy of all parts of DWSMA plan pertaining to feedlots
 |  |
| * 1. Is the approximate depth to regional water table estimated?
 | YES NO |
| * 1. All LMSAs must have a soils investigation that includes items 2.7.1 to 2.7.11
 |  |
| * + 1. Soils investigation completed with use of backhoe excavation, hollow stem auger, or push probe. Solid stem rotary auger is only allowed when approved by the MPCA.
 | YES NO |
| * + 1. Site plan indicating LMSA location and location of each boring?
 | YES NO |
| * + 1. Borings at two locations within LMSA boundaries for first half acre and a minimum of one boring per additional acre?
1. Borings may be located outside of LMSA footprint (no farther than 25 ft.) if there is concern of soil support for the LMSA due to borings within the footprint.
 | YES NO |
| * + 1. Soil boring depth below the proposed LMSA bottom adequate?
 | YES NO |
| 1. In Non-Karst susceptible areas, at least half of the required minimum number of borings must advance to 5 ft. below the bottom of the LMSA; remaining borings must advance to the bottom of the LMSA liner.
 |  |
| 1. In Karst susceptible areas, ALL the required minimum number of borings must advance to a identified depth in the chart below, based on animal units and liner types, or until bedrock is encountered. c
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| Total AU at facility contributing to liquid storage | Non-Concrete(earthen, GCL, etc) | Concrete Liner | Synthetic Liner underlain by 2 ft. of cohesive soil. | Concrete Liner underlain by 2 ft. of cohesive soil, Synthetic Liner underlain by 3 ft. of cohesive soil, or above ground storage system.  |
| less than 300 AU | 20 ft. | 10 ft. | 10 ft. | 10 ft. |
| 300 – 999 AU | 30 ft. | 10 ft. | 10 ft. | 10 ft. |
| 1,000 or more AU | 40 ft. | 15 ft. | 15 ft. | 10 ft. |

 |
| c if bedrock is encountered then an interpretation of type of bedrock must be included |  |
| * + 1. Each soils record identifies the date the investigation was completed
 | YES NO |
| * + 1. Each soils record identifies the natural ground elevation and LMSA bottom elevation
 | YES NO |

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| * + 1. Each soils record identifies soil type and thickness indicated and described by either:
 | YES NO |
| 1. Soil texture (ex: loam, sand) and soil color based upon USDA soil survey manual (EX: “brown (10YR 5/3),dry and smoothed”) **OR**
 |  |
| 1. **U**nified **S**oils **C**lassification **S**ystem (USCS) (ex: SM, OL, CL)
 |  |
| * + 1. Each soils record identifies approximate depth to seasonal water table
 | YES NO |
| * + 1. Analysis of foundation soils for suitability of the proposed structure
 | YES NO |
| * + 1. Sufficient soil records have been obtained to represent soil conditions at the site
 | YES NO |
| 1. Are soil profiles somewhat similar in soil types, water elevations, and bedrock?
 |  |
| * + 1. Each borehole was sealed throughout the entire depth by a method that will ensure that it does not become a preferential flow path for groundwater transport.
 | YES NO |
| * 1. If the soils investigation indicates a seasonal water table above the proposed LMSA floor elevation, is there a plan for a perimeter tile that meets the following?
 | N/A |
| * + 1. For vertical wall concrete tanks, is the tile located at least 1 ft. but no more than 7 ft. outside the LMSA footing?

Note: a drainage system incorporated into the forms is allowed (i.e. form-a-drain) | YES NO N/A |
| * + 1. For earthen or GCL lined basins, is the tile located either:
 | YES NO N/A |
| 1. Directly below the top of the berm wall **OR**
 |  |
| 1. No closer than directly below ⅔ down the length of the interior slope and the tile outlet is a surface outlet (no direct connection to tile system or water body)
 |  |
| * + 1. Tile installation depth at least as deep as the bottom of the LMSA liner
 | YES NO |
| * + 1. A separate drain tile system for each LMSA
 | YES NO |
| * + 1. Access for collection of tile-water samples for each drain tile system
 | YES NO |
| * 1. In a Karst susceptible area, does the LMSA comply with the bedrock separation distance in the table below? Note: separation distance is measured from the top of the floor of the LMSA to the start of the bedrock.
 | YES NO N/A |
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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Total AU at facility contributing to liquid storage | Non-Concrete(earthen, GCL, etc) | Concrete Liner | Synthetic Liner underlain by 2 ft. of cohesive soil. | Concrete Liner underlain by 2 ft. of cohesive soil, Synthetic Liner underlain by 3 ft. of cohesive soil, or above ground storage system.  |
| less than 300 AU | 20 ft. | 5 ft. | 5 ft. | 5 ft. |
| 300 – 999 AU | 30 ft. | 10 ft. | 10 ft. | 5 ft. |
| 1,000 or more AU | 40 ft. | 15 ft. | 15 ft. | 10 ft. |

 |
| * 1. In a Karst susceptible area, is bedrock removal in order to comply with the applicable separation distances planned*? If* ***“YES”*** *the plan must be approved by the MPCA.*
 | YES NO N/A |
| * 1. Plans estimate storage capacity volume and length of time before LMSA will reach full capacity.
 | YES NO |
| 1. If site is 1,000 AU or more, then the liquid manure storage capacity at the facility, when all LMSAs are added together, provides a total of at least 9 months of storage.
 |  |
| 1. The total liquid storage capacity of the facility, including the proposed LMSA and any animal unit increase, does not exceed 14 months.
 |  |
| * 1. Does the LMSA have adequate freeboard?
 | YES NO |
| 1. All LMSAs (including below barn LMSAs) must have at least 1 ft. of freeboard
 |  |
| 1. If the LMSA stores animal manure and runoff, the freeboard must be increased beyond 1 ft. if necessary to contain the volume generated by the 25 year/24 hour rainfall event.
 |  |
| * 1. All penetrations identified w/info on purpose, dimensions, and methods for sealing? Only penetrations for manure transfer systems are allowed (no water lines, etc.).

Extra attention should be given to pipe penetrations through synthetic liners as they are typically an area where leaks develop.The LMSA handbook provides example drawings. | YES NO N/A |
| * 1. O & M plan for LMSA that includes the following items?
 | YES NO |
| 1. Routine inspections, repair methods and recordkeeping to document repairs
 |  |
| 1. Methods used to monitor the liquid level in the LMSA and identify freeboard
 |  |
| 1. Routine inspections of perimeter tile line outlets and inspection manholes
 |  |
| 1. General description of design and operational assumptions
 |  |
| 1. Provisions to protect the liner during manure removal activities
 |  |

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| 1. Additional Requirements for Concrete Liners
 | N/A |
| * 1. If a LMSA is proposed to be constructed of Pre-Cast Panels (i.e. Weiser tank), does the plan meet the following:
 | YES NO N/A |
| 1. The floor of the LMSA must meet all of the requirements below (3.2 to 3.8)
2. The floor must have a keyway in which the wall panels sit (not secured on top of a flat slab). This joint must utilize water stop or joint sealant materials.
3. The wall panels must be certified by the manufacturer as appropriate for the use in the LMSA construction. (no need to evaluate the panels with the checklist)
4. The wall panels must utilize water stop or joint sealant materials at all joints between precast panels.
 |  |
| * 1. Plans for and location of water stops or joint sealant materials **and** keyways or reinforcement at all construction joints?
 | YES NO |
| Construction Joint = The junction of two successive placements of concrete with a keyway or reinforcement across the joint. |  |
| * 1. Plans for sealing of all cracks which may extend through concrete liner with appropriate materials? (epoxy injection; routing and joint sealant; stitching, etc.)
 | YES NO |
| * 1. Floor is at least 5 in. thick and have **one** of the following:
 | YES NO |
| 1. Fiber reinforcing and specifications on type of fibers and the dosage rate? **OR**
 |  |
| 1. Steel reinforcing based on subgrade drag theory? (Slabs on Grade, ACI-360)
 |  |
| * 1. Provisions for supporting reinforcing steel in intended location by appropriate chairs or concrete blocks.
 |  |
| * 1. Adequate footings for walls and **columns**?
 | YES NO |
| 1. 8 in. min. with rebar reinforcement
 |  |
| 1. 10 in. min. with rebar reinforcement if footing not poured continuous with floor
 |  |
| * 1. Provisions for supporting reinforcing steel in intended location by appropriate chairs or concrete blocks.
 |  |
| * 1. Minimum compressive strength of concrete mix? (typically 3,500 or 4,000)
 | YES NO |
| * 1. Do the plans contain a Quality Assurance/Quality Control (QA/QC) plan that includes the following elements?
 |  |
| * + 1. Plan for inspections during construction by an inspector who is either:
 | YES NO |
| 1. ACI concrete 1 Field Test Certified,
 |  |
| 1. A MN P.E. or person working under direct supervision of a P.E., or
 |  |
| 1. A NRCS approved person
 |  |

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| * + 1. Plan for testing methods during construction that complies with one of the following:
 | YES NO |
| 1. ACI 318-02 field testing methodology
 |  |
| 1. ACI 301-99 field testing methodology
 |  |
| 1. ASTM C-94
 |  |
| 1. List of separate tests that includes all of the following:
 |  |
| 1. ASTM C-172 = concrete sampling
 |  |
| 1. ASTM C-31 & C-39 = Compressive Strength (min. @ 150 cy or different mix)
 |  |
| 1. ASTM C-138 or C-173 or C-231 = Air Content (note: only recommended)
 |  |
| 1. Slump: (a) ASTM C-143 OR (b) if plasticizer in concrete indicate dosage
 |  |
| 1. ASTM C-1064 = Temperature
 |  |
| * + 1. Plan for additional testing to represent new mixes or different concrete suppliers
 | YES NO |
| * + 1. Frequency of testing is stated and is not less than @ 150 cy for strength
 | YES NO |
| * 1. Specifications for liner protection during and after construction? Does it include protection from:
 |  |
| * + 1. Drying and cracking during and after liner construction
 | YES NO |
| 1. How to keep moist options: (a) spray or pond; (b) cover plastic or burlap; (c) curing compound; (d) steam
 |  |
| * + 1. Freezing and Thawing
 | YES NO |
| 1. After construction – maintain water level, heat, etc.
 |  |
| 1. In the event of non-use will protection from concrete freeze-thaw be needed?
 |  |
| * + 1. Hot and cold weather construction?
 | YES NO |
| 1. Hot: ACI 305R “Hot Weather Concreting” or detailed instructions
 |  |
| 1. Cold: ACI 306.1 “Standard Specification for Cold Weather Concreting” or detailed instructions
 |  |

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| 1. Additional Requirements for Earthen Liners

**Note:** Earthen liners that serve as a secondary liner as part of a dual or composite liner system are addressed separately in Section 8.A summary of required testing is included as Attachment B. | N/A |
| * 1. Has the source of the liner soils been adequately identified (on-site or borrow site)?
 | YES NO |
| 1. For borrow sites a map of the location and an estimation of the volume of soils available must be included.
 |  |
| * 1. Do the results of the following required tests performed on the liner material comply with the minimums stated? (tests are required with all earthen liner proposals)
 | YES NO |
| 1. Atterberg Limits – Soil Plasticity Index (values of 11-30)
 |  |
| 1. Particle Size – Sieve Analysis (greater than 20% passing #200 and less than 20% retained on #4)
 |  |
| 1. Standard Proctor - Optimal Moisture Content and Density (no minimum values)
 |  |
| * 1. If an in-place earthen liner is proposed, do the facility, structure, and natural soils meet **ALL** the criteria contained in the LMSA handbook (also Appendix A) for in-place liners?

(i.e. less than 300 AU, correcting a pollution hazard, no more than 750,000 gal, etc.) | YES NO N/A |
| *If* ***“YES”*** *the liner is not required to be evaluated according to the remaining portions of Section 4 of this checklist applicable to earthen liners.* |  |

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| * 1. Does the plan identify the minimum liner thickness?
1. Minimum liner thickness is 2 ft., however when placed over sand and gravel deposits the liner must be increased to 2.5 ft.
 | YES NO |
| * 1. Is there an analysis of the seepage from the basin demonstrating that the basin will meet the seepage standard of 1/56 inch/day (approximately 500 gal/acre/day)?

*A basin seepage and volume calculator is available at:* <http://www.pca.state.mn.us/index.php/view-document.html?gid=15889> | YES NO |
| * 1. For seepage calculations that assume a soil permeability of less than 1 x 10-7 cm/sec, do the plans contain results of pre-construction permeability testing?
 | YES NO N/A |
| 1. Permeability tests are required in the following situations:
	1. Liner thickness of 2 ft. and LMSA depth minus freeboard greater than 8.5 ft.
	2. Liner thickness of 2.5 ft. and LMSA depth minus freeboard greater than 10.5 ft.
	3. Liner thickness of 3 ft. and LMSA depth minus freeboard greater than 12.5 ft.
2. Frequency of 1 test per 4 ac. of basin area with a minimum of 2 tests.
 |  |
| * 1. If equipment access is needed (i.e. manure removal activities), are concrete ramps at least 16 ft. wide planned?

(ramps less than 16 ft. wide are allowed if a concrete curb at least 6 in. high is planned) | YES NO N/A |
| * 1. Where agitation is planned within the LMSA, is a concrete agitation pad that meets one of the following included?
 | YES NO N/A |
| 1. minimum dimensions of 20 ft. by 20 ft. and designed as a sump.
2. minimum dimensions of 20 ft. by 20 ft. and at least a 6 in. curb at the rear of the pad.
3. minimum dimension of 20 ft. by 30 ft. (30 ft. out from the toe of the slope)
 |  |
| * 1. Are protective measures for the liner planned where manure enters the LMSA?

(i.e., splash pads, runoff chutes, etc.) | YES NO N/A |
| * 1. Do the plans specify the maximum thickness of soil lifts prior to compaction?
1. Lift thickness cannot more than 3 in. greater than the tamping roller feet with a maximum thickness of 9 in.
 | YES NO |
| * 1. Is construction of the liner planned between October 15 and April 15?

*If* ***“YES”*** *approval from the MPCA feedlot engineers is required.* | YES NO N/A |
| * 1. Do the plans contain a Quality Assurance/Quality Control (QA/QC) plan that includes:
 |  |
| * + 1. Plan for inspections during construction by an inspector who is either:
 | YES NO |
| 1. A MN P.E. or person working under direct supervision of P.E., or
 |  |
| 1. A NRCS approved person
 |  |
| * + 1. Plan for testing methods during construction that comply with the following:
 | YES NO |
| 1. Moisture (min of 4/acre/ft. of liner) according to one of the following:
 |  |
| 1. ASTM D6938, D2216, D4643, D4959, or D4944 **OR**
 |  |
| 1. Method specification (i.e. soil ribbon)
 |  |
| 1. Density/Compaction (min of 4/acre/ft. of liner) according to:
 |  |
| 1. ASTM D6938, D2167, D5080, D2937, or D1556 (method specification can be used if pre-approved by the MPCA)
 |  |
| * + 1. When pre-construction permeability testing is required, a plan for post construction permeability testing to verify adequate liner had been constructed
 | YES NO N/A |
| 1. Minimum of 1 test per 2 ac. of basin area, with at least 1 test in the floor and 1 in the sidewall (ASTM D5084 or D5856)
 |  |
| * 1. Specifications for liner protection during and after construction that include:
 | YES NO |
| 1. Drying and cracking during and after liner construction
 |  |
| 1. Freezing and thawing
 |  |
| 1. Additional Requirements for Synthetic (Plastic) Liners

Plastic refers to all petroleum based products. Specific requirements based on the type of material will be specifically noted. | N/A |
| * 1. Does the plan identify what type of material will be used? (HDPE, LLDPE, EPDM)
 | YES NO  |
| * 1. Does the liner have a thickness of at least 60 mil. (45 mil. for EPDM)?
 | YES NO  |
| * 1. Do the plans have a material specification sheet that identifies the properties of the product to be used and does the material meet the requirements of the NRCS material specification 594 (See Appendix F of the LMSA handbook).

*NRCS material spec* 594 is available at:ftp://ftp-fc.sc.egov.usda.gov/NHQ/eng/neh642/ms-pdf/ms594.pdf | YES NO  |
| * 1. Is there a plan for a venting system under the plastic liner?
 | YES NO  |
| * 1. Do the plans call for removal of all rocks ½ in. or greater and all other angular objects?
 | YES NO  |
| * 1. Do the plans call for removal of all organic materials prior to liner placement?
 | YES NO  |
| * 1. Do the plans require smooth drum rolling of the subgrade prior to liner placement?
 | YES NO  |
| * 1. If equipment access is needed (i.e. manure removal activities), are concrete ramps at least 16 ft. wide planned?

(ramps less than 16 ft. wide are allowed if a concrete curb at least 6 in. high is planned) | YES NO N/A |
| * 1. Where agitation is planned within the LMSA, is a concrete agitation pad that meets one of the following included?
 | YES NO N/A |
| 1. minimum dimensions of 20 ft. by 20 ft. and designed as a sump
2. minimum dimensions of 20 ft. by 20 ft. and at least a 6 in. curb at the rear of the pad
3. minimum dimension of 20 ft. by 30 ft. (30 ft. out from the toe of the slope)
 |  |
| * 1. If equipment access is needed (i.e. manure removal activities), do the plans include specific methods for installation of the concrete ramps and pads that include either:
 | YES NO N/A |
| 1. Provisions for installation of embedment strips within the concrete to which the liner is welded
 |  |
| 1. Provisions for installation of the concrete on top of the plastic liner that includes a sacrificial sheet of plastic or geotextile between the concrete and the plastic liner.
 |  |
| * 1. Do the plans contain a QA/QC plan that includes:
 |  |
| * + 1. Plan for inspections during construction by an inspector who is either:
 | YES NO |
| 1. A MN P.E. or person working under direct supervision of P.E., or
 |  |
| 1. A NRCS approved person
 |  |
| * + 1. Plans for testing methods of the plastic liner that comply with the following:
 | YES NO |
| 1. Air pressure tests performed in accordance with ASTM D5820 on all double-track fusion seams. (not applicable for EPDM)
 |  |
| 1. Vacuum box tests performed in accordance with ASTM D 5641 on all seams and repairs made by extrusion welds. (not applicable for EPDM)
 |  |
| 1. Air lance tests performed in accordance with ASTM D 4437 on single-track fusion welds and on adhesive EPDM seams.
 |  |
| 1. Destructive seam testing at one sample per 500 ft. of weld. All destructive seam samples shall be tested in shear and peel modes in accordance with ASTM D 6392.
 |  |

|  |  |
| --- | --- |
| 1. Additional Requirements for Geo-Synthetic Clay (GCL) Liners
 | N/A |
| * 1. Is there an analysis of the seepage from the basin demonstrating that the basin will meet the seepage standard of 1/56 inch/day (approximately 500 gal/acre/day)?

*A basin seepage and volume calculator is available at:* <http://www.pca.state.mn.us/index.php/view-document.html?gid=15889> | YES NO |
| * 1. Do the plans have a material specification sheet that identifies the specific product to be used and does the material properties meet the requirements of the NRCS material specification 595 (See Appendix E of the LMSA handbook).

There are many configurations and types of GCL liners available, it is important to know what type of GCL will be installed.*NRCS material spec* 595 is available at:ftp://ftp-fc.sc.egov.usda.gov/NHQ/eng/neh642/ms-pdf/ms595.pdf  | YES NO |
| * 1. Do the plans call for removal of all rocks ½ in or greater and all other angular objects?
 | YES NO  |
| * 1. Do the plans call for removal of all organic materials prior to liner placement?
 | YES NO  |
| * 1. Do the plans require smooth drum rolling of the subgrade prior to liner placement?
 | YES NO  |
| * 1. Provisions for liner overlap of at least 12 in. at the edge of the roll and 2 ft. at the end of the roll and call for the use of granular bentonite within the overlap?

(a reference to the manufacturers installation guidelines is also acceptable) | YES NO |
| * 1. If equipment access is needed (i.e. manure removal activities), are concrete ramps at least 16 ft. wide planned?

(ramps less than 16 ft. wide are allowed if a concrete curb at least 6 in. high is planned) | YES NO N/A |
| * 1. Where agitation is planned within the LMSA, is a concrete agitation pad that meets one of the following included?
 | YES NO N/A |
| 1. minimum dimensions of 20 ft. by 20 ft. and designed as a sump
2. minimum dimensions of 20 ft. by 20 ft. and at least a 6” curb at the rear of the pad
3. minimum dimension of 20 ft. by 30 ft. (30 ft. out from the toe of the slope)
 |  |
| * 1. Do the plans call for a minimum of at least 1 ft. of cover soil that meets the following:
 | YES NO |
| 1. No sharp, angular stones or any objects that could damage the liner.
2. Maximum allowable particle size of ½ in., unless the liner is protected by a geotextile
3. Cover material placed within 24 hours of liner installation of liner material
4. Cover material placed without driving on uncovered liner material
 |  |
| * 1. Do the plans contain a Quality Assurance/Quality Control (QA/QC) plan that includes:
 |  |
| * + 1. Plan for inspections during construction by an inspector who is either:
 | YES NO |
| 1. A MN P.E. or person working under direct supervision of P.E., or
 |  |
| 1. A NRCS approved person
 |  |
| * + 1. Plans for specific observations of the following activities:
 | YES NO |
| 1. Subgrade preparation
2. Placement of liner material
3. Seaming operations
4. Installation of cover soil
 |  |

|  |  |
| --- | --- |
| 1. Additional Requirements for Above-ground LMSAs

For concrete tanks and the concrete floor of the steel tank, Section 3 of this checklist should be used for the review.This portion of the checklist is designed for steel tanks (i.e. Slurry-store). | N/A |
| * 1. Do the plans include the manufacturer recommendations for installation?
 | YES NO |
| * 1. If the tank is “used”, do the plans prohibit the re-use of any panels that were embedded in concrete and replacement of any damaged panels and hardware that shows signs of deterioration?
 | YES NO N/A |
| * 1. Do the plans contain a QA/QC plan that includes:
 |  |
| * + 1. Plan for inspections during construction by an inspector who is either:
 | YES NO |
| 1. A MN P.E. or person working under direct supervision of P.E., or
 |  |
| 1. A NRCS approved person
 |  |
| * + 1. Certification from the manufacturer that the tank was installed according to their recommendations.
 | YES NO |

|  |  |
| --- | --- |
| 1. Additional Requirements for Secondary Earthen Liners

The primary liner (typically concrete or plastic) should be evaluated with the applicable section of this checklist. | N/A |
| * 1. Has the source of the liner soils been adequately identified (on-site or borrow site)?
 | YES NO |
| 1. For borrow sites a map of the location and an estimation of the volume of soils available must be included.
 |  |
| * 1. Do the results of the following required tests performed on the liner material comply with the minimums stated? (tests are required with all earthen liner proposals)
 | YES NO |
| 1. Atterberg Limits – Soil Plasticity Index (values of 11-30)
 |  |
| 1. Particle Size – Sieve Analysis (greater than 20% passing #200 and less than 20% retained on #4)
 |  |
| 1. Standard Proctor - Optimal Moisture Content and Density (no minimum values)
 |  |
| * 1. Is the thickness of the secondary cohesive soil liner at least 2 ft.?
 | YES NO |
| * 1. Do the plans specify the maximum thickness of soil lifts prior to compaction?
1. Lift thickness cannot be more than 3 in. greater than the tamping roller feet with a maximum thickness of 9 in.
 | YES NO |
| * 1. Is construction of the liner planned between October 15 and April 15?

*If* ***“YES”*** *approval from the MPCA feedlot engineers is required.* | YES NO N/A |
| * 1. For LMSAs with sloping sidewalls does the secondary liner meet the following:
 |  |
| * + 1. Is the secondary liner planned under all areas of the primary liner (i.e. liner installed along the entire sloping wall length)
 | YES NO N/A |
| * + 1. When the primary liner is not placed in direct contact with the secondary liner, installation of free draining fill and additional tile system between the liners must be included. (this must be separate from a perimeter tile used to control the seasonal water table)
1. Provisions must also be included for removal (via pump) of accumulated liquids from this area along with visual observations for evidence of seepage through the primary liner.
 | YES NO N/A |

|  |  |
| --- | --- |
| * 1. For LMSAs with vertical concrete walls does the secondary liner meet the following:
 |  |
| * + 1. Is the secondary liner constructed like a “bowl” that includes the following:
 | YES NO N/A |
| 1. Secondary liner sidewalls are at least 2 ft. high.
2. Secondary liner sidewalls are no closer than 2 ft. from the concrete footing/wall.
 |  |
| * + 1. Installation of free draining fill and additional tile system within the “bowl” created by the secondary liner.

(this must be separate from a perimeter tile used to control the seasonal water table) 1. Provisions must also be included for removal (via pump) of accumulated liquids from this area along with visual observations for evidence of seepage through the primary liner.
 | YES NO N/A |
| * 1. Do the plans contain a QA/QC plan that includes:
 |  |
| * + 1. Plan for inspections during construction by an inspector who is either:
 | YES NO |
| 1. A MN P.E. or person working under direct supervision of P.E., or
 |  |
| 1. A NRCS approved person
 |  |
| * + 1. Plan for testing methods during construction that comply with the following:
 | YES NO |
| 1. Moisture (min of 4/acre/ft. of liner) according to one of the following:
 |  |
| 1. ASTM D6938, D2216, D4643, D4959, or D4944 **OR**
 |  |
| 1. Method specification

(i.e. Soil will form a long ribbon when rolled between hands without breaking) |  |
| 1. Density/Compaction (min of 4/acre/ft. of liner) according to:
 |  |
| 1. ASTM D6938, D2167, D5080, D 2937, or D1556 **OR**
2. For facilities with 300 or less AU a method specification
 |  |

**Disclaimer:** This checklist is a summary of the requirements for design, construction, and operation of liquid manure storage areas and was developed to cover common types of liquid manure storage areas. In some situations additional requirements may be deemed necessary by the MPCA based upon site specific circumstances or alternative liquid manure storage area design, construction, or operation techniques/methods.

**Attachment A**

Karst Feature Inventory Reporting Form
For a Proposed Liquid Manure Storage Area (LMSA)

The purpose of this form is to provide documentation regarding all karst features identified within ½ mile from the facility. Additional follow-up inspections may be needed by qualified individuals to assess potential karst features. Submit this form and required map(s) along with your plans and specifications for the LMSA.

|  |
| --- |
| **Proposed LMSA Location** |
| County: |       | Township: |       | Sect.: |    | ¼ Sect.: |    |
| Facility Owner Name: |       | Phone: | (   )       |
| **Inspector Information** |
| Name: |       | Date of Field Inspection: |       |
| Company/Organization: |       | Phone: | (   )       |
| Field Conditions (snow cover, vegetation, etc.): |       |

**Karst Feature Inventory DocumenTation**

The inspector must review existing map resources for all land within ½ mile of the proposed site and must also conduct a visual on-site inspection of the land within 1,000 feet of the proposed site, traversing the land closely enough to identify small sinkholes or other karst features. The following documentation is required.

1. Where sinkhole probability maps exist, attach a copy of the map showing the location of the LMSA and all sinkholes within ½ mile.
2. Attach a copy of an aerial photograph showing the location of the LMSA and all karst features within ½ mile. Number each Karst feature on the aerial photograph and provide a description in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| **Feature Sketch ID and Description** | **Source of information** | **Feature size and description**  | **Distance from LMSA &****Other information** |
| *Ex.* | *Depression in the landscape*  | *Walk-over survey* | *12 ft. in diameter and 1-2 ft. deep* | *Located 500 ft. from LMSA* |
| **#1** |       |       |       |       |
| **#2** |       |       |       |       |
| **#3** |       |       |       |       |
| **#4** |       |       |       |       |
| **#5** |       |       |       |       |
| **#6** |       |       |       |       |
| **#7** |       |       |       |       |
| **#8** |       |       |       |       |

**Attachment B**

Earthen LMSA Liner Construction Testing Summary

(alternatives may be required/approved by the MPCA based on site specific circumstances)

**4. Is liner permeability less than 1 x 10-7 cm/sec
needed for the LMSA to meet the seepage standard?**

* No pre construction permeability testing required.
* Daily construction inspection *(when liner placed)*
* Moisture tests at 4/acre/ft. of liner (or method specification)
* Density tests at 4/acre/ft. of liner (min of 5/ft. of liner)

(pre-approved method specification may be allowed)

* No post construction permeability testing required.

*Post-construction permeability tests may be required based on Moisture/Density test results*

* Pre-construction permeability testing frequency of 1 test per liner soil type per every 4 acres of basin area (minimum of 2 tests).
* Moisture tests at 4/acre/ft. of liner (or method specification)
* Density tests at 4/acre/ft. of liner (min of 5/ft. of liner)
* Post-construction permeability test frequency of 1 test per 2 acre of basin area
(min of 2/cell – 1 floor &1 sidewall)

NO

YES

**3. Does facility, structure, and natural soils meet
the criteria for an
in-place liner?**(see next page)

No further testing required if daily construction inspection is done.
*Stop Here*

*Go on to Question 4*

NO

YES

**2. Does the liner material meet both of the following?**

1. At least 20% passing the #200 sieve and
less than 20% retained on the #4 sieve.
2. Plasticity index of 11 to 30.

NO

Soil cannot be used as a liner material.
*Stop Here*

YES

*Go on to Question 3*

No minimum requirements for liner material and no pre or post construction testing required.
*Stop Here*

**1. Does the earthen LMSA meet ALL of the following?**

1. Designed, operated, and maintained as a solids settling area included as part of a NRCS level 4 or 5 vegetative treatment system;
2. Liquids will be removed within 24 hours
3. The floor of the LMSA is either
	1. concrete or
	2. at least 1 ft. of cohesive soil separated from bedrock by at least 2 ft. of soils that are not coarser than a sandy loam

YES

Pre-construction sieve, Atterberg, and proctor tests required
(minimum of one test per liner soil type).

*Go on to Question 2*

NO

**Liner Exception**

Minn. R. 7020.2100 requires that LMSAs be lined to either provide a maximum theoretical seepage rate which does not exceed 1/56 of an inch per day for a liner consisting only of compacted cohesive soil, or 1/560 of an inch per day for LMSAs required to have composite liners. Long-term protective and maintenance measures are required to meet this limit throughout the life of the structure.

Except as described in below, the use of undisturbed, “in-place” soils is not considered to provide an adequate seepage control in most instances, for the following reasons:

* There is no assurance that soils of low permeability are of sufficient thickness in all areas of the structure; and
* Sand and gravel lenses, and ”macropores” from soil fissures, root channels, and animal and earthworm burrows are present in most undisturbed fine textured soils, which provide conduits for leakage from the structure.

Exception: With prior approval from the MPCA, “in-place” undisturbed soils may be utilized as liners in situations where a surface water pollution abatement system has been proposed and the following conditions are met:

* There is an existing feedlot facility of less than 300 AU with a documented pollution hazard that requires construction of a LMSA to correct;
* Construction is not within delineated wellhead protection areas of public water supply wells;
* All wells are located at least 150 ft. (30 ft. for sensitive wells) from the LMSA;
* Native soil physical properties (verified by lab tests) meet the acceptable ranges for Sieve Analysis and Atterberg Limits
	+ Greater than 20% passing #200;
	+ Less than 20% retained on #4 sieve
	+ P.I. of 11 to 30
* Basin storage capacity is less than 750,000 gallons;
* Basin depth does not exceed 9 ft.
* Sideslopes will not be steeper than 3:1 (horizontal: vertical);
* The upper 6 in. (minimum) of the excavated pond surface (including sidewalls) is scarified and recompacted/remolded;
* Protection of the basin sideslopes and floor from damage caused by erosion, manure agitation, and pumping is provided;
* Plans and specifications are prepared by a registered professional engineer or under the NRCS approval authority;
* The facility is not in a geologically sensitive area (e.g. sinkhole plain);
* For facilities in a Karst susceptible area, separation to bedrock is verified as 20 ft.
* Daily (at a minimum) construction inspection is done; and
* A compacted cohesive soil liner is planned if sand or gravel lenses, bedrock, or soils classified by the NRCS 313 standard as group I or II are discovered during soil investigations or during construction.